

...of Pigments and Paint

*Quantifying Ochre
and Rock Art in the
Cederberg
(Western Cape, South Africa)*

Cuan Hahndiek



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Department of Archaeology

Univeristy of Cape Town



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* * *

Abstract

This dissertation quantifies and compares the mass of the ochre assemblages and the surface area of rock paintings from the same sites based on colour classification from the Later Stone Age assemblages of three rock shelters, De Hangen, Andriesgrond and Diepkloof in the Western Cape, South Africa. This work begins to bridge the gap that exists between the excavated archaeology and the examination of rock paintings which has been primarily focused on the iconography. The colours present in the rock art are quantified using a standardised colour system. A preference is shown for saturated 10R hues, based on the Munsell classification, in the fine line and handprinting rock art traditions, whilst the colonial era paintings may illustrate a more ad hoc approach, an interpretation bolstered by survey analysis. The colours of the ochres from the excavated assemblages do not match the colours seen in the rock paintings, the colours of the ochres being clustered more toward 2.5YR and 5YR Munsell hues. The concept of “ghost ochre” has been proposed in order to describe those ochres, in the colours shown to be preferentially used in the rock art, that have been utilised in their entirety and are accordingly absent from the archaeology. A proposed cause for this is that the primary ochre processing strategy employed by the inhabitants may have been that of pulverisation rather than grinding. Some experimental hearths were conducted to examine possible colour changes in buried ochres, and these samples were analysed by colorimetric means and by X-ray diffraction. Ultimately it has been demonstrated that the relationship between ochre and rock paintings from the same site is more complex than has been previously assumed. The findings in this thesis have implications for future research in rock art studies and analyses of LSA and MSA ochre assemblages.

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Heart of Ochre

Written by Lesley Beake

Bo was very still. An ant crept over his foot, but he didn't notice. Quiet, that's what his father had told him. Focus, Stop your child-chattering mind and be still. Bo listened to his father – always – so he was still, and he listened.

He was in a shelter not far above the river. The sound of the water was smooth on the summer stones, cool. At first he had listened to it and his thirst had almost driven him out of the shelter. His father would never know! But he stayed.

The heat baked back from the rocks. He ignored it. He was just still, just there.

Honey-buzzing of bees came to him, but he did not look that way, did not register. He was thinking of his people, and when he thought of them, he thought of his grandfather and the dancing. The dancing happened often, sometimes small - big when people needed it. As Bo sat he could almost feel the vibrations of footsteps in soft, trampled dust, smell the ashes of the fire, hear the rhythmic double-clapping of the women and their music. He half-smiled at the memory, but he did not move.

He remembered the time his grandfather had gone from them, so far that his body lay, quiet and only just breathing for many hours before he opened his eyes and spoke. Bo's heart slowed to the pace of the dancing feet, his mind travelled.

On the rock wall of the shelter were paintings of animals, animals that Bo knew well. He knew their tracks in the dust and their smell. He knew the taste of some of them. Once, his mouth would have watered at that thought, but not now. He was still.

Much later, his father's voice brought him back from the place where he had been, that, and the comfort of a hand on his shoulder.

'Bo? Come home.' Together, they walked back to where the others were. They did not speak.

In the shelter, moonlight crept across the painted eland and the elephant, the klipspringer and the duiker. In the shivering, silvered light, they seemed alive; they seemed real

*

After that day of stillness, Bo had a better understanding of ... everything. There were other boys too, boys of his age group. They did not talk about their experiences. But their eyes had changed.

They knew something they had not known before. They would look at each other, looks clear and open, but not sharing what they had found inside themselves. That would come later.

Their fathers had changed too, in the way they spoke to their sons, in the way they were with them. Other things changed too. Bo's friend Bau did not quite meet his look. Her eyes slid past his and she smiled a small smile that made Bo uncomfortable. Why?

But other things stayed the same. They still went – men and boys – to look for porcupines in the sandy hills. The old men taught them how to make snares, with bent blades of grass, for small birds. Less often than before, they went with the women to look for veld foods. Time passed.

There was a day when Tsau spoke at the fire, in the morning.
'Today, we will go hunting, not for meat, for the red earth!'

Bo felt a small prickle of excitement, a day away from the every-things. A change. He hoped his face had not shown his thinking. It was good to be still, to be strong.

The men took their bows and arrows; their spears, they always did, something might come; something might pass. Bo took his own quiver with the arrows his uncles and grandfather had given him. He took his hunting spear that he had made himself, fire-blackened, sharp. He took his expectation and he took his courage.

There were several red-earth places near their summer camp. Bo had been to some of them, when he was younger. This time felt different.

The other boys were quiet too, but Bo could sense their excitement. The older men talked softly. It was best not to disturb the creatures that lived here. Sometimes one of them would hold up a hand, signaling silence and everyone would concentrate on what he had seen, what he had heard. They made no kills. It was not really a hunting day.

When they came close to the red-earth place there was a change. Something in the tension between the men and the boys was different. There was an importance about the day.

First they collected some of the red-earth in small duiker-skin bags they had brought. The red-earth was strong under Bo's fingers. He treated it with respect, as he would a hunting-animal. His father showed him how to mix the earth with water they had brought in an ostrich-egg. It was smooth and silky under his fingers.

Then they made a small fire in the shelter nearby. There was nothing to cook. Maybe the fire was for comfort? Suddenly the sun seemed less strong, less bright.

Bo's father came to him and took both his hands. He pressed the red-earth onto Bo's right fingers and palm. He led his son to the rock. He pressed Bo's hand against the rough stone of the shelter wall. When he released his son's hand, there was left a memory of Bo – a handprint, red against the grey of the stone.

Gently, Bo put his hand back onto the image. It was him – but it was rock now, too. He looked into his father's face. He saw love there and care and concern. He kept his hand, carefully, on the small print he had made of himself. It fitted perfectly.

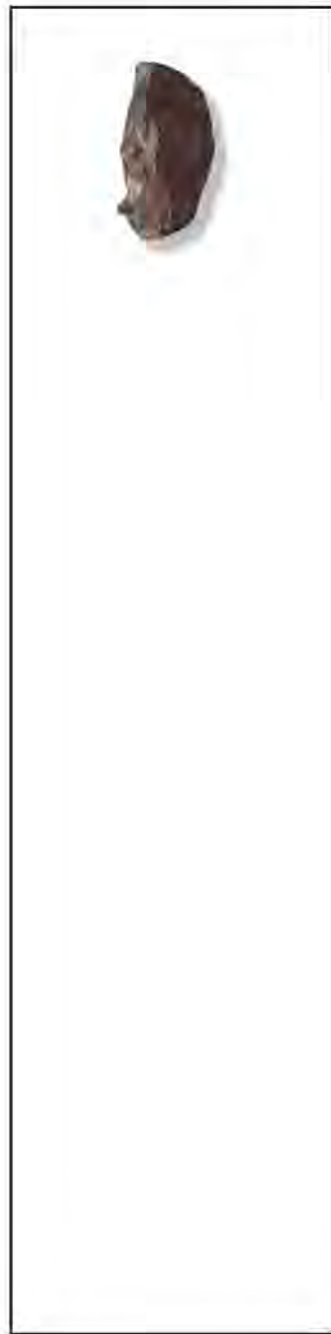
Bo smiled, and under his fingers the rock leapt and flew, like birds, like animals, like stars. Under his fingers the other world he had sensed on his day of quiet came true – came true, and became part of Bo's heart.

* * *

Lesley Beake has been writing for 25 years and much of her writing has been linked to her work with San communities in Namibia and Northern Cape.

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1. Introduction



1. Introduction

A background examination and justification for a comparative analysis of Later Stone Age ochre and Rock Art.

This thesis explores the complex relationship that exists between excavated ochre assemblages from Later Stone Age contexts and rock paintings. This relationship has, until now, been based primarily on the assumption that this relationship is a relatively uncomplicated one, and little attempt to explore this link has been made. Using colour as a common thread, the ochre and rock art have been carefully examined and compared, and the observations from one have been found to have a marked impact on the understanding of the other.

In the records and analyses of Later Stone Age sites in South African archaeology the role and importance of ochre has been largely underplayed. Excavation reports frequently discuss at length the lithic assemblages, faunal remains and plant materials present at these sites. Ochre, however, is seldom ascribed much importance, and usually gets only a nominal description, outlining the number of pieces found and commenting on a few notable nodules which may show obvious striations (Avery *et al*, 1997; Barham, 1989; Deacon, 1979; Jerardino & Yates, 1996; Kaplan, 1987; Mazel, 1986a, 1986b, 1988a, 1988b; Orton & Mackay, 2008; Parkington, 1972; Parkington & Poggenpoel, 1971, 1987; Rijssen & Avery, 1992; Robey, 1987; Schrire & Deacon, 1989; Wadley, 1989, 2000). This point was also made by Rudner when she wrote: *“Although many archaeological reports mention the finding of pigments or evidence for the use of pigments, few stress the information, and one suspects that such finds have been overlooked or not thought worth mentioning”* (Rudner, 1982. pp.233).

Excavations are *“never done on the spur of the moment. They need to be carefully planned, funding has to be secured, and permits and permissions have to be obtained. Archaeologists excavate to test hypotheses and answer specific questions.”* (Deacon & Deacon, 1999.

pp.107). The primary function of any excavation, therefore, is to examine specific questions which a researcher may be exploring and Later Stone Age ochre was not something targeted with much intent by archaeologists during the 1970's and 80's, with the majority of research being focused on other areas. The reason for this, as outlined below, is that motivating factors for excavation were to test hypotheses which were not directly related to ochre-based evidence. A brief look at some of the historical causes for this lack of interest in ochre is relevant to the discussion on the importance of the ochre study conducted in this thesis.

During the 1970's and 80's Deacon (H.J.) and Parkington, two of the primary researchers in Later Stone Age archaeology during this period, were primarily motivated by a research framework based essentially on an ecological model (Deacon, H 1972, 1976; Parkington, 1971, 1972, 1977, 1980). This ecological model was, in brief, an archaeological framework within which justifications for habitation and movement patterns of (pre)-historic peoples are motivated primarily by changes in the environment over other potential factors. The place of ochre within this framework is minimal in that it offers very little information about seasonality and as such it was excavated and recorded but then given very little subsequent attention. The primary seasonal markers relate to the floral and faunal components to the assemblages as they provide reliable indicators of seasonal habitation and movement. Towards the goal of examining environmental models both researchers aimed at finding clarity at sites which may show evidence of a seasonal occupation; and excavations were therefore focused on the floral and faunal material as well as the artefactual remains which may be indicative of seasonal patterning. Ochre is not a clear environmental marker although the potential for ochre provenance studies based on geochemical identification, like that of Dayet (2013), may, in conjunction with other sources of data, yet be able to allude to seasonal occupation of sites.

This environmental and seasonal 'Zeitgeist' of the period, and its associated preoccupation with subsistence strategies, is nowhere more apparent than in the 1987 publication *Papers in the Prehistory of the Western Cape, South Africa* (Parkington & Hall eds, 1987). In this volume, the focus on environmental factors is apparent in the majority of contributing

articles (Avery, 1987; Deacon, J, 1987; Kaplan, 1987; Klein & Cruz-Uribe, 1987; Liengme, 1987; Poggenpoel, 1987, Smith, 1987; Sealy & Van der Merwe, 1987). In this atmosphere ochre analyses were of minimal importance to the then current debate and as such very little interest was shown in the ochre assemblages excavated from sites during this period. It may be noted that the region these papers focus on is the same as that examined in this thesis.

Progressing from the 1990's through to the present, there has been a shift in focus away from Later Stone Age studies to an increasingly hotly contested debate on the Middle Stone Age. The impact of this concentrated attention on the MSA has resulted in the predictable neglect of the Later Stone Age components to many excavated sites. The fact remains, however, that shelters that contain MSA deposits are almost always overlain by LSA deposits. Many new sites are being excavated with the primary interest being on the underlying MSA layers. As a result, excavators have to dig the LSA layers from these sites, and, whilst these excavations are conducted with the utmost professionalism and precision, the resulting assemblages are reported but largely unexamined (Orton & Mackay, 2008).

It is clear, then, that the ochre from the Later Stone Age has been largely unexplored. A potential cause for this omission in the discourse may owe its origin to a basic assumption made about ochre in that it is directly correlated to rock art. Whilst this link may seem apparent, it is based primarily on assumption and circumstantial evidence garnered from ethnographic accounts (Katz, 1982; Lee, 1979, Marshall 1962, 1969, 1976) all of which suffer from the issue of ethnographic analogy when applied to ochre use and its correlation to rock paintings in the Later Stone Age past. In her seminal monograph, *Khoisan pigments and paints and their relationship to rock paintings* (1982), Rudner deals extensively with a range of ethnographic records and personal ethnographic research with the primary focus being on the potential ingredients required for rock painting. Whilst the main thrust of this research deals with the extenders, binders and adhesives which would have been used, she provides some evidence for the use of iron oxides and more specifically haematites, including a few reported accounts from the late nineteenth century and early twentieth century of haematites

being heated. These primarily anthropological studies have been readily taken up in rock art research, but have not been paralleled with detailed ochre analyses.

Rock art studies began with a basic descriptive reference, where authors, describing the rock art, adopted “*a simplistic approach and treated the paintings as if they were illustrations of myths much in the same way that a child's book may be illustrated*” (Lewis-Williams, 1972. pp.61). Examples of this framework can be seen in articles such as Woodhouse (1969) relating South African rock art to bull-jumping imagery from the Mediterranean, and Cooke (1957) relating dots and circles in southern Zimbabwean rock art to the presence of waterholes. Lewis-Williams rejected these somewhat simplistic and ethnocentric descriptions and instead looked toward the ethnographic studies and proposed a trance symbolism and shamanistic interpretation for the rock art of southern Africa. The trance hypothesis has been progressively built upon and expanded until the present where it has wide acceptance. The basics of the hypothesis are that the rock paintings are depictions of trance-induced states, experienced primarily by shamans, where they can travel to the spirit realm to give expression to their spiritual beliefs, acquire healing powers and bring rain (Lewis-Williams, 1981; Lewis-Williams & Dowson, 1988). Descriptive markers in rock art which are claimed to point toward the trance experience include zig-zag entoptic forms, human and therianthrope figures bending forward, hair raised and bleeding from the nose (Lewis-Williams, 2004).

The trance hypothesis for rock art interpretation helped to pave the way for rock art analyses that attempted to delve into symbolic thought and action which had been largely absent from rock art description prior to this. It has been argued, however, that the trance hypothesis has been stretched well beyond reasonable viability, as evidenced by the heated exchange in print between Solomon (2006a, 2006b, 2007) and Lewis-Williams (2007). The author of this thesis proposes that the field of rock art interpretation is primarily an anthropological one, which bases much of its findings on ethnographic analogy and has a reduced emphasis on quantitative observations in favour of qualitative ones. Whilst various arguments may be persuasive, especially with reference to specific images or motifs, the field suffers from a few key shortfalls. The interpretations are always going to be based upon ethnographic

analogy, which, due to distances in time and space, make such analogy fundamentally problematic; the ethnography, whilst providing a window enabling possible interpretation, is flawed by definition. The most telling problem, however, is one centred on fundamental scientific principles in that the hypotheses motivating the interpretations are ultimately untestable. In other words, there are no measurable criteria for disproving such hypotheses.

It is important to make the point that initial interest in rock art came from non-professionals (Johnson, 1957). Subsequently rock art began to receive attention from archaeologists such as Lewis-Williams (Lewis-Williams, 1979) who were amongst the first to examine the rock art from an analytical perspective. Their interest lay primarily in an examination of the iconography of the paintings. Gradually since then, as will be shown, the archaeological focus has been progressively emphasised. The link between the ochre and the rock art was implied in the studies dealt with below but was not explicitly explored as is the case in this thesis.

This new emphasis in rock art study in the first instance treats the rock art as an archaeological artefact rather than an iconographic marker. In other words, the images are treated as physical artefacts in their own right, and not simply what they depict. An important example of this, relevant to this thesis in particular, examines certain motifs present in the rock paintings and identifies them as being distinct traditions. (Manhire, 1998; Meister, 2003; Mguni, 1997; Van Rijssen, 1984). A chronology of rock art traditions was argued by an examination of the superimpositioning of images that were ascribed to one tradition or another. It was shown that at Diepkloof Kraal Shelter, for example, fine line images were never superimposed over handprints, as in turn handprints were never superimposed over the farmer or colonial era paintings (Mguni, 1997). Indeed, there has been found to be a clear progression with one tradition essentially replacing another (op cit). Tony Manhire (1998) examined the relative sizes of handprints with the aim of attempting to ascertain average stature. Based on the measurements of 382 handprints from two distinct research areas, he proposed that due to their diminutive size even when compared with analogous San populations, the handprints were likely those of adolescents (Manhire, 1998). He hypothesises that the

handprint tradition may be linked to initiation rites. This hypothesis, in conjunction with the author's research, formed the background for Lesely Beake's evocative tale presented in the preface. In contrast to the iconographic interpretative views as previously discussed, these studies are rooted in an archaeological framework as opposed to an anthropological one. It is to this archaeological approach that the author aligns his comments and observations regarding the rock art presented in this thesis.

An omission from all of the rock art studies is a clear, systematic and standardised method of accurately describing the colour in which the images are painted. Researchers have routinely used their own descriptive terminology-set despite the call for a standardised system made over half a century ago by Van Riet Lowe (1945). Rock art records frequently describe images as being painted in Red, Brick Red, Orange, Orange-Brown, Yellow etc. (Dowson, 1994; Hollmann, 2005; Lewis-Williams & Pearce, 2004; Vinnicombe, 1967 etc...). It is perhaps unsurprising that with the preoccupation with iconography in rock art research, a systematic analysis of colour has been sorely neglected. A useful synthesis of this point can be seen in the structure of Janette Deacon's 1999 article entitled: *South African Rock Art*. In it she presents the current state of research and knowledge on the subject with a list of questions. These are, in the order as presented: *Who made the rock art? When was the rock art done? How was the rock art done? Where was San rock art done? What does the rock art depict? And lastly: Why was the rock art done?* Under the question of how the rock art was done, one finds the only - and brief - description of colour where she says of ochre, *"its usual colour range is from red to maroon, orange, yellow, and brown"* (Deacon, 1999. pp.53). The author of this thesis asks: Where is the section under the heading: *"In what colour was the rock art done?"*. Some authors (Blundell, 2004; Russell, 2013) have addressed this topic, but it remains an open question to the field as a whole as to why a standardised practice of colour classification is not consistently applied.

A second omission to the discourse is that rock art studies have left aside the archaeology. It is perhaps a slight irony that the bulk of ochre research, focused on the Middle Stone Age, has been conducted *in absentia* of any clear art. Perhaps the only instance in the MSA

of ochre and symbolism being directly correlated are the engraved ochres from Blombos (Henshilwood, 2009). The appeal of MSA ochre is that it is an apparent marker for symbolic thought during the contested period in which researchers argue that anatomically modern humans and behavioural modernity first appear.

Ochre, as a potential marker for symbolic and abstract thought, has become a key feature in Middle Stone Age research over the last twenty years (Barham, 2002; Dart & Beaumont, 1969; Hovers *et al*, 2003; Knight *et al*, 1995; McBrearty & Brooks, 2000). The importance of ochre is that it may hold a variety of functions, many of which imply symbolic and abstract thought in a way not easily observable from other material artefacts. In the case of the engraved ochres from Blombos, such symbolic inferences are quite easily made, by an examination of the patterned scratches along the surface which are clearly not the result of grinding (Henshilwood *et al*, 2009). In this instance, however, the ochre itself is not the symbolic marker as much as the incised pattern on the ochre. To reinforce this point, there are similar indicators from other materials which owe nothing to ochre or ochre processing. At Diepkloof, for example, there is a substantial body of evidence pointing toward the symbolic engraving of ostrich eggshell; these fragments provide equal evidence for abstract thought processes as the engraved ochres from Blombos (Texier *et al*, 2010; Henshilwood *et al*, 2009). Providing clear evidence that the ochre itself is important as a marker for abstract concepts and symbolic thought patterns is not a simple task. Another example to reiterate this point is the ochre-processing toolkits also found at Blombos (Henshilwood *et al*, 2011). These toolkits provide clear evidence that MSA peoples were processing ochre as early as 100 000 years ago, but despite the inference that the procedure followed in the production of ochre powders or paints alludes to advanced cognition, the final function of those powders remains unclear (Henshilwood *et al*, 2011). In the LSA, there is clear evidence for a symbolic use of these ochre powders in the form of rock art, but the mere production of these powders does not yet constitute that final step toward evidence of abstract symbolic cognition, no matter how tantalizingly close it may come.

Watts (1997) examined Middle Stone Age ochres with a view to providing some evidence for

their cultural and symbolic function. A prime feature of his research was that he identified a noticeable preference for superior quality saturated red ochres. He linked this preference with a symbolic ideology and connected this to ethnographic accounts which showed similar preferences for ochres in these colours. Whilst initial research conducted in this thesis seemed to concur with Watt's hypothesis, further examination provided potential criticism rather than support in that an inherent correlation between ochre hue and streaking quality may preclude the preferential selection and use of these saturated red ochres.

Lynn Wadley (2009, 2010b) has shown that an argument for colour symbolism should be mitigated by the fact that post-depositional heating of ochres may cause colour changes from yellow to red. There are additional geochemical analyses which also point toward this change (Gualtieri & Venturelli, 1999; Pomies *et al*, 1998, 1999). This transformation will cause red ochres to be overrepresented in the excavated assemblages from the majority of sites, and especially those such as Sibudu which have an abundance of excavated hearths (Wadley, 2010a). This argument impacts Watt's position in that it provides alternate, non-symbolic causes for the abundance of red ochres.

In addition, there has been other work and analysis conducted which point towards functional uses of ochre in the MSA which exclude the symbolic interpretation and provide further possible uses for ochre as a resource in the MSA and LSA alike. In LSA contexts these possible functions show that ochre had a multitude of uses and not only the production of paints. Use-wear analyses, in addition to experimental analyses (Lombard, 2006, 2007; Rots, 2011; Wadley, 2005; Wadley, Williamson & Lombard, 2004), have shown that ochre may be a vital component in the production of mastics and the hafting of artefacts. As an ingredient in the mastic for the hafting process, ochre has been shown to strengthen the mixture, making it less brittle or prone to shattering when a secure hafting was required. The residue analyses have supported this by providing clear proof that ochre was a component in the mastics used by MSA peoples evidenced by traces of ochre being present on the hafting surfaces of MSA artefacts (Lombard, 2006, 2007).

Another sphere in which ochre may potentially have been used that would seem to counter the symbolic interpretation is in tanning for hide preservation and the creation of leather garments. Watts (2002) argues that the use of ochre in hide preservation is an unlikely function due to its rarity in ethnographic accounts and to the preference shown for specific ochre colours from archaeological contexts. In a series of experiments in hide tanning and preservation, various types of ochre were used to prepare animal skins in methods which might mimic those of prehistoric peoples (Rifkin, 2011). Based on these experiments it was noted that, whilst some ochre forms do indeed have antibacterial and antimicrobial agents, their overall effectiveness was somewhat limited (Rifkin, 2011). Both Rifkin and Watts suggest that, should ochre have been used on leather garments, then it would have been used primarily for its symbolic or decorative function over preservative properties.

The idea of colour as a symbolic marker is also questioned by implication by Hodgekiss, working on the MSA at Sibudu. Her research focuses primarily on the knowledge and cognitive underpinnings of the processes required in the production of ochre powders (Hodgekiss, 2010; 2012, 2013). A correlation between the colour and the usability of the ochre is also alluded to, which is strongly supported by geochemical analyses of ochre properties (Cornell & Schwertmann, 2003; Hodgekiss, 2012). This same point is also presented in the findings of this thesis. Hodgekiss, working under the basic assumption that ochre hue is not necessarily important, looks toward the operational traces on the ochres themselves and she finds that, whilst many ochres show use-wear relating to a grinding or rubbing function, *“some engravings demonstrate intentionality and an awareness of space and symmetry that may demonstrate abstract thought”* (Hodgekiss, 2014).

Middle Stone Age ochre studies, as discussed, suffer from an absence of clear and observable evidence for ochre being used in a symbolic manner. The assumption that it is a symbolic identifier originates from ochre use in the Later Stone Age, where the art and ethnography provide clear evidence for its use in symbolic mediums such as rock art. It is crucial, therefore, that a detailed account of ochre use in the Later Stone Age – which has been shown to be inadequate - is documented, not only for its own sake but also for its

function as a comparative model for ochre use in the Middle Stone Age. Whilst a direct link or comparison between the LSA and MSA ochre would be presumptuous, an understanding of ochre use, in a context where there are other sources of relevant information, make it an invaluable platform to learn more about ochre as a resource. In fact, the analysis of the rock art carried out in this thesis provides a wealth of information about the ochre assemblages at each of the sites which would otherwise have been absent. Interest in ochre grew primarily from research in the MSA, but it has been studied in the absence of a greater knowledge and understanding of its use in more recent contexts. One of the key motivators for this thesis is to provide Middle Stone Age ochre studies with a Later Stone Age comparison where other sources of information are available. The result, as will be discussed, is that there are implications regarding what is known or even observable about MSA ochre assemblages.

A second key function tackled in this thesis is a detailed examination of the colours of the rock paintings using a standardised system. The Munsell Soil Colour Chart is familiar to most archaeologists, but its use to characterise and accurately record the colour of rock paintings has been overshadowed by the iconographic approach with little emphasis on colour. Whilst using colorimetric observations was a possibility, the Munsell Soil Colour Chart proved to be a more pragmatic method and in fact provided a level of detail more than adequate for this research (Hodgekiss, 2012; Watts, 1997).

This research also serves to provide an early attempt at bridging the gap between rock art and the artefactual assemblage that is so blatantly apparent, though some attempts have been made (Mazel, 1992; Jerardino & Swanepoel, 1999). This is an ambitious objective and as such this thesis presents the first steps toward this goal by constructing a multifaceted methodological approach which may provide the first insights into the detailed relationship that exists between the ochre and the rock art.

This thesis answers four broad-ranging inter-related questions which may describe human activities surrounding ochre and its use in rock art in the Later Stone Age, each of the questions emphasising a different aspect.

- 1. Is there evidence for the preferential use of specific colours or pigments, and, if so, does it reflect a symbolic motive or a functional quality?*

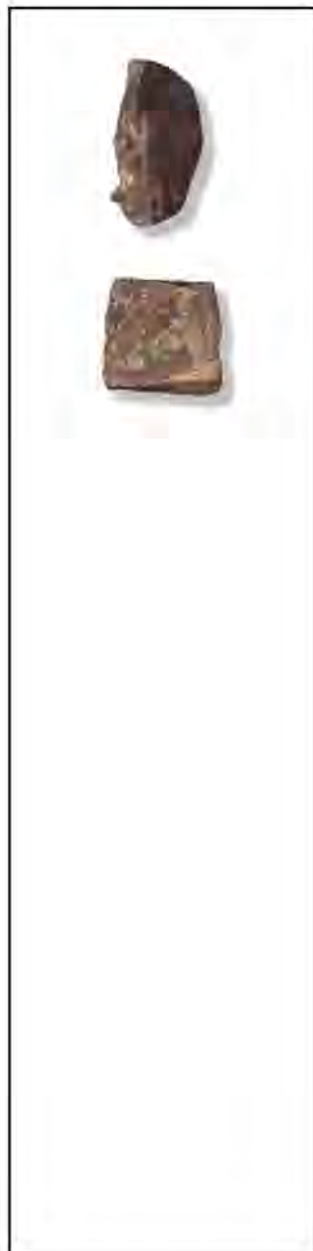
- 2. To what extent is the potential ochre assemblage reflected in the excavated material and how much of the total ochre application is evidenced by striated nodules?*

- 3. Do the colours represented in the rock art accurately predict the colours in the excavated material (and vice versa)? What are the implications for ochre use if they do not?*

- 4. How much of the excavated ochre assemblage is in fact artefactual? How else might ochre enter the deposits at a site and would such an occurrence represent a unique situation?*

Following this introduction and literature review which provides justification for this research, the thesis is divided into four major subsequent chapters. The first of these details the methodology used by the author in order to gather all of the relevant observations for the variety of analyses that were conducted. The methodology, important in any research project, is perhaps even more important in this study as it involves entirely new lines of research for which there is no established methodology. It could therefore be viewed as a vital component to this thesis. The next chapter details the findings made at each of the sites in terms of the ochre assemblages and of the rock art. This presentation of results is then used as a springboard into a range of experimental research outlined in the following chapter, aimed at broadening the understanding and interpretations of the archaeological observations. The final chapter discusses the key findings arrived at in this thesis.

2. Methodology



Methodology

The methodology of any scientific endeavour is of vital importance in that it lays the foundations upon which all findings and later conclusions must be based. Faults, flaws and gaps in the methodology can therefore lead to fallacious arguments and incorrect findings and conclusions. Archaeology straddles a difficult boundary between the sciences and the humanities. Insofar as it makes quantitative observations in an attempt to investigate subjective human behaviours, this makes the importance of clearly defining one's methodology all the more essential. An additional factor to consider, is that this thesis represents entirely new research and there is therefore no previously established methodology. This section will illustrate how each of the components of this thesis was recorded; it will also provide a basis for defending the choices made regarding the methods adopted.

The section will be structured to fit a broad narrative starting with archaeological discovery and then flowing into an exploration of the ochre and its use. This is used primarily as a structural device for layout, rather than a methodological one. It will touch on the Cederberg region as a whole as the selected region for this study; then it will outline the reasons behind the selection of the three chosen archaeological sites. The methods for recording and analysing the rock art will be dealt with before looking down from the walls of the rock shelters to the ochre contained within the archaeological deposits. Turning to look away from the sites themselves, the question as to where the ochre in the deposits may have come from will be examined by means of survey work. A glimpse into one of the several transformations that occur between the ochre source and its eventual application in rock painting will be investigated by means of experimental heating or burning of ochre and subsequent laboratory X-Ray diffraction and colorimetric analyses thereof.

The Cederberg:

The Cederberg mountain range of the Western Cape is one of the richest archaeological

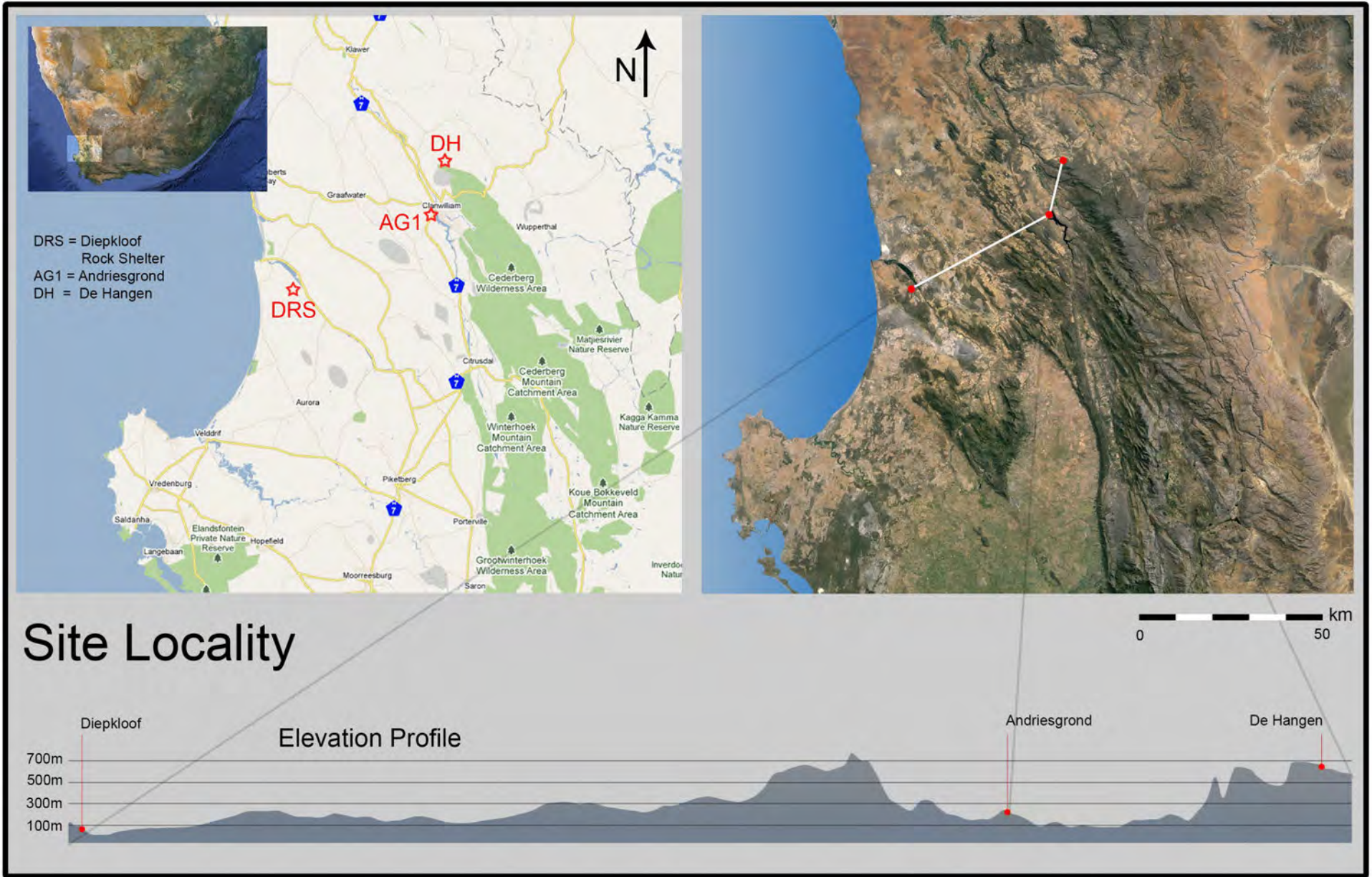


Figure 2.1.1: Site Locality

regions with reference to the Later Stone Age. The mountainous region boasts one of the highest concentrations of rock art and corresponding archaeology in the world (Parkington, 2003). The geology of the area is such that the rock formations readily create the overhangs, shelters and terraces that make for not only ideal canvases, but also comfortable living areas for Later Stone Age people. The riverine systems starting from small mountain streams feeding into the Olifants River and the Verlorenvlei to the west, would have provided people with ideal access to both water and an abundance of wildlife, albeit on a seasonal basis in some areas.

The area has been the focus of extensive archaeological study over preceding decades as outlined in the literature review. The archaeological wealth of the region makes it ideal for the outlined goal of correlating excavated ochre to the corresponding rock art. With a profusion of potential sites upon which to work, which sites were eventually chosen and why?

De Hangen:

De Hangen is a north-facing shelter situated at high altitude in the Cederberg Mountains, north of the town of Clanwilliam. The site was selected for study in the author's honours dissertation "*The Ochre and Rock Art of De Hangen Rock Shelter*" in 2007. As such, it was the test site for some of the fundamentals of the methodology that will be explained in this section.

The site was excavated in 1968 by John Parkington and Cedric Poggenpoel. It had a shallow deposit of no more than 20cm at its maximum depth, to the disappointment of Parkington who had hoped to find a deep sequence at the site. The shallow deposit indicated a short period of occupation, which is supported by the dating of materials at the site which place the main period of occupation between 1400AD and 1800AD (Parkington; 1971). De Hangen is important in that it was one of a limited number of sites which were excavated in their entirety. Subsequent legislation made such excavations impossible for numerous reasons, retention of deposits for future archaeological techniques and site preservation to name but two. The

benefit of this comprehensive excavation for this study is that the assemblage is complete, and does not merely represent a sample of the ochre in the site. This means that there could be no potential gaps in the assemblage based on anything other than the motives of those inhabiting the site and making the paintings. The shortness of the occupation also affects the association of ochre to the rock art on the walls of the site. If, as all evidence suggests, the occupation was a brief one, then one might assume that all the ochre in the assemblage is likely to be contemporary with the rock art. The possibility does remain, however, that people may have visited the site in order to paint in an unrelated event to the occupation of the site, as has been shown where dated rock art coincides with a period of non-occupation of a site (Mazel & Watchman, 2003). A basic assumption is made in this thesis that the two sets of evidence are fundamentally related. For these reasons, De Hangen was a logical first choice to be examined in this study.

Andriesgrond:

Andriesgrond is another site in the region with an abundance of both rock art and excavated ochre. The site was excavated not long after De Hangen in part of a series of excavations done in the region (Parkington, 1972). Based on the results of the author's Honours dissertation, Andriesgrond was selected for study based on the variation within the colours in its rock art. With a series of images painted in yellow, it provided a useful contrast to the rock art of De Hangen which contained no yellow images. Another influencing factor was its position in the landscape as an intermediary position between the Cederberg mountains and the coast which may be important to seasonal movements (Parkington, 1972).

Diepkloof:

Diepkloof is geographically the exception of the three selected sites. It was initially excavated as part of the same extended interest into seasonal mobility patterns of LSA peoples conducted by Parkington (1972, 1987). The site is situated close to the west coast town of Elands Bay. Despite this, it is near enough to the Cederberg to be included into this broad

region. This separation from the immediate vicinity of the Olifants river valley and of the Cederberg mountain range means that Diepkloof represents a change in landscape for the study, which may prove to be significant for the site and its use.

The sequence at Diepkloof stretches from the colonial period back into the mid to early MSA. Significantly, the stratigraphy at Diepkloof is one of the most important for the chronology of the MSA in southern Africa (Parkington *et al*, 2013). Contemporary research done on the MSA ochre by Laure Dayet, of Bordeaux University, provides a unique opportunity to work co-operatively to examine differences and similarities between ochre use strategies of MSA and LSA peoples (Dayet *et al*, 2013). The site may thus provide a window into the deeper past through current and future research.

Rock art in the Western Cape is frequently separated into three ideologically distinct groupings, these being fine line imagery, handprinting and paintings in the colonial era (Mguni, 1997; Parkington, 1989; van Rijssen, 1984). Diepkloof contains representative samples from each of these rock art 'traditions,' which may be able to provide an extra dimension to the study and create linkages to other related studies.

A final issue that needs to be addressed is to note that Diepkloof consists of two bounded sites, namely Diepkloof Rock Shelter (DRS) and Diepkloof Kraal (DKS). The Diepkloof ochre assemblage as examined in this thesis comprises material excavated from Diepkloof Rock Shelter only. The two sites are, however, predominantly treated as one site for the purposes of the rock art recording and subsequent analyses.

Rock Art Recording:

Upon entering each of these sites, one of the most striking and evocative features is the rock art adorning the walls. Consequently, it is not surprising that the rock art has been subject to extensive study over preceding decades. The overwhelming majority of these studies have endeavoured to explore and interpret the social significance of the images based on the

aforementioned iconographic framework. In this regard, anthropological studies based on living communities have frequently been used to model ancient motives and ideology (Katz, 1982; Lee, 1979, Marshall 1962, 1969, 1976; Rudner, 1982, 1983). This dissertation makes little attempt to decipher the possible meaning or interpretation of the images, but rather is concerned with attempting to link the paintings on the wall with the ochre in the deposit. The two most important factors with regard to recording the rock art are the colour of the painted images and the surface area they occupy.

A further point to be made is that the black and white pigments were recorded but not subsequently analysed in the same manner as the other pigments as the paints were comprised primarily of other raw materials such as charcoal for black and raptor faeces for white (Basset, 2001). This means that these pigments do not owe their origin to sourced ochres, and therefore are not directly relevant to this study. These colours also occupy a negligible percentage of the surface area of the rock paintings and as such would not have had a marked impact on this research.

Before continuing to examine the methods used in recording the rock art there are a few important points which need to be raised. First the rock art as recorded is not the same as the rock art as painted, in other words the rock art has undergone changes due to preservation and weathering since it was painted. In instances where the rock art was too heavily weathered to be able to define the surface area or colour, it was disregarded, although this was surprisingly rare. Second, in many instances the painted images are heavily superimposed over one another which may result in the destruction of underlying images (Russell, 2000). Where possible, the image colour was assigned to that portion of an image that was not over-painted and that colour determination was then given to the entire image, and the overlying image may have a large portion of the same surface area but with a different assigned colour code. Whilst some errors of colour observation may have resulted, the volume of observations would help to substantively mitigate the effect of such errors. Third, in the absence of absolute dating of the rock art (as done by Mazel and Watchman 2003), it is impossible to directly link the rock art to the occupation layers

excavated. That being said, it is self-evident that the ochre used to make the paints for the rock art must have been present at the site, even if only brought in on a single occasion. There is an intrinsic link between the ochre and the rock art. The author accordingly, as a starting methodological assumption, chose to treat all ochre evident at the site as being related to the rock art. A more accurate position is then determined based on the results and findings made in the course of this study. This is explored in detail in the Discussion chapter.

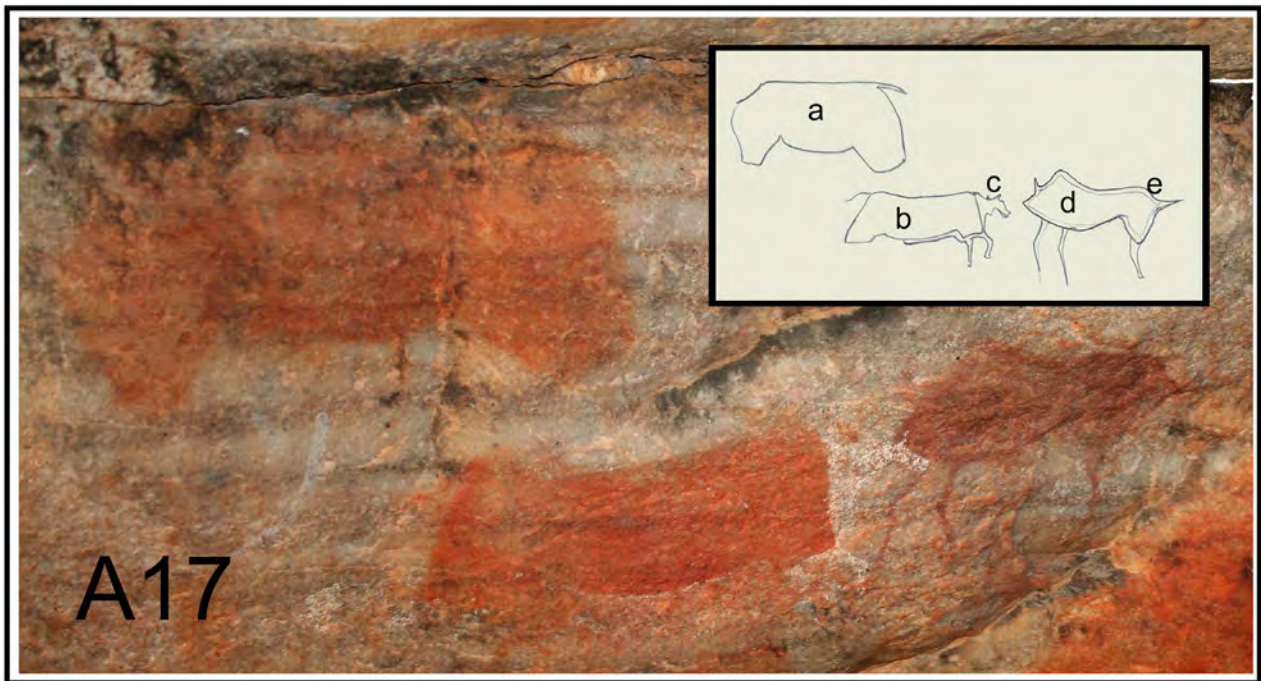


Figure 2.1.2: Rock Art Image Code Plan

Image Code: The rock surface at each site was divided into alphabetically labelled panels. The delineation of these panels was based chiefly on arbitrary but prominent features on the rock surface; examples of this include extended cracks, gaps in the rock and noticeable changes in surface angle. The motivation for this was to divide the observation and subsequent recording process into manageable sections which could be easily identified on site. This is also useful for subsequent researchers returning to these sites to examine the rock art for future studies. These panels were sketched, photographed and given a written description; an example of which is the following:

“De Hangen Area C: Area C consists of a clustering of images that is positioned above Area

B on the eastern wall. The images here are high up and are a fair distance above head height; i.e. a minimum of 2 metres from the floor at that point, and are positioned on a slight overhang. The innermost edge of Area C is defined by a point at which the rock face turns toward the rear of the shelter.”

Within the described panels the rock art was further divided into small clusters based on subject matter, colour and proximity. These groupings were labelled numerically from left to right within each panel. An additional alphabetical subdivision was then created for each image number to distinguish between different figures or between different constituent colours. These are strictly lower case letters so as to avoid any possible confusion with the letters assigned to the panels. A visual example of this labelling system is shown in the following figure 2.1.2

Colour Coding: In order to compare the colours of the paintings with the pigments in the ochre assemblage, a standardised colour coding system was required. The use of a Munsell Soil Colour Chart for the classification of ochre pigments was suggested by Watts in his PhD thesis as a potentially powerful tool for colour classification (Hodgekiss, *personal communication*; Watts, 1997). The chart has been used in this study with regard to both the ochre pigments and the rock paintings (figure 2.1.3).

It is important at this stage to highlight relevant issues relating to the use of a Munsell chart with regards to this thesis. The lighting conditions under which the Munsell chart is used may have an impact on the eventual colour classification due to the inherent visible range of light itself. Natural light encompasses the entire spectrum of colours, creating white light. Artificial lights, however, do not produce the full spectrum of light, and thus incandescent and fluorescent lighting is tinted yellow and blue respectively. For this reason artificial light was not used during the colour classification of the rock art or the ochre.

A second concern with the use of the Munsell chart is the issue of temporal variation in the way an individual observes or classifies a painted image or ochre streak. This creates an overall subjectivity that not only occurs between observations made by different viewers, but

also, to a lesser extent, in the way in which an individual may view it. To reduce the impact of this subjectivity, all colour codings in this thesis were done by the author. In addition to this, repeat tests on previously classified colours were done to check their accuracy.

The use of a colorimeter as a means to circumnavigate the issue of subjectivity with the Munsell chart was explored but ultimately rejected for use in this study. The potential benefit of its use would be a colour classification that was absolute and free of human intervention. Due to the transient and frequently heavily weathered nature of rock painting, the level of precision gained by a colorimeter may exceed its usability. Any given image, for example, could create an array of classifications due to the changeability of the paint and the level of precision that a colorimeter offers. Selecting the portion of an image that is used to classify its colour is an active process requiring careful consideration on the part of the observer, this already introduces an aspect of subjectivity that renders a colorimeter somewhat redundant.

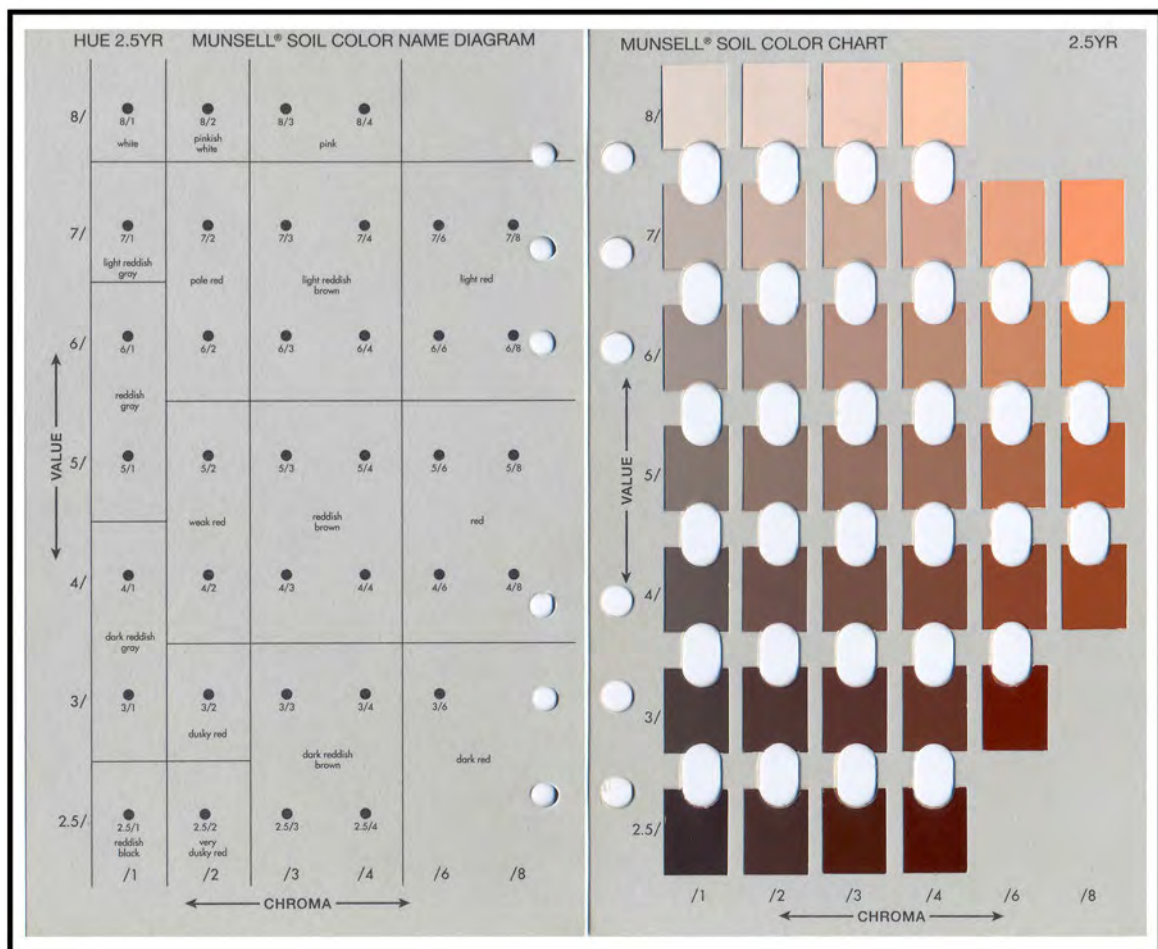


Figure 2.1.3: Example of Munsell Chart

An additional factor when looking at the rock paintings is the sheer volume of paint on the walls at each of the three sites. Taking this into account, the amount of time required to record the rock art in its entirety with a colorimeter would have been excessive. The Munsell chart proved to be the most pragmatic and efficient method of colour classification for this research as it fulfilled the requirements needed. (A colorimeter was used for colour classification in experimental work under laboratory conditions when working with geological ochre samples, as outlined later.)

Munsell notation is comprised of three separate qualities of colour, namely; hue, value and chroma, presented in that order. In addition, each category of colour is then given an adjectival description to accompany it (e.g. 2.5YR 5/8 – Red).

Hue: The hue is best described as the prismatic colour, such as red, green or blue. The chart, by virtue of its being a soil colour chart, limits the hues to shades of red and yellow. Each page represents a different hue ranging from red to yellow (5R; 7.5R; 10R; 2.5YR; 5YR; 7.5YR; 10YR; 2.5Y; 5Y). The extremes on either end of the scale were not represented in either the rock art or the ochre from any of the sites and the eventual range observed was within the range 10R to 10YR.

Value: This number represents any given colour's place on the spectrum in terms of its brightness, where 0 represents absolute black and 10 absolute white. These values run from darkest, at the bottom of the page, to the brightest at its top (e.g. 2.5YR 2.5/1 – Reddish Black to 2.5YR 8/1 – White)

Chroma: The chroma scale represents the saturation level or purity of the colour. The scale is again from 0 to 10, where 0 is completely desaturated and 10 is the most vibrant. The scale run from left to right across the page with the least saturated colours on the left hand side (e.g. 2.5YR 5/1 – Reddish Grey to 2.5YR 5/8 – Red).

Colour Classification (refer to figure 2.1.4): The colour categories which were finally

assigned for use in this thesis were carefully assembled based on the array of colours recorded from the rock art and ochre assemblages from all three sites. The categories represent the best possible fit for the range of colours recorded based on the number of observations made for each of the Munsell classifications. An additional factor which was considered was to attempt to make the assigned categories cover a wide enough spectrum to enable their use in future research.


Colour Classifications		
Dusky Red 10R 3/3 : 10R 3/4 : 2.5YR 3/2 	2.5YR Dark Red 2.5YR 3/6 	Reddish Yellow 5YR 6/6 : 5YR 6/8 : 5YR 7/6 5YR 7/8 : 7.5YR 6/6 7.5YR 6/8 : 7.5YR 7/6 7.5YR 7/8 
10R Dark Red 10R 3/6 	Reddish Brown 2.5YR 4/3 : 2.5YR 4/4 2.5YR 5/3 : 2.5YR 5/4 5YR 4/3 : 5YR 4/4 : 5YR 5/4 	Brown 7.5YR 4/2 : 7.5YR 4/3 7.5YR 4/4 : 7.5YR 5/3 7.5YR 5/4 : 10YR 4/3 10YR 5/3 
Weak Red 10R 4/3 : 10R 4/4 10R 5/4 : 2.5YR 4/2 	2.5YR 4/6 & 4/8-Red 2.5YR 4/6 : 2.5YR 4/8 	Strong Brown 7.5YR 4/6 : 7.5YR 5/6 7.5YR 5/8 
10R 4/6 & 4/8-Red 10R 4/6 : 10R 4/8 	2.5YR 5/6 & 5/8-Red 2.5YR 5/6 : 2.5YR 5/8 	Very Pale Brown 10YR 7/3 : 10YR 7/4 10YR 8/3 : 10YR 8/4 
10R 5/6 & 5/8-Red 10R 5/6 : 10R 5/8 	Light Red 2.5YR 6/6 : 2.5YR 6/8 2.5YR 7/6 : 2.5YR 7/8 10R 6/6 : 10R 6/8 	Yellow 10YR 7/6 : 10YR 7/8 10YR 8/6 : 2.5Y 7/6 2.5Y 7/8 : 2.5Y 8/8 
Dark Reddish Brown 2.5YR 2.5/4 : 2.5YR 3/3 2.5YR 3/4 : 5YR 3/3 5YR 3/4 	Yellowish Red 5YR 4/6 : 5YR 5/6 5YR 5/8 	<p>* Colours represent approximation of component Munsell notations</p> <p>** Printed colours will NOT accurately reflect actual Munsell colours</p>
Excluded Colours 2.5YR 3/1 : 5YR 4/2 : 5YR 2.5/1 : 7.5YR 2.5/1 : GLEY1 2.5/N : 5YR 6/2 : 7.5YR 6/2 10YR 3/1 : 10YR 3/2 : 10YR 4/2 : 10YR 4/4 : 10YR 6/2 : 10YR 6/3 : 2.5Y 5/6 7.5YR 3/2 : 7.5YR 3/4 : 10YR 6/4 : 10YR 6/6 : 10YR 6/8 : 10YR 5/4 : 10YR 5/6 5YR 7/4 : 5YR 8/4 : 7.5YR 7/4 : 7.5YR 8/4 : 5YR 6/4 : 2.5YR 6/4 : 7.5YR 6/4		

Figure 2.1.4: Colour Classifications Showing Compacted Munsell Notations

Some colours, which relate to a significant number of observations within the rock art and/or the ochre assemblages, will have fewer constituent Munsell classifications. It is for this

reason that there are in fact four different categories which bear the adjectival description of “Red”. These four different 'Red' categories have each been assigned their own distinct category name in order to make them easily identifiable. These categories are comprised of two Munsell classifications each, which are grouped together based on the Chroma rather than the Value, as the adjacent colours on the Chroma scale bear greater similarity than adjacent colours on the Value scale. A further reason for these four Red colour categories is that the two 10R-Red categories are dominant in the rock paintings whilst the 2.5YR-Red categories are dominant in the ochre assemblages. This dichotomy is an important feature which will be examined later. The level of precision in the Red categories proved to be a pivotal issue with strong implications about the use of ochre.

Some of the colours (Dusky Red, Weak Red, Dark Reddish Brown, Reddish Brown, Light Red, Yellowish Red, Reddish Yellow, Brown, Strong Brown, Very Pale Brown, and Yellow) are grouped together even further so that the observations made would be meaningful when analysed alongside the more prevalent Munsell classifications such as the Reds mentioned above. These colour categories are grouped together based on their adjectival descriptions as they appear on the Munsell chart. In these grouped categories, the most prevalent Munsell classifications are presented first.

The remaining Munsell colour classifications, of which there were only very scarce quantities in the ochre assemblages and the rock art, were grouped in the category of “Excluded Colours”. The colours represented here, as listed in the figure under “Excluded Colours”, were not grouped into other categories as they are assigned different adjectival descriptions within the Munsell chart and could therefore not be grouped together with any integrity.

Finally, the colour categories were arranged according to their primary Munsell Hue classification and ordered in sequence from left to right, as seen in the graphs presented in the following chapter. In this sequence the colour categories on the left represent those colours that tend toward the 10R Munsell Hues whilst those on the right tend toward the 10YR Munsell Hues.

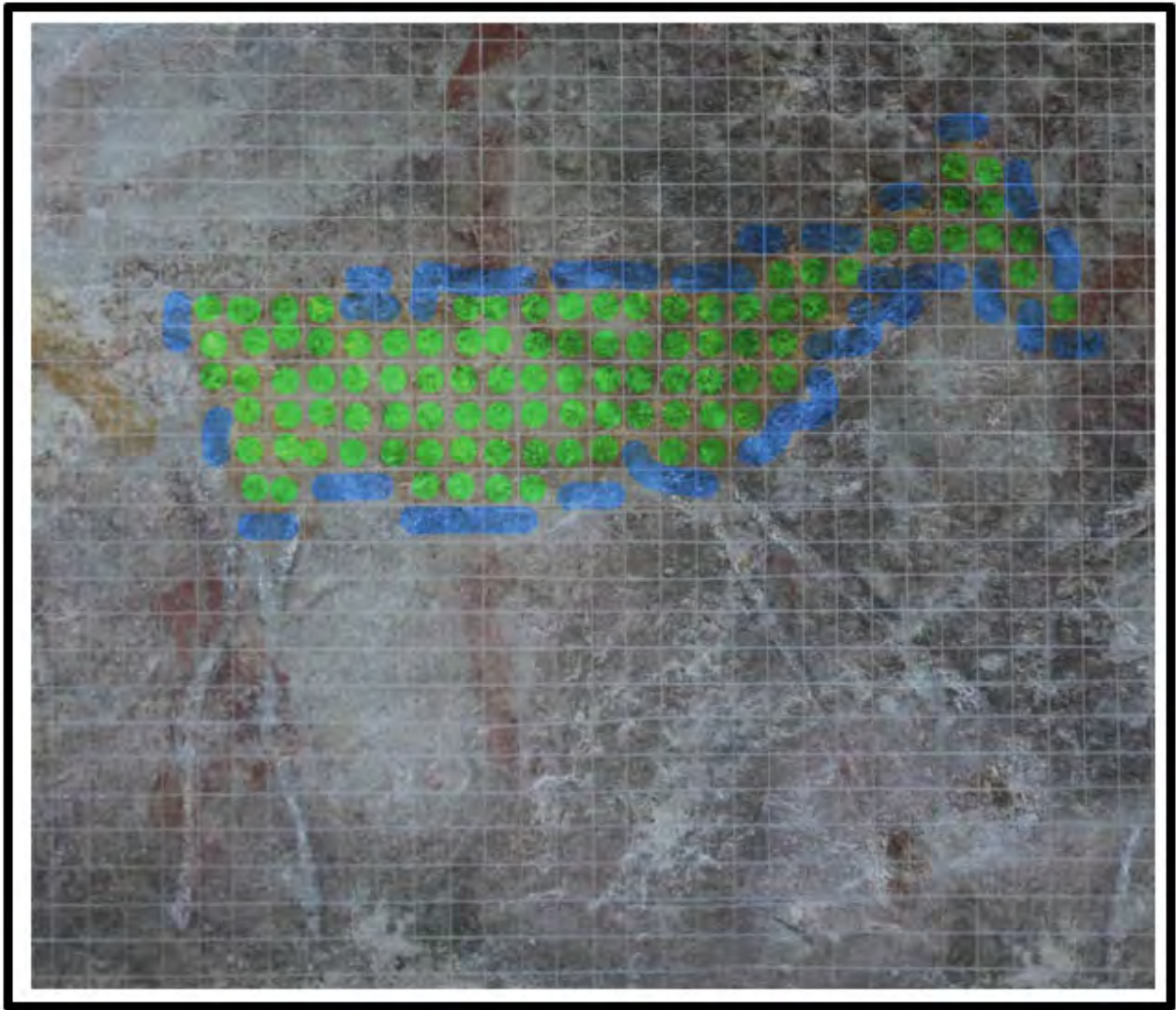


Figure 2.1.5: Rock Art Surface Area Recording Example

*Green dots represent 1cm². Blue Areas represent composite areas equating to 1cm²

Surface Area: To begin making comparisons between the rock art and the ochre, obtaining a precise measure of the surface area of each of the component colours was necessary. Eventual comparisons would hinge on the measured extent of the colours present in the rock art in relation to the mass of the respective archaeological ochre. After the recording process on the data capture sheets was completed and the images sketched, the rock art was photographed through a 1m² piece of clear perspex with a 1cm grid etched onto its surface. The camera numbers for these images were carefully entered onto the recording sheets so that the images could then be easily separated into their constituent image numbers, avoiding any possible confusion when coupled with the sketches. The 1cm blocks were then counted to give a close approximate surface area of each image. An example of how this was done is shown in figure 2.1.5.

Ochre Recording:

Upon visiting one of the three sites, after the initial spark of interest is ignited by the rock paintings, attention usually shifts to the deposit upon which one stands, and what it may contain. A logical question that jumps to mind is: *What were they using to make their paints?* One might assume that ochre excavated within a LSA context is associated with the rock paintings of that same site. To date, however, there has been very little work to investigate this link. Ochre pieces showing working such as bevelling, striations and polishing, in addition to ethnographic accounts of ochre use (Rudner, 1982, 1983), strongly suggest a connection between ochre use and rock painting. In order to be able to draw links between the rock art and the excavated ochre, there needed to be some common factors established in the methodology.

Before examining the methodology used in recording the properties of the ochre assemblages a crucial point needs to be made regarding the provenance of the excavated ochres. Whilst the ideal situation would be to have a detailed description of where various samples originated from within each of the sites with regards to their stratigraphic position, this is not the case with ochre assemblages presented in this thesis. With regards to both De Hangen and Diepkloof this is not as much of an issue as it could be, as both of these sites contain a very shallow deposit that was excavated in two primary contexts which were described as being contemporaneous to one another (Parkington, 1971; Parkington & Poggenpeol, 1987). For these two sites the stratigraphy was essentially limited to a short occupation. Andriesgrond, however, was slightly more problematic in that the depth of the deposit was slightly more substantial, reaching an approximate depth of 40cm in places. When examining the ochre assemblage from Andriesgrond, it became apparent that a combination of factors would make the provenance of the ochre nodules largely impossible to reconstitute. The excavation as described in print and the layer descriptions presented on find-bags did not correlate for a large number of ochre nodules. With the already small ochre assemblage from Andriesgrond of 215 pieces, this would have severely impeded the integrity of statistical analyses. The lack of clear stratigraphic provenance for the ochres is

regrettable but ultimately unavoidable in this thesis.

The methodology for the ochre recording for this thesis is based largely on the methodology used by Watts (1997). This thesis is therefore comparable in many aspects to that of Watts, although it has a shift in focus from analyses of the Middle Stone Age ochre assemblages to those in the Later Stone Age with the presence of associated rock paintings. Additionally, it provided a solid platform upon which to build, and Watts provided ideas for ways in which his methodology could be improved upon when the criteria of the project were slightly different to his, as they are in this case (Watts, 1997). This section will first outline the methodology employed by Watts in his research, and will then go on to detail the methodology of this study and show how it has deviated from the former.

Ian Watts' Methodology (Watts, 1997):

Ways of Defining a Pigment: Watts, working with Middle Stone Age ochre, specifically questioned whether all of the material excavated and classified as ochre from any given site can be reliably thought of as being used as pigment. To explore this he set out three main criteria. First, and most convincingly, is the issue of whether or not the piece shows signs of utilization. Secondly, Watts suggests that pieces that are closest to primary hues, such as vivid reds and yellows, are more likely to have been used as pigment than those tending towards browns. Lastly there is the issue of pulverance, the importance of which was whether or not the piece of ochre could be ground down to a homogenous powder which could then be used to make paint. Samples with variations in particle size would not make suitable mediums for paints.

Methodology used when Describing a Sample (Watts; 1997): The total mass of an ochre nodule is important in attempting to assess its potential use. Excavations frequently use different size mesh sieves which, when sites are compared to one another, may skew the statistical analysis when working with the samples from different excavations. The differences in the geological form were recorded, as it was an aspect that influenced the

friability of the material; these include haematite and other ferrous oxides, manganese, specularite, mudstone, sandstone and shales. These materials have differing degrees of friability ranging from fine to medium grain, to soft, to barely able to make a streak.

The streak colour of a piece of ochre best describes its powdered pigmentation; the ochre streaking process will be described shortly. The powdered colour therefore provides the closest approximation to the eventual paint colour. The colour of the powder made from a piece of ochre is best represented by its streak and not the colour of the piece itself. Consequently, all colour assessments made by Watts were done on streak colour as they are in this thesis.

Watts used 47 different adjectives for describing the colour of the ochre, and provided a rough equivalent to his colour classifications on the Munsell Soil Colour Chart. He himself recognised that a subjective adjectival classification suffers from a lack of standardisation, thus making it very difficult to replicate. His reasoning for not using the Munsell chart was based on the volume of material which he worked with. He felt that had he used the Munsell chart he would not have been able to work with as many samples as he would have liked (Watts, 1997).

The texture of the ochre nodules and the geological or physical form of the ochre are intrinsically linked. The assessment of texture relates directly to the question of friability, the finer grained the material, the greater the likelihood that it was used as a pigment. Making paint from coarse grained material would have produced a very poor quality paint that would have been very difficult to use, especially when working onto the already rough surface of the rock.

For a measure of the hardness of a piece, Watts did not use an absolute standard but instead used an adjectival description of the hardness of the pieces, being very hard, hard, medium and soft. The issue here again is that the adjectival descriptions are not standardised and thus cannot be replicated. One means of standardising the measure of hardness is to use

the MOH scale which provides a table of comparison based on the hardness of known minerals. The scale provides measured incremental steps for comparative hardness but not an absolute value. The MOH scale was explored as an option for this thesis but was rejected for a broader categorisation as outlined later.

Watts provided a four-step incremental category of utilisation based on the confidence with which one can determine whether or not a piece of ochre has been utilised. These four categories are: Definitely, Probably, Possibly and Unmodified. In much of his work Watts collapsed these four categories into two, namely Definitely and Unmodified.

Ochre methodology in this thesis:

Although the methodology of this study strongly mirrors that of Watts, some important changes have been made in how the ochre was dealt with and categorised. To begin with, each individual piece of ochre was assigned a unique number code, and was given a detailed label with all of the important attributes as shown in the accompanying figure and detailed below. This method of curating pieces separately enables later reintegration of all of the measured variables with regards to certain nodules.

DRS – OCHRE

Piece#: _____

Square: _____

Pigment: _____

Weight (g) : _____

(mm)L : _____ Br: _____

100(L/B) : _____ STQ: _____

Modification: Definitely / Probably / Possibly / Un

Hrd: _____ Grain.S: _____

Comments: _____

Weight: The weight of each individual piece of ochre was recorded with an electric scale with precision to within 1/10th of a gram. The importance of the weight for this study is that in order to make the comparison with the rock art, the weight of each piece is significant in determining the quantity of paint that it could produce and thus how large an area it could

Figure 2.1.6: Sample of Ochre Recording Tag

cover once made into a paint. It is also important in that the size of a piece of ochre could well affect its potential usage.

Dimensions: The dimensions of the pieces were recorded for the purposes of completeness rather than their immediate need for this study. The maximum length of each piece was measured, and then a maximum breadth was measured occurring at 90° to the maximum length. In addition to these two measurements, each piece was also given an index value by means of the equation $100L/B$, or the length divided by the breadth times 100. This index is given as a means of being able to ascertain a rough estimation of the shape of the piece without having to check the length and breadth values. A score of 100 means that the piece is roughly as long as it is wide, whilst a score of 200 means that the piece is twice as long as it is wide etc.

Modification/ Utilisation: This was kept the same as in Ian Watts' study. All the pieces were divided into four categories based on the confidence with which the utilization of each piece can be assessed. These four categories are: Definitely, Probably, Possibly and Unmodified. Whilst Watts eventually collapsed these four categories down to two, in this study they were only collapsed into three categories, those that are Definitely modified, Probably/Possibly and Unmodified. The middle category was maintained in order to ensure the integrity of the other two categories. An example of a Definitely modified piece is illustrated in figure 2.1.7.

Colour Coding: The streak colour of a piece of ochre is the equivalent of the colour of its powder. Consequently, the colour coding of the ochre was done based on its streak and not its exterior colouration. In order to gauge the constituent weight of the colours, every piece of excavated ochre was streaked. The downside to this is that the streaking process is a destructive one, which will leave each and every piece of ochre from the assemblages with a small amount of surface damage. The amount of damage done in streaking ochre is minimal, and its future differentiation from archaeological working is easily apparent, as gauged by pieces streaked in earlier studies. The modification confidence given to each



Figure 2.1.7: Example of Striated Ochre Nodule

piece on its label will additionally serve to clarify which pieces showed no signs of use prior to this study. Despite this, damaging archaeological material remains problematic. In this instance it is unavoidable as there is no alternative non-destructive method in ascertaining the powdered colour of a piece of ochre. In order to do an absolute minimum of damage, the pieces were all streaked onto unglazed porcelain dinner plates with their corresponding sample number. These plates will ultimately be stored alongside the ochre so that future work will not require further damage to the ochre. In order to keep the colour coding system consistent with the rock art analyses, the ochre streaks were also colour coded with the Munsell chart.

StQ (Streak Quality): The *Streak Quality* classification is a subjective measure created for this study that represents a combination of three physical properties of ochreous materials. These three qualities are texture or friability, hardness and the percentage of ferruginous iron content within a given piece. Ideally these variables could be examined individually

to gauge their impact on the overall streak, but an analysis of this sort would be entirely impractical when working with samples as large as the ones presented in this study. The StQ classification is therefore a combination of these three variables. In (pre)-historic contexts, ochre would have been selected for use based directly on the quality of the streak it produces regardless of the physical property responsible for that streak. The system is broken down into five categories for streaking quality namely; *No Streak (N/A)*, *Poor (1/P)*, *Average (2/A)*, *Good (3/G)* and lastly *Excellent (4/E)*. Those pieces that made no streak were later removed from analyses but remain contained within the ochre assemblages.

Survey Work:

Each of the three sites in this study are situated on raised rock outcrops, with a large view of the surrounding area. Turning one's back to the site and looking out over these panoramic landscapes, the issue as to the origins of the archaeological ochre becomes apparent. Do the ochre assemblages mirror the distribution of ochre across the surrounding landscape, are ochre sources freely available or is ochre a prized commodity for which people would be willing to travel great distances? These questions all bear relevance to the trends which may be noticeable within any given assemblage. Exploring the surrounding landscapes to gauge a measure of availability is therefore an important task in looking at ochre usage and is a pivotal starting point to mapping ochre from its source to its eventual inclusion in a rock painting.

The survey work was divided into two main objectives. The first of these was a detailed coverage of the immediate surroundings of each site. This was to give an estimate of the spread of ochre as encountered within the general landscape specific to each site. The second objective was to locate potential ochre sources to which Later Stone Age people may have travelled for the specific task of collecting ochreous materials. Geological maps were heavily referenced here in order to pinpoint potential areas of concentrated ochres, such as geological landforms containing a high density of shales.

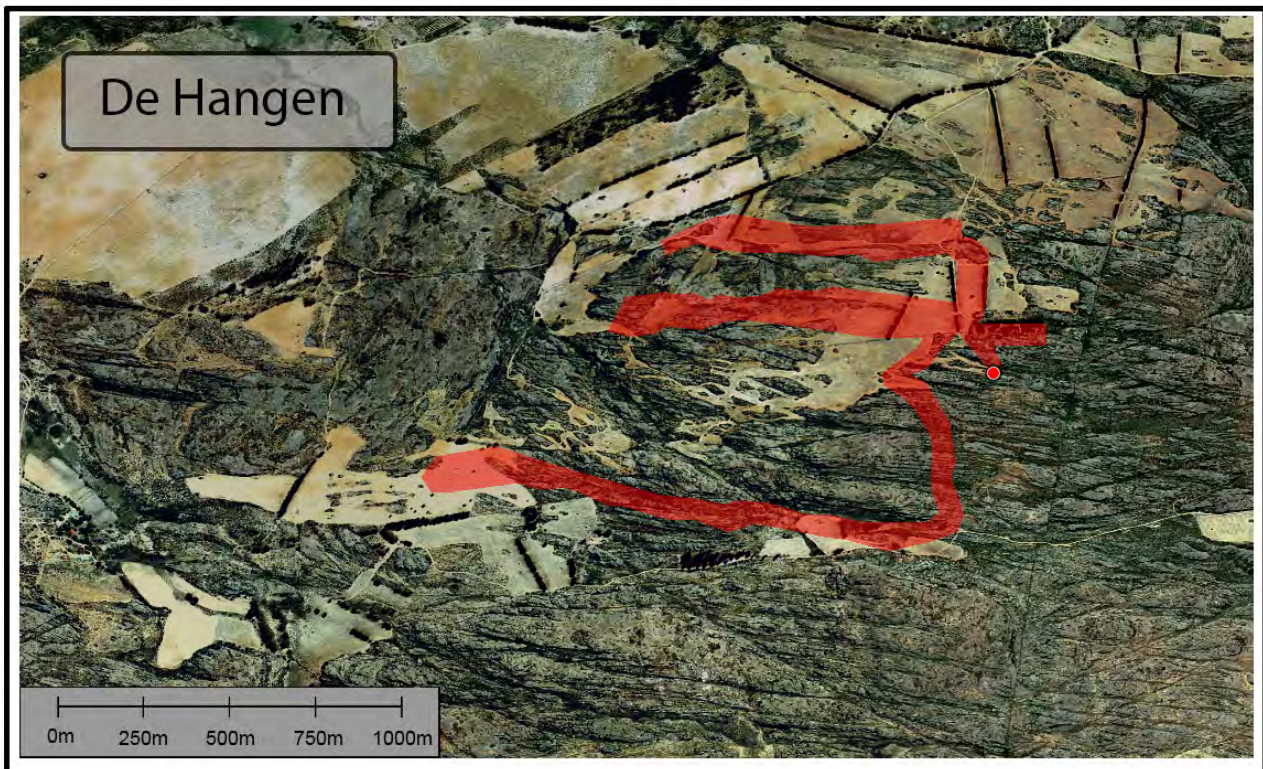


Figure 2.1.8: Example Map of Survey Track

The surveys were carried out with a team of five to six people over a period of several weeks. The areas walked around the sites were broken down into different tracks each of which was recorded separately. Surveyors were spaced at approximately 20m intervals and then surveyed in parallel lines as accurately as the vegetation and landscape would allow. A total of three hand-held G.P.S devices were run concurrently in order to accurately define the area surveyed, one G.P.S at each extreme and one in the centre. The track logs for each device were then uploaded and projected onto detailed maps and aerial photographs using Global Mapper. At the start and end of each track a panoramic photograph was taken with an associated G.P.S point. An example of this method is shown in figure 2.1.8.

Each surveyor carried several fragments of unglazed plate upon which to streak the ochre they found (figure 2.1.9). Each plate fragment was used to streak multiple pieces of ochre, and was then bagged separately with a label detailing the track information. The use of the plate fragments for survey work kept the colour coding consistent with the process used to classify the archaeological ochre. The colour coding was done solely by the author within laboratory conditions, this once again being done for consistency with the use of the Munsell Chart.

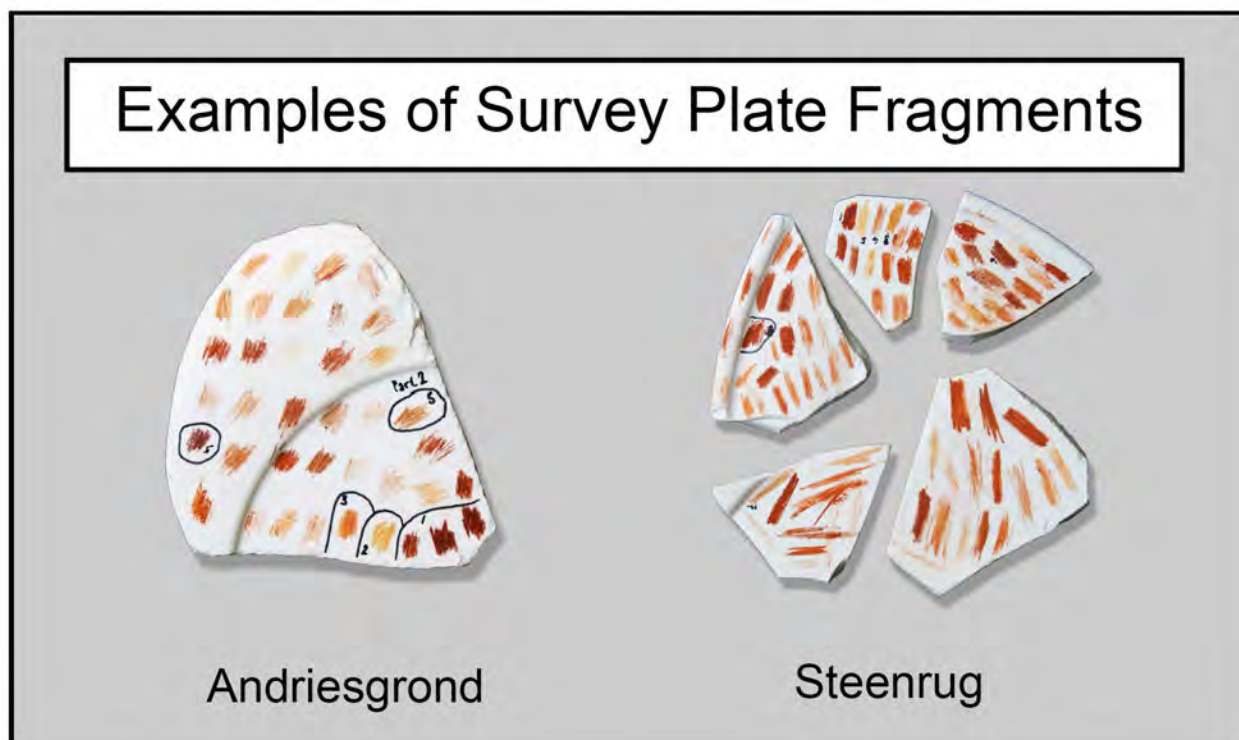


Figure 2.1.9: Examples of Survey Plate Fragments

All of the fragments for a given track were then examined as a single entity. From this, the total number of streaks was tallied, and divided by the number of surveyors on a given track, to attain an average streak per person. The total distance covered, and the time taken in covering that distance were also captured; from this a survey rate was calculated. The importance of this is that the speed with which a survey was conducted may have an impact on the perceived density of ochre in a given area due to the meticulousness with which it was conducted. This was also factored in as an aspect of the ratio described below.

A final step in the process was to create an ochre encounter rate which attempts to show the density of ochre in an area. The equation for this rate is as follows: $[(\text{total distance} / \text{average streak per person}) / \text{survey rate}]$. This value represents the amount of time between encountering pieces of streak-able ochre. The step of dividing by the survey rate serves to normalise the different tracks; an area with a high density of ochre will be shorter and surveyed slower than an area with a very low density. Whilst the accuracy of this value is imprecise, the differences between surveyed areas are sufficiently divergent to render the value important, as will be illustrated later.

Experimental Hearths:

Once the prevalence of ochre in the vicinity of each of the three sites has been roughly ascertained, the next logical step is to explore possible transformations of the ochre from its geological source to its eventual excavated state or its use in a rock painting. One such transformation would be the heating of ochre within or underneath historical hearths. Whilst there is some ethnographic evidence that ochre may have been heated intentionally (Rudner 1982, 1983), this is decidedly difficult to ascertain for ochre from archaeological contexts. The heating of ochre is therefore treated primarily as a serendipitous event as argued by Wadley (2009) for the over-representation of red ochres from archaeological sites. Regardless of the intention or function of these hearths, the heat conducted through the soil below such a hearth has been shown to impact on the chemical composition of buried ochre at depths of up to 10cm (d'Errico *et al*, 2010; de Faria & Lopes, 2007; Gialanelli *et al*, 2011; Pomies *et al*, 1998; Wadley, 2009). Chemical change in ochre is inherently linked with colour change. This will also be demonstrated in a later chapter. As this thesis hinges strongly on colour classifications and comparisons, the issue of ochre heating was one that warranted detailed enquiry.

The experimental hearths were closely modelled on those done by Wadley (2009) in order to replicate conditions as closely as possible to enable comparison. Furthermore the same fuel, a Namibian hardwood, was used consistently in all three hearths to have a constant variable and in hearths #2 and #3 the same quantity (11 kg) was used. The object of the first experimental hearth was primarily for the author to devise appropriate reliable methods for the subsequent experiments. As such, the results from the first hearth were excluded from the study due to the erratic nature of the collected data.

The deposit used in hearth #2 was exclusively back-fill deposit originating from the site of Klipfonteinrand in the Cederberg, courtesy of Alex Mackay. The deposit used in hearth #3 was entirely non-archaeological, store-bought river-sand. This was done partially as no other archaeological deposits were available at the time, but also to examine the differences

that various deposits may have on heat induction below a fire. Archaeological deposits from rock shelters are usually very fine-grained and are rich in organic components and residues whilst river sand is coarse-grained and by comparison organically barren.

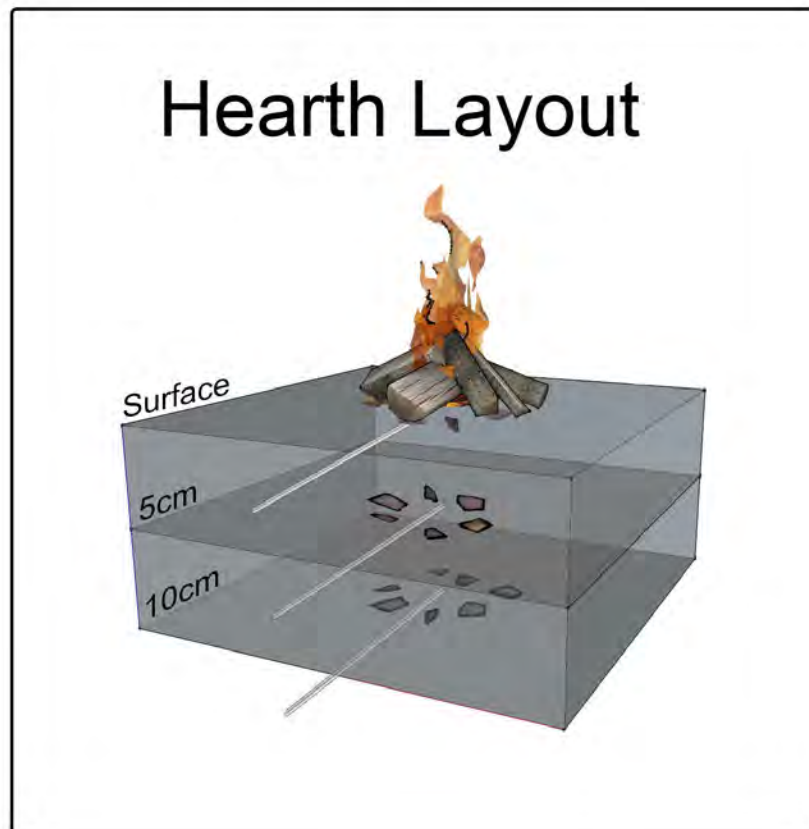


Figure 2.1.10: Layout of experimental hearth

For hearths #2 and #3 a square 60cm x 60cm pit was dug to a depth of approximately 20cm (see figure 2.1.10). The bottom of the pit was lined with deposit from the relevant origin. The pit was then filled to just below ground level with the same deposit, ochre samples and thermocouples being buried at a measured 10cm and 5cm below the surface. Finally a last set of ochre samples and a third thermocouple were placed on the surface. The fires were subsequently lit directly on top of the surface ochre samples. Temperature readings were taken with a single-input MT-630 thermometer at 15-minute intervals for the first hour, and thereafter every 30 minutes for a total duration of 30 hours.

#	Volume of wood	Deposit Origin	Max Temp °C surface	Max Temp °C 5cm	Max Temp °C 10cm	Total time measured
Hearth #1	+/- 70 kg	Elandsbay Cave ¹	956	365	141	13hrs
Hearth #2	11 kg	Klipfonteinrand ²	535	337	218	30hrs
Hearth #3	11 kg	Sterile River Sand	615	342	231	30hrs

Table 2.1.1: Experimental hearth variables

¹: Backfill deposits courtesy of Guillaume Porraz

²: Backfill deposits courtesy of Alex Mackay

Laboratory work on the geological ochre samples from the experimental hearths:

Ochre preparation:

The first step in the process of preparing the ochre samples for analysis was to assign each sample a laboratory code. These codes are essential in order to provide easy reference after the research has been conducted, regarding which samples were processed, where they originated, and a brief outline of what analyses were carried out.

Prior to any archaeometric analysis, the ochre samples needed to be prepared into a processed form, fitting the required specifications for each test. In the case of X-ray diffraction, the ochre must be in the form of a fine-grained powder. The powdering process was as follows: an approximately uniform-sized piece was cut off each of the samples using a diamond-tipped laboratory saw. The remainder of each sample was kept should further alternative analysis be conducted in future. The outer layers of the cut samples were removed by means of sandpaper and/or grinding on a low-powered saw, thus reducing surface contamination. The samples were then physically crushed with a hammer and a table-mounted clamp until the fragments were, on average, smaller than 5mm. The fragments were then placed inside a laboratory ball-mill at a rotation speed of 400 rpm for a duration of 10 minutes per sample. The milling process reduces the samples into a fine-grained powder. This powder was then further crushed with a pestle and mortar to ensure homogenous grain size.

A total of 46 samples were prepared in this manner. Due to time constraints, not all of these

samples were analysed with X-ray diffraction, although the remaining samples are already prepared and could be easily run at a later stage. Thirty-two of the samples prepared (labelled V, T and L) originated from three points within the geological source present at the Diepkloof archaeological site. A further 14 samples were collected at two different sources within the Western Cape; 7 of these (labelled E) originated from the Warmwaterberg region, and 7 (labelled B) from alongside the Swartberg Pass south of Prince Albert. These alternate sources were tested alongside the Diepkloof samples in order to provide comparative data.

X-ray diffraction methods:

In order to run X-ray diffraction on the ochre samples, they needed to be prepared in one of two ways, each of which has advantages and disadvantages (Dayet personal communication, 2012). The first of these is to mount the powdered ochre samples within small sample holders. The random-particle orientation of this set-up produces a strong X-ray diffraction signal, enhancing the reliability of database comparisons; however, the clay components within the samples will be less apparent. This set-up also requires more time in order to prepare the samples to a satisfactory level. The second set-up (which was eventually used) is to mix the powdered samples with a small amount of water and place them on transparent slides. The slides were then dried in a low-temperature oven to evaporate off the water content. The major disadvantage of slide preparation is that the particles become orientated along the plane of the slide which reduces the strength of the X-ray signal, especially when compared with the relevant databases (Dayet personal communication, 2012). This same orientation of particles, however, has the advantage of highlighting the clay components within each sample, which potentially would provide interesting findings. Slide preparation was also significantly quicker and easier in comparison to the powdered set-up; this was a strong motivating factor in its use due to time constraints.

The instrument parameters for the X-ray diffraction were as follows: Structural phases were determined by X-ray diffraction; data was collected with a Bruker D8 Advance diffractometer, equipped with a PSD Linxeye detector and operating with a Cu K α radiation ($\lambda=1.5405 \text{ \AA}$);

Bragg-Brentano geometry was used to analyse powder samples, which were deposited on glass slides by evaporation of a water suspension; and a Ni-filter was used to remove the Cu K β ray (Dayet, 2013). Average running time per sample was approximately 9 hours (Dayet personal communication, 2012; Dayet, 2013).

Colorimetric Methods:

Colorimetric analysis was also conducted on the ochre samples, as colour change is indicative of chemical change. Using colorimetric methods removes the subjectivity that arises when using alternate colour measurements such as the Munsell Soil Colour Chart used to colour code the rock art and archaeological ochre streaks. Despite the production of colorimetric measurements, colour is in fact an incredibly difficult attribute to quantify. Colour, by its very nature, is inherently an aspect of the quality of light reflected off the surface of any object. As such, the colour of an object is dependent on the light source.

Colorimetric measurements taken on the surface of actual ochre samples could not adequately account for the nuances and variations that routinely occur. There were, indeed, large disparities between the surface colour and the interior or powdered colour within the same ochre piece. As such, there is little correlation between surface colour and powder colour. A further problem with surface measurements derives from the influence of provenance. The deposit within which a piece of ochre is situated may have varying effects on the surface colour due to a staining of the surface material. Attempts to establish whether non-destructive surface colour measurements may help indicate interior colour, and consequently hint at the chemical constituents of archaeological ochre, were largely abandoned due to the aforementioned problems.

Colorimetric analysis of homogenous ochre powders proved to be highly effective, but was labour-intensive and proved excessively time-consuming. Taking colour measurements on slides already analysed by X-ray diffraction provided the most reliable, consistent and time-effective method. At this point it is important to note that colorimetric measurements taken

BDX 15476 E1-0 POW	BDX 15476 E5 - 1 POW	BDX 15476 E7 - 1 POW	BDX 14048 V1 - 0 POW	BDX 14048 V10 - 1 POW	BDX 14048 V7 - 2 POW
BDX 15476 E1-0 Slide	BDX 15476 E5 - 1 Slide	BDX 15476 E7 - 1 Slide	BDX 14048 V1 - 0 Slide	BDX 14048 V10 - 1 Slide	BDX 14048 V7 - 2 Slide

Figure 2.1.11: Colour Swatch Showing Colour Variation on Colorimetric Readings Taken on Powders and Slides

on slides are not immediately comparable to measurements taken on ochre powders. The preparation conditions have a marked effect on the colour readings as seen in the figure (2.1.11) presented. The measurements taken on ochre powders are consistently darker and more colour-saturated than their slide counterparts. Consequently, all the comparisons could only be meaningfully carried out between samples measured on slides, and the data is not readily comparable to other measurements. The colorimetric data generated in this work generally is therefore restricted, and only data on colour change specifically can be compared between studies.

The colorimetric instrument parameters were as follows:

Instrument : Konica Minolta CM-2600d

Illuminant : D65

With UV

Angle: 10°

Without specular reflection

Aperture: 3 mm

* * *

With a clear methodology established, the ochre assemblages and the corresponding rock art from each of the three sites can now be examined within this framework. In the following chapter a background discussion presenting the excavation history of the sites and a short compilation of the complete LSA assemblages is given. The ochre is then discussed in detail before the rock art findings are presented and then compared with the ochre assemblage.

3. Archaeological Results



3. Archaeological Results

This chapter provides descriptions of the archaeological material from each of the three sites studied in this thesis. It is divided into sections, each covering both a research background and a detailed description of the ochre assemblage and the rock paintings from each site individually. The background description serves to situate the current research within the context of previous studies and analyses of the archaeology pertaining to each site. The task of situating one's research within the framework of previous studies helps to illustrate the angle of approach required to shed new light on old evidence and previously excavated materials. Current research is inherently built upon, and motivated by, the results of prior study. The reader is reminded that some of the difficulties regarding the comparison of ochre to rock art, such as the issue of superimposition of one image over another and the colour of that image, have been touched on in the Methodology chapter.

De Hangen

The site of De Hangen is nestled deep in the Cederberg mountains, north of the town of Clanwilliam in the Western Cape. The co-ordinates of the site are 18°52' East and 32°5' South. At an altitude of approximately 580 metres above sea-level, it is the highest of the three sites examined in this research area. It is a northerly facing shelter raised up on a rock platform several metres above the surrounding terrain (figure 3.1.1).. The shelter itself is not a sealed unit in that it is merely the most northerly end of a tunnel feature that extends further southward through the sandstone ridge in which it is embedded. The recess area of the tunnel is very narrow and was not inhabited in any way by people; and deposits therein are purely natural accumulations (Parkington & Poggenpoel, 1971).

The raised platform that forms the floor of the site provides a wide view of the shallow valley to the immediate north of the site, culminating at the Doorn River valley 18 km north (Parkington & Poggenpoel, 1971). The valley contains several seasonal streams which all drain westward towards the Olifants River, some 10 km away. This route is one taken fairly



Figure 3.1.1: De Hangen Rock Shelter

easily on foot, and therefore provides easy access to the Olifants River valley and the low-lying landscape westward of the Cederberg towards the coastal region. The site sits within a rough plateau between the various mountain peaks. To the south of the site the mountains rise up to heights of nearly 1000m for the highest peaks. In several places the drop from the edge of the Cederberg is sheer and difficult to navigate, though there are some 4x4 trails that do wind their way up onto this plateau. This shows that, whilst seemingly impassable, there are access routes southward that people may have used in order to navigate their way through the landscape and arrive in the wide valley where the town of Clanwilliam lies today.

The site itself is a comparatively small shelter with a limited habitation space toward the back wall; the archaeological deposits are clustered toward this area. In front of this there is a wide area of sloping rock platform, referred to in the excavation report as the 'talus', which slopes downwards toward the mouth of the shelter but ultimately dips down in a deep pit feature at the front of the site (Parkington & Poggenpoel, 1971). Surrounding this pit, the rock platform at the mouth of the shelter is higher than the sloping area of platform behind it within the site.

Background

The site was excavated in 1968 as part of a series of excavated sites (of which Andriesgrond and Diepkloof were a part), aiming to trace seasonal mobility patterns of later stone age people (Parkington, 1972). The excavated deposits were broadly described in three units: Grass Layer, Main Ash Concentration and Brown Sand. The Grass Layer refers primarily to the bedding area which forms an arc against the rear and side walls of the shelter. The depth of the excavated grassy deposits ranges between 10cm and 20cm at its maximum. Contained within this arc is the Main Ash Concentration which can be described as an area of consistent regular hearth features, this unit being primarily comprised of fine wood ash with a series of white ash concentrations within it. These concentrations are the result of a series of discrete hearth features which were lit within the same general area. The Grassy Layer and the Main Ash Concentration units are likely to be contemporary to one another based upon the stratigraphic interleaving that occurs at the boundary between them; as such they broadly represent a single event or period of habitation. The last of the excavated units, the Brown Sands, represents the underlying deposits which are a combination of archaeological debris and the basal sands created by the weathered sandstone that forms the bedrock of the site. This underlying unit is therefore also likely to be contemporary with the other two units in that it is a combination of the basal geological sands and the filtration or compaction of archaeological remains into this layer from the overlying period of occupation (Parkington & Poggenpoel, 1971).

The deposits that were present on the 'talus' slope, running from the main habitation area down towards the rock pit near the front of the site, were unstratified and appeared to be derived from the habitation area towards the rear of the shelter. Artefactual remains found here were therefore likely to be the result of post-depositional movement of sediments rather than a feature of habitation. The pit, being an obvious catchment area for sediment run-off, had nearly been filled to the level of the surrounding rock basin with matching Brown Sand sediments. At the base of the pit, however, a small stratified hearth feature was excavated which appeared to closely match the sediments of the Main Ash Concentration. Whilst a

direct stratigraphic link between the two was impossible, there is a strong likelihood that the two areas were contemporary, based on the artefactual remains (Parkington & Poggenpoel, 1971).

The radiocarbon dates obtained for the site range from 1465 A.D. to 1869 A.D. approximately, with a cluster of dates falling in the centre of that range at around 1600 A.D. Two of these middle dates come from samples taken from the Main Ash Concentration whilst the third comes from the hearth feature within the pit. This adds credence to the notion that the hearth in the pit and Main Ash Concentration were related events occurring at a roughly contemporaneous period. There was one major outlier which gave an approximate date of 100 A.D. The sample for this date was collected from within a small ash and charcoal lens within the loose bedrock that underlies the Grass Layer in square H. This may be evidence of a brief visitation to the site around that period (Parkington & Poggenpoel, 1971).

The stone artefacts excavated from the site contained a range of raw materials including quartz, fine-grained quartzite, chalcedony, indurated shales and silcrete. More than half of the lithic material is made up of quartz with the remaining materials accounting for the rest. The majority of artefacts and formal tools are small in size, with most weighing in at under four grams. The likely implication of this is that not only were the tools fashioned from raw material pieces of diminutive size, but also that the lithics may have formed part of composite tools. The abundance of tools with gum or mastic adhering to them, as part of the hafting process, supports this notion (Parkington & Poggenpoel, 1971). Additionally it may be important to note that there is an abundance of quartz inclusions in the geology all around the site, and indeed throughout much of the Cederberg range. As the most easily accessible stone resource, it seems unsurprising that the majority of the lithic assemblage is comprised of quartz. It is important to note this fact when examining the evidence obtained from ochre survey analyses carried out in the surrounding area, as discussed in the chapter on experimental research, the two resource materials showing very different availability.

In addition to the lithic assemblage there were artefacts and tools made of other materials

including bone, ivory, wood, fibres, shells and leather. Some splinters of bone derived from the long bones of large bovids had been shaved and sharpened into projectile points and awls. There were 225 fragments of polished tortoise carapace which were likely fashioned into bowls or scoops. Indeed, one near-complete tortoise carapace bowl was found in the hearth feature in the pit. There were two ivory artefacts recovered, one linkshaft from a composite arrow and a decorated knife which had been broken into nine fragments. Wooden artefacts recovered from the site included a 48cm-long digging stick; five blacked wooden cones which may have been utilised as fire drills; thirty-eight wooden 'pegs' and lastly 844 wood shavings. Eight pieces of leather were excavated; of these, one was a tailored item of clothing comprised of four separate sections of leather stitched together with thread made of sinew. Beads found at the site were primarily made of ostrich eggshell, but some were made of seed and the polished long bones of birds. Lastly, there were 330 potsherds excavated of which 20 were rim fragments, 45 showed decoration, 4 were partial lugs and one was a base section (Parkington & Poggenpoel, 1971).

The faunal remains excavated at the site include: one partially burnt human skull fragment; part of a baboon mandible; an array of small bovids including klipspringer, duiker, steenbok and grysbok; a large number of dassies and a few other small rodents including gerbil, mouse, shrew and rat. Reptile remains are scarce throughout the site with exception of tortoises with at least 313 individuals represented. Other faunal remains included eland, domestic cattle and sheep/goat, hare, mongoose, genet, honey badger, jackal, porcupine, lizard, snake, frog and guinea fowl (Parkington & Poggenpoel, 1971).

The diet of people living at site was comprised primarily of a few staple sources. The flora aspect to the diet was comprised mostly of rootstocks, such as corm bases, bulb cases and tuber cases which are common throughout the site with the addition of some fruits. The main faunal component of the diet came primarily from dassie and tortoise and was supplemented with other small game and small bovids when available (Parkington & Poggenpoel, 1971).

Ochre

One of the original motivations for choosing the site of De Hangen for the author's Honours thesis was that the site had been excavated in its entirety. The importance of this was that the entire ochre assemblage is represented and not merely a sample. This factor remains relevant to this research and allows for some subsequent observation and comment.

A total of 200 pieces of ochre were excavated; of that total, 17 pieces made no streak and were therefore removed from further analysis. Three pieces were 'two-toned', meaning that they made two streaks of differing colour. These were also removed from the analyses as they would split into different colour categories, thereby making a clear determination of the mass of the component colours unreliable. It is important to note that the two-toned property is a likely, but by no means conclusive, indication of burning or heating. Lastly, two further pieces of ochre were removed as they had too great a mass in comparison with the rest of the assemblage, and would therefore skew the mass data significantly. These two pieces had a mass of 41.1 and 54.7 grams respectively. The total sample number used in the analyses is therefore reduced from 200 down to 178. In the instances where the excluded pieces are mentioned hereafter, they will be appear in brackets e.g. (+1) or (+2.1g) alongside the relevant values. The 178 pieces of ochre have a total mass of 566.5 grams.

The first step in the process was to categorise the ochre assemblage into its constituent colour categories, these categories being created from a collation of Munsell Soil Colour categories as outlined in the methodology chapter. It is important to note that the colour categories do not represent equal colour variance, in that some categories are comprised of up to eight different Munsell classifications, whilst others comprise only one.

(Refer to figure 3.1.2) The De Hangen assemblage is dominated by Red ochres (2.5YR 4/6 and 2.5YR 4/8) which have a total mass of 244.9 grams and account for 43% of all the ochre from the site. The adjacent colour category is also a Red found on the 2.5YR hue, (2.5YR 5/6 and 2.5YR5/8), and comes to a total mass of 76.1 grams. These two categories, as the

De Hangen: Ochre Assemblage in Constituent Colour Categories

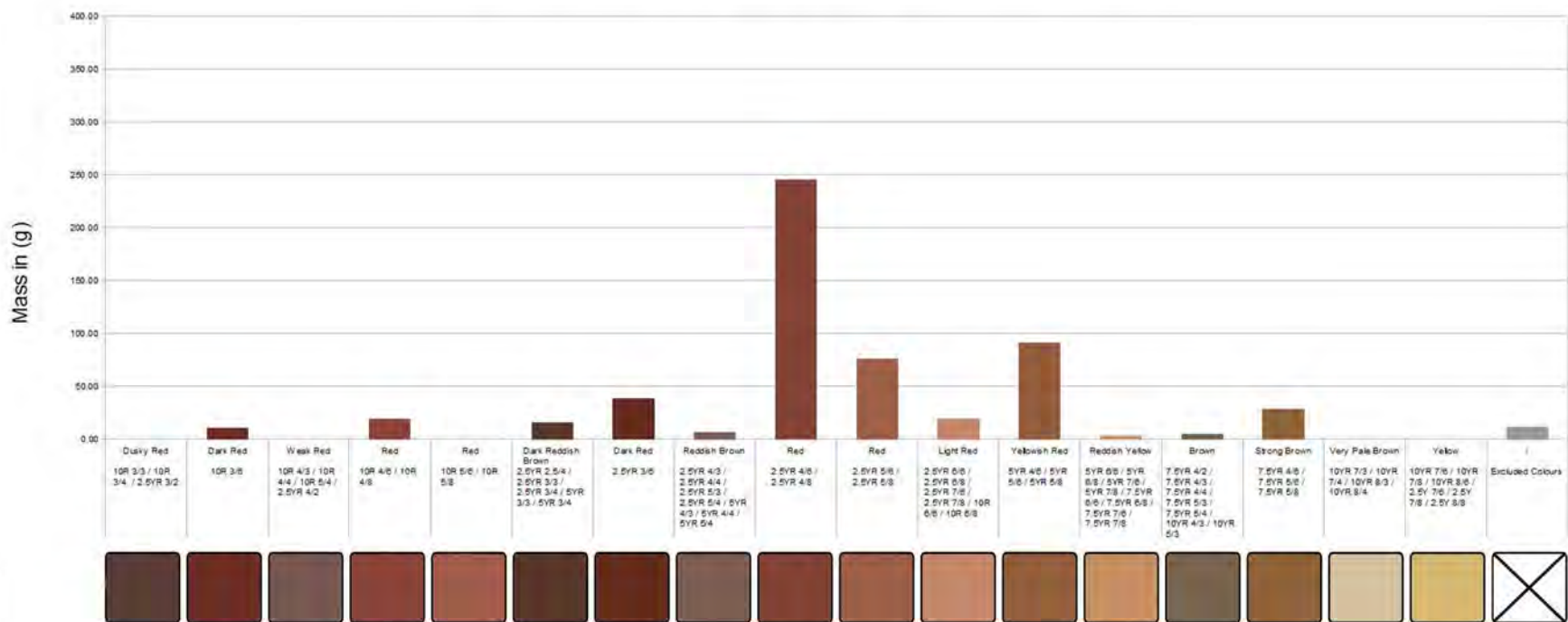


Figure 3.1.2: De Hangen: Ochre Assemblage in Constituent Colour Categories

most prevalent colours, have been used as a significant middle point for the colours found along the spectrum at all three sites. Additionally, they prove to be of vital importance when comparing the ochre assemblage to the Rock Art (as discussed later). Moving left from the 2.5YR Reds, we move gradually toward the more saturated vibrant Reds found on the 10R Munsell hue. Working from right to left these are Reddish Brown 5.8g; 2.5YR-Dark Red 38.1g; Dark Reddish Brown 15.8g; 10R 4/6 and 4/8-Red 18.9g; and lastly 10R-Dark Red 10.5g. To the right of the 2.5YR Red middle point, we move gradually towards the browns and yellows of the 10YR and 2.5Y Munsell hues. From left to right these are Light Red 18.8g; Yellowish Red 90.6g (the second most common colour found at De Hangen); Reddish Yellow 2.6g; Brown 4.7g; and Strong Brown 28.4g. This division on either side of the 2.5YR Reds, whilst somewhat arbitrary, does have implications for the physical nature, and the chemical composition, of the ochre (as will be discussed in the chapter pertaining to experimental research). Lastly there are a few pieces that fall within the category of Excluded Colours; these include Black, Light Olive Brown, Dark Brown and Yellowish Brown - collectively they have a mass of 11.3g.

The streaking quality of the ochre is important when trying to determine the potential usage - or lack thereof - of the ochres from the site. Ochres producing a Poor or Average streak are likely to have been thought undesirable for the production of paints or powders, regardless of their eventual function. Contrastingly, ochres with a Good or Excellent streaking quality would be more suitable and therefore more likely to be utilised. When working with the streaking quality of the ochres, the following graphs (figures 3.1.3 & 3.1.4) examine the count percentage of colours present within each streak-quality category, namely Poor, Average, Good and Excellent.

The two central 2.5YR Red categories, when combined, make up 38.3% by mass of all the Poor streak-quality ochre (a total of 47 pieces were classified as having Poor Streak Quality). To the left of these (towards 10R Munsell hues), there are only a handful of pieces represented and collectively the eight categories only make up 10.6%. Contrastingly, to the right of the 2.5YR Reds is where the majority of all the poor streak-quality ochre is

represented, with just over half (51.1%) comprising of Light Red (4.3%), Yellowish Red (23.4%), Reddish Yellow (4.3%) and Strong Brown (19.1%).

A total of 57 pieces of ochre were classified as having an Average Streak Quality. The spread of colours is broadly similar to that just described in the Poor classification. The two central 2.5YR Reds make up 40.3%. To the left of these (towards 10R) there has been a slight increase, up to 17.6%, this comprised of Dark Reddish Brown (7%); 2.5YR-Dark Red (8.8%) and Reddish Brown (1.8%). To the right of the central 2.5YR Reds (towards 10YR/2.5Y) there is also only a slight change with 42.1% of average streak-quality ochre falling within the colours Yellowish Red (28.1%), Brown (7%) and Strong Brown (7%).

The pattern looks radically different when the pieces classified as having a Good Streak Quality are examined (a total of 47 pieces) see figure 3.1.4. The central 2.5YR Reds now constitute 61.7%, with the 2.5YR 4/6 and 4/8 category comprising the majority of this increase, jumping up to 42.6%. The colours to the left (tending toward 10R) also increase and now make up 24.5% of the Good Streak Quality total. The colours represented here are 10R-Dark Red (2.1%), 10R 4/6 and 4/8-Red (5.4%), Dark Reddish Brown (6.4%) and 2.5YR-Dark Red (10.6%). To the right (tending toward 10YR and 2.5Y), the percentage plummets and there are now only two colours represented here with a combined value of 12.8%, namely Yellowish Red (8.5%) and Strong Brown (4.3%)

The Excellent Streak Quality classification for De Hangen is compromised by a low sample size with only twenty pieces being classified as such. Bearing this in mind, the two central Reds make up 45%. To the left of the central Reds there is a marked increase with 45% being present here, comprising 10R-Dark Red (5%), 10R 4/6 and 4/8-Red (10%), 2.5YR Dark Red (25%) and lastly Reddish Brown (5%). To the right of centre (tending toward 10YR and 2Y), there is only one colour represented, namely Reddish Yellow (10%). It should be stressed again that the low sample size has a marked impact on this graph, and perhaps a more realistic measure would be simply to look at the presence or absence of various colours rather than at their percentage values.

Figure 3.1.3: De Hagen: Poor and Average Streak Quality Ochres in Constituent Colour Categories

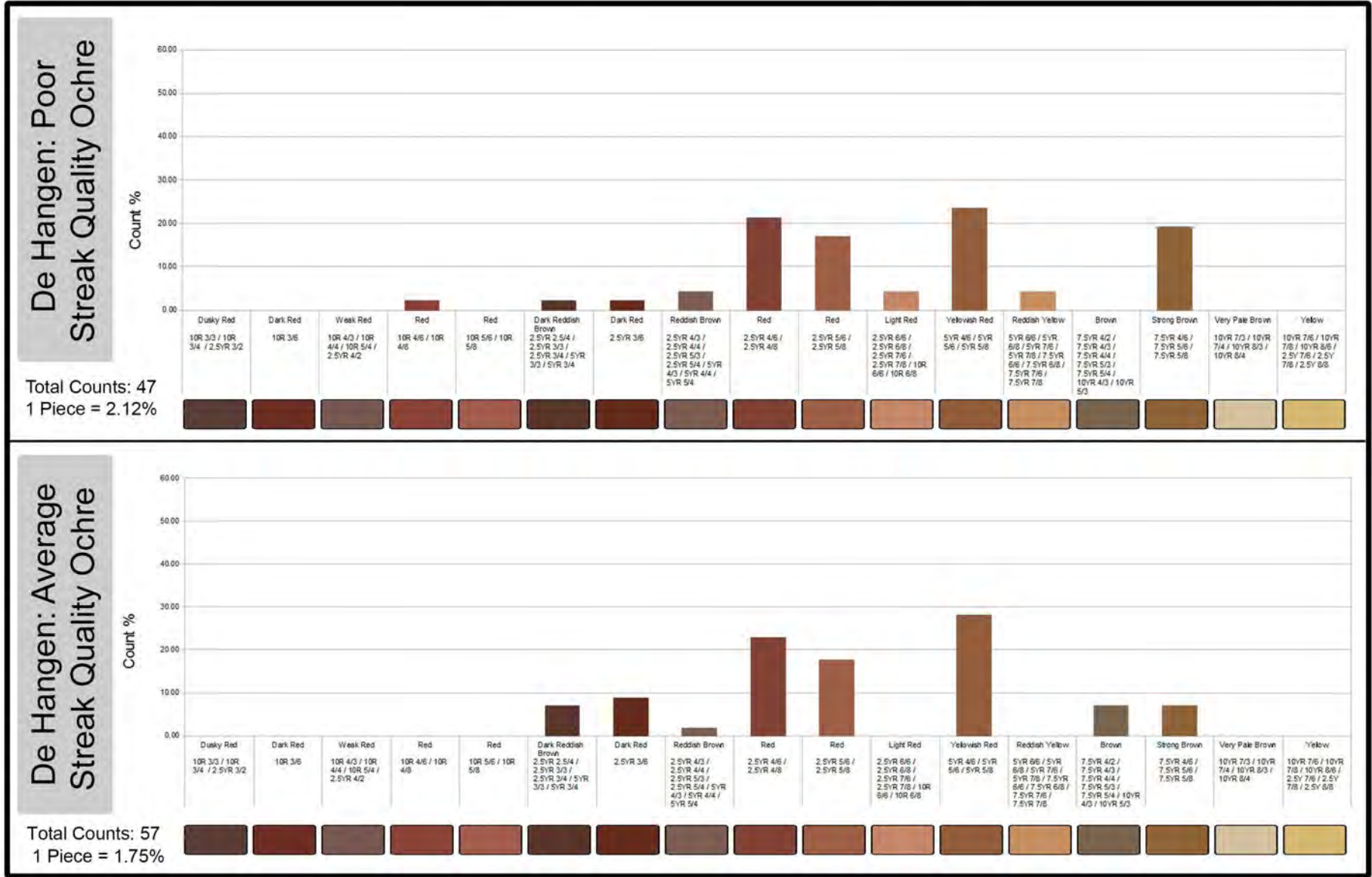
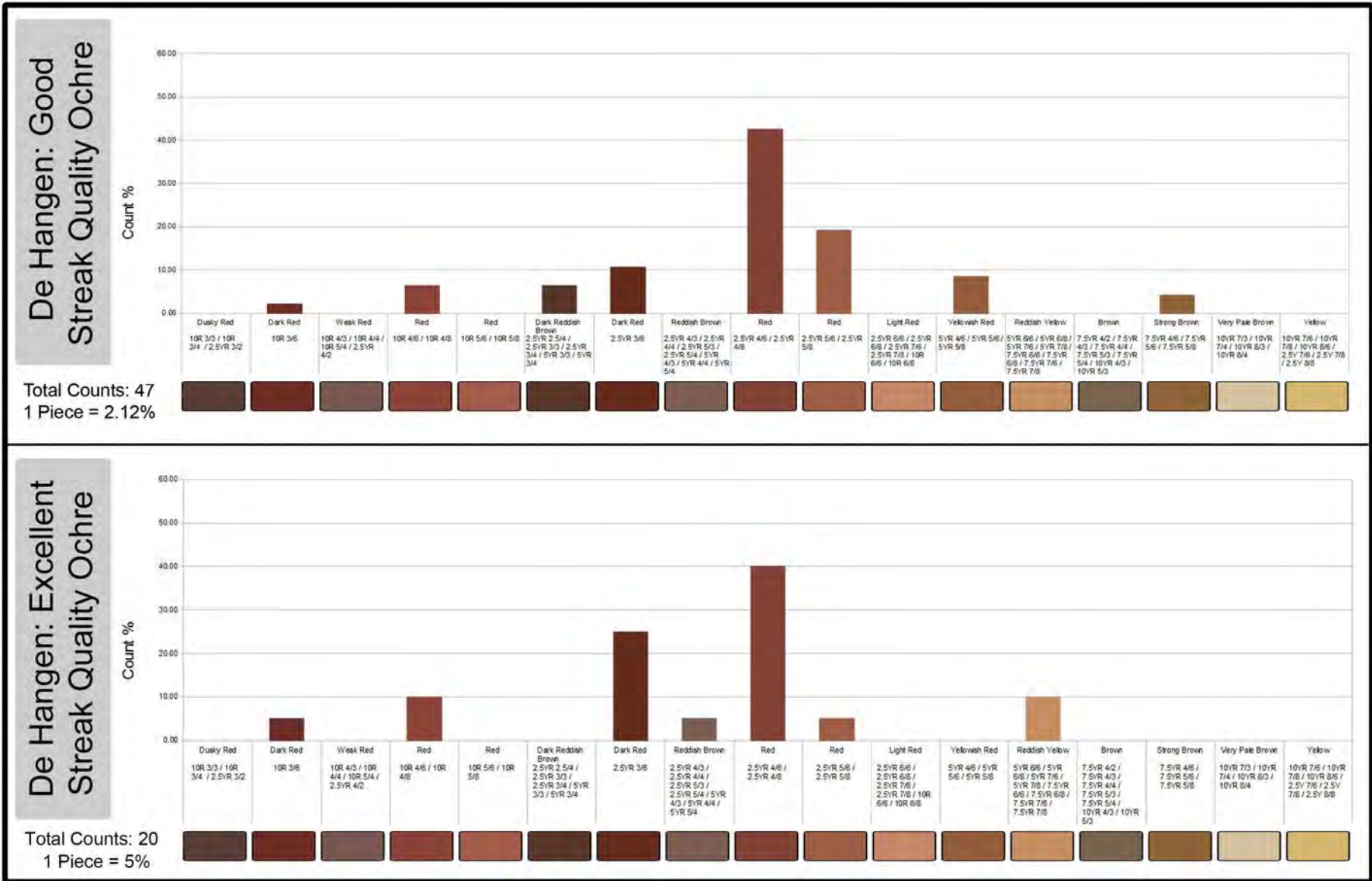


Figure 3.1.4: De Hangen: Good and Excellent Streak Quality Ochres in Constituent Colour Categories



The trend when looking at the streak quality of ochre at De Hangen shows that the 2.5YR Reds are represented throughout, with a steep increase as the streak quality improves to Good and Excellent. The more saturated hues that appear to the left of centre are almost entirely absent at the Poor and Average classification but show a marked increase in the Good and Excellent categories. Lastly, the colours that appear to the right of centre (Light Red, Yellowish Red, Reddish Yellow, Brown, Strong Brown), are predominately of Poor or Average streak quality.

As previously postulated, ochre of better streaking quality is more likely to have been used in the production of paints and/or powders. To test for this the ochre was categorised by its modification status, namely Unmodified, Possibly/Probably modified and lastly Definitely modified. In summary, ochre with clear facets and striations were classified as being Definitely modified, whereas pieces that had some faceting but were not obviously striated were classified as being Probably modified. Ochre that showed signs of possible modification but were not convincing were classified as possibly modified. The Possibly and Probably categories were then collapsed into one middle category. Lastly, ochre that showed no sign of modification whatsoever was obviously classified as being Unmodified. Each of these three categories was then split into its constituent Streak Quality classifications, the assumption being that a correlation should exist between modified ochre and streak quality.

At De Hangen 138 pieces of ochre were classified as Unmodified, of these 44 had a poor streak, 48 had an average streak quality, 34 had a good streak quality and only 12 had an excellent streak quality. These values are expressed in figure 3.1.5 in terms of their percentage of the total 138 Unmodified pieces. As such the Poor streak-quality ochre constitutes 31.9%, the average streak-quality ochre 34.8%, the good streak-quality ochre 24.7% and lastly the excellent streak-quality ochre 8.4%. Poor and Average streaking quality within the entire Unmodified ochre classification are clearly dominant.

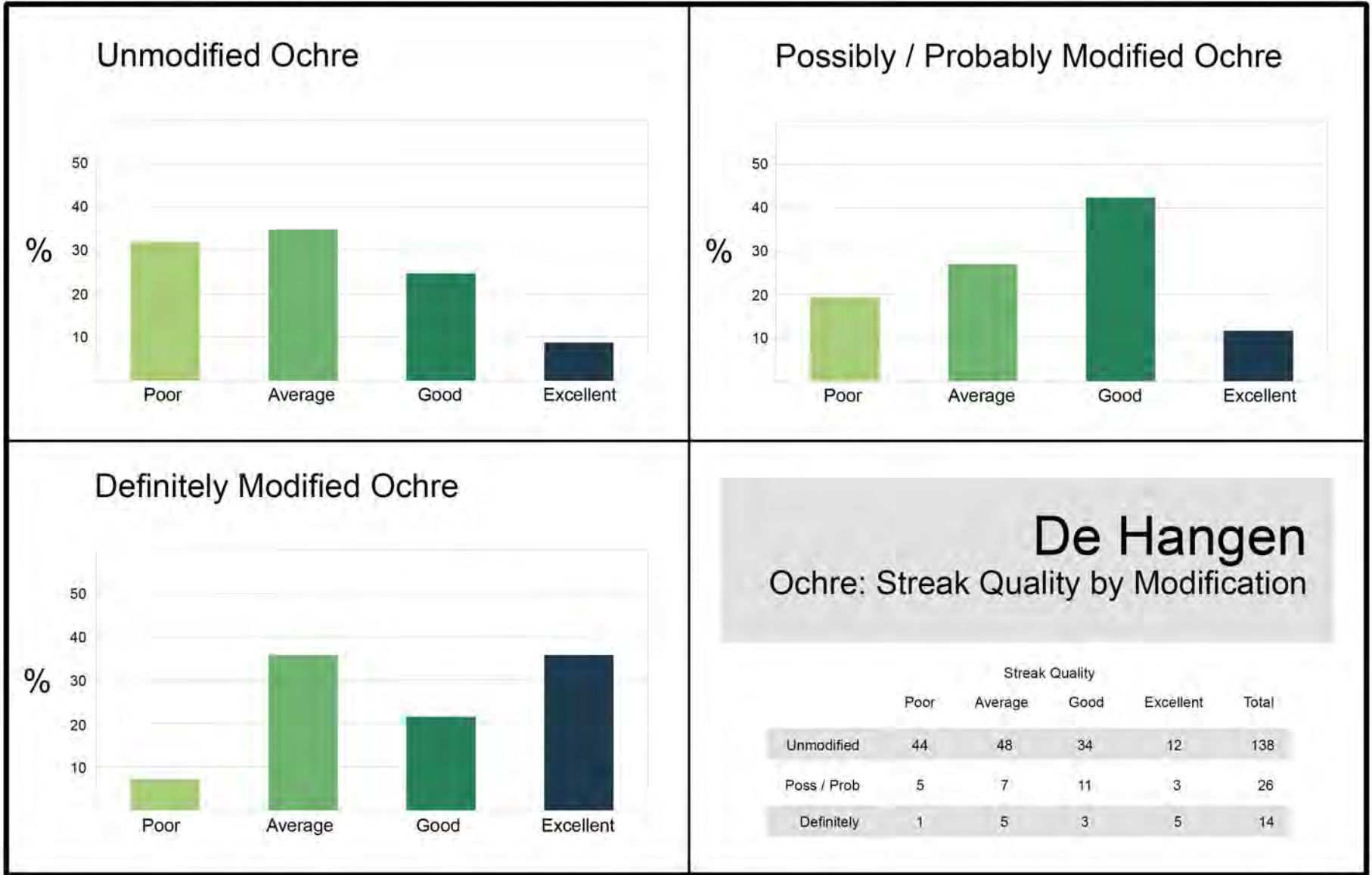
The Possibly/Probably modified ochre category contains only 26 pieces of ochre. These separate out into their streak-quality classifications as follows: Poor 5 (19.3%); Average 7

(26.9%), Good 11 (42.3%); and Excellent 3 (11.5%). The ochre in this category has now shifted away from Poor streak quality, with the majority now having a Good or Average streak quality. As the Possibly/Probably category is in essence an intermediate category ensuring the purity of those on either side of it, this intermediate phase in streak quality is unsurprising.

There were only 14 pieces of ochre that were classified as have been definitely modified out of the entire ochre assemblage at De Hangen. There is once again an issue here with sampling size but this could not be avoided. The single piece of modified ochre that had a Poor streak quality is somewhat inexplicable in that it contradicts the expected pattern and, as will be seen later, is the only piece from all three sites to do so. Due to the low sample size, this single piece contributes 7.1% of the overall Definitely modified category. There are five pieces with an Average streak quality and these account for 35.7%; three pieces with a Good streak quality, accounting for 21.5%; and lastly, five pieces with an Excellent streak quality, also making up 35.7%. Despite the sampling issue, which is entirely unavoidable, there is a fairly clear trend that occurs in streaking quality as one moves from the Unmodified pieces to those that have definitely been modified regardless of their ultimate use. The Poor streak-quality ochres drop quite sharply from Unmodified pieces to Definitely modified. So, as one would expect, there is fairly strong evidence of an obvious preference for Good or Excellent streak-quality ochres.

Whilst the data and information regarding the sourcing of ochre is examined in the subsequent chapter on experimental research, it is important to comment here on the scarcity of ochre in the surrounds of the site itself. Whilst there is a relative abundance of ochreous rocks, it is part of the Table Mountain sandstone group, which is primarily a quartzitic sandstone. The ochreous nodules (refer to figure 4.1.2) found in the area are therefore not suitable for being turned into powders and paints, and there are also no pieces in the excavated assemblage that bear any resemblance to them. By implication, it seems apparent that all of the ochres found in the excavated assemblage would have had to have been transported to the site from a more distant source, including all those pieces with a Poor streaking quality (see

Figure 3.1.5: De Hangen: Ochre Streak Quality by Modification



ochre sourcing section). Why these pieces of a poor streaking quality were brought to the site is somewhat puzzling, though it may be, as postulated later, that the ochre assemblage may in fact have been larger and that the preferred ochre nodules would have been used in their entirety and are therefore unrepresented in the archaeology.

Rock Art

The study of rock art has tended to focus upon the interpretative. Attempts to define or ascertain potential meanings and symbolic mythologies from rock paintings have been a primary concern (Lewis-Williams, 1981, 2004; Solomon, 1994, 1996). As outlined previously, the approach in this thesis is to treat the images as archaeological artefacts and not delve into interpretative models. To this end, the rock art at each of the three sites is examined with regard to their respective colours and the surface area which they occupy on the wall. In addition to this, however, the data acquired also allows a further examination to be made when looking at different rock art motifs or traditions and their colours, and this will be done briefly in the context of the subject matter of this thesis. Mguni (1997), postulates that the rock art in the Cederberg region can be broadly defined in three separate categories or periods; namely, fine line, handprints and Colonial Era paintings. The data presented in this research enables a further look into these categories and, indeed, a wealth of potential future research. This approach has already yielded some interesting results with regards to Diepkloof, as will be examined in detail in the discussion section but also touched on when examining the data from the site. At De Hangen, however, there are no handprints or colonial era paintings present. Yet, it is important to give an example of the rock art motif present at the site.

The rock art at De Hangen was broken up into five separate panels when recorded in order to assist in later analysis and re-identification of images once the study is completed. Each of these areas or panels, as termed here, are defined primarily by the physical features of the rock face itself, or by features present on the floor surface which are easily related to specific areas on the walls of the site (refer to figure 3.1.6).

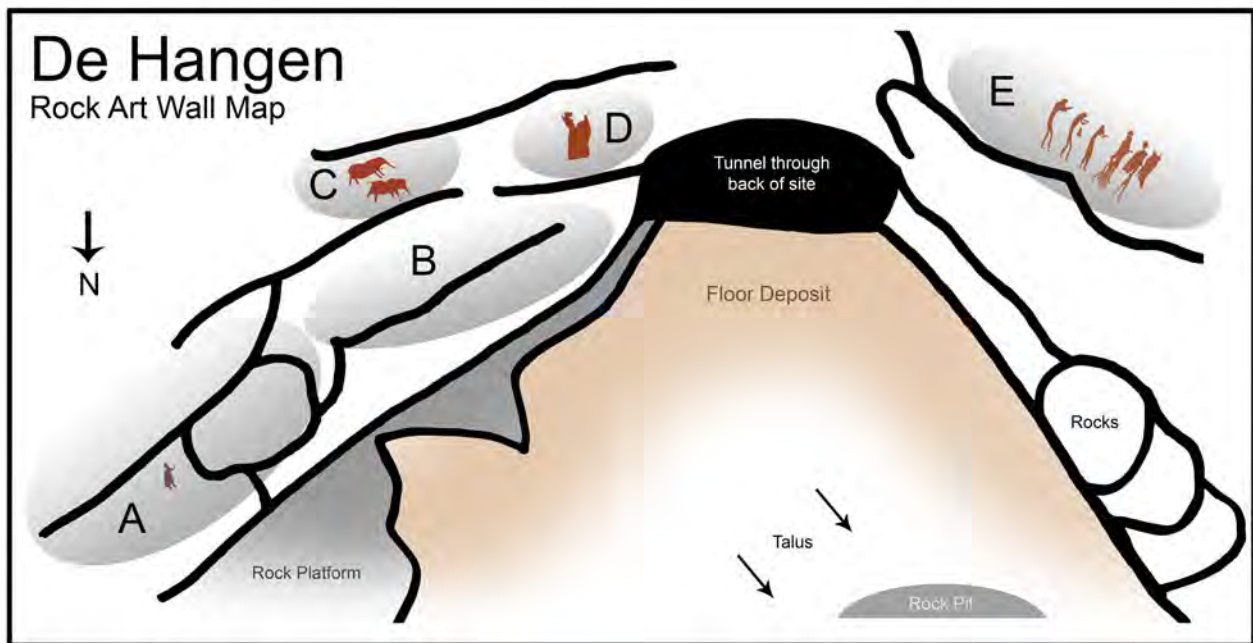


Figure 3.1.6: De Hangen: Rock Art Wall Map

Area A had the highest concentration of images compared with the others, and contains a fair range in terms of content. It has a large number of eland which all appear to have been painted within a discreet area. Towards the entrance side of Area A there is a long string of dancing figures intermingled with two patches of colour, roughly oval in shape, which could potentially be a forward-facing, squatting figure.

Area B is a fairly thin band of images running from the right hand edge of Area A and sloping gently toward the floor at the rear of the site. The images are predominantly of eland with only a single, poorly painted, human figure being represented. The eland appear to be contemporary as they are painted in a straight line, with no overlap of images. These eland face toward the entrance of the shelter predominantly as opposed to facing toward the rear of the site.

Area C is situated above Area B, high up on the side wall with a slight overhang. Generally the images here are of fairly poor quality with the exception of four exquisitely painted elephants, labelled C03 and C04 (Figure 3.1.7)..

Area D is a small concentration of images comprising of several different human figures, some of which have white faces, one eland and a few indeterminate patches of paint. Area D is by far the smallest of the areas and the images are all painted within close proximity of each other.

Area E is situated on the opposite wall of the site and consists almost entirely of human figures. Some of the images in this area are fine line images whilst others appear to have been done with fingers and are comparatively crude. There is one unusual image which appears to be a pair of human legs without a torso. This is painted very high up compared with all the other images at the site. The entire Area E is in fact painted unusually high.

As will be discussed when Andriesgrond and Diepkloof are examined later in this chapter, rock art motifs in the Cederberg can be broadly classed into three periods which are, from oldest to most recent, fine line, handprints and colonial (Mguni, 1997; Manhire, 1998; Meister, 2003; Van Rijssen, 1984). This chronology is based upon the superimposition of these different motifs, as it is found that fine line paintings do not overlap handprints, as handprints do not overlap colonial imagery. As such these create a chronology that cannot gauge time depth but can describe the order in which the paintings were created. Despite the fairly late occupation at De Hangen, the imagery is entirely dominated by fine line paintings. The exceptions are some of the human figures in Area E which appear to be finger-painted, and additionally an abundance of what appear to be negative finger-dots which were near impossible to quantify for lack of clarity. In the site we find 35 human figures (or parts thereof), 26 eland, 4 elephant, a quiver with arrows and 25 areas with indeterminate patches of paint, frequently recorded as 'daubs' or 'smears'

Whilst not the focus point of this research, brief descriptions and images will be provided for some of the more notable images or motifs found in each site, with special reference to the colour classification where significant. At De Hangen there are two very notable images, these are outlined below.

C03a,b:

Colour Code: Red 10R 4/8

Surface Area: 69 & 65cm²

Rock Art Tradition: fine line

See Figure: 3.1.7

Description: C03a and b are two elephants, with “a” situated slightly above “b”. Both elephants are facing to the right, which is toward the rear of the shelter. Elephants are comparatively rare finds in the rock art of the Cederberg region, although they are not so rare as to be thought unusual. The pigment of the elephants is in the 10R hue of the Reds, meaning that their colour is quite strikingly red. To the right of these are two further painted elephants roughly equivalent in size; these however are more faint and difficult to see.

E04a-h:

Colour Code: Various

Surface Area: 150cm² combined

Rock Art Tradition: fine line

See Figure: 3.1.8

Description: E4 is a line of human figures. E4b is particularly interesting due to the large “water droplet” shape hanging from the figure’s bent arms. What this shape is, however, is unclear, and a best guess would be that it might be a bag of some sort. The other figures to the right are not in poses that would be indicative of dancing. Figure f has a hollow head which could be interpreted as the face looking out of the wall. The angles of the face and head, however, seem to indicate that whilst the body is facing toward the right, the head is turned to look over its shoulder. Figure f is also easily identifiable as male, due to the obvious penis and hunting equipment slung over the shoulder. To the right of f there is a patch of paint which might be another human figure, although it is unclear and could also be identified as an item carried by the figure f. Figure h looks like a later addition done over the previous images as it is out of keeping stylistically with the rest of the “canvas”. It is rough

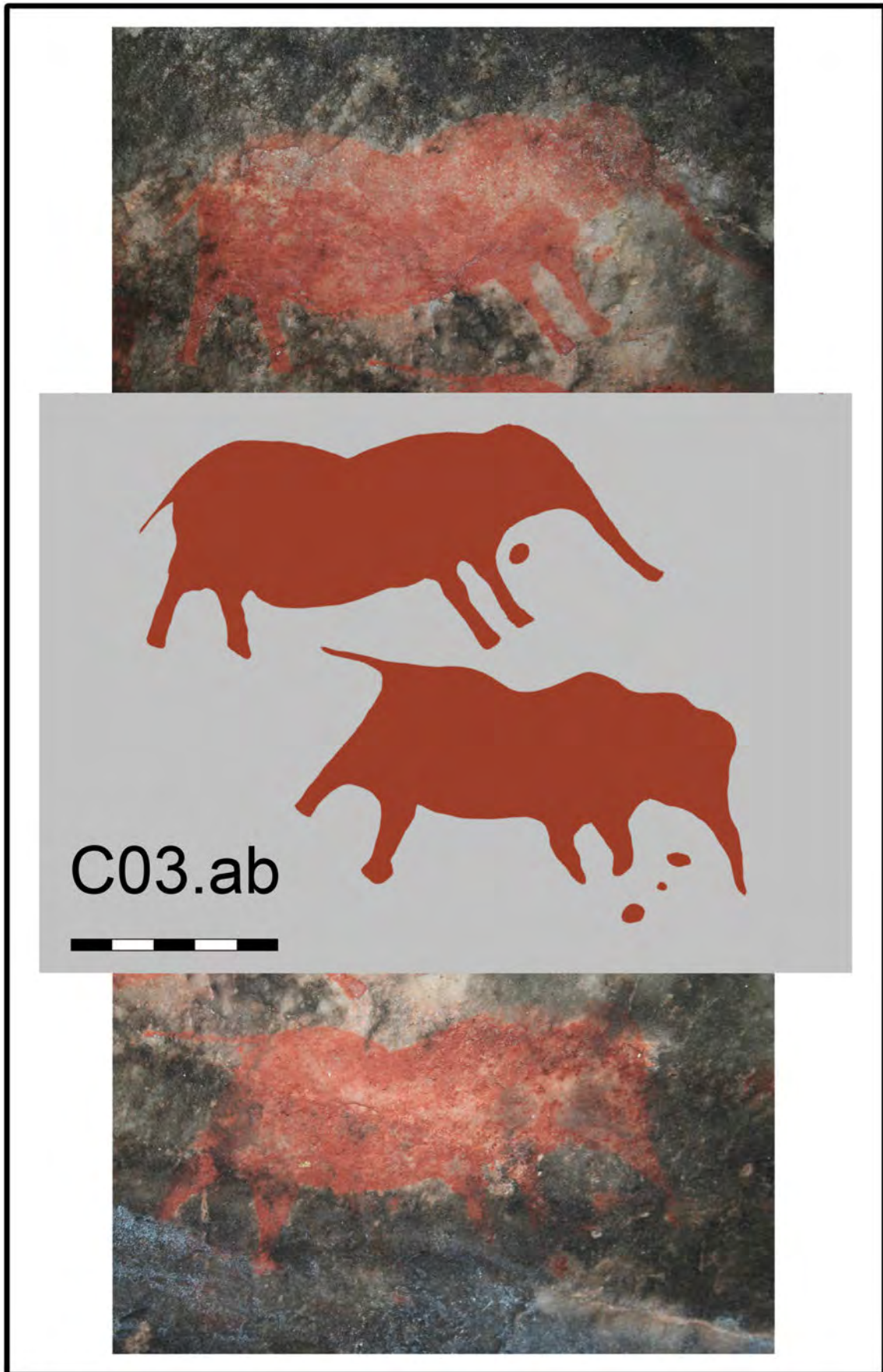


Figure 3.1.7: De Hangen: Rock Art Image C03.ab. Elephants

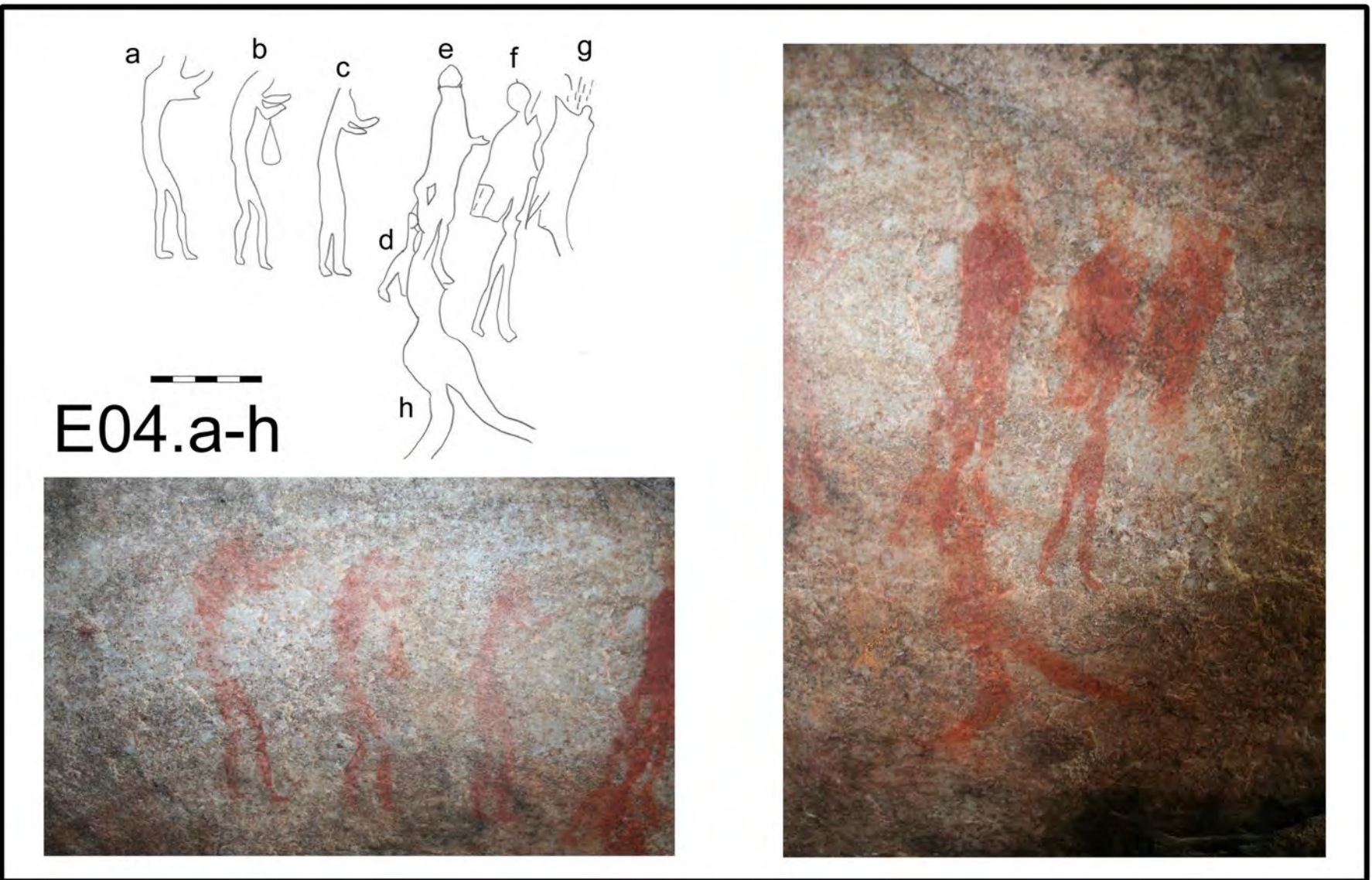


Figure 3.1.8: De Hangen: Rock Art Image E04.a-h

and probably finger-painted as opposed to the others which are fine line paintings. This is one of the images at De Hangen which could potentially be included into the category of Colonial Era painting. The last oddity in the E04 series is E04d, which appears to be little more than an extra set of legs for figure E04e.

The spread of colours found in the rock art at De Hangen is comparatively narrow in comparison with both Andriesgrond and Diepkloof. (Refer to Figure 3.1.9) The two central 2.5YR Red categories dominate with 2084cm² (32.79%) being classified in the 2.5YR 4/6 and 4/8 category and 1919cm² (30.19%) falling into the 2.5YR 5/6 and 5/8 category. The next two largest categories are the 10R 4/6 and 4/8-Red with 1316cm² (20.71%) and 10R 5/6 and 5/8 with 438cm² (6.89%). Collectively these four categories account for 90.58% of all the rock art present at the site. The remaining percentage is comprised of five colours which are, in order from left to right on the graph (figure 3.1.9) : 10R-Dark Red, 34cm² (0.53%); Dark Reddish Brown, 230cm² (3.62%); 2.5YR-Dark Red, 97cm² (1.53%); Reddish Brown, 79cm² (1.24%); and lastly Light Red, 159cm² (2.50%).

Ochre and Rock Art Comparison

(with reference to figure 3.1.10)

The main thrust of this research is to ascertain whether or not a link can be made between the rock art and the ochre assemblage from within a given site. To assume that such a correlation can be made based solely upon colour without caution would be naïve. That said, however, there are strong inferences that can be drawn from the data which are hard to refute.

The two central 2.5YR-Red categories are strongly correlated in both rock art and ochre, with high percentage values being present for each. This link suggests that the colours represented in the ochre assemblage roughly mirror the colours within the rock art, with specific reference to the two 2.5YR-Red categories. (It is important to note here that whilst the correlation is relatively strong at De Hangen for these colours, the same cannot be

De Hangen: All Rock Art in Constituent Colour Categories

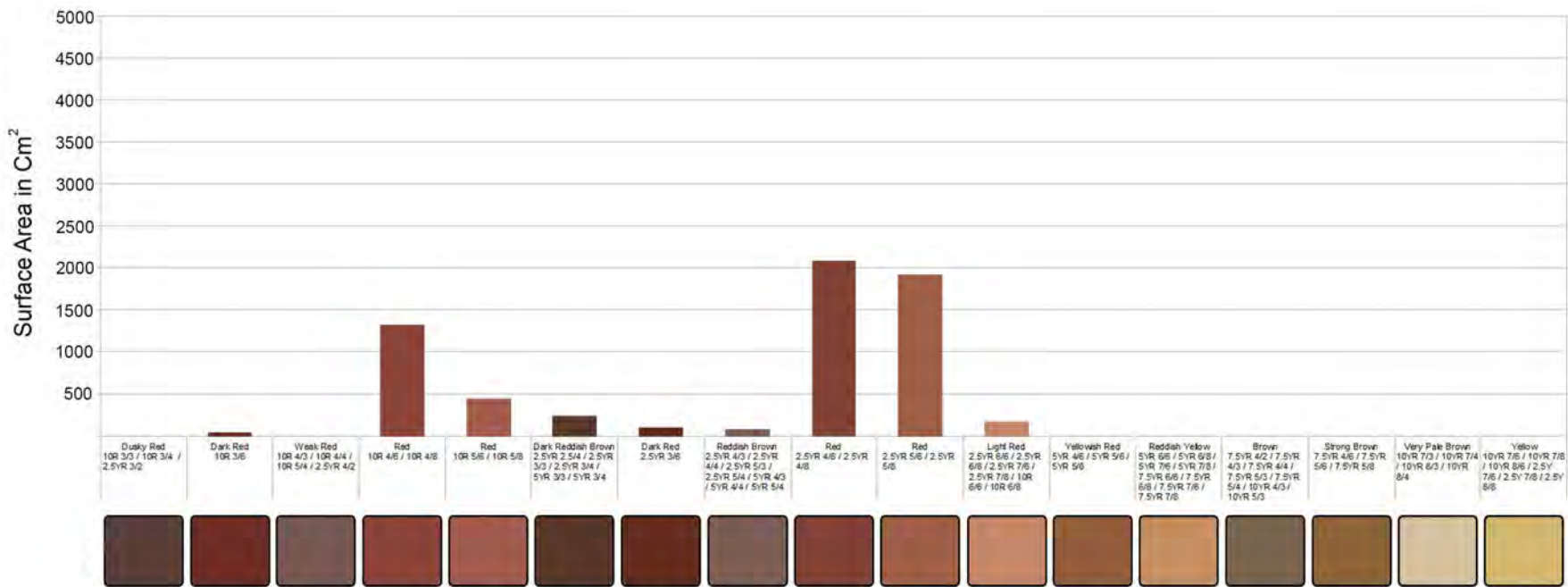


Figure 3.1.9: De Hangen: All Rock Art in Constituent Colour Categories

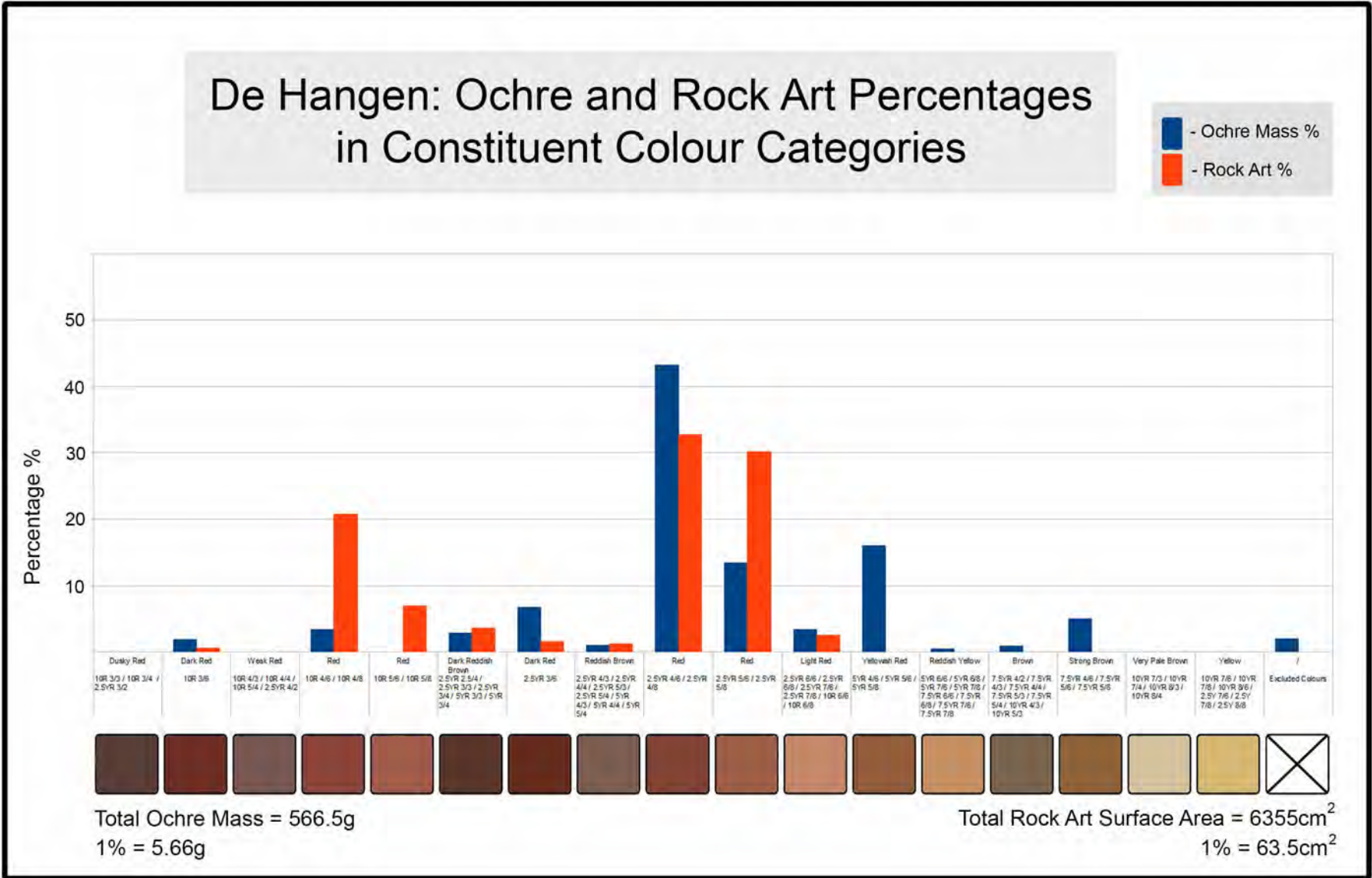
said for Andriesgrond and Diepkloof). When considering this link, it must be stressed that the excavated ochre represents only those pieces that were discarded; the actual ochre processed for paint-making is inherently absent from the excavated assemblage. It is also important to highlight that all the ochre present in the assemblage was transported from a relatively distant source, and was ultimately discarded at the site. (This observation is site specific and must be with reference to a survey carried out in the surrounding area, as will be discussed in the subsequent chapter). At De Hangen the abundance of ochre in the 2.5YR-Red categories and the prevalence of the same colours in the rock art suggest that the ochre used to create the paintings was of similar origin to the ochre found within the deposit.

Several of the other colours show a similar correlation between ochre and rock art, albeit with comparatively low values for each. Both the 10R-Dark Red and the 2.5YR-Dark Red show a broadly comparable percentage with slightly higher values on the ochre. Dark Reddish Brown, Reddish Brown and Light Red are also all fairly well matched.

Some colours are well represented within the ochre assemblage but are completely absent from the rock art. Primarily these are Yellowish Red and Strong Brown, with a few pieces in Reddish Yellow and Brown. If a positive correlation is to be drawn between the ochre and the rock art, the absence of these colours in the rock art is an anomaly. However, referring back to the examination of the ochre assemblage, it can be noted that the ochre in these colours is primarily of Poor or Average Streak Quality. With this in mind, it is not surprising to find these colours absent from the rock art.

The last two colours to be discussed are in some regard the most important. 10R 4/6 and 4/8-Red as well as 10R 5/6 and 5/8-Red are both well represented in the rock art and are poorly represented or absent in the ochre assemblage. If, as postulated by Watts (1997), there is a strong preference for ochre use in highly saturated hues, then an abundance of rock art in the bright and saturated 10R hues is obvious. If these colours are also rare in the landscape then one may assume that, as a prized commodity, ochre in these colours would be either used in its entirety or carried with people as they moved across the landscape.

Figure 3.1.10: De Hangen: Ochre and Rock Art Percentages in Constituent Colour Categories



This again reiterates the point that excavated ochre represents only those pieces that were discarded, and the ochre used in the creation of paints and subsequent rock art are not to be found in the assemblage.

Andriesgrond

The site of Andriesgrond sits on the eastern edge of the Bobbejaanskop hill just to the west of the town of Clanwilliam. The co-ordinates for the site are 32°11'40" S and 18° 51' 30" E (-32.194236, 18.8675). The shelter itself is at an altitude of approximately 240m above sea level (the maximum altitude of Bobbejaanskop is 278m). The shelter nestles at the base of the steep rocky cap of the hill, with a fairly gentle slope leading up to the entrance of the site itself. The shelter faces near due East, with a panoramic view of the Olifants River Valley and the western edge of the Cederberg Mountains. The shelter is easily accessible and passage between the site and the Olifants River would have been routinely negotiated.

The dimensions of the shelter are fairly small, but unlike De Hangen, the site is narrow, and elongated in a North-South direction. The habitable area is concentrated toward the rear wall of the shelter and the deposits follow a similar pattern to De Hangen with patches of bedding and ash being the primary components (Anderson, 1991). The dimensions and directionality of the shelter mean that early morning sun fills the entire shelter and even some of the lower rock art panels on the rear wall, with obvious repercussions for the preservation of the rock art in these areas. In front of the site there is an initial moderately steep slope, which tapers into a more gradual slope. Both this 'upper' and 'lower' talus slope have a high artefact density (Including several striated pieces of ochre).

Background

Andriesgrond was excavated in two seasons, each lasting for a duration of three weeks, in June/July of 1977 and 1978 by Parkington and Poggenpoel (Anderson, 1991). The excavations at the site extended over an area of 42m² with deposits that never exceeded more than 40cm in depth at their maximum. There were 154 natural stratigraphic units excavated; these were mostly extremely small and localised and as a consequence the stratigraphy was later grouped into eight amalgamated units (Anderson, 1991). The stratigraphy was primarily comprised of grassy bedding patches, ash concentrations or hearths, various



Figure 3.2.1: Andriesgrond Rock Shelter

small patches of iridescent foodwaste all of which were underlain by gritty soil with variable amounts of bone and roof-spall. The discontinuous nature of the stratigraphic units may represent episodic use of the shelter for an extended period of approximately 4000 years (Anderson, 1991).

Due to the complexity exhibited within the 154 natural stratigraphic units, the stratigraphy of the site was grouped into eight units in order to best represent activity at, and usage of, the site. Unit 1 was the uppermost unit of widely dispersed surface materials comprised largely of the dung of domestic animals and included three modern hearths. Unit 2 contained the majority of the bedding areas, a few richly vegetated patches and numerous associated hearths and ash dumps. A sample of grass from one of the uppermost bedding patches had a radio-carbon of 180 ± 50 years B.P. Unit 3 consisted primarily of the Main Ash Concentration, with a few small associated patches of vegetation and a small pit containing some stones and a wad of buchu. Some of the ashy concentrations were cemented or consolidated, likely due to water permeation from the drip-line. A radio-carbon date of 430 ± 50 B.P was obtained

from a charcoal sample. Unit 4 was comprised of a few patches of cemented ash with no botanical features at all and an abundance of charcoal; an associated radio-carbon date of 1649 ± 50 B.P was obtained. Unit 5 was four small vegetated patches and six hearths that were somewhat separate from both Units 2 and 3 and appeared to underlie Unit 4. Unit 6 was a small group of vegetated areas with a few accompanying hearths that appeared to underlie Unit 3 but may be more recent than Unit 4. Unit 7 described a series of small units which had a burial-pit dug into it by Holocene peoples (this burial-pit was excavated separately from the surrounding Unit). A large portion of the Unit was comprised of charcoal-flecked deposit. A radio-carbon date obtained on a sample of tortoise bone gave a date of $14\ 870 \pm 150$ B.P. The final unit, Unit 8, was mostly gritty sand deposits with a low artefact density which was laid directly on bedrock. A radio-carbon date of $11\ 590 \pm 190$ B.P (also obtained on a sample of tortoise bone) is incongruent with the date for Unit 7. Either one, or both, of these dates is therefore likely to be inaccurate (Anderson, 1991).

The lithic assemblage consists of 13 491 stone artefacts. The majority of these artefacts are made from quartz; other raw materials present, in order of prevalence, are silcrete, quartzite, hornfels and crypto-crystalline silicates (CCS). The assemblage was dominated by the presence of adzes (and accompanying wood-shavings), which were used as wood-working tools especially in the manufacture of bow shafts and digging sticks. Many of these adzes were formed from older Middle Stone Age flakes which were hafted and re-used (Anderson, 1991).

The other artefactual remains at the site largely mirror those of other bedding and ash sites excavated in the region; significantly these include De Hangen, Renbaan and Diepkloof (Parkington and Poggenpoel, 1971, 1987; Kaplan, 1987). There were several worked reed fragments, presumably for the creation of arrow shafts; some perforated and cut pieces of reeds used in the creation of bedding mats; blackened wood cones used as fire drills; some string and lastly some pieces of worked bone. Interestingly there were 248.8g of marine shells excavated from the site, but due to the distance from the coast these were obviously not used as a food source but rather as tools or ornaments. Several black mussel shells

had bevelled and worn edges indicative of use as a food scoop or 'spoon'. Ostrich eggshell was also well represented in the deposit with 335g being excavated, the majority of this mass coming from fragments of broken water flasks, including three decorated pieces. A total of 86 ostrich eggshell beads were present, found almost exclusively in Units 1 to 3; additionally, a string of beads was found in association with the burial in the burial-pit.

The diet of the site's inhabitants was dominated by starchy corms and tubers which are found in abundance throughout the excavated stratigraphic Units. The abundance of adzes and wood-shavings for the manufacture of digging sticks is therefore unsurprising. The faunal component of the diet is, as with most sites in the region, dominated by tortoise. There were some bovid remains found in addition to an array of microfauna including snake, fish and lizard (Anderson, 1991). Many of these may have found their way into the site through non-anthropogenic means and some accumulations may be due to the use of the site as a nesting roost for owls which are visible at the site today.

Ochre

A total of 215 pieces of ochre were excavated from the site. Of that total, 10 pieces made no streak and were removed from further analysis. One piece was 'two-toned' and was removed from further analysis as it could not be wholly classified into a single colour category. This piece, sample number # 092, was strongly para-magnetic or ferro-magnetic and showed clear signs of utilisation in the form of a small striated facet. The significance of this piece will be discussed later. Lastly, two further pieces were removed due to disproportionate mass in comparison with the rest of the assemblage. These two pieces had a mass of 109.1 and 280.5 grams respectively. The second of these, piece number # 215, will be discussed in detail first. The total sample number used for the majority of further analyses is therefore reduced from 215 down to 201. These 201 pieces of ochre have a total mass of 665.7 grams.

Ochre piece number # 215 (figure 3.2.2) from the site is a unique piece when compared with



Figure 3.2.2: Andriesgrond Ochre Nodule #215. Large Striated Nodule

the ochre from all three assemblages. It has been broken into a number of large fragments and numerous smaller fragments. The cause of this fragmentation of the piece is unclear but due to the clarity of the breaks and the snugness of the refits at least some of this damage has occurred during excavation or subsequent curation of the piece. The piece is relatively friable and laminated, making it fragile and prone to breakage, especially when considering the ultimate size of the piece. Its mass, 280.5g, far exceeds that of any other piece found, and represents the remains of a much larger piece due to extensive utilisation as evidenced by very large striated facets covering most of the exterior surface. (See figure: 3.2.2).

The ochre assemblage at Andriesgrond, when grouped into the constituent colour categories, looks quite different from that at De Hangen and Diepkloof (figure 3.2.3), especially with reference to those colours tending toward the 10R Munsell hues. The one similar feature is that the 2.5YR 4/6 and 4/8 category is again the largest. At Andriesgrond it has a total mass of 207.4g and makes up 36.6% of the entire assemblage. Its neighbouring 2.5YR 5/6 and 5/8-Red is poorly represented with only 36.0g making up 5.4%. These two reds once again are used as a middle point from which to describe the rest of the assemblage. On the

Andriesgrond: Ochre Assemblage in Constituent Colour Categories

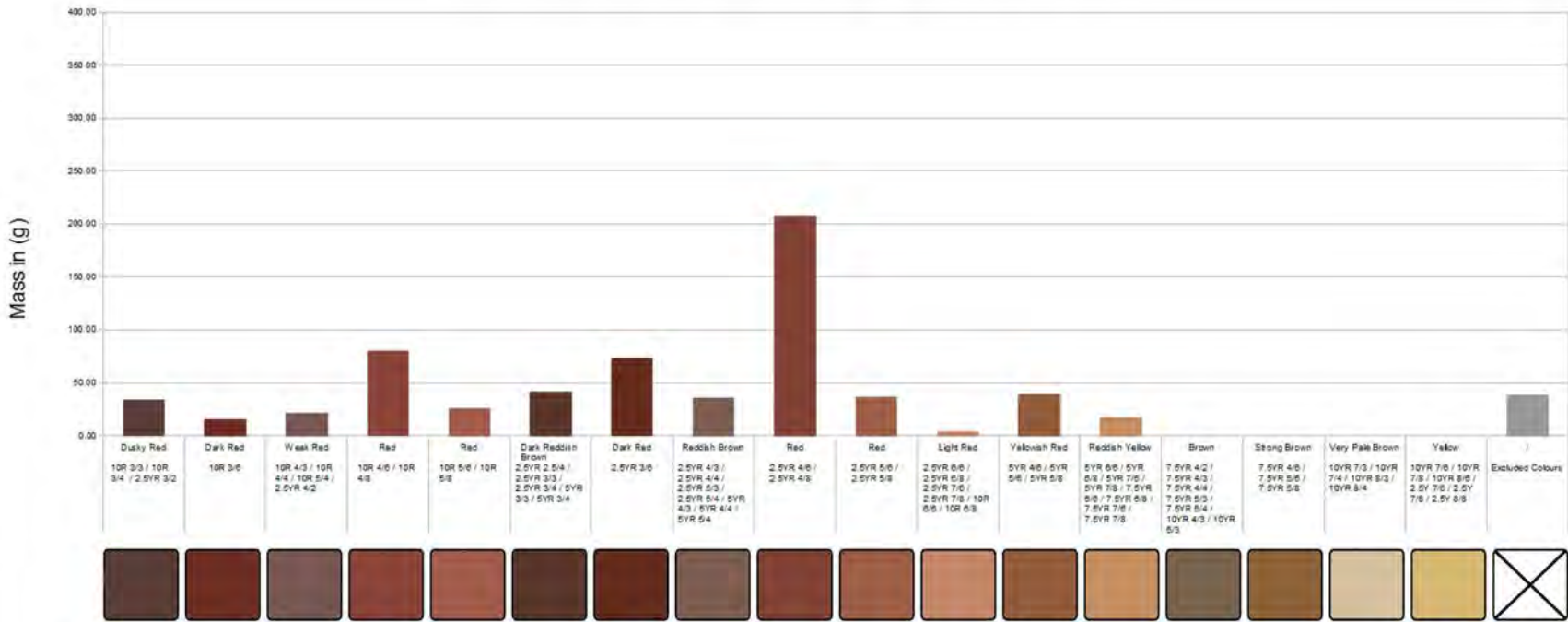


Figure 3.2.3: Andriesgrond: Ochre Assemblage in Constituent Colour Categories

Figure 3.2.4: Andriesgrond: Poor and Average Streak Quality Ochres in Constituent Colour Categories

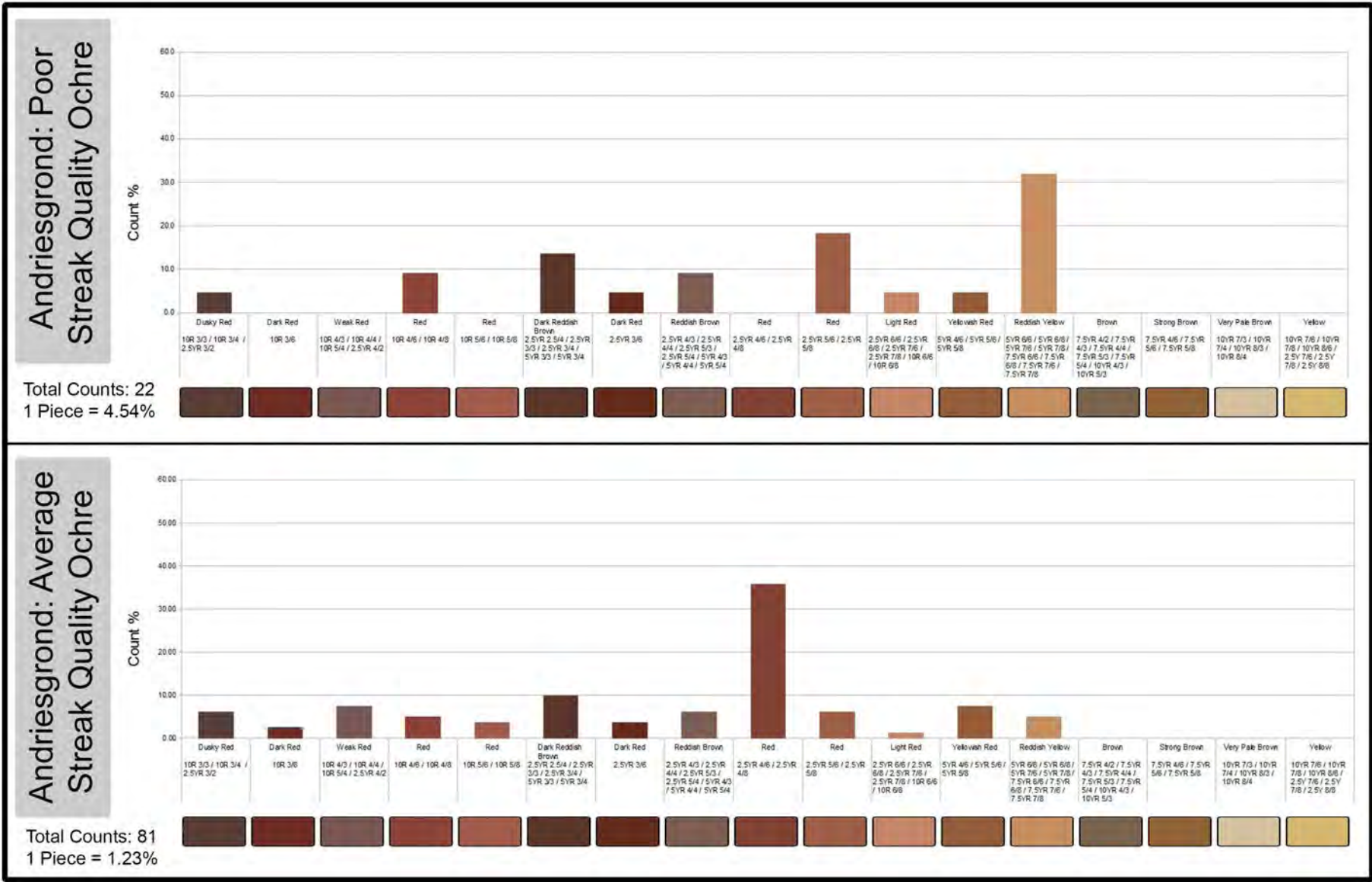
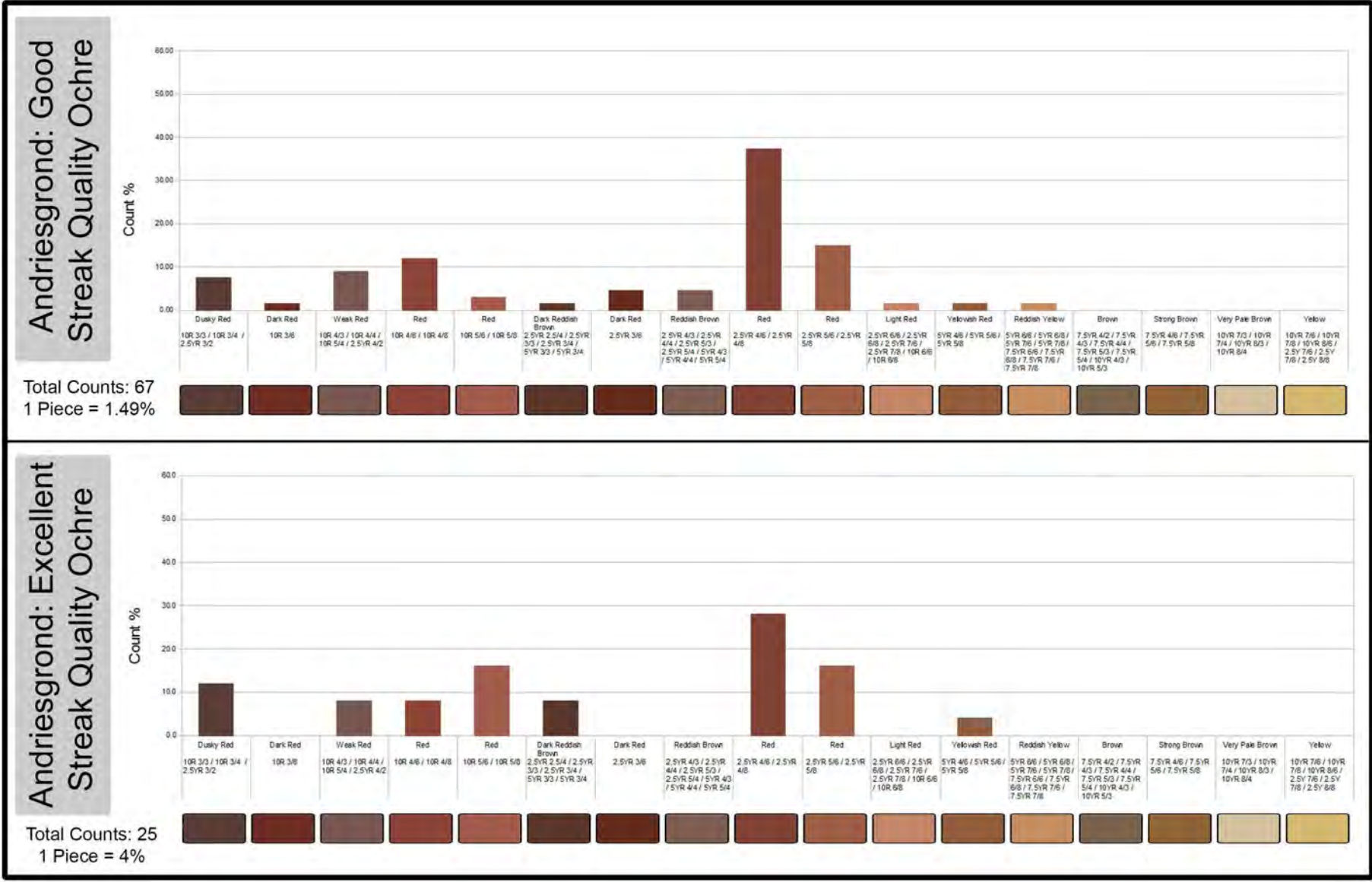


Figure 3.2.5: Andriesgrond: Good and Excellent Streak Quality Ochres in Constituent Colour Categories



left of this central point, tending toward more saturated vibrant reds closer to the 10R Hue, we find almost half of the assemblage being represented with 48.9% of all the ochre from Andriesgrond falling into these eight colour categories. Working from the centre towards the far left these are: Reddish Brown 35.1g; 2.5YR-Dark Red 73.0g; Dark Reddish Brown 41.5g; 10R 5/6 and 5/8-Red 25.0g; 10R 4/6 and 4/8-Red 80.1g; Weak Red 21.3g; 10R-Dark Red 15.3g; and, lastly, Dusky Red 33.7g. On the opposite side of the central Reds, tending towards yellows, we find only 9% of the total assemblage being represented. Again moving from the centre outwards, to the right this time, they are Light Red 3.2g; Yellowish Red 39g, and lastly Reddish Yellow at 17.0g. As can be clearly seen in figure 3.2.3, the majority of the ochre assemblage is to be found on the 2.5YR and 10R Munsell hues, which is somewhat different from De Hangen, and, as will be discussed later, Diepkloof. Lastly, six pieces fall into the category of Excluded Colours; these include Dark Reddish Grey, Black, and Dark Brown – collectively they have a mass of 38.1g.

When examining the streaking quality of the ochre from Andriesgrond, it must be re-iterated that the percentage values being given represent counts of ochre pieces and not their mass as in the preceding paragraph. Additionally, it can be re-stated that ochre of Poor or Average Streak Quality represents ochres that would be undesirable in paint or powder production whilst those of Good or Excellent Streak Quality would have been more suitable. The following graphs (figures 3.2.4 & 3.2.5) examine the count percentage of colours present within each streak-quality category, namely Poor, Average, Good and Excellent.

A total of 22 pieces were classified as having a Poor Streak Quality; this is a small sample, but when compared with the subsequent categories, is still meaningful. The two central 2.5YR-Reds comprise only 18.2%, with the entirety of that figure coming from 2.5YR 5/6 and 5/8-Red. There is an interesting equal split on either side of this with both left and right having 40.8%. On the left (tending toward 10R) this value is comprised of Reddish Brown (9.1%); 2.5YR-Dark Red (4.5%); Dark Reddish Brown (13.6%); 10R 4/6 and 4/8-Red (9.1%); and, lastly, Dusky Red (4.5%). On the right of the central Reds the percentage is comprised of only three colour categories: Light Red (4.5%); Yellowish Red (4.5%); and,

lastly, Reddish Yellow (31.8%).

The sample size for ochre with Average Streak Quality is significantly better with 81 pieces being represented. The central 2.5YR-Reds now contribute 42% of the total, with 2.5YR 4/8 and 4/6-Red comprising 35.8% and 2.5YR 5/6 and 5/8-Red 6.2%. The colour categories to the left of the centre (tending toward 10R) make up 44.5%, this percentage being comprised of: Reddish Brown (6.2%); 2.5YR-Dark Red (3.7%); Dark Reddish Brown (9.9%); 10R 5/6 and 5/8-Red (3.7%); 10R 5/6 and 5/8-Red (4.9%); Weak Red (7.4%); 10R-Dark Red (2.5%); and, lastly, Dusky Red (6.2%).

A total of 67 pieces of ochre from Andriesgrond were classified as having a Good Streak Quality. The Central 2.5YR-Reds make up 52.2% with 37.3% being in 2.5YR 4/6 and 4/8-Red and 14.9% being in 2.5YR 5/6 and 5/8-Red. To the left of the centre, (tending toward 10R), we find 43.4% being represented, this percentage being comprised of: Reddish Brown (4.5%); 2.5YR-Dark Red (4.5%); Dark Reddish Brown (1.5%); 10R 5/6 and 5/8-Red (3%); 10R 4/6 and 4/8-Red (11.9%); Weak Red (9%), 10R-Dark Red (1.5%); and, lastly, Dusky Red (7.5%). To the right of the central Reds we now find only 4.5% of the ochre being of Good Streak Quality. This low percentage is comprised of only three colours, namely, Light Red (1.5%); Yellowish Red (1.5%) and lastly Reddish Yellow (1.5%).

The graph showing the Excellent Streak Quality ochre from Andriesgrond, (a total count of 25 pieces), largely mirrors that of the Good Streak Quality. There is a slight drop in the central Reds with 44% being represented; with 2.5YR 4/6 and 4/8 and 2.5YR 5/6 and 5/8 comprising 28% and 16% respectively. On the left, (tending toward 10R), we now find 52% of the ochre, comprised of: Dark Reddish Brown (8%); 10R 5/6 and 5/8-Red (16%); 10R 4/6 and 4/8-Red (8%); Weak Red (8%); and, lastly, Dusky Red (12%). Again the values on the right of the central Reds are very low with only a single colour, Yellowish Red, comprising of 4%.

To summarise: The central 2.5YR-Reds only make up a small amount of the Poor Streak

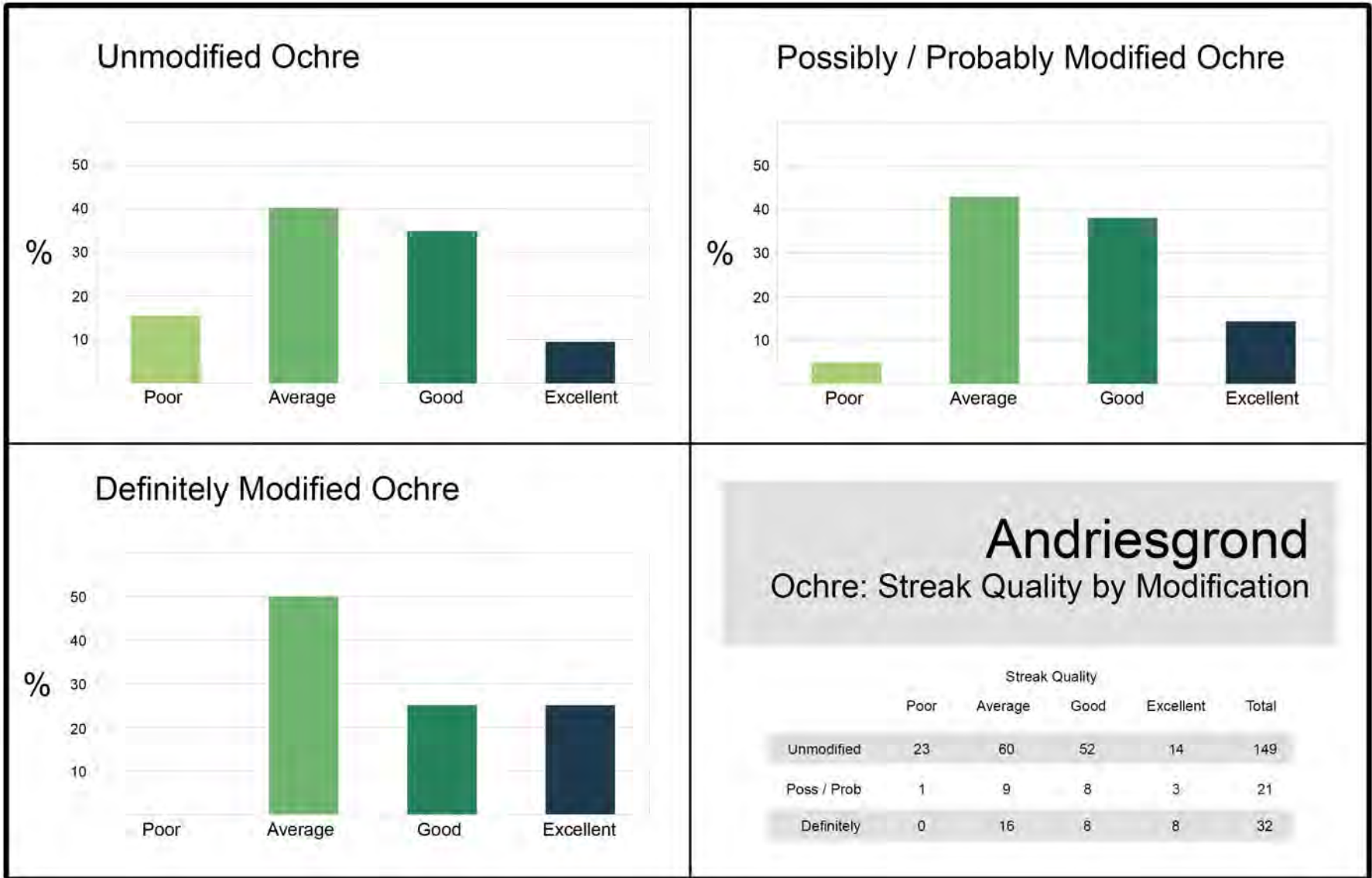
Quality ochre, but amount to 40-50% for each of the categories Average, Good and Excellent Streak Quality. The colour categories to the left of the centre, (the more saturated vibrant colours tending toward 10R Munsell Hues), remain consistent throughout with only a slight, steady increase from Poor to Excellent Streak Quality starting at 40.8% for Poor to 52% for Excellent. Interestingly, the ochre to the right of centre, (tending towards browns and yellows of 10YR and 2,5Y Munsell Hue), tells an interesting story. It can be clearly seen from figures 3.2.4 & 3.2.5 that the vast majority of ochre in these colours are shown to have a Poor or Average Streak Quality (40.8% and 13.5% respectively) and are almost entirely absent from Good or Excellent Streak Quality ochre. This trend is consistent with that seen at De Hangen.

As discussed before in relation to the De Hangen ochre assemblage, ochre of better streaking quality is more likely to have been used in the production of paints and/or powders. If this statement is to be supported, the trends at Andriesgond should be broadly similar to those shown at De Hangen.

(With reference to figure 3.2.6) One hundred and forty-nine pieces of ochre were classified as being Unmodified; of these, 23 had a Poor Streak Quality, 60 had an Average Streak Quality, 52 had a Good Streak Quality and 14 pieces had an Excellent Streak Quality. These values expressed in their percentage of the 149 total count are as follows: 15.4% Poor, 40.3% Average, 34.9% Good and 9.4% Excellent. The pattern is broadly similar to that from De Hangen, and the key indicators to note are the presence of Poor Streak Quality ochre and the low frequency of Excellent Streak Quality ochre.

The Possibly/Probably modified ochre category contains 21 pieces of ochre. Of these 21 pieces, only one had a Poor Streak Quality and as such accounts for 4.7%; nine pieces had an Average Streak Quality comprising 42.9%; eight pieces had a Good Streak Quality making up 38.1%; and, lastly, only three pieces had an Excellent Streak Quality and therefore make up 14.3% of the total. As with De Hangen, the intermediary nature of the category means that the shape of the graph is an intermediate between the Unmodified and Definitely

Figure 3.2.6: Andriesgrond: Ochre Streak Quality by Modification



modified categories.

A total of 32 pieces of ochre from Andriesgrond were classified as having been Definitely modified. This is just over twice as many as at De Hangen, but is nevertheless still a small sample size. There were zero pieces that had a Poor Streak Quality, as would be expected, and 16 pieces had an Average Streak Quality thereby comprising 50% of the total. There were eight pieces in both the Good and Excellent Streak Quality categories, meaning that each makes up 25% of the total.

The percentage values of Average or Good Streak Quality ochre remain largely constant throughout, with Average Streak Quality ochre fluctuating between 40% and 50% and Good Streak Quality between 25% and 42.9%. The latter of these may appear significant; however, despite the relatively low sample sizes, a total of 25% remains a significant proportion. The important indicators to notice are the rapid decline of Poor Streak Quality ochre, moving from 15.4% in the Unmodified category down to 0% in the Definitely Modified Category. The second important feature is the Excellent Streak Quality ochre which shows a steady increase from Unmodified to Definitely modified, shifting from 9.4% up to 25%. These indicators lend credence to the notion that ochre of better streaking quality was more likely to have been used in the production of paints and/or powders due to the inherent properties present in a given piece of ochre. It is important to remember that the Streak Quality classification is an amalgamation of two physical properties, namely hardness and grain size. It is therefore unsurprising that better streak quality ochres were more likely to have been utilised.

Rock Art

At Andriesgrond there is a substantial amount of rock art covering the rear wall of the shelter. In fact, there is just over twice as much categorised rock art as there is at De Hangen. In addition to this there were also two panels that were not recorded, as the rock art on those panels was heavily weathered and faded to a point where colour classification and identifying motifs became impossible. A probable cause for this is the easterly facing mouth

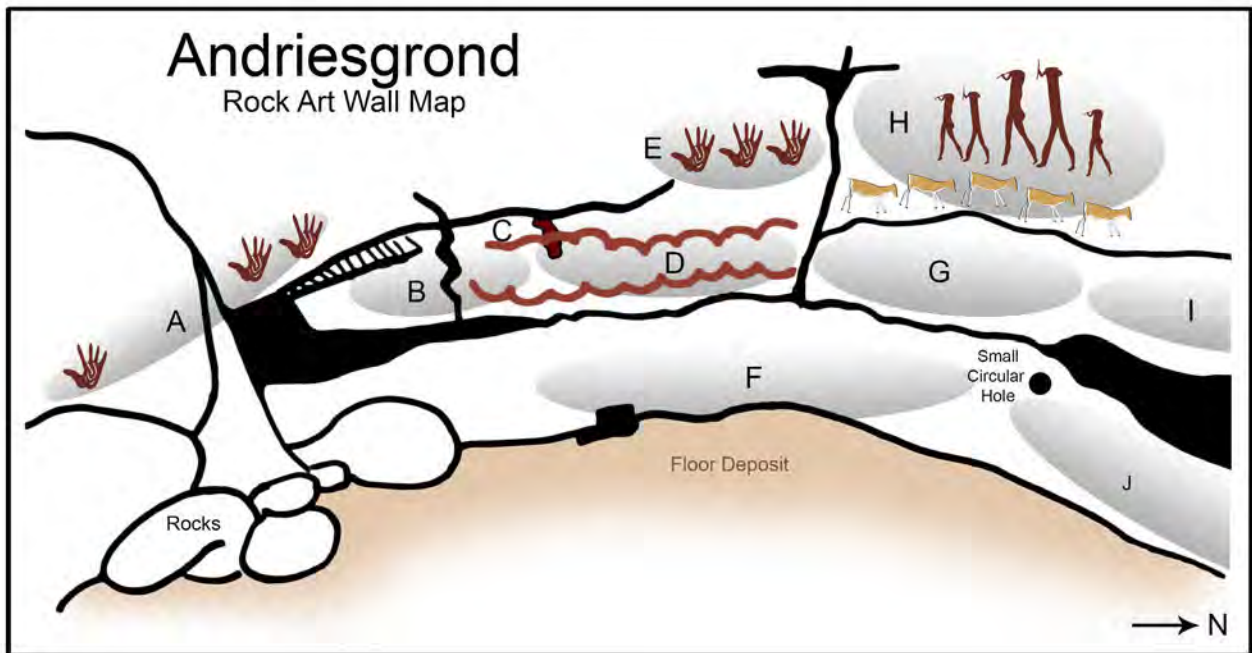


Figure 3.2.7: Andriesgrond: Rock Art Wall Map

of the shelter, as a result of which the lowest panels at the rear of the site receive several hours of morning sun with predictable harmful results for the preservation of rock art present there.

The rock art was broken up into ten different areas or panels named from A through to J. As at the other sites, these are defined primarily by features on the surface of the rock itself such as cracks or holes; and on occasion by motif or association (refer to figure 3.2.7). Area A consists of a few small handprints to the left hand side of the site (all orientation regarding rock art at this site is based on left being south and right being north when facing the rear wall of the shelter). Area B is a panel with a set of images on an indented area above a gap in the rear wall and ends in a dark 'palette' motif. Area C is not a description of an area or panel but rather represents the dual wavy lines of paint that run roughly parallel to each other from Area B right across Area D (these wavy lines will be touched on later). Area D runs from the dark 'palette' feature at the end of Area B; it is defined by a downward and subsequently lateral crack in the rock's surface, and ends in a deep vertical crack towards the right of the site, bordering on Area G. Area E sits directly above Area D and is defined primarily by a change in motif; the images here are all handprints. Area F runs along the

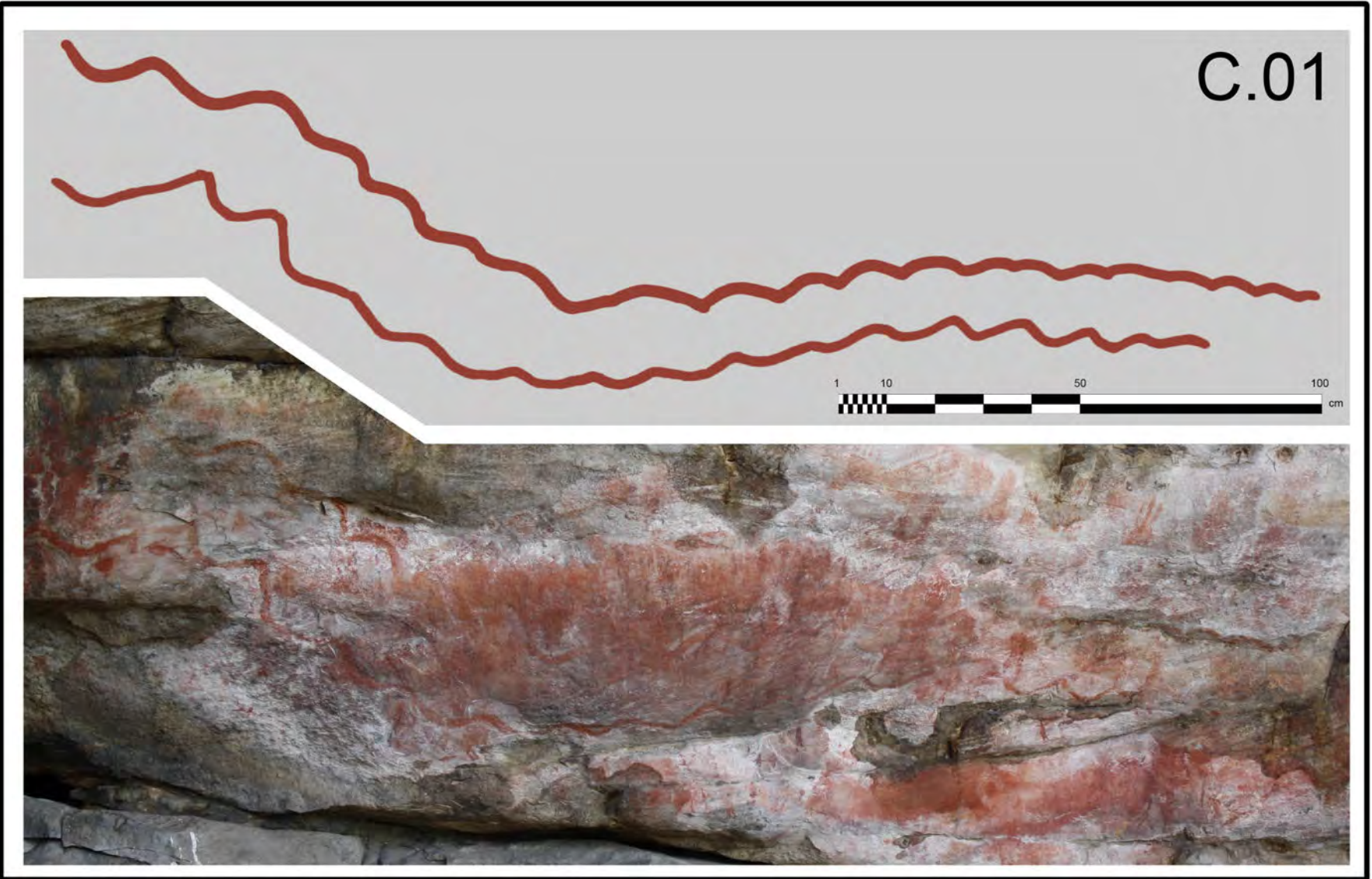


Figure 3.2.8: Andriesgrond: Rock Art Image C01

bottom of the rock wall, starting below the right hand edge of Area B, and runs all the way along to the right of the site and ends with a small circular-shaped hole in the rock. Area F was entirely disregarded for recording purposes. As mentioned previously, the sun shines directly onto this panel for the morning hours and as such attempting to identify anything is impossible, and if any attempt were made, the results would mostly likely do more harm by generating data that would potentially be entirely incorrect. Area J, to the immediate right of Area F, suffers from exactly the same issue and was also not recorded. Area G is a rectangular panel that is neatly defined by cracks in the wall; it lies between Area D and Area I. Area H sits above Area G and I and has the best preserved rock art at the site, with very fine detail remaining visible: there is a line of yellow hartebeest, and several dancing figures depicted just above the hartebeest. Area I sits on the very far right of all the rock art and is defined by a crack above it and a deep indentation below it.

The rock art at Andriesgrond contains several images and/or motifs which may be considered of special interest. As stressed previously, the focus of this research is not on rock art interpretation. However, several of the images do warrant a brief description and mention of possible interpretations. The colouration of these motifs, also present at other sites, may be significant for future study and comparison.

C.01

Colour Code: Red 10R 4/8

Surface Area: 1009cm²

Rock Art Tradition: fine line (by association)

See Figure. 3.2.8

Description: C.01 is a pair of roughly parallel wavy lines that run the entire length of Area D and follow the natural shape of the rock surface. Whilst it may be tempting to draw associations between these lines and other imagery at the site, the link is somewhat tenuous. Both animal and human figures alike seem to fall within, over and outside these lines in no obvious pattern. Should one take a 'shamanistic' or 'trance'-orientated interpretation, such

as that propounded by Lewis-Williams and Pearce (2004), these would likely be described either as lines of energy or as the boundary between our mundane realm and those places reached through trance in order to gain spiritual potency. Lines very similar in form to these at Andriesgrond are found at several other sites in the Cederberg.

D15.a

Colour Code: Red 10R 4/8

Surface Area: 6cm²

Rock Art Tradition: fine line

See Figure. 3.2.9

Description: D15.a is the clearest example of what could be referred to as 'birthing' figures at the site (Solomon, 1994, 1996; Humphreys, 1996; Thorp, 2013). These figures seem to be forward-facing with legs spread wide in a birthing pose. One feature of this image in particular is that it is neatly painted within an oval patch where the overlying rock has flaked off, providing a natural 'window' in which to paint, as can be seen in the accompanying image. The flake in the rock likely pre-dates much of the rock art, as part of the line of C.01 can be seen to the left of the figure in the diagram. This indicates that the C.01 line must post-date the likely natural flaking-event that created the small 'window' feature.

H9.c

Colour Code: Yellow 10YR 7/8

Surface Area: 121cm²

Rock Art Tradition: fine line

See Figure. 3.2.10

Description: This yellow hartebeest is one of a line of hartebeest that runs the width of Area H. This one in particular is the best preserved example, with the greatest amount of remaining detail. The white legs and underbelly are clearly visible, and the black edging to the legs,



Figure 3.2.9: Andriesgrond: Rock Art Image D15.a

H.09.c

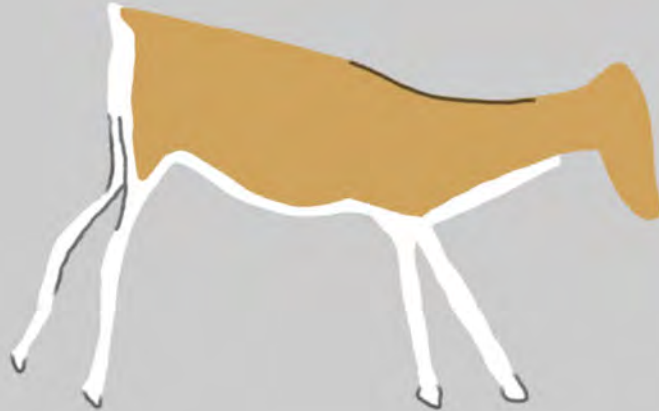


Figure 3.2.10: Andriesgrond: Rock Art Image H09.c

back and hooves provides a level of extra detail that gives the image a three dimensional quality. This line of yellow hartebeest was one of the pivotal motivations for choosing the site of Andriesgrond, as it provided a comparatively large surface area of yellow paint not seen in other excavated sites. As discussed previously in the methodology chapter, the black and white paints are recorded but not elaborated on, partially due to the very small surface area which they occupy, but also in that the materials for these pigments are not ochre-based.

H16.a & .b

Colour Code: Dark Red 10R 3/6

Surface Area: 75cm² and 73cm² respectively

Rock Art Tradition: fine line

See Figure. 3.2.11

Description: H16.a and .b are two left-facing human figures that form part of a larger group. These two are represented here as they retain the greatest amount of detail within the group. Both figures are carrying sticks, one being held vertical and the other horizontal. Both figures have small traces of white paint remaining on them, painted over the red-paint. These appear as dots around the knees and ankles predominantly and may represent some form of dress or accompaniment to dancing such as rattles. The right-hand figure of the two, H16.b, also has white paint on each of its feet which resembles some type of footwear. Strangely, whilst some of the other figures in this group retain heads, neither of these two figures do, despite the retention of a greater level of detail in the bodies than the others.

Andriesgrond has a substantial volume of rock art covering a surface area of 13 248cm² across all the colours. This number would be even higher if the excluded Areas F and J were sufficiently well preserved to be recorded. The spread of colours found in the rock art at Andriesgrond is quite different to that at De Hangen. (Refer to figure 3.2.12) The two central 2.5YR Red categories are almost absent from the rock art and combined only cover 857cm² (6.47%) with 413cm² (3.12%) being classified as 2.5YR 4/6 and 4/8 Red and 444cm² (3.35%) being classified as 2.5YR 5/6 and 5/8. These values are in stark contrast

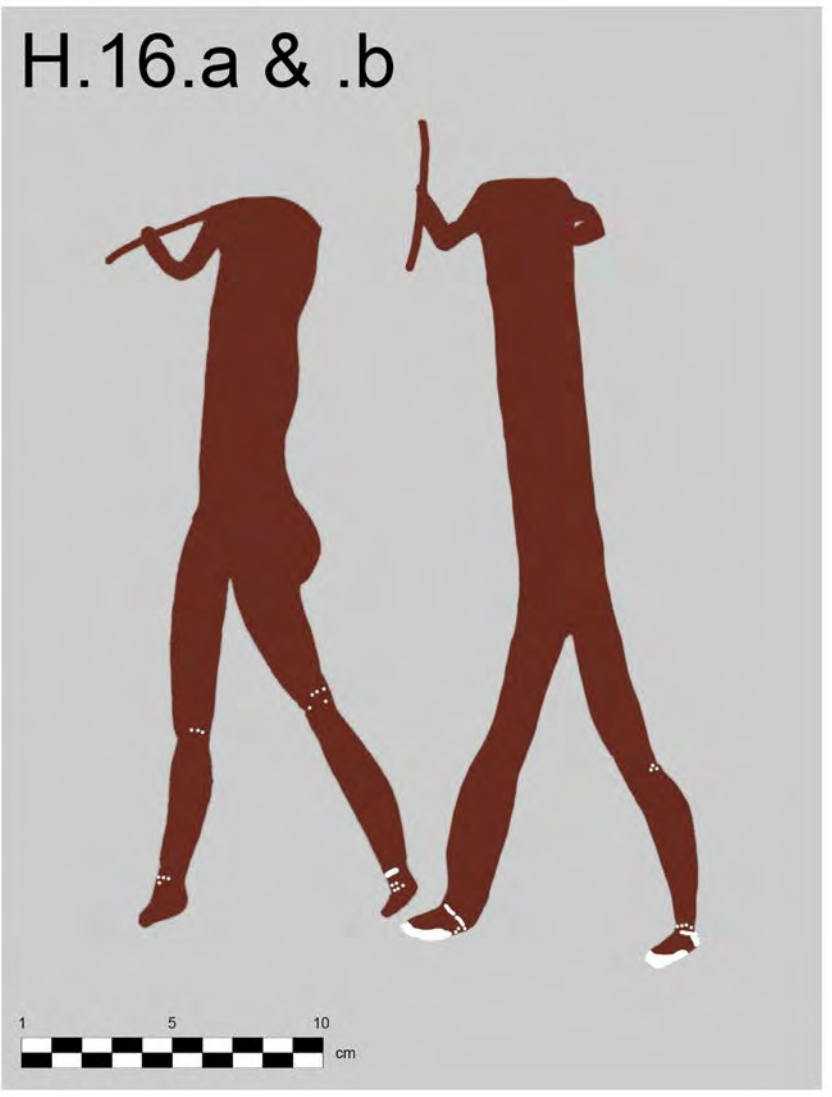


Figure 3.2.11: Andriesgrond: Rock Art Image H16.a&b

Andriesgrond: All Rock Art in Constituent Colour Categories

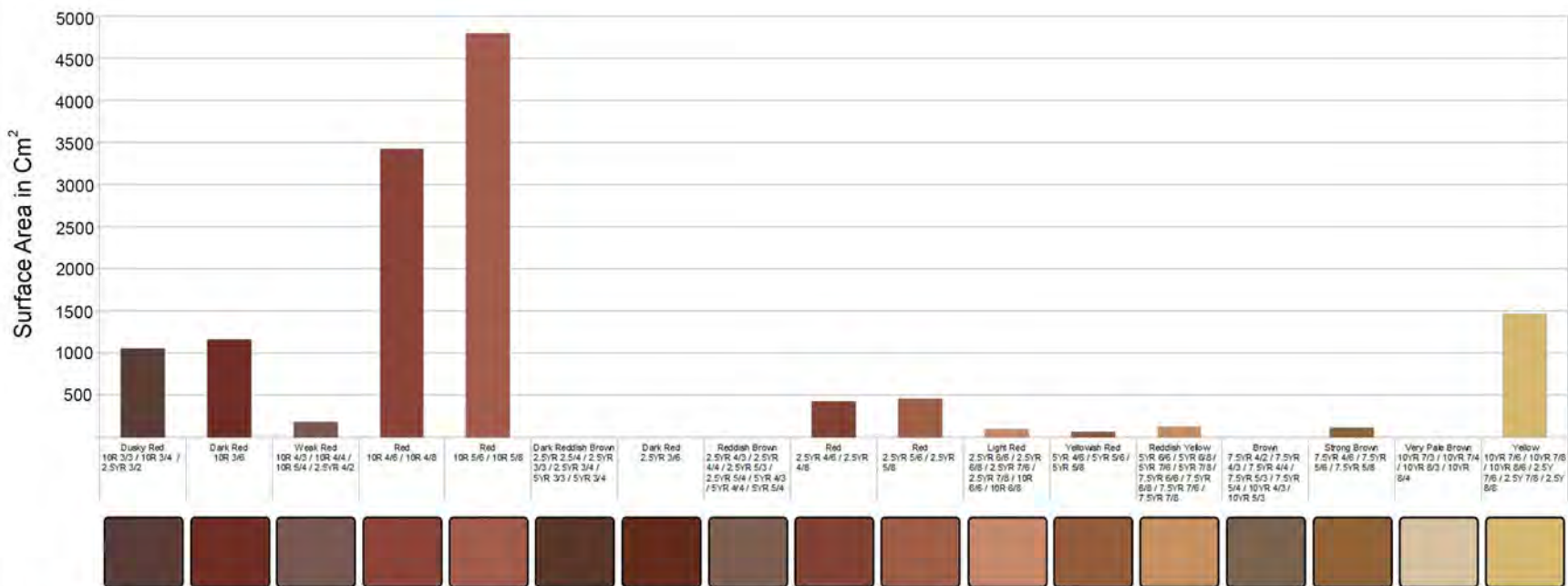


Figure 3.2.12: Andriesgrond: All Rock Art in Constituent Colour Categories

to those at De Hangen where these two colours dominated. The majority of the rock art at Andriesgrond falls far to the left of the two central reds with 79.86% of all the rock art being present in these categories: they are Dusky Red 1041cm² (7.86%); 10R-Dark Red

1149cm² (8.67%); Weak Red 174cm² (1.31%); 10R 4/5 and 4/8-Red 3420cm² (25.82%); and, lastly, 10R 5/6 and 5/8-Red 4796cm² (36.20%). This prevalence of colours tending towards the brighter 10R Hues conforms with the preference for these colours over those which are slightly less saturated and tend more towards browns. The remaining colours, falling to the right of the two central 2.5YR Reds, collectively comprise 13.67%. Of that total, 1455cm² (10.98%) is Yellow, with the remainders being: Light Red 85cm² (0.64%); Yellowish Red 58cm² (0.44%); Reddish Yellow 112cm² (0.85%); and, lastly, Strong Brown 101cm² (0.76%). The Yellow paint, one of the prime reasons for Andriesgrond's initial inclusion in this research, is made up entirely of a line of Yellow hartebeest that span the width of Area H, an example of which has already been shown.

When the colour spread is shown with specific reference only to those images that were clearly classifiable as rock art of one tradition or another, as opposed to just daubs or smears, there are only two discernible periods or styles present at Andriesgrond, namely fine line imagery and handprints (figure 3.2.13). This identification massively reduces the viable surface areas of the different colour categories, but there are four colour categories where the two traditions show a marked difference. In the Dusky Red category there is almost no fine line imagery (101cm²), but 940cm² of handprints. In the 10R-Dark Red category however we find no handprints at all, yet there is 806cm² of fine line painting; with a similar pattern present for the 10R 4/6 and 4/8-Red category with 67cm² of handprints and 652cm² of fine line. The last and obvious difference is in the Yellow category; here the row of hartebeest cover a surface area of 1451cm² whilst there are no handprints in Yellow at all.

Andriesgrond: Fine-Line and Handprints in Constituent Colour Categories

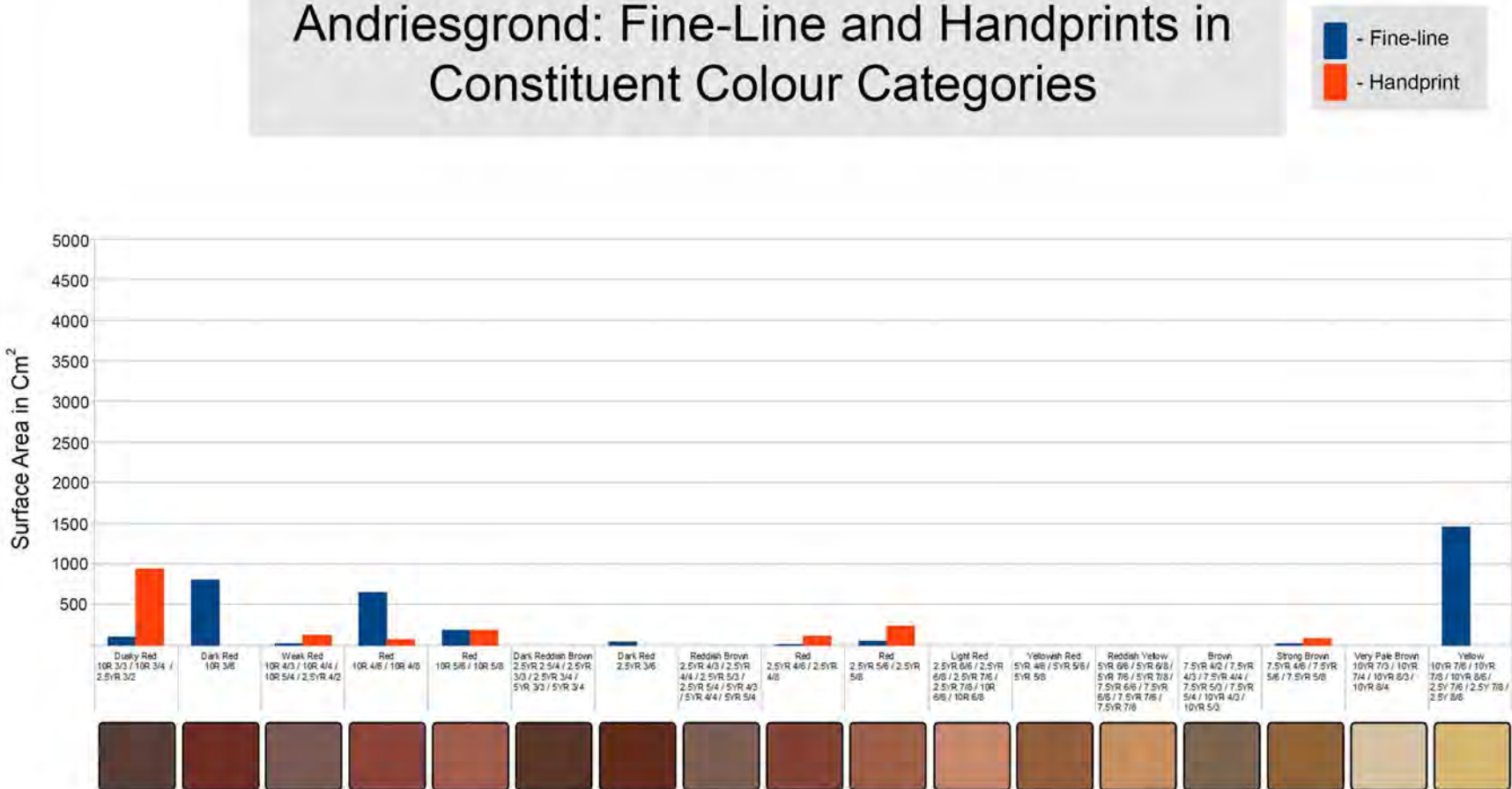


Figure 3.2.13: Andriesgrond: Fine Line and Handprints in Constituent Colour Categories
 *Scale presented here is consistent with all other surface area graphs presented in this chapter.

Ochre and Rock Art Comparison

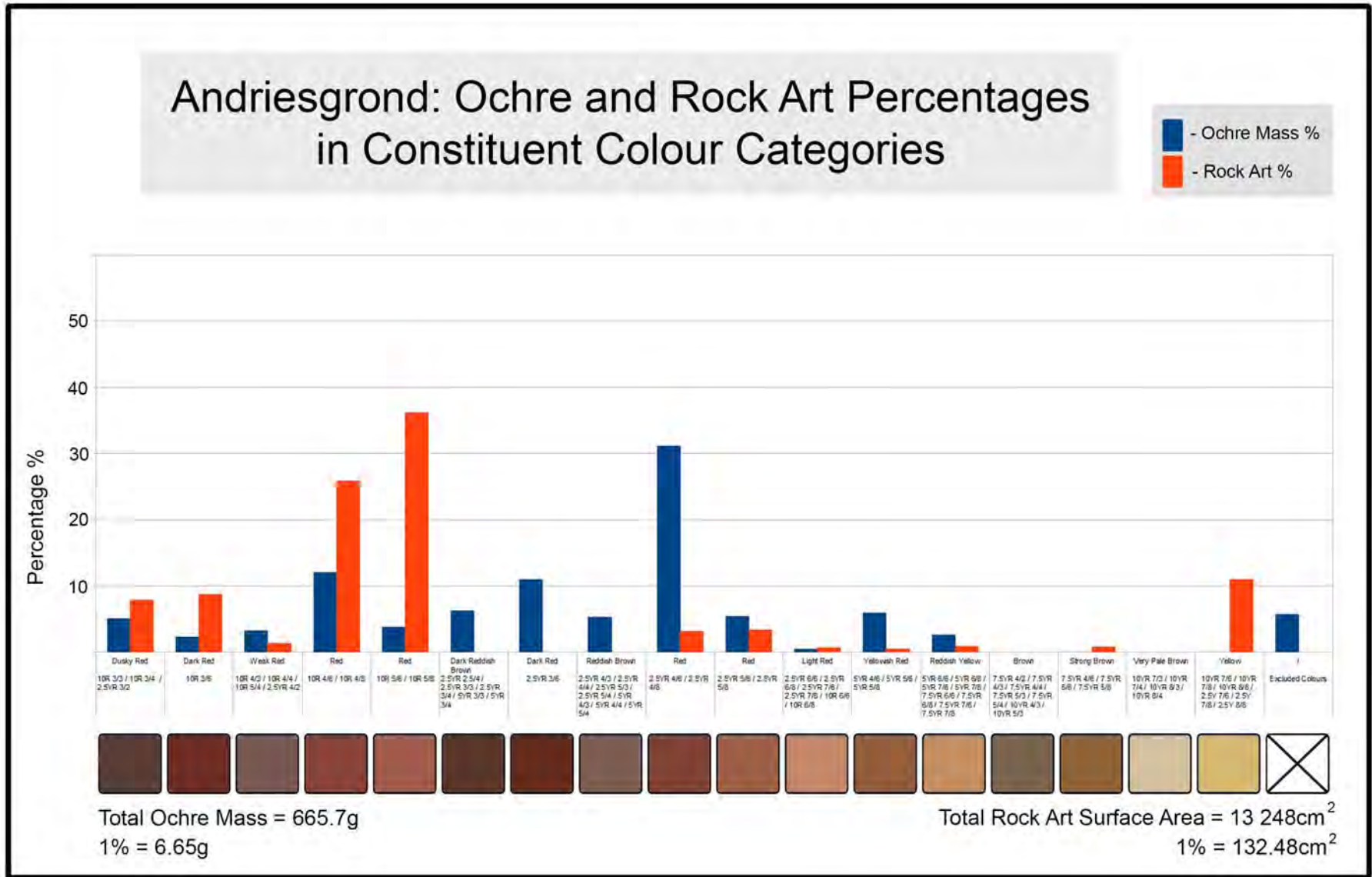
(with reference to figure 3.2.14)

It bears repetition that, whilst the main focus of this research is to examine the link between excavated ochre and rock art within a given site based on colour classification, this correlation must be considered with caution. This thesis seeks to create a workable methodology to describe ochre use from its landscape origin through to its final inclusion in rock painting or discard into the deposits of a given site. With this cautionary note in mind, we shall now examine the relationship between the percentage mass of ochre and the percentage surface area of rock art as described by their constituent colour categories.

Unlike De Hangen, there is no significant correlation between the rock art and ochre in the two central 2.5YR-Red categories, with the highest mass of ochre being in the 2.5YR 4/6 and 4/8 Red category and only minimally present in rock art. By contrast, the majority of the rock art is painted in the 10R 4/6 and 4/8 and 10R 5/6 and 5/8 categories, with only minimal amounts of ochre present in these colours. This would reinforce the idea that there was a predilection for paints tending toward saturated 10R hues and that the ochre in these colours is substantially reduced in the excavated assemblage. It must once again be said that the excavated ochre represents only those pieces that were discarded; the actual ochre processed for paint-making is obviously absent from the excavated assemblage.

Additionally there are several other categories, namely Dark Reddish Brown, 2.5YR-Dark Red and Reddish Brown, where there is a fair quantity of ochre but no rock art present at all. There is the possibility that ochre in these categories may have been heat-transformed from yellow geotite-based ochres which are notably absent in the Yellow classification. The ochre used to create the paint for the Yellow hartebeest may well have been present in the deposit and later, through subsequent incidental heating, been transformed into the Dark Reddish Browns and Reddish Browns mentioned above. This possibility will be dealt with more thoroughly in a subsequent chapter after a closer examination of the chemical changes involved is discussed.

Figure 3.2.14: Andriesgrond: Ochre and Rock Art Percentages on Constituent Colour Categories



In general terms, the broad profiles across the colour categories for both ochre and rock art look vastly different. With the low numbers of utilised pieces being present in the ochre assemblage, the possibility that the ochre used in the creation of the paints was used in its entirety, or was considered prized and carried with people as they moved from site to site, seems a likely explanation. Needless to say, the only thing that can be said with much certainty is that the two profiles do not match. The ochre assemblage and the rock art do not match in terms of colour classification, and accordingly - a point that cannot be stressed enough - the ochre in the excavated assemblage has been specifically discarded and therefore inherently cannot be the same ochre as that used to create the paints for the rock art.

The different scenarios for ochre use and the nodules found in the assemblage, or absent from it, in relation to the rock art present at a site is discussed in full after the experimental research has been presented.

Diepkloof

Diepkloof Rock Shelter is a north-easterly facing rock shelter formed in the quartzitic sandstone cap of a steep-sided kopje. It is situated on the south bank of the Verlorenvlei, which the kopje rises above by a height of approximately 100m. Its co-ordinates are 32°23'12" S and 18°27'10" E, placing it approximately half way between the towns of Redelinghuys and Elands Bay (approximately 18km West of Diepkloof), well known to archaeologists for the site of Elands Bay Cave (Parkington & Poggenpoel, 1987).

The kopje in fact contains two overhangs, namely Diepkloof Rock Shelter, which has seen extensive excavation, and Diepkloof Kraal Shelter, which has shallow deposits but extensive, detailed rock art. Whilst there is a fair volume of rock art present at Diepkloof Rock Shelter, the range of motifs and the preservation of the rock art is comparatively poor. Diepkloof Rock Shelter is a spacious overhang with approximately 200m² of potential habitation space that provides not only protection from sun and rain, but also, as experienced during fieldwork, a cool space which is a welcome reprieve from the high temperatures reached in the area during the summer months. For the remainder of this chapter the two shelters will be identified separately except when they are treated as one site, when it will be referred to simply as "Diepkloof".

Background

Excavations began at the site in 1973, undertaken by Parkington and Poggenpoel, towards furthering an understanding of Later Stone Age mobility patterns after Parkington's 1972 publication regarding seasonal movement patterns. The site of Diepkloof Rock Shelter provided an opportunity to examine further the seasonal model, based on excavations in the Cederberg, and comparing them with the Sandveld region. Parkington had hoped to find a deep deposit of Later Stone Age material at the site, but, as with De Hangen, found that the LSA levels at the site were very shallow (Parkington & Poggenpoel, 1987).



Figure 3.3.1: Diepkloof Rock Shelter

It was clear from early on in the excavation that the basic structural layout of the site was very similar to that of De Hangen. The broad 'Bedding and Ash' deposit pattern at Diepkloof duplicated the pattern at both De Hangen and Andriesgrond. It was apparent that the different sites were utilised by their inhabitants in similar ways. The bedding layers, however, provided a somewhat more detailed stratigraphy than at De Hangen. In the north western corner of the excavation, for example, Parkington and Poggenpoel identified three different grass and bedding layers superimposed upon one another. Based upon the observed similarity in the preservation of the bedding material from all of these layers the assumption was made that whilst there were chronological breaks between them, the time span between these different events would not likely have been more than a few hundred years (Parkington & Poggenpoel, 1987).

Before continuing with the background of the excavations, the author of this thesis would like to stress the significance of this very shallow deposit for the analyses conducted on the Later Stone Age ochre from the site. The importance of placing the excavated nodules within a stratigraphic sequence must be emphasised. However, the very shallow deposits, excavated largely as two interrelated units, described as the 'Bedding and Ash' units did not provide much of a stratigraphic sequence within which to work. The ochre from the site therefore was treated as a chronologically single event as it spanned only a few hundred years (Parkington & Poggenpoel, 1987).

There were four dates obtained from the Later Stone Age levels at Diepkloof Rock Shelter which were: 390 ± 30 B.P on grass bedding from the rear of the site; 900 ± 50 B.P from a charcoal sample from a small hearth feature in the bedding layers; 1050 ± 85 B.P from the grass bedding; and, 1590 ± 45 B.P on a charcoal sample from the Main Ash Concentration. Samples from the orange and black complex found below the Bedding and Ash layers were dated between 29 000 and 45 00 B.P. These dates, in combination with the rich lithic materials, immediately placed them within the MSA (Parkington & Poggenpoel, 1987).

There were few recognisably Later Stone Age formal lithic tools recovered from the excavation. Those that were found and classified represented only a small number of formal tool types; these included adzes, thumbnail scrapers and a few backed pieces which would likely have been hafted (Parkington & Poggenpoel, 1987).

Whilst the lithic tools were scarce, formal tools made of other materials were not: Seven wooden and three bone points were excavated which were likely used in composite arrows; and there were numerous other arrow related finds such as link-shafts and even main shafts made of reed. There were no clear and obvious remnants of actual bows discovered, but the related arrow remains illustrated that hunting by means of bow and arrow would have been an important strategy employed by the site's inhabitants (Parkington & Poggenpoel, 1987).

Other artefactual remains included: several pieces of string and cord; a piece of hunting net; at least one part digging stick, the tip of which had been charred and shaved into a point; some cuts of leather; three fire drills; bone awls; bone and wood shavings; a large number of ostrich eggshell beads; many fragments of worked marine shells, possibly used as scoops; a string of shells still attached to cord likely used as a pendant; and, lastly, 227 pot sherds including seven decorated and four rim sherds. Some of the sherds, importantly, were burnished with red ochre (Parkington & Poggenpoel, 1987).

The faunal and floral subsistence patterns of the inhabitants show a diet broadly based on underground corms and fruits supplemented by a range of fauna, including at least two individual sheep, tortoise, dassie, steenbok or grysbok and a range of marine resources. This pattern broadly mimics that from De Hangen, but the flora and fauna are represented in different proportions, likely due to the change in landscape from the Cederberg to the Sandveld (Parkington & Poggenpoel, 1987).

Ochre

The ochre assemblage at Diepkloof Rock Shelter is radically different from that at both De Hangen and Andriesgrond. There are many possible reasons for this difference, some of which will be examined later in this chapter and also in the subsequent analysis in the discussion section. What those differences are will become immediately apparent as the data is examined in this chapter.

To date, a total of 1093 pieces of ochre have been excavated from the Later Stone Age levels at Diepkloof Rock Shelter (The ochre analysed in this research relates to the LSA specifically). Of the 1093 pieces of ochre, 25 were excluded as they did not make a streak. There were two pieces excluded as they were two-toned, making their colour classification problematic when examining ochre pieces based on mass; as mentioned previously, the two-toned quality is often a result of heating, and piece number DRS.0359 is also strongly

magnetised, another by-product of heating. Finally, two further pieces were excluded due to their disproportionate mass (40.18g and 56.80g). These were removed to prevent distortion of the mass data. This brings the total sample size down from 1093 to the 1064 pieces that were eventually used in the comparative analyses that follow. The 1064 pieces of ochre have a collective mass of 1983.59 grams.

At this juncture a major difference between Diepkloof Rock Shelter and the other sites examined is already apparent in that the sample size of the Diepkloof assemblage is much larger than its counterparts. This increase in sample size may have several different causes. The first and most obvious of these is that the surface area of the site is significantly larger than that of either of the other two sites. A second potential cause is the shale band that runs through the rock structure at the rear wall of the site (this will be examined in detail in the discussion section). Indeed, this shale band was instrumental in the very formation of the site. The significantly larger sample size of the Diepkloof assemblage has many statistical benefits, and some analyses where sample sizing was an issue for the other sites is not the case at Diepkloof.

The increase in total volume of ochre is clearest in figure 3.3.2 where the ochre assemblage is represented in its colour categories. It is immediately apparent that the volume of ochre is substantially more than at either De Hangen or Andriesgrond. Of particular interest are the shifts in proportions of some of the major colour categories. Following the format of the previous sites, this breakdown begins by looking at the two central 2.5YR categories, which jointly constitute 32.01% of the total assemblage. Individually the 2.5YR 4/6 and 4/8-Red category contains 381.13g (19.21%), this being the largest single category; and 2.5YR 5/6 and 5/8-Red contains 254.11g (12.81%).

To the left of these central Reds are the more saturated hues, described previously as tending toward the 10R Munsell hue. This distinction is important when one examines the comparison with the Rock Art as already shown for both De Hangen and Andriesgrond where colours in these hues have dominated the rock art. These eight colour categories

Diepkloof: Ochre Assemblage in Constituent Colour Categories

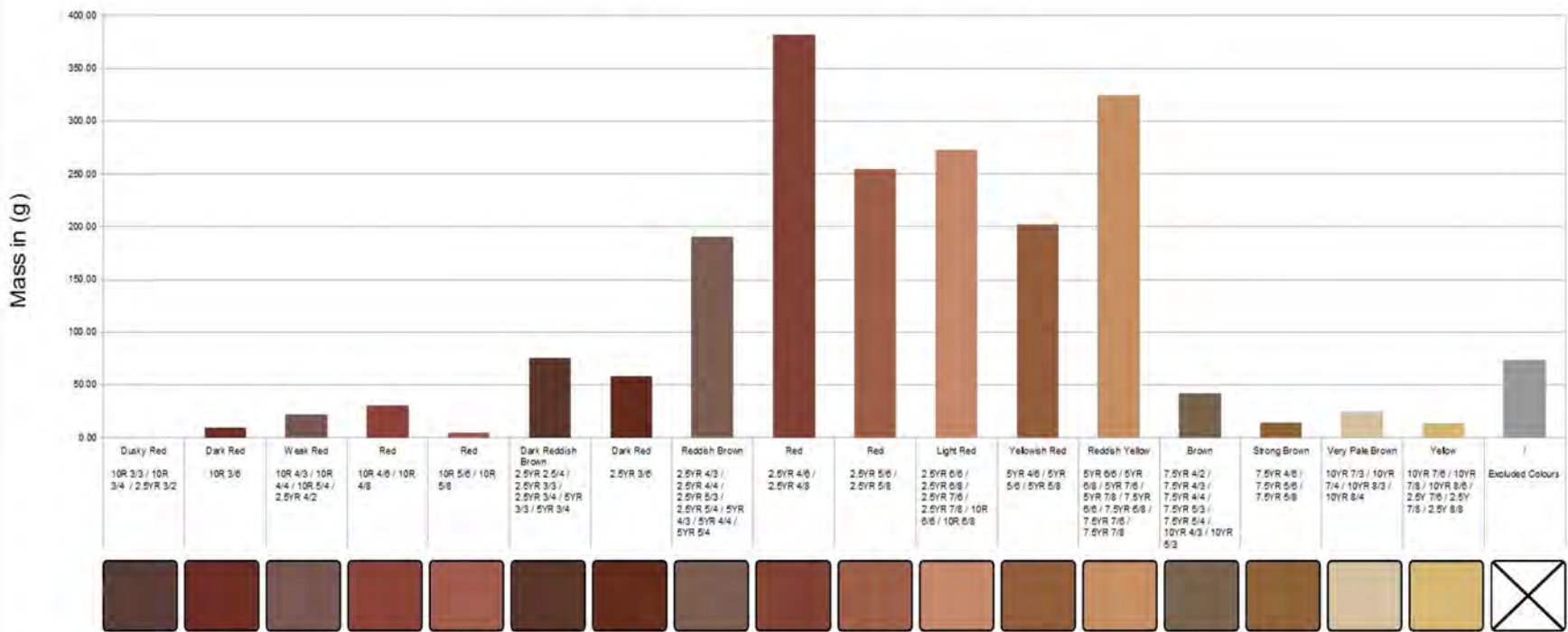


Figure 3.3.2: Diepkloof: Ochre Assemblage in Constituent Colour Categories

to the left of the central reds make up only 19.48% of the total. Only seven of these eight categories are represented and they are from left to right: 10R-Dark Red 8.76g (0.44%); Weak Red 20.99g (1.06%); 10R 4/6 and 4/8-Red 30.16g (1.52%); 10R 5/6 and 5/8-Red 5.75g (0.19%); Dark Reddish Brown 75.36g (3.80%); 2.5YR-Dark Red 57.72g (2.91%); and, lastly, Reddish Brown 189.59g (9.56%).

To the right of the two central Reds the picture is radically different with 44.81% of the total assemblage being spread across seven colour categories. Colours in these categories move from the central Reds and tend towards the yellow of the 10YR Munsell hue. These seven categories are dominated by three colours which comprise almost all of the ochre to the right of the central Reds. These seven colour categories are: Light Red 272.26g (13.73%); Yellowish Red 201.17g (10.14%); Reddish Yellow 323.96g (16.33%), this being the second largest category represented at the site; Brown 41.48g (2.09%); Strong Brown 13.76g (0.69%); Very Pale Brown 23.55g (1.19%); and, lastly, Yellow 12.55g (0.63%).

The Excluded Colours, as outlined in the methodology, for Diepkloof warrant a brief explanation in that they comprise 73.15g, which is 3.69% of all the excavated ochre. Whilst not the highest for any assemblage based on percentage, Andriesgrond having 5.72%, the increased sample size for Diepkloof means that the 3.69% accounts for 63 individual pieces of ochre with, as previously stated, 73.15g. That value is, however, spread across 14 different Munsell classifications, none of which represent a significant contribution on their own, nor could they be justifiably included within any of the presented categories without compromising the integrity of the presented categories.

Separating out the ochre assemblage within its spread of colours based on the streaking quality of the ochre provides an additional level of information regarding the ochre from the site. As previously discussed the streaking quality of the ochre is a measure of how readily the ochre nodule could be turned into a useful powder. As such, it contains two separate measures, namely the hardness and the grain size. The likelihood of Poor or Average Streak Quality ochre being used in the production of powders is low. Ochres with a Good

Figure 3.3.3: Diepkloof: Poor and Average Streak Quality Ochres in Constituent Colour Categories

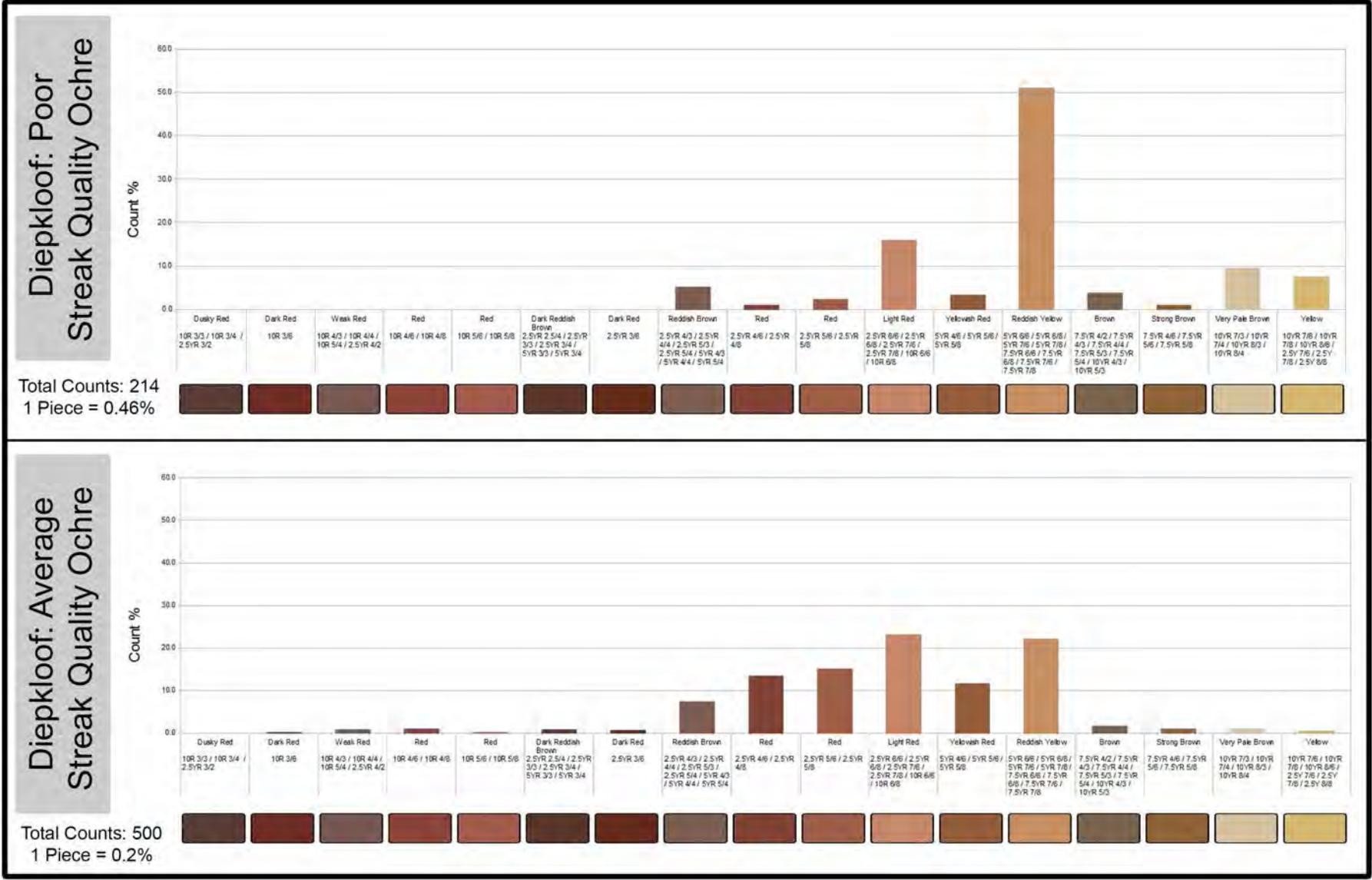
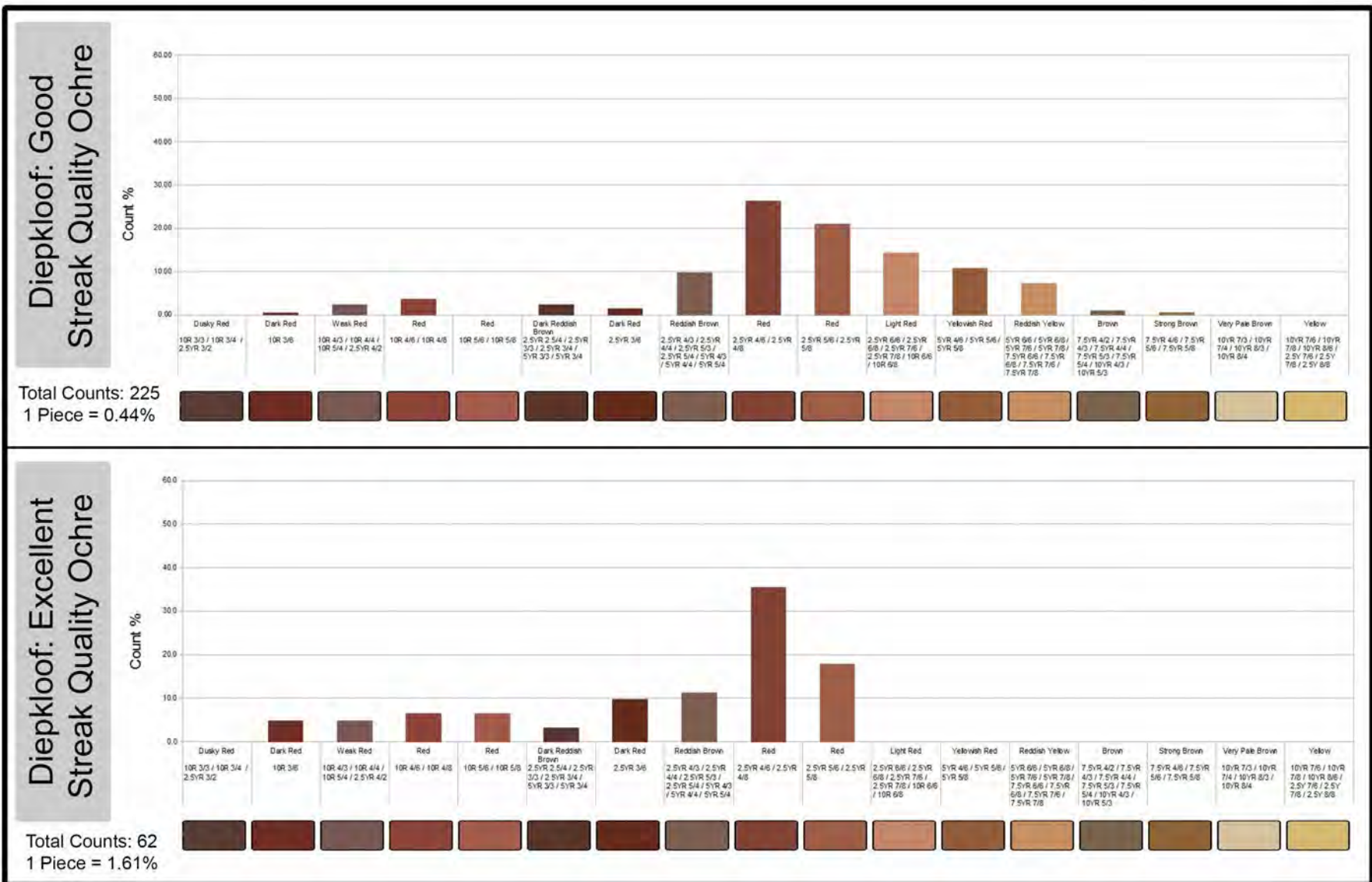


Figure 3.3.4: Diepkloof: Good and Excellent Streak Quality Ochres in Constituent Colour Categories



or Excellent Streak Quality, however, would be ideal in the production of powders and as such should represent the most plausible candidates for the base ochres for the production of paints. It is important to note here that ochre powder may have had numerous uses that are not necessarily related to paint production. This issue will be examined in greater detail in the discussion section. When examining the following graphs (3.3.3 & 3.3.4), the pieces of ochre whose colour fell within the Excluded Colours category are not shown.

(Refer to figure 3.3.3) A total of 214 pieces of ochre were classified as having a Poor Streak Quality. The mass of the two central Red categories is almost entirely negligible, accounting for only 3.2%. Individually these are 2.5YR 4/6 and 4/8-Red 0.9% and 2.5YR 5/6 and 5/8-Red 2.3%. To the left of these we find only one colour category being represented, that of Reddish Brown which accounts for 5.1%. The remaining 91.5% of the Poor Streak Quality ochre therefore falls to the right of the central Reds, in the colour categories tending towards the 10YR Munsell hues. This value is made up of the following constituent colours: Light Red 15.9%; Yellowish Red 3.3%; Reddish Yellow 50.9%; Brown 3.7%; Strong Brown 0.9%; Very Pale Brown 9.3%; and, lastly, Yellow 7.5%.

Slightly under half of the entire ochre assemblage from the site was classified as having an Average Streak quality, representing 500 pieces. The mass in the central Red categories show a marked increase from those which have a Poor Streak Quality and now represent 28.4%; with 2.5R 4/6 and 4/8-Red comprising 13.4% and 2.5YR 5/6 and 5/8-Red comprising 15%. The percentage value on the left of the central reds has risen to 11% and now represents a much wider array of colour categories, which are: 10R-Dark Red 0.2%; Weak Red 0.8%; 10r 4/6 and 4/8-Red 1%; 10R 5/6 and 5/8-Red 0.2%; Dark Reddish Brown 0.8%; 2.5YR-Dark Red 0.6%; and, lastly, Reddish Brown 7.4%. The great majority of the Average Streak Quality ochre still falls to the right of the central Reds with 60.6% being represented here. Individually the colours are: Light Red 23%; Yellowish Red 11.6%; Reddish Yellow 22%; Brown 1.6%; Strong Brown 1%; Very Pale Brown 1%; and, lastly, Yellow 0.4%.

A total of 225 piece of ochre were classified as having a Good Streak Quality. The two central

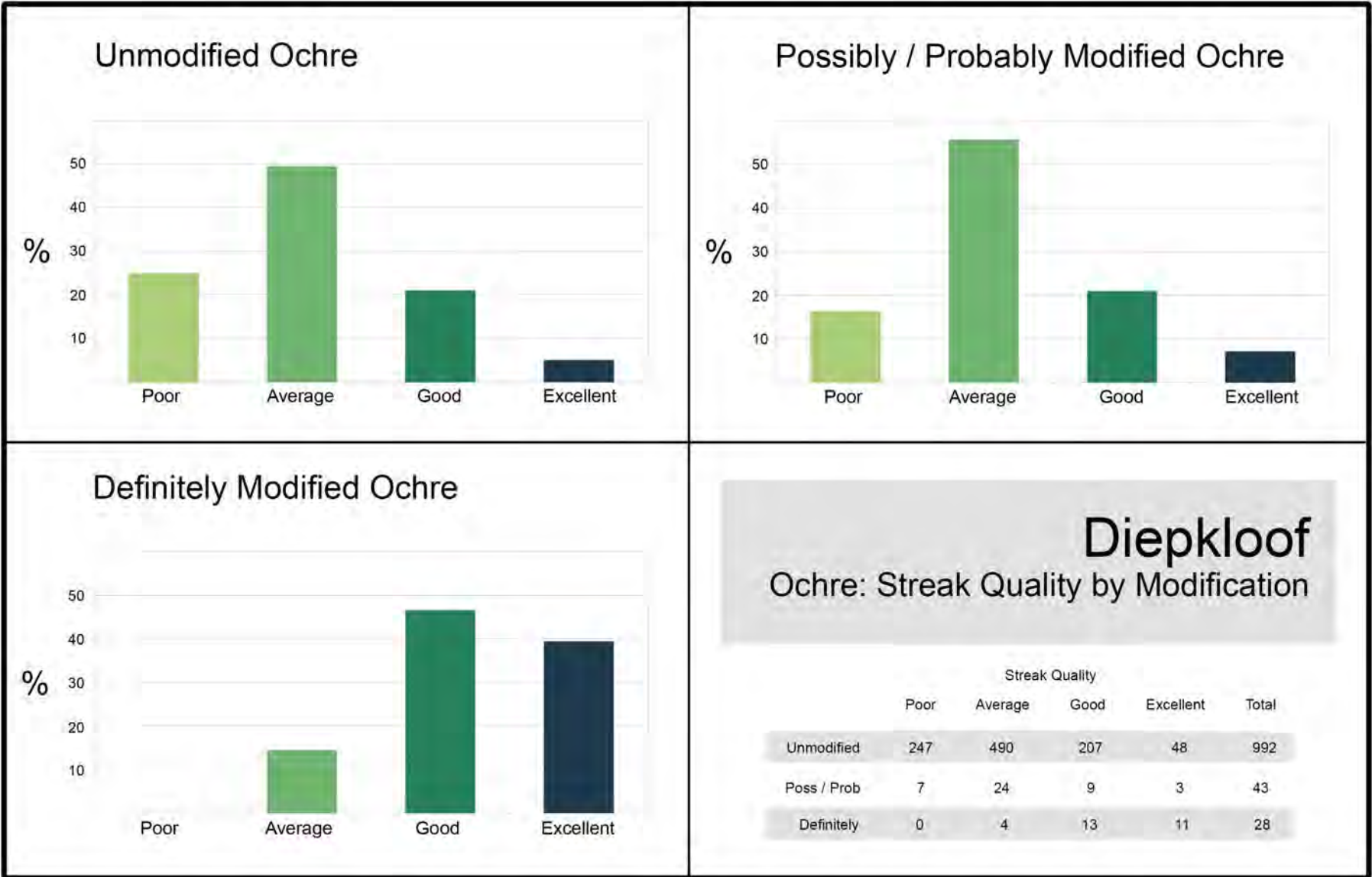
Red categories have shown an increase from the Average Streak Quality, and now represent 47.1% of all the Good Streak Quality ochre. The individual categories are: 2.5YR 4/6 and 4/8-Red 26.2% and 2.5YR 5/6 and 5/8-Red 20.9%. The colours to the left of the central Reds now represent 19.5%, comprised of: 10R-Dark Red 0.4%; Weak Red 2.2%; 10r 4/6 and 4/8-Red 3.6%; Dark Reddish Brown 2.2%; 2.5YR-Dark Red 1.3%; and, lastly, Reddish Brown 9.8%. The colours to the right of the central Reds have decreased significantly and represent 33.3% of the all the Good Streak Quality ochre. This 33.3% is comprised of the following categories: Light Red 14.2%; Yellowish Red 10.7%; Reddish Yellow 7.1%; Brown 0.9% and, finally, Strong Brown 0.4%.

In the ochre classified as having an Excellent Streak Quality there are a total of 62 pieces. The two central Red categories have increased again from the Good Streak Quality ochre, and now represent 53.2%, this number being comprised of 2.5YR 4/6 and 4/8-Red 35.5% and 2.5YR 5/6 and 5/8-Red 17.7%. To the left of these central Reds (tending toward 10R) we find 46.8% of the Excellent Streak Quality ochre being represented. This is comprised of: 10R-Dark Red 4.8%; Weak Red 4.8%; 10R 4/6 and 4/8-Red 6.5%; 10R 5/6 and 5/8-Red 6.5%; Dark Reddish Brown 3.2%; 2.5YR-Dark Red 9.7%; and, lastly, Reddish Brown 11.3%. On the right of the central Reds we find no pieces represented.

The sample size at Diepkloof Rock Shelter is significantly larger than that at either of the other two sites; and greater numbers leads to better clarity and reliability with regards to the statistical analyses. This is particularly true for the examination of the Excellent Streak Quality ochre from all three sites. At De Hangen and Andriesgrond, the sample sizes were low, meaning that the results at those sites, whilst still visibly suggestive, do suffer in terms of reliability. At Diepkloof, however, an increase in sample size provides a better supported analysis. Importantly, the results at Diepkloof broadly match those at both of the other two sites.

At Diepkloof Rock Shelter, ochre of a Poor Streak Quality is dominated by Yellows and Browns, colours tending towards the 10YR Munsell Hues. As the ochre Quality improves,

Figure 3.3.5: Diepkloof: Ochre Streak Quality by Modification



however, we find a steady shift towards the colour categories ranging from the 2.5YR-Reds to the bright and saturated 10R hues. This trend is broadly consistent with the findings from both De Hangen and Andriesgrond. The potential causes for this trend will be examined later.

A final and significant observation from the Diepkloof assemblage is that Light Red and Reddish Yellow ochre are much more common there than at either of the other two sites. Additionally, the bulk of the ochre in these colours is classified as having a Poor or Average Streak Quality. This will be pursued further in the discussion chapter; it can just be noted at this point, as referred to previously, that the abundance of these colours is linked to the presence of the ochreous shale band at the back at the site.

When examining the utilised ochre, one would expect that those pieces of ochre which can be clearly seen to have been utilised, should be of a better streaking quality. The expectation is perhaps an obvious one, in that the possible use for Poor Streak Quality ochre must be drastically limited in comparison with those of a Good or Excellent Streak Quality which could be used to generate a fine-grained powder. This should hold true regardless of what the final function of the powder may be.

At Diepkloof a total of 992 pieces of ochre were classified as Unmodified. The streaking quality of the 992 pieces is expressed in figure 3.3.5 in terms of percentage values. Of the 992 pieces, 247 (24.9%) had a Poor Streak Quality; 490 (49.4%) had an Average Streak Quality; 207 (20.9%) had a Good Streak Quality; and 48 (4.8%) had an Excellent Streak Quality. Of particular interest here are the number of pieces with a Poor Streak Quality. Whilst by no means the largest grouping, they represent a sizeable portion of all Unmodified ochre.

In the Possibly/Probably modified category there were a total of 43 pieces. Of those pieces, 7 (16.3%) had a Poor Streak Quality; 24 (55.8%) had an Average Streak Quality; 9 (20.9%) had a Good Streak Quality; and only 3 (7%) had an Excellent Streak Quality. As the

category of Possibly/Probably modified was created to ensure the integrity of the Unmodified and Definitely modified categories, it should broadly represent an average between those two extremes. In this instance, however, it almost exactly mirrors the pattern seen in the Unmodified ochre.

Perhaps the most important of the three categories is that of ochre that was Definitely modified. There were only 28 pieces classified in this category and when illustrated according to their streaking quality they are represented as follows: zero pieces had a Poor Streak Quality; 4 (14.3%) had an Average Streak Quality; 13 (46.4%) had a Good Streak Quality; and 11 (39.3%) had an Excellent Streak Quality. The Poor and Average categories are greatly diminished, and a corresponding increase is present in the Good and Excellent categories.

It is readily apparent upon examination of these graphs that there is a clear preference for ochre of either a Good or Excellent Streak Quality. This would be expected, but is now substantiated with a Fisher P value of less than 0.001. With the complete absence of Poor Streak Quality ochre, and a meagre 14.3% Average Streak Quality ochre, the Definitely modified pieces highlight a very strong preference for using ochres of better streaking quality. The first graph, showing the Unmodified ochres, appears to give an approximate geological signal of the range of ochres available, but, if ochres of Good or Excellent Streak Quality were used preferentially, then they would be under-represented. The point should be reiterated here that ochre which was ground into powder and then used for an array of possible functions, like rock art, body painting, hafting etc, will be largely absent from the excavated assemblage.

Rock Art

There is a substantial amount of rock art present at Diepkloof. Importantly, the subject matter of this rock art covers the full spectrum of motifs, namely fine line, handprints and colonial or farmer era paintings, as outlined by Mguni (1997). It is unique amongst the sites examined in this research in this regard as there are images that clearly fall into each of the

three categories, namely fine line, handprint and colonial era. This again makes Diepkloof a pivotal site in this research as it gives a unique opportunity to examine the different motifs with regards to their respective colours. To this end; examples of imagery classified within these different motifs will be presented before the colour analyses of the rock art as a whole are examined.

The analyses conducted for the rock art at Diepkloof refer not only to those images present at the Diepkloof Rock Shelter, but also at the adjacent site called Diepkloof Kraal Shelter. The two sites are in such close proximity to one another (less than 50m apart), that for the purposes of this research they have been largely treated as a single site. Whilst the entirety of the ochre assemblage originates from Diepkloof Rock Shelter, the rock art present there is comparatively poor, especially in light of the array of images at Diepkloof Kraal. It is for this reason that Diepkloof Kraal site is focused on with regards to the rock art; and several images which serve as exemplars of the three rock art periods will be shown in order to visually illustrate the differences.

The rock art at Diepkloof Kraal site was divided up into five separate Areas or Panels, which are again defined by the surface of the rock which constitutes the rear wall of the shelter. These can be seen with reference to the rock art wall map provided (figure 3.3.6). Area A is situated to the extreme left and is characterised by a line of 12 detailed eland that stretch across most of the panel. The boundary between Area A and B is a deep vertical crack in the rock which forms a semi-circular arch over Area B. Area B contains some fine line imagery as well as some graffiti which may date to the early 1900's by association with other graffiti present. Area C is a panel of rock which intrudes under the arch that constitutes the top of Area B, and contains several Colonial era paintings. Area D is adjacent to Area C and also sits within its own 'rock window' defined by the cracks in the rock around it. Lastly, Area E is situated to the extreme right at the site and contains several small fine line images as well as a line of decorated handprints, but is most notably characterised by a large piece of graffiti dated to the early 1900's. (The shale Band is also indicated on the rock art wall map)

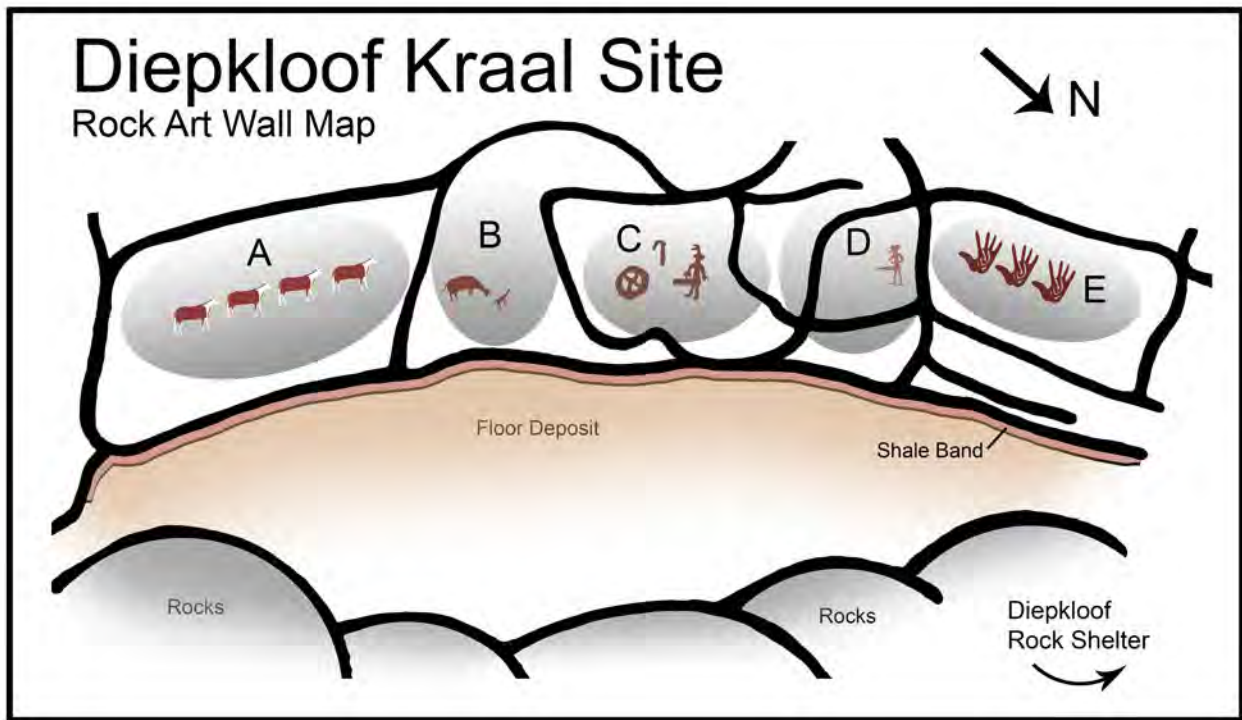


Figure 3.3.6: Diepkloof Kraal Shelter: Rock Art Wall Map

It should be noted here that whilst the entirety of the excavated assemblage discussed in this thesis with regard to Diepkloof originates from the site of Diepkloof Rock Shelter, the rock art, is primarily dealt with in terms of the images at Diepkloof Kraal Shelter. The rock art at Diepkloof Rock Shelter, whilst not being insubstantial in terms of surface area is rather poor when considering the motifs represented and has comparatively poor preservation of rock art. As the images from the shelter are not discussed directly in relation to the identified traditions, the panels and rock art from the site are not described here in detail, though their surface areas are incorporated into the general discussion of the rock art from Diepkloof as the site is treated largely as a single entity for the purposes of this thesis.

A4abc

Colour Code: Red 10R 4/8 (White, Black)

Surface Area: 76cm² (White 29cm²; Black 4cm²)

Rock Art Tradition: fine line

Figure: 3.3.7

Description: A4.abc describes one of a line of 12 eland that span the width of Area A. A4.abc



Figure 3.3.7: Diepkloof: Rock Art Image A4.abc

B3.d & B3.e

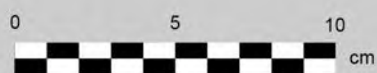


Figure 3.3.8: Diepkloof: Rock Art Image B3.d&e

is the best preserved of the 12 eland with both the white and black paint being clearly visible. The white paint was used for the head, neck, legs, and a thin line for the underbelly. There are small traces of black paint remaining on the hooves of the eland as well as clear lines on the back and front of the neck and on the top of the head. In the vast majority of cases, all that remains of such painted images is the residual red, 'hump-like shape' of the red paint that constitutes the torso of the eland. This particular image provides a clear example of the paint that is frequently missing in painted eland.

B3.d&e

Colour Code: B3.d - Red 10R 4/6 / B3.e Weak Red 10R 4/4

Surface Area: 76cm² / 10cm²

Rock Art Tradition: fine line

Figure: 3.3.8

Description: B3.d&e are two rather unusual images (there are several others nearby) which fall within the fine line tradition. B3.d appears to be a bovid or buck of some description as evidenced by its clearly defined, though unusual, hooves. Hooves such as these are rare when examining fine line imagery, and are most frequently depicted with a small patch of black paint. Another unusual feature is the grazing pose of the animal: head bowed and open-mouthed. B3.e is also a rather strange image. It depicts what appears to be a juvenile animal, with very skinny legs and tail as well as an overly prolonged neck.

E5.b (part)

Colour Code: Red 10R 4/6

Surface Area: 104cm² (full line of handprints)

Rock Art Tradition: handprint

Figure: 3.3.9

Figure 3.3.9: Diepkloof: Rock Art Image E5.b



Description: There are a large amount of handprints at both Diepkloof Kraal and Diepkloof Rock Shelter. In Diepkloof Kraal these are present in the form of a double line of handprints that span almost the entire site from Area A through to Area E. The majority of the handprints are undecorated, though there are many decorated ones nonetheless. The example given here is of a decorated handprint. This would have been produced by covering the entire hand with paint and then removing paint in a semi-circular, or nested U shape; the hand was then pressed to the wall's surface. The majority of handprints throughout the region are unusually small (this being a typical example). Whilst the hand sizes of those inhabiting the site would undoubtedly have been smaller than our own, these handprints may well be those of adolescents. Indeed, Manhire (1998) postulates that the handprints may well have been part of an initiation ceremony for adolescents coming of age, which would account for their consistent small size.

C1.a-d

Colour Code: Reddish Brown 2.5YR 4/4

Surface Area: C1.b - 108cm² / C1.c – 28cm² / C1.d - 115cm²

Rock Art Tradition: Colonial

Figure: 3.3.10

Description: C1.a-d is a good example of what constitutes the Colonial era painting. C1.b is a circular shape with crossed lines through the middle. It seems plausible to define this as a wagon-wheel when the time period is considered. C1.c resembles a question mark (?) and may represent a feather (based on C1.d). C1.d is quite clearly a depiction of a colonial European settler. The figure is wearing a hat, with feathers in it; and the wide armed pose is also typical, though often shown as hands on hips as seen in D1.b. The rather odd feature of the massive penis is also typical for paintings depicting Europeans. The colour in which these are painted, as will be shown later, is not the same as that of fine line imagery or of handprints.



Figure 3.3.10: Diepkloof: Rock Art Image C1.a-d

D1.b



Figure 3.3.11 : Diepkloof: Rock Art Image D1.b

D1.b

Colour Code: Red 2.5YR 5/6

Surface Area: 93cm²

Rock Art Tradition: Colonial

Figure: 3.3.11

Description: D1.b is another clear example of Colonial era rock art. The image is of a European settler as evidenced by a range of telling traits. Once again the figure has rounded wide-spread arms; in this instance, as with many others, with the hands on the hips or waist, or in the pockets. The figure also has a massively oversized penis once again, this being a fairly common trait amongst colonial imagery. Another tell-tale indicator is the presence of clearly painted shoes, in this case with heels. Lastly, the figure also appears to be wearing a hat and smoking a pipe.

When examining figure 3.3.12 showing the spread of colours in the rock art from Diepkloof, it is important to highlight that for this and all subsequent rock art analyses, Diepkloof Kraal and Diepkloof Rock Shelter sites are treated as a single entity. The total surface area of rock art comes to 16 408cm², spread across both sites (see appendix for data from each shelter). After the observations in relation to the two previous sites, the range of colours, or lack thereof, is not surprising in that both De Hangen and Andriesgrond display a limited range of colours. The two central Reds make-up 24.51% of all the rock art; with 2.5YR 4/6 and 4/8-Red covering 972cm² (5.92%) and 2.5YR 5/6 and 5/8-Red covering 3050cm² (18.59%). To the left of the central Reds we find the vast majority of the rock art being represented, with 70.99%. This number is dominated by the 10R 4/6 and 4/8-Red category with 7890cm² (48.09%), a fraction under half of all the rock art. The second largest category here is the neighbouring 10R 5/6 and 5/8-Red, with 2071cm² (12.62%). The rest is comprised of the six other colour categories which are as follows: Dusky Red 426cm² (2.60%); 10R-Dark Red 31cm² (0.19%); Weak Red 372cm² (2.27%); Dark Reddish Brown 186cm² (1.13%); 2.5YR-Dark Red 190cm² (1.16%); and, lastly, Reddish Brown 587cm² 2.94%). On the right of the two central Reds there is only a smattering of rock art present, with only 3.86% of all the

Diepkloof Kraal and Diepkloof Rock Shelter: All Rock Art in Constituent Colour Categories

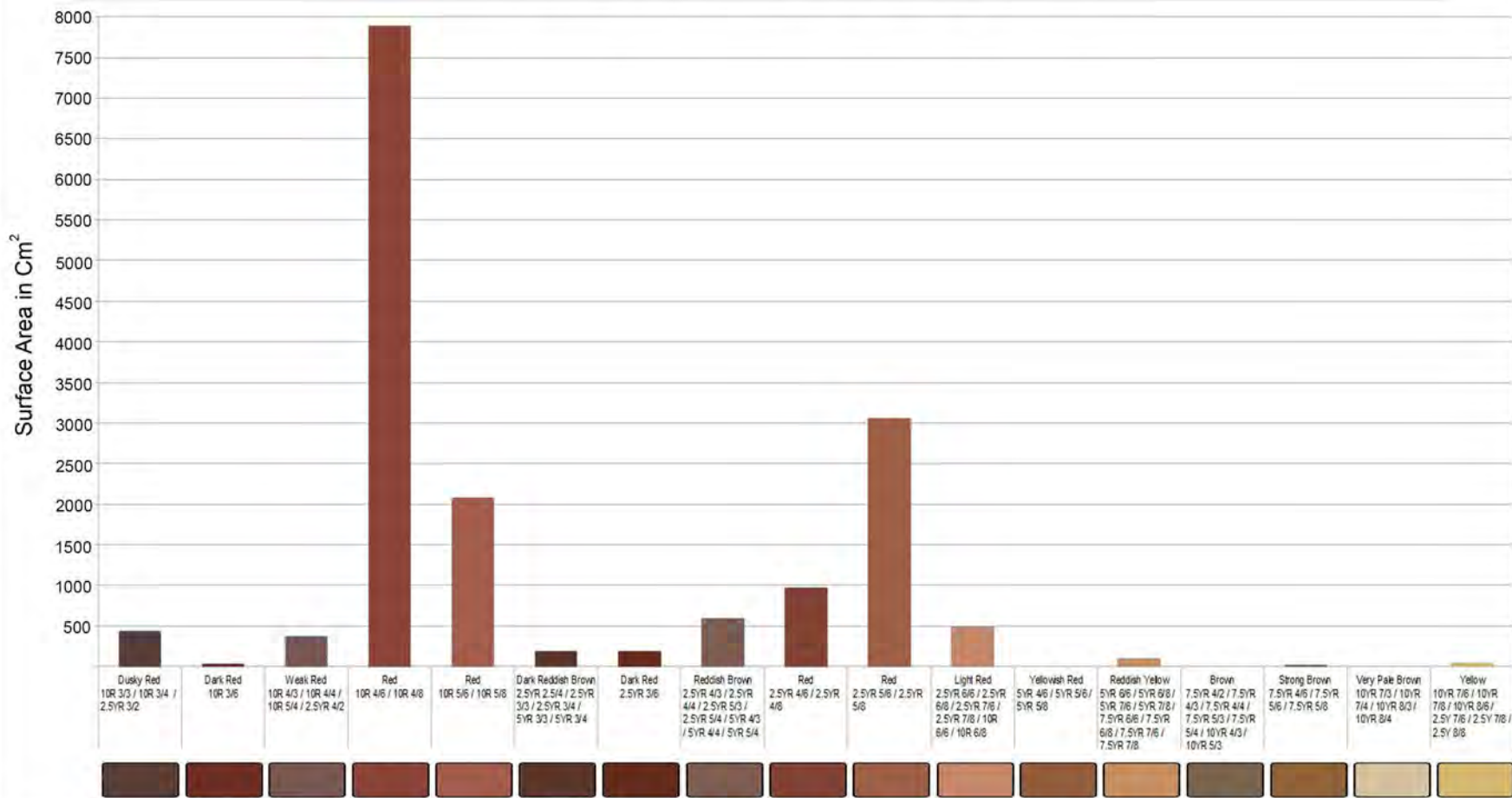
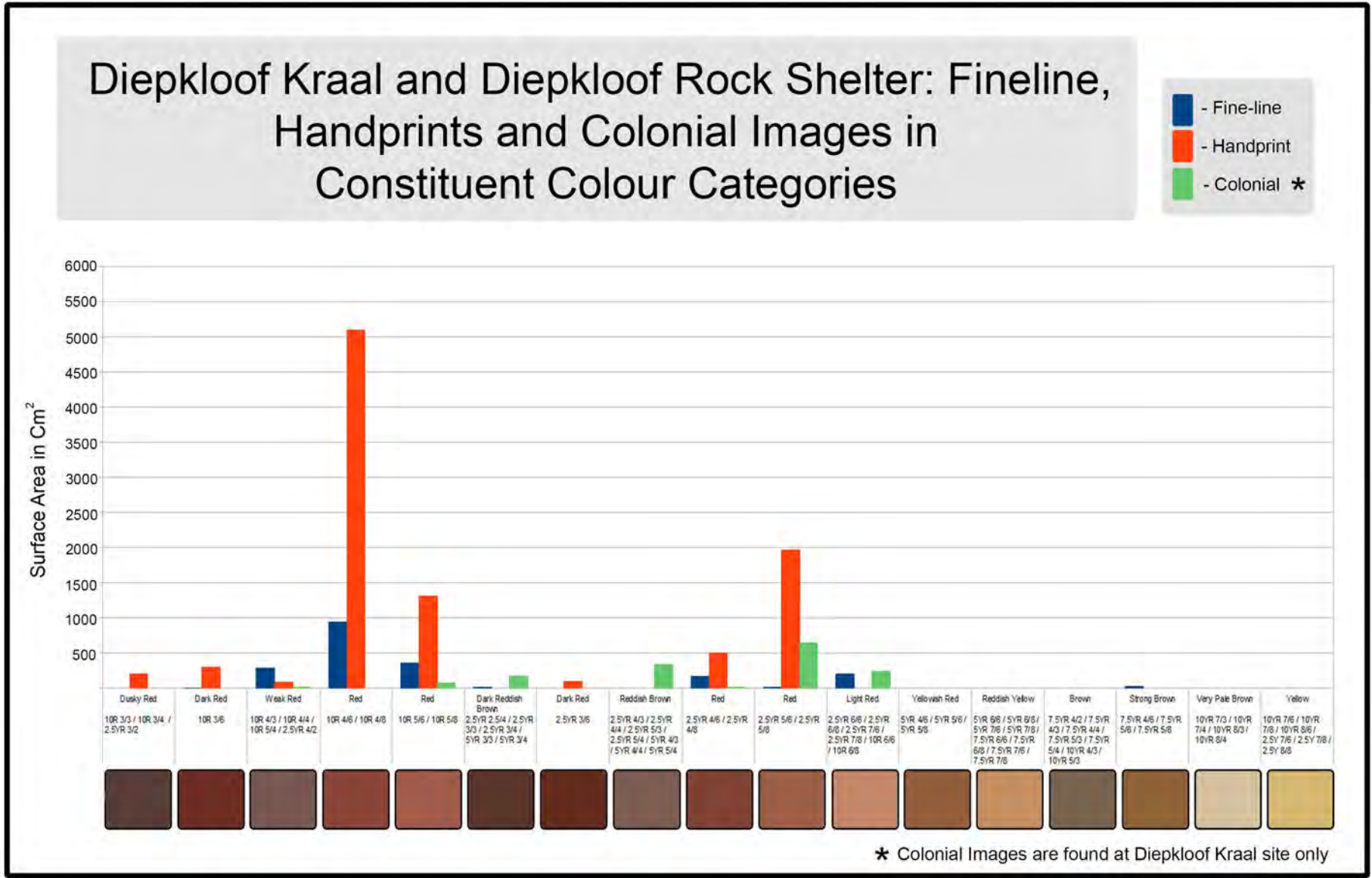


Figure 3.3.12: Diepkloof Kraal and Diepkloof Rock Shelter: All Rock Art in Constituent Colour Categories

Figure 3.3.13: Diepkloof Kraal and Diepkloof Rock Shelter: Fine Line, Handprints and Colonial Images in Constituent Colour Categories



rock art being painted in these colours. There are only four of the seven colour categories here that have any paint. These are: Light Red 490cm² (2.99%); Reddish Yellow 89cm² (0.54%); Strong Brown 16cm² (0.10%); and, lastly, Yellow 38cm² (0.23%). As seen quite clearly in figure 3.3.12, the colours of the rock art are strongly clustered toward the left, in those colours tending towards the 10R Munsell hue with the notable dominance of the 10R 4/6 and 4/8-Red category.

When the colour spread of the rock art is subdivided into the three different traditions which are present at Diepkloof, several notable patterns appear. (see figure 3.3.13). Firstly, it is clear that the massive quantity of paint in the Red categories is comprised mainly of handprints, the largest of these being 10R 4/6 and 4/8-Red, with 5090cm². The fine line images present are a far more subtle signal in comparison but are nevertheless spread across a similar colour range to the handprints. Two exceptions to this are the presence of fine line images painted in Weak Red (279cm²) and Light Red (206cm²). The focus of the colonial imagery, however, is situated more to the right on the given colour spectrum. The main colours represented here are: 2.5YR 5/6 and 5/8-Red, Reddish Brown, Light Red and Dark Reddish Brown. Whilst far from definitive, the different traditions do show a varying signal which, with further research on different sites, may provide a sharper picture. What this information shows, however, is that people inhabiting the site of Diepkloof at different times had a different approach to ochre and its use. One such possibility will be examined in the discussion chapter.

The surface area of each colour with regards to the rock art tradition is presented here, the values being presented as they appear on figure 3.3.13 from left to right, as follows:

Fine line: 10R-Dark Red 2cm²; Weak Red 279cm²; 10R 4/6 and 4/8-Red 933cm²; 10R 5/6 and 5/8-Red 357cm²; Dark Reddish Brown 13cm²; 2.5YR 4/6 and 4/8 Red 159cm²; 2.5YR 5/6 and 5/8-Red 10cm²; Light Red 206cm², and lastly, Strong Brown 16cm².

Handprints: Dusky Red 198cm²; 10R-Dark Red 294cm²; Weak Red 77cm²; 10R 4/6

and 4/8-Red 5090cm²; 10R 5/6 and 5/8-Red 1308cm²; 2.5YR-Dark Red 95cm²; 2.5YR4/6 and 4/8-Red 499cm²; and, lastly, 2.5YR 5/6 and 5/8-Red 1962cm²
Colonial Imagery: 10R Dark Red 2cm²; 10R 5/6 and 5/8-Red 73cm²; Dark Reddish Brown 170cm²; Reddish Brown 336cm²; 2.5YR 4/6 and 4/8-Red 5cm²; 2.5YR 5/6 and 5/8-Red 642cm²; and, lastly, Light Red 231cm².

After this discussion of the rock paintings which outlines the colours represented in the various traditions and the proportions of those colours, the paintings are next compared with the ochre assemblage.

Ochre and Rock Art Comparison

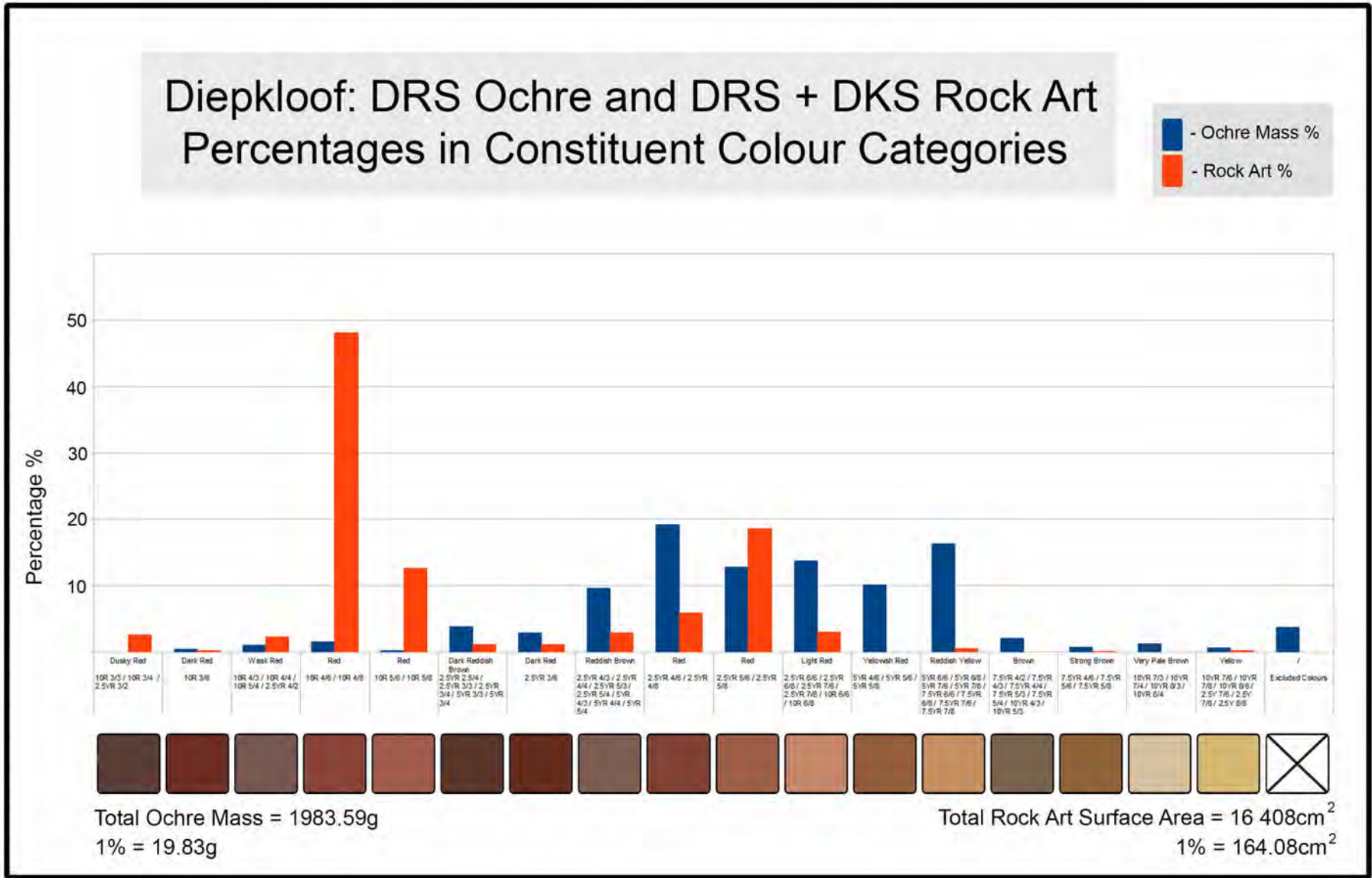
(with reference to figure 3.3.14)

The primary impetus for this research was to examine the correlation, if any, between the excavated ochre and the rock art from the same site. To assume that a precise correlation is possible based solely on colour classifications would be naïve. That said, however, the colour classifications represent amalgamations of closely related Munsell hues, which separate out rather dramatically when the ochre and rock art are examined. Nowhere is this better illustrated than at Diepkloof where the large ochre assemblage and extensive rock painting make such observations more reliable.

The two central Reds show a fair level of correlation, with a reasonable percentage of both rock art and ochre being present in these two categories. This observation is not overly surprising, as these two colours appear prevalent throughout. The more interesting and telling observations, however, are to be made on either side of these central Reds.

To the left of the central Reds in those colour categories tending toward the 10R Munsell hue, we find a very distinct picture. In the 10R 4/6 and 4/8-Red and 10R 5/6 and 5/8-Red categories we find the vast majority of all the rock art being represented, yet only a fraction

Figure 3.3. 14: Diepkloof Kraal and Diepkloof Rock Shelter: Ochre and Rock Art Percentages on Constituent Colour Categories



of the ochre assemblage. Looking back at the traditions in the rock art, we can see clearly that these two categories are dominated by handprints. (refer to figure 3.3.13). Notably, these two categories are also the two largest with regards to the fine line imagery. With such an abundance of these pigments in the rock art, one would expect, perhaps, to see a substantial amount of residual ochres in these colours, but this is not the case. In order for these colours to appear in the rock art, their corresponding ochre must have been present. As touched on previously, ochre used to create powders or paints can no longer be present in the deposit. This will be expanded upon in the discussion section.

Two further notable colour categories on the left of the central Reds that will be shown to be significant are those of Reddish Brown and Dark Reddish Brown. In figure 3.3.14 alone, these two colours do not appear to hold any significance until they are looked at with regards to their tradition as well as the comparison between ochre and rock art. The rock art present at Diepkloof in these two colours consists of Colonial era paintings only. In the light of the subsequent section describing the experimental work, these categories will prove significant. This will also be examined in greater detail in the discussion section once the experimental findings have been presented.

On the opposite side of the central Reds, on the right, in those colours tending toward the 10YR Munsell hue we find a substantial amount of the ochre assemblage, but only a fraction of the rock art, which is the inverse of the observation illustrated on the left side of the central Reds. The abundance of these colours in the assemblage may have several root causes, some of which relate to the ochreous shale band that runs through the rear of both of the shelters on the kopje. When these ochres are examined in conjunction with figure 3.3.3, displaying the Poor and Average Streak Quality ochres from Diepkloof, it is apparent that ochre in these colour categories will not create good quality powders or paints, and as such their absence in the rock art is not surprising.

Summary

The data presented in this chapter for each of the three sites illustrates quite clearly that each site is unique. The number of variables which can affect the ochre assemblage and the rock paintings is large, to the point where there is a long list of differences between sites. To begin with, a brief look will be taken at some of the differences between the sites.

The ochre assemblages from the three sites show variability in different features. De Hangen and Andriesgrond are relatively similar in both volume and colour spread, with an approximately similar mass and number of ochre pieces; Diepkloof, by stark contrast, has a massive ochre assemblage with a very different spread of colours. The geography and geology of each site is also different, with De Hangen being high in the Cederberg mountains, Andriesgrond being at the edge, and Diepkloof being some distance away toward the coast. The rock art present at each site is also different, with an array of different motifs of different traditions being present at each. All of these broad differences have many finer aspects to them which collectively bring about a very wide range of potential variation between sites. Despite all of the variation between sites, there are, however, as shown by this research, some significant similarities that also exist. There is a strong preference for the use of ochres tending toward the 10R Munsell hue in the rock art across all the sites. A strong link can be drawn between the streaking quality and colour of a piece of ochre, based either on human agency bringing colours preferentially to sites, or perhaps something inherent in the chemistry and physical properties. Modified pieces of ochre tend to have better streaking quality, meaning that the quality of the powder produced from the ochres was a significant motivating factor in its selection and use. Despite the variation between sites, there are important inferences to be drawn which tell us a great deal about ochre use and activities associated with it.

There remain, however, a range of questions and factors which cannot be explored merely by an examination of the archaeology, not matter how detailed that examination may be, issues such as: the availability of ochre to the inhabitants of any given site; and the

potential transformations of ochre, whether intentional or unintentional, and the result of post-depositional influences such as incidental heating and consequential changes in the chemistry of ochres, affecting their colour and functionality. These are questions which can only be answered by examination of the current landscape and the use of experimental methods. This will shed additional light on the archaeological examinations and help to describe otherwise unobservable patterns. The next chapter therefore deals with the experimental research conducted for this thesis; which will then be used in conjunction with the archaeological findings to substantiate the arguments that will be postulated in the discussion section.

* * *

After this presentation of results from the archaeological enquiry for each of the three sites, some experimental research will be detailed. This experimental work serves to fill some of the apparent gaps in the sequence of events from ochre sourcing to its final inclusion into rock paintings, or the discard of ochre nodules into the deposits which are subsequently excavated by archaeologists. The key features examined include a look at the surrounding landscapes at each site to determine possible ochre sourcing, followed by a close look at the potential effects on the ochre assemblages of post-depositional heating.

4. Experimental Research



4. Experimental Research

After the description of the archaeological assemblages and the rock paintings there were a variety of aspects that required some means of clarification which was unobtainable from the archaeology. These involve issues such as the origin points of the ochres and the array of possible transformations which ochre and paint may undergo. The experimental work served to fill in some of the conceptual gaps that exist between the ochre as a source material found within the landscape and its ultimate inclusion in rock paintings and its deposition as ochre nodules within the archaeological layers.

This chapter examines the occurrence of ochre within the landscape in the immediate vicinity of each of the three sites by means of careful survey. This is followed by further examination of the landscape looking to pin-point potential local sources of ochre, which will serve to provide a context against which the archaeological ochre may be viewed. Once the survey work has been discussed, a possible transformation of ochre brought to the site is examined through the use of experimental hearths. These hearths may illustrate archaeological motive in changing the physical properties of the ochre before it was used to make paint, although differentiating this process from an unintentional, serendipitous process through post-depositional heating may prove difficult (Wadley. 2009, 2010b). The experimental hearths are also discussed in relation to the assumption that the colour of the archaeological ochre can be reasonably compared with the colour of the rock art (this correlation being a foundational assumption underpinning much of this thesis). The significance of the heating of ochre, whether intentional or not, is that it can change the chemical properties of ochre buried below a hearth and consequently produce a colour shift in that ochre. To further examine this transformation, ochre samples from these hearths were taken to the Institut de Recherche sur les Archéomatériaux (IRAMAT-CRP2A) laboratory in Bordeaux, France, where X-ray diffraction and colorimetric analyses were carried out.

Survey Work

De Hangen

The slope directly below the site was strewn with archaeological ochre including several utilised pieces. These pieces were examined and carefully recorded and it was found that this ochre was unlike geological ochre occurring in the surrounding area. These ochre nodules closely resembled the archaeological ones from the excavated assemblage, and these therefore represent nodules brought to the site and either used in front of the site, or eroded out of the shelter.

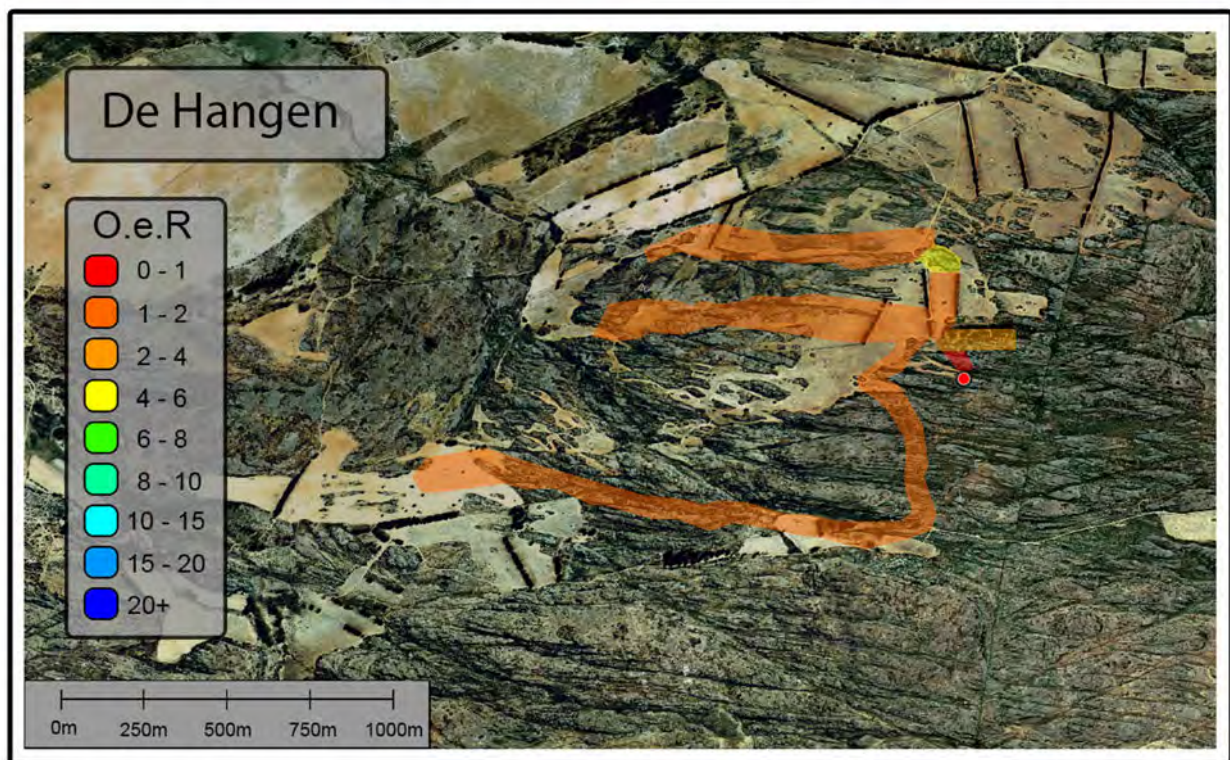


Figure 4.1.1: Surveyed Area around De Hangen showing Ochre encounter Rate.
Lower Value Means Higher Density

A total of 6 survey tracks of varying duration and distance were conducted around the site. The rooibos fields in the area provided a useful means to cover large distances effectively despite the fact that the ground was obviously disturbed by ploughing. The last track to be carried out was primarily through the dense vegetation to the south of the site, this area proving to be very difficult to survey due to the nature of the vegetation and the sheer landforms such as cliff faces and steep-sided gullies.

De Hangen	Duration (mins)	Distance Covered (m)	Survey Rate (m/min)	Tot # of Streaks	Tot # of streaks / surveyors	ochre encounter rate. (D/Stp.p)/Rate	Streak Quality STQ
Track 1	33	174	5.27	80	16	2.06	Poor
Track 2	23	152	6.61	69	13.8	1.67	Poor
Track 3	8	100	12.5	9	1.8	4.44	Poor
Track 4	28	709	25.32	95	19	1.47	Poor
Track 5	32	802	25.06	106	21.2	1.51	Poor
Track 6	14	353	25.21	47	9.4	1.49	Poor

Table 4.1.1: De Hangen survey showing ochre density

The ochre encounter rate, or O.e.R. as referred to in the provided survey maps, as described in the methodology section, is a rough representation of the density of ochre found in the landscape, the number representing the amount of time between encountering nodules of streakable ochre. The equation for this rate is: $[(\text{total distance}/\text{average streak per person}) / \text{survey rate}]$. As stated, whilst this rate is far from precise, it does provide a rough gauge by which the density of ochre can be estimated.

A cursory examination of the above map (figure 4.1.1) showing the ochre density gives the impression that the area around De Hangen is rich in ochre and the inhabitants of the site would not have had to travel far in order to obtain supplies of ochre. This is almost certainly false, however, as evidenced by examining the associated table, making reference to the poor

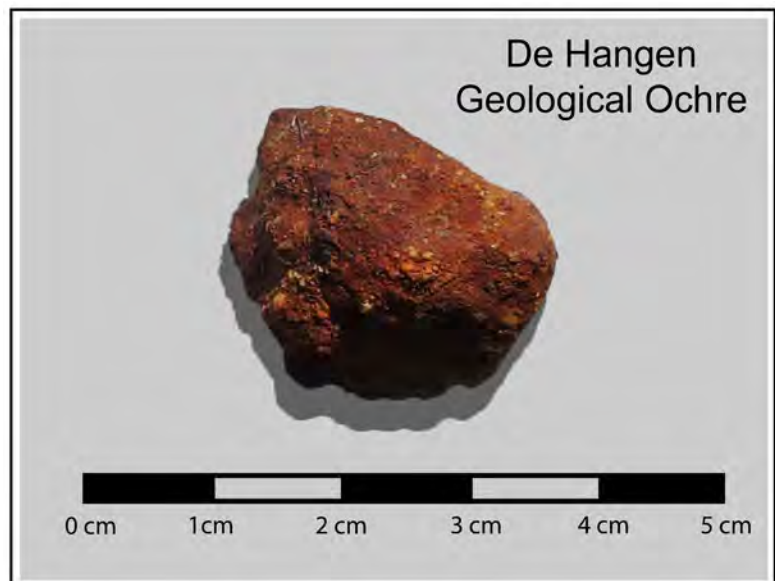


Figure 4.1.2: Ochre Sample from nearby De Hangen

streaking quality of the ochre found. Whilst a large quantity of streakable pieces of ochre are present, they are of very poor quality with large quartz inclusions present throughout. The geology of the area is dominated by quartzitic sandstone, and as such, the poor quality of the ochre found is unsurprising as it owes its origins to this formation. The quartzitic

sandstone formation makes up a substantial proportion of the Cederberg mountain range as a whole. De Hangen sits squarely within this formation with the closest change in geology occurring more than 10km from the site. In addition, the excavated ochre assemblage from the site is primarily made up of shale based haematites and therefore bears no resemblance to the samples found during the survey.

Andriesgrond

The talus slope in front of Andriesgrond was roughly divided into three sections, the middle section describing the area between the upper slope with the immediate run off from the deposit to the edge of the lower talus slope where the gradient of the slope levels out to a large degree. Due to the time spent examining the talus slope at De Hangen, a change in strategy was employed when examining the talus slope of Andriesgrond. Two 9m² squares were set out at two different spots on the middle section of the talus slope. The middle section was chosen as cursory observation showed that a greater concentration of ochre occurred there and there was significantly less on the upper slope, likely due to erosion. All of these pieces were classified as being archaeological in origin due to their immediate

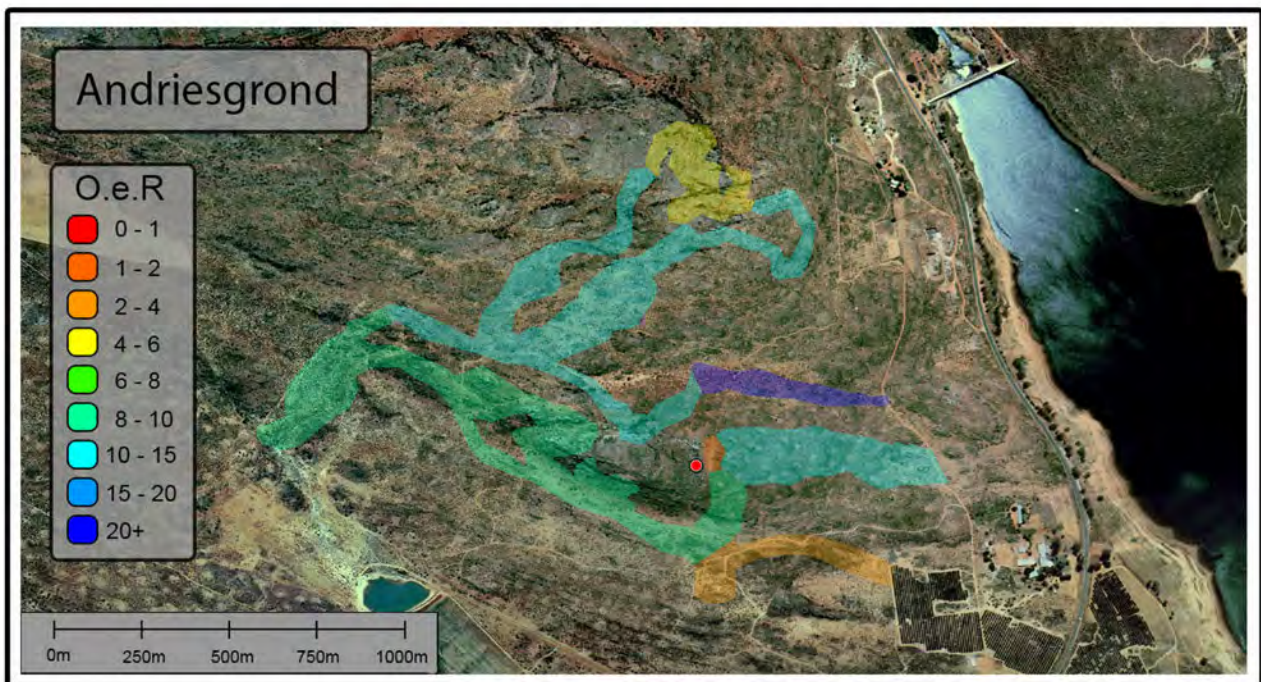


Figure 4.1.3: Surveyed Area around Andriesgrond showing Ochre encounter Rate. Lower Value Means Higher Density

proximity to the site. (refer to table 4.1.2).

Andriesgrond	STQ. Poor	STQ. Average	STQ. Good	STQ. Excellent	Total
Square A	2	6	5	0	13
Square B	4	4	2	1	11

Table 4.1.2: Andriesgrond: sample from middle talus slope.

The first survey track covered the lower talus slope. This area is clearly visible on the map provided as the small orange-shaded area. The ochre found in this area was all classified as being archaeological in origin due to the proximity to the site, and, indeed, two utilised pieces of ochre were found, providing support for this classification. Additionally, the concentration of ochre in this area points to its archaeological origin when compared to the neutral non-anthropogenic signal provided by the surrounding landscape.

Andriesgrond	Duration (mins)	Distance Covered (m)	Survey Rate (m/min)	Tot # of Streaks	Tot # of streaks / surveyors	ochre encounter rate. (D/Stp.p)/Rate	Streak Quality STQ
Track 1	29	67	2.31	111	18.5	1.57	Excl / Good
Track 2	27	462	17.11	0	0	20	N/A
Track 3	30	554	18.47	15	2.5	12	Poor
Track 4	49	518	10.57	25	5	9.8	Poor
Track 5	45	959	21.31	16	3.2	14.06	Poor
Track 6	36	367	10.19	44	8.8	4.09	Ave / Poor
Track 7 part 1	38	720	18.95	65	13	2.92	Good / Ave
Track 7 part 2	158	1812	11.47	93	18.6	8.49	Poor

Table 4.1.3: Andriesgrond: survey showing ochre density.

The area surrounding Andriesgrond contains a very low density of poor-quality geological ochre, as shown in the map provided (figure 4.1.3). The underlying geology of the immediate area is the same quartzitic sandstone as seen around De Hangen, though there is a major difference in the quantity of overlying soil deposits. This makes the presence of the poor-quality ochre with quartz inclusions far less numerous than was the case around De Hangen. The lower eastern slopes in front of the site are very sandy and thickly vegetated. This makes whatever ochre might be present difficult to spot under the vegetation, and any ochre present is indeed also quite likely to be buried beneath the sand layer. The western and northern regions did not have the same sandy soil, but contained an almost equally low density of geological ochre. The yellow-shaded area to the north shows a higher ochre

density than the rest of the landscape. This is likely due to a percentage of imported ochre as there are several surface scatters of stone artefacts along these rocky outcrops. The light-orange area to the south east of the site contained several haematite nodules. Whether or not these nodules were of archaeological origin or not is difficult to determine.

The survey data gives a clear indication that the historic inhabitants of Andriesgrond would have had to travel away from the immediate vicinity of the site in order to gather ochre but, as will be shown, the nearest potential ochre source is quite close.

Ochre Sourcing in the Olifants River Valley

A survey plan was devised, with reference to the geology, in order to find possible ochre sources. The primary target of the survey was to examine the various shale-based geological formations. These shale formations are the most likely source of the ochres found in the archaeological assemblages for both Andriesgrond and De Hangen.

The first shale formation targeted was the C1S2G shale-band, which comprises of shales, arenaceous shales, tillite and grit, and conglomerate. It forms part of the Table Mountain series and is represented by the orange band on the geological map (refer to figure 4.1.4). Its proximity to both Andriesgrond and De Hangen made it an obvious first choice for examination. Area E on the map, Kransvlei farm, is approximately 3km from Andriesgrond. Three separate transects were made across the formation, and the ochre found was sparsely distributed and was of poor quality.

Areas F and H (Langkloof and Kleinkliphuis, respectively) also fall on the C1S2G shale band and were comparably low in ochre density with the area at Kransvlei (area E). At Langkloof the shale formation forms a very narrow band and is clearly visible upon the landscape, which is not the case at other areas along this formation. The density shown for Kleinkliphuis is somewhat misleading as the majority of the ochres found occurred within a short distance of the newly constructed asphalt road at the start of the Pakhuis-Pass. The

earth works involved in the building of the road may potentially have had some impact on the occurrence of ochre close to the road, though this is merely supposition.

Area G, situated on the farm Steenrug, lies just south of the steep-sided edge of the Cederberg mountains, and was the last spot at which the C1S2G Table Mountain shale was surveyed. Here there was a high density of good quality ochre spread evenly across the surveyed slope. The ochre was dominated by rich red hues of good streaking quality, but was restricted to small nodules only. The presence of high quality ochre at Steenrug is somewhat of an anomaly when compared with the other places surveyed on the same shale formation. It is, however, less than 1km from the mixed shale formation belonging to the Lower Bokkeveld group, which, as will be discussed subsequently, is rich in very similar ochreous material.

Area C and D (Augsberg and Patrysvlei, respectively) lie within a mixed shale conglomerate within the Lower Bokkeveld formation. Area C lies in the C2S1 band shown in purple on the geological map. It forms the slope of a hill just to the north of Clanwilliam. This slope, at Augsberg, showed a high density of Good Streak Quality ochre with nodules that were relatively small and dispersed between numerous shale pieces with dull pigmentation. This ochre dispersion pattern is very similar to the one at Steenrug (Area G). However, at Augsberg there is a higher density of ochre and a far greater number of streakable ochre nodules. The small size of the individual nodules mitigates against this area as a potential ochre source; a large outcropping of ochreous shale would be a more obvious landscape marker which people would frequent as a source of ochre. The valley immediately to the north, however, provided exactly that. At Area D, on the Patrysvlei farm, a large outcrop of ochre-bearing rocks was found. The area sampled fell on the border between a C2S1 band and a C2Q1 shale band, represented by the blue shaded area on the geological map (figure 4.1.4).

The entire Lower Bokkeveld inclusion in the Olifants River Valley may prove to be a likely ochre source for LSA inhabitants in the region. The discovery of a large ochre outcropping

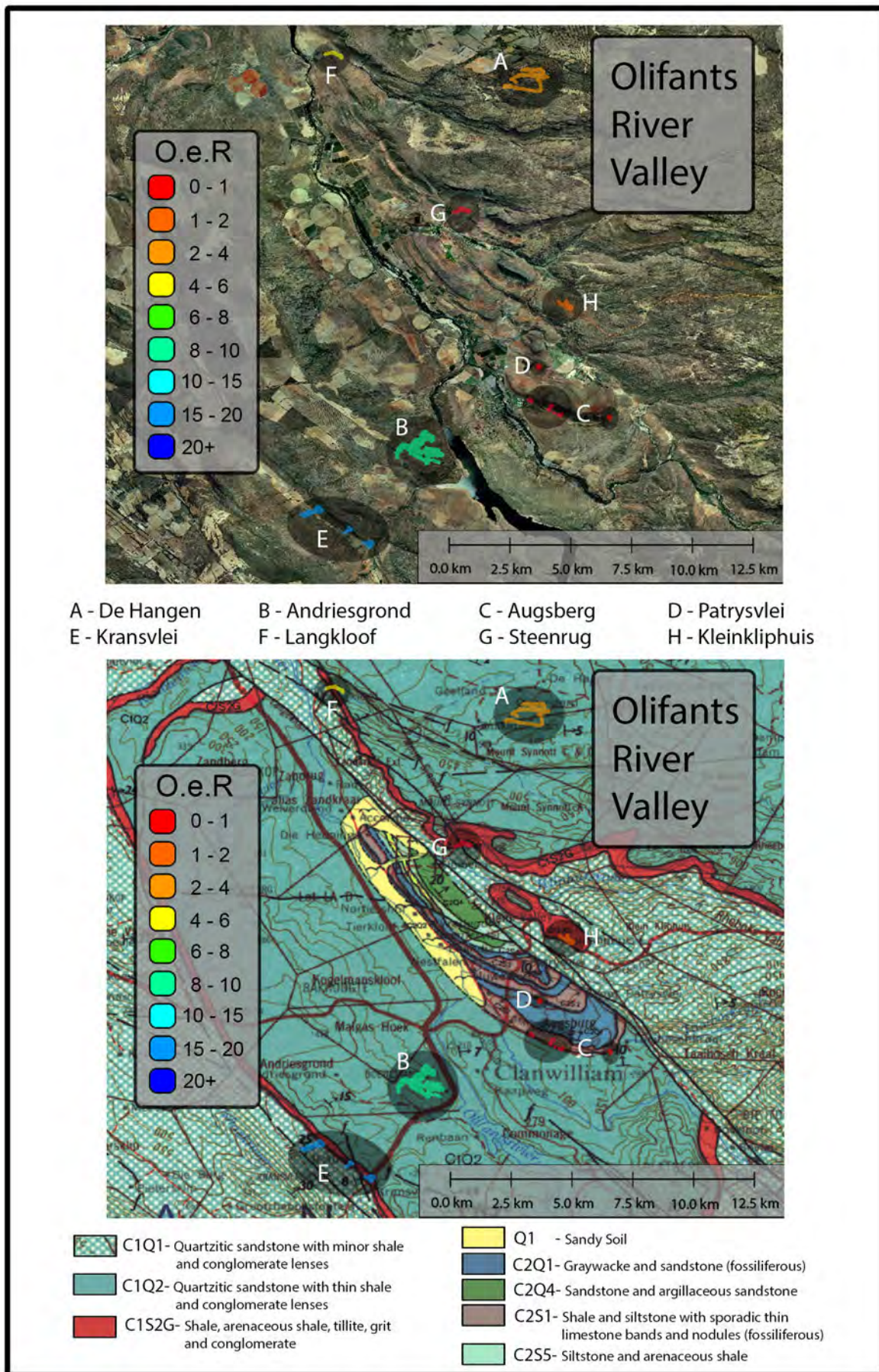


Figure 4.1.4: Olifants River Ochre Sourcing Survey showing Ochre encounter Rate. Lower Value Means Higher Density

of ferruginous shale on the Patrysvlei farm provides the most plausible source encountered during the two-week long survey. Indeed, an additional inspection further south at another section of the Lower Bokkeveld formation close to Citrusdal gave very similar results to those provided here. Whilst inconclusive, the Lower Bokkeveld formation does provide strong evidence as being an ochre source for the region. The entire formation is radically different in appearance to the surrounding geology in that it forms a smooth rounded hill as opposed to the jagged rocks and boulders of the greater Cederberg. This may have been a prominent, navigational feature within the landscape that LSA inhabitants could have easily utilised. Its centralised locale and proximity to the Olifants River would make it easily accessible to people travelling through the landscape, perhaps from the interior regions of the Cederberg down to the river as part of seasonal rotations, resource gathering or even extended hunting trips.

Whilst still inconclusive, the Patrysvlei sample provided a very likely ochre source within the region. A more detailed look at the entire Lower Bokkeveld inclusion within the Olifants River valley would need to be conducted before a more conclusive statement could be made. Further research to support or refute this idea would have to include an analysis of potential routes through the mountains. A study such as this would determine the feasibility of access for LSA people living in the Cederberg.

Area (#) and Track	Duration (mins)	Distance Covered (m)	Survey Rate (m/min)	Tot # of Streaks	Tot # of streaks / surveyors	ochre encounter rate. (D/Stp.p)/Rate	Streak Quality STQ
Augsberg (C) 1	47	90	1.91	18	9	5.22	Ex/Goo
Augsberg (C) 2	27	183	6.78	34	17	1.59	Ex/Good
Augsberg (C) 3	28	144	5.14	58	29	0.97	Ex/Good
Augsberg (C) 4	35	106	3.03	373	62.1	0.56	Ex/Good
Patrysvlei (D)	n/a	n/a	n/a	n/a	n/a	n/a	Ex/Good
Kransvlei (E)	n/a	n/a	n/a	n/a	n/a	n/a	Ave/Poor
Langkloof (F)	50	720	14.4	17	8.5	5.88	Poor
Steenrug (G)	34	579	17.03	75	37.5	0.91	Ex/Good
Kleinkliphuis (H)	39	441	11.31	152	30.4	1.28	Good/ Poor

Table 4.1.4: Survey tracks in the Olifants River Valley
*refer to figure 4.1.4

Diepkloof

Diepkloof falls well outside the accessible range of the Olifants River Valley, and as such the sourcing work done there does not directly apply to Diepkloof. In the accompanying map, the site is placed centrally with the ochre encounter rate data of the surveyed areas displayed.

The front slope below the site of Diepkloof was surveyed first (with reference to figure 4.1.5). The upper section, close to the site, is very steep and difficult to navigate. The first survey track skimmed the very upper edge of the middle slope and ran parallel to the rock face of the site itself. This area contained only sporadic ochre nodules of varying quality. The majority of these pieces appeared to be haematite-rich and were in the form of rounded nodules and not the laminar structure indicative of ferruginous shales. The third track, running parallel with the first but on the lower slope close to the Verlorenvlei, produced a similar pattern with only a marginal increase in density.

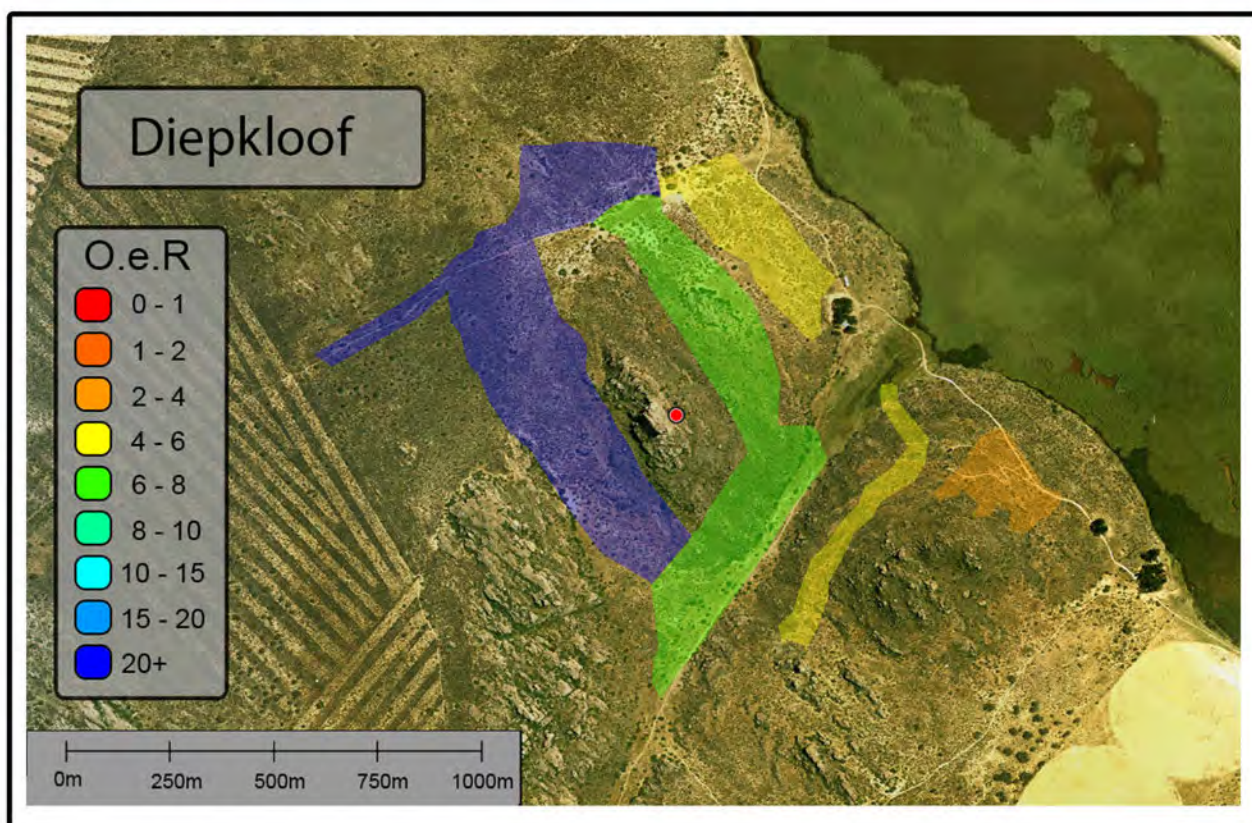


Figure 4.1.5: Surveyed Area around Diepkloof showing Ochre encounter Rate. Lower Value Means Higher Density

Tracks 2 and 5, shaded in blue, were almost entirely devoid of ochre. Track 2, occurring to the north of the site, was densely vegetated with a predominance of soft sandy soil. The area was almost completely devoid of nodules or pebbles of any kind and only three pieces of Poor Streak Quality ochre were found. Track 5 covered the valley to the west of the site. The valley was dense with pebbles and stones, none of which however were ochreous.

The last area surveyed was on the adjacent hill to the south-east of the site. A first look along the side slope of the hill, showed a low density occurrence of Good Streak Quality ochre of shale origin. Whilst still low density, this was the first indication of good quality ochre appearing in the landscape adjacent to the site itself. A further examination of the northern slope of the hill produced more of the same ochre type with a higher density. An attempt to find a vein or geological layer from which this ochre may have originated proved unsuccessful.

Diepkloof	Duration (mins)	Distance Covered (m)	Survey Rate (m/min)	Tot # of Streaks	Tot # of streaks / surveyors	ochre encounter rate. (D/Stp.p)/Rate	Streak Quality STQ
Track 1	54	677	12.54	33	8.25	6.55	Poor
Track 2	22	367	16.68	3	0.75	29.33	Poor
Track 3	33	353	10.70	23	5.75	5.74	Good
Track 4	46	604	13.13	24	6	7.67	Poor
Track 5	36	910	25.28	0	0	n/a	n/a
Track 6	37	688	18.59	34	8.50	4.35	Good
Track 7	32	202	6.31	62	15.50	2.06	Good/Ave

Table 4.1.5: Diepkloof: survey showing ochre density.

Another possible source of ochre is within the site itself. On the rear wall of both Diepkloof Rock Shelter and Diepkloof Kraal there is a band of ferruginous shale which may well represent a large portion of the excavated ochre assemblage; whether its inclusion is anthropogenic or not will be examined later. Several samples were taken from this ochreous shale band in 2009 in conjunction with Laure Dayet of Bordeaux University. Dayet ran numerous analytical tests on these samples as part of her study of the MSA ochre (Dayet, 2013). She compared these samples, and numerous others, with archaeological samples from the MSA layers at the site in order to attempt to ascertain their sourcing point. There is some evidence that the ochre from this shale band may be the same as contained within

the archaeological layers (Dayet, 2013). As will be discussed later, this may be due to the fact that the ochre from the site may have entered the archaeological layers without human intervention of any sort due to their immediate proximity.

The author took the corresponding ochre samples and included them within a series of experimental hearths to examine chromatic and chemical changes that may be induced through the heating of ochre.

Experimental Hearths

Three hearth experiments were conducted, primarily to examine one of the numerous transformations that a nodule of ochre may undergo between its natural occurrence in the landscape, through collection, heating, and mixing of paints, to its eventual use in rock paintings. Changes in the colour of ochres by induced heating thereof may have strong implications for the reliability of clear comparisons to be made between the excavated ochres and the rock art. The examination of hearths and hearth structures (Bensen, 2012, 2013) and the experimental heating of ochres under such hearths (Wadley 2009, 2010b) have shown that incidental heating of ochre below prehistoric camp fires can significantly change the pigment or hue of the ochre. It is a distinct possibility that ochre already used in the manufacture of paint could have later been heated post-depositionally and have undergone a colour change which would have an impact on the colour comparisons attempted in this work.

The physical attributes of hearths #2 and #3 (hearth #1 being omitted as explained earlier) will be detailed first, looking at how the different deposits transmitted heat and illustrating what temperatures were reached at the three depth increments below the actual fires. Only after the hearth conditions have been examined will the ochre samples be introduced into the discussion and the heating effects described and discussed.

Hearth #2 (refer to figure 4.1.6) The deposit in hearth #2 was composed entirely of back-dirt from excavations at Klipfonteinrand, a site in the eastern Cederberg. The deposit was donated by Alex Mackay after an excavation season at the site in 2011. The graph below illustrates temperature at the three different levels that were measured.

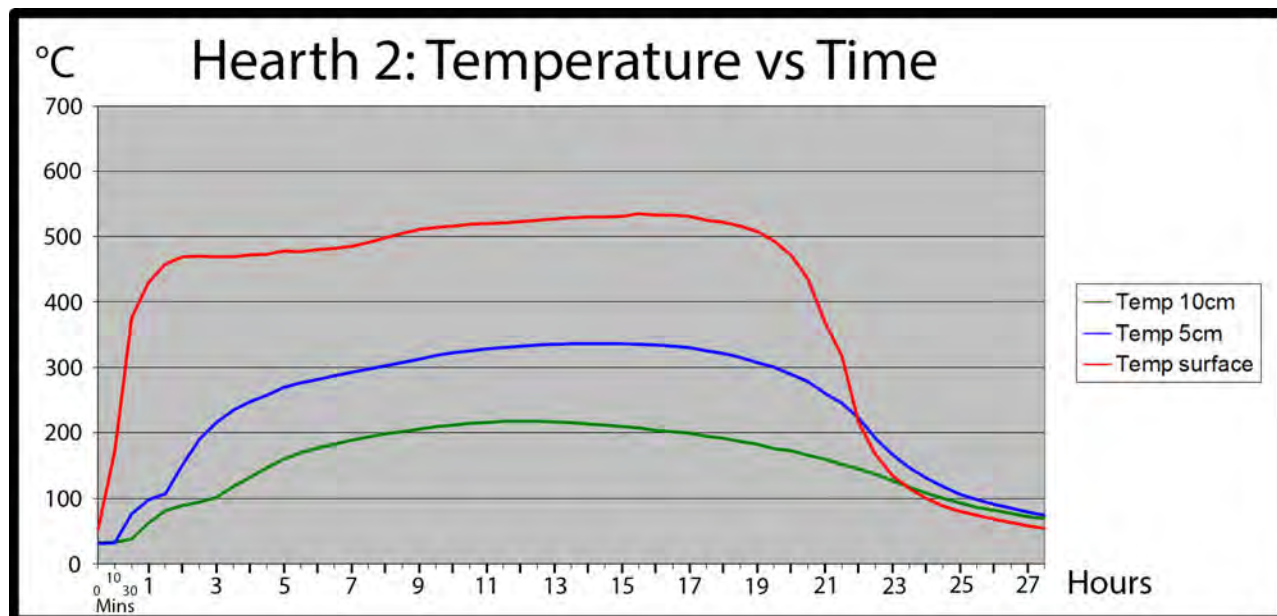


Figure 4.1.6: Hearth #2: Temperature versus Time
*Klipfonteinrand Deposit

The surface temperature, for obvious reasons, rapidly increased upon lighting of the fire. The maximum surface temperature of 535°C, however, was only reached after 15½ hours. The absence of an initial peak or heat spike for the first 2 hours (as seen in hearth #3, below) may have been caused by the fire itself. It is possible that the cold-point of the thermocouple used to measure the surface temperature may have been slightly heated by its proximity to the flames. This may have caused the initial readings to be lower than expected. Extra precautionary steps were taken in the set-up of hearth #3 to prevent this from occurring. The temperature graph for hearth #3 does show a more plausible initial rise and fall of temperature.

At the 1½ hour mark in hearth #2 there is a steep temperature increase at the 5cm level that coincides with the moment when the last flames died off. (This change is mirrored at the 10cm level after 3 hours). As the surface coals cool, they would appear to act as an

insulation barrier and prevent much of the heat from the underlying embers from escaping upwards; this results in more of the heat penetrating downward into the underlying deposit.

After the initial heating, the deposit retains a relatively consistent temperature from approximately the 5-hour mark through to the 20-hour mark. Around 20 hours the temperature rapidly falls, with the surface temperature dropping from 472°C at 20 hours to 135°C only 3 hours later. It is also interesting to note that the surface temperature dips below the 5cm temperature from the 22-hour mark onwards and below the 10cm temperature from the 23½-hour mark. The temperature graphs for the 5cm and 10cm depths show a very gradual increase and decrease in temperature for the duration of the experiment. This heat retention is a definite characteristic of the organically-rich archaeological deposit, as will be shown when contrasted to the sterile sand of hearth #3.

Hearth #3 (refer to figure 4.1.7) The deposit for hearth #3 was store-bought sterile sand. As was expected, it showed a clear difference in heating to the archaeological deposit used in hearth #2. The sand particles were large and granular with a high percentage of quartz grains. The sand used closely resembles beach sand.

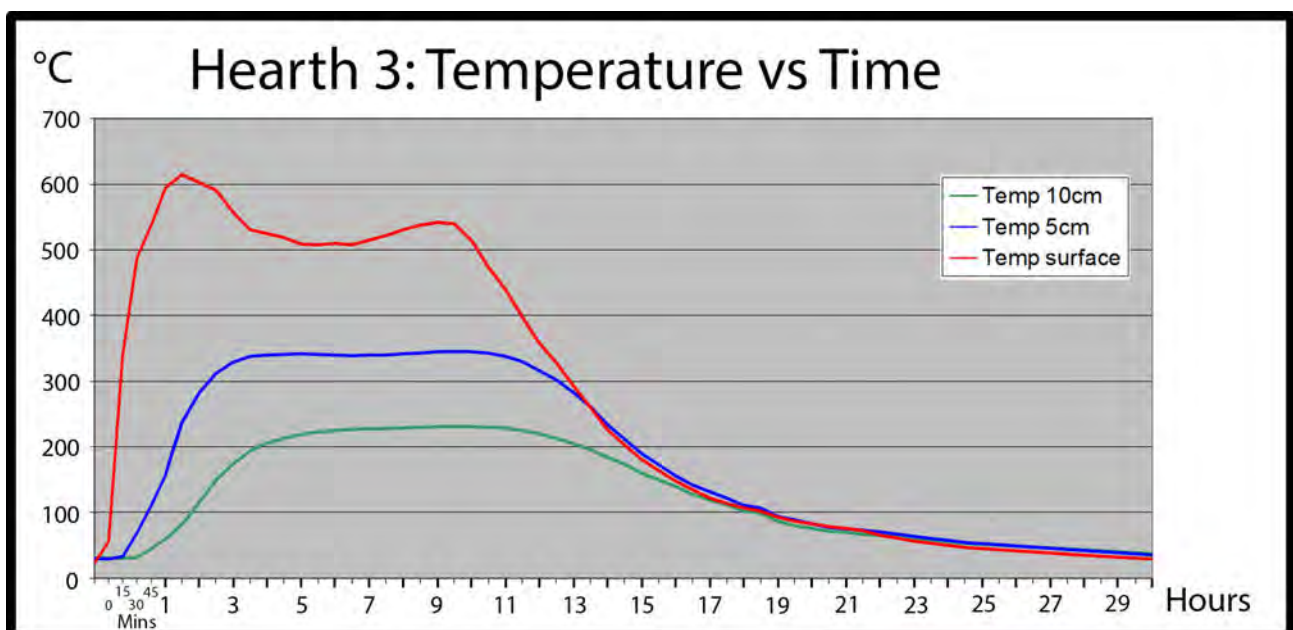


Figure 4.1.7: Hearth #3: Temperature versus Time
*Sterile Sand

The initial surface temperature reached its maximum of 615°C 1½ hours after being lit. This mark, as with hearth #2, was the moment at which the last flames disappeared. This was followed by steady cooling until the 5-hour mark, and then a new heating phase after 6½ hours pushed the surface temperature up to its second peak maximum temperature of 542°C at the 9-hour mark. The initial peak is the peak which may have been absent from the temperature graph of hearth #2 due to accidental heating of the thermocouple's cold-point in that experiment (it is important to note that the same type and quantity of wood were added at the same increments for both hearths). The second heating phase directly mirrors that seen in hearth #2 in that after an initial cooling of the surface coals, a barrier is created that blocks much of the heat from escaping upwards. The temperature at the 5cm depth plateaus at around 340°C from the 3-hour mark through to the 11-hour mark. This pattern is mirrored for the 10cm depth which levels out at a temperature of approximately 220°C from 5 hours through to 12 hours.

Table of comparative temperatures between hearth experiments #2 and #3.			
Surface			
	Duration over 400°C	Duration over 500°C	Maximum temperature and time it occurred
hearth #2	20 hrs	11 hrs	535°C at 15.5 hrs
hearth #3	11 hrs	10 hrs	615°C at 1.5 hrs & 542°C at 9 hrs
5cm below surface			
	Duration over 200°C	Duration over 300°C	Maximum temperature and time it occurred
hearth #2	19.5 hrs	12 hrs	337°C at 13.5 hrs
hearth #3	13.5 hrs	10.5 hrs	345°C at 9 hrs
10cm below surface			
	Duration over 100°C	Duration over 200°C	Maximum temperature and time it occurred
hearth #2	22 hrs	9 hrs	218°C at 11.5 hrs
hearth #3	16.5 hrs	9.5 hrs	231°C at 9 hrs

Table 4.1.6: Comparative temperatures between hearth experiments #2 and #3.

Comparison between hearths #2 and #3: As illustrated in table 4.1.6, the temperatures are comparable between the two experiments. The maximum temperatures reached at the three levels are remarkably similar. This is also the case with the duration for which the upper ranges of temperatures are reached at each depth increment. An example of this is the duration for which the surface temperatures for the hearths were above 500°C, being

11 hours for hearth #2 and 10 hours for hearth #3. This does seem rather surprising upon initial inspection of the temperature graphs in the light of the noticeable variation between them. There are two main ways in which the variation between the temperature graphs can be explained, and in both cases they are fundamentally linked to the heat-retention of the deposits. Using hearth #2 as the baseline for comparison, we can clearly see that the sterile sand of hearth #3 heats up to its maximum temperature far sooner and then releases it again much earlier. This is also shown by the duration for which each hearth remains above a slightly lower temperature range than its maximum, and here there is a radical difference between the two experiments. The temperature at the surface of hearth #2 remains above 400°C for a duration of 20 hours whilst that of hearth #3 for only 11 hours.

With both experimental hearths using the same quantity of matching wood type added at equal time increments, it seems that the amount of energy introduced may give the same maximum levels of heat throughout the underlying soil deposits regardless of their composition. The difference lies in how resistant the deposit is to a change in its temperature. The organic-rich archaeological deposit is more resistant to being heated than the sterile sand, but, once heated, it retains that heat for far longer.

Heated Ochre Samples:

The issue of post-depositional heating for this study is that some ochres buried within archaeological deposits may change colour when they are heated from above from hearths which may occur at the site well after the ochre was deposited. Whilst there are ethnographic descriptions of haematite nodules being heated intentionally (Rudner, 1982, 1983), it is likely that large portions of the ochre assemblage would have been heated in an unintentional post-depositional manner (Wadley, 2009, 2010b). These nodules may exhibit colour change which was not the intention of the inhabitants who were using the ochre to create paints and rock paintings. It is therefore important to consider these implications when comparing the ochre to the rock art based on colour determinations.

Several nodules of ochre that were sampled from Diepkloof Rock Shelter and Diepkloof Kraal Shelter were heated in both hearts #2 and #3. Ochre pieces from two additional sources were also included, namely yellow goetite nodules from the Warmwaterberg region in the Karoo, and several dense red ochres from the Swartberg mountains south of the town of Prince Albert. These experimental hearths were aimed firstly to replicate some of the findings presented by Wadley (2009, 2010b), and secondly to examine what colour changes, if any, would be exhibited by the ochre samples from the Diepkloof shale band.

The yellow goetite nodules placed on the surface and buried at 5cm below the surface from Warmwaterberg exhibited the expected colour change from yellow to red (Cornell & Schwertmann, 2003; de Faria & Lopes, 2007; Gianlanella, 2011; Pomiès *et al*, 1998, 1999; Wadley, 2009, 2010b; Watari *et al*, 1982). This colour change is associated with a chemical change within the nodules from yellow goetite to red haematite. The yellow goetite sample E.4 buried at a depth of 10cm below hearth #2 did not exhibit any change in colouration whilst samples of goetite in Wadley's experiments did exhibit a change in colour at that depth (Wadley 2009, 2010b).

The dense bright-red coloured haematite nodules sourced from the Swartberg mountains were less susceptible to colour change and only the two samples placed on the surfaces of hearths #2 and #3 exhibited any change. These two samples changed from Red to Dark Yellowish Brown and Brown, respectively, this colour change being associated with a chemical change from haematite to magnetite or maghemite (Cornell & Schwertmann, 2003, Dayet, *personal communication*; Mooney, 2003).

The samples that originate from the Diepkloof shale band provided a mixed result, with some nodules exhibiting a slight colour change whilst others remained entirely unchanged. Of the three samples that were placed on the surface of the hearth, two exhibited a marked colour change in comparison to the all the other Diepkloof samples.

Ochre Samples from Hearth #2 and #3.

Sample #	Source	Hearth #	Depth	Mass (g) (Before)	Mass (g) (After)	Difference B-A (g)	% Mass lost	Magnetic (after burning)	Colour Change	Colour descr. (Before)	Munsell code (Before)	Colour descr. 1 (After)	Munsell code 1 (After)
E7	Warmwaterberg	2	Surface	2.7	2.6	-0.1	-3.7	Strong	Strong	Yellow	10YR 7/8	Dark Yellowish Brown	10YR 4/4
E5	Warmwaterberg	2	5cm	15.4	14.7	-0.7	-4.5	No	Strong	Yellow	10YR 7/8	Red	2.5YR 4/8
E4	Warmwaterberg	2	10cm	16.7	16.6	-0.1	-0.6	No	N/A	Yellow	10YR 7/8	Yellow	10YR 7/8
E8	Warmwaterberg	3	5cm	46.2	45.3	-0.9	-1.9	No	Strong	Yellow	10YR 7/8	Red	2.5YR 4/8
B6	Swartberg	2	Surface	67.1	60.2	-6.9	-10.3	Strong	Strong	Red	2.5YR 4/8	Brown	10YR 4/3
B7	Swartberg	2	5cm	45.8	45	-0.8	-1.7	No	N/A	Red	2.5YR 4/8	Red	2.5YR 2/8
B12	Swartberg	2	10cm	21.8	21.4	-0.4	-1.8	No	N/A	Red	2.5YR 4/8	Red	2.5YR 4/8
B10	Swartberg	3	Surface	46.7	28.4	-18.3	-39.2	Strong	Strong	Red	2.5YR 4/8	Brown	7.5YR 4/3
B8	Swartberg	3	5cm	53.0	51.8	-1.2	-2.3	No	N/A	Red	2.5YR 4/8	Red	2.5YR 4/8
B11	Swartberg	3	10cm	29.0	28.7	-0.3	-1.0	No	N/A	Red	2.5YR 4/8	Red	2.5YR 4/8
V9	DRS sample 5	2	Surface	2.9	2.8	-0.1	-3.4	Very Weak	Slight	Light red	2.5YR 6/6	Light Reddish Brown	2.5YR 6/4
V5	DRS sample 5	2	5cm	9.2	9	-0.2	-2.2	No	Slight	Light red	2.5YR 6/6	Light Red	10R 6/6
V6	DRS sample 5	2	10cm	5.3	5.2	-0.1	-1.9	No	N/A	Light Red	2.5YR 6/6	Light Red	2.5YR 6/6
V10	DRS sample 5	3	Surface	4.1	3.8	-0.3	-7.3	Yes	Slight	Light Red	2.5YR 6/6	Light Reddish Brown	2.5YR 6/4
V7	DRS sample 5	3	5cm	6.6	6.5	-0.1	-1.5	No	N/A	Light Red	2.5YR 6/6	Light Red	2.5YR 6/6
Y3	DRS sample 4	2	5cm	12.2	11.4	-0.8	-6.6	Very Weak	Slight	Reddish Yellow	5YR 6/6	Yellowish red	5YR 5/6
X5	DRS sample 3	2	5cm	5.6	5.5	-0.1	-1.8	No	Strong	Light red	2.5YR 6/6	Reddish Brown	5YR 5/4
X3	DRS sample 3	3	5cm	11.7	11.3	-0.4	-3.4	No	N/A	Light Red	2.5YR 6/6	Light Red	2.5YR 6/6
Z3	DRS sample 2	2	5cm	10.5	10.2	-0.3	-2.9	No	N/A	Light red	2.5YR 6/6	Light Red	2.5YR 6/6
T6	DRS	2	5cm	34.3	31.4	-2.9	-8.5	Very Weak	Slight	Light red	10R 6/6	Reddish Brown	2.5YR 5/4
T4	DRS	2	10cm	19.8	18.2	-1.6	-8.1	No	N/A	Light Red	10R 6/6	Light Red	10R 6/6
T10	DRS	3	5cm	27.9	25.6	-2.3	-8.2	No	N/A	Light Red	10R 6/6	Light Red	10R 6/6
T8	DRS	3	10cm	8.6	7.9	-0.7	-8.1	No	N/A	Light Red	10R 6/6	Light Red	10R 6/6
L6	DKS	2	Surface	4.0	3.6	-0.4	-10.0	Strong	Slight	Red	10R 5/6	Reddish Brown	5YR 5/4
L5	DKS	2	5cm	10.0	9.3	-0.7	-7.0	No	N/A	Red	10R 5/6	Red	10R 5/6
L7	DKS	2	10cm	6.4	6.2	-0.2	-3.1	No	N/A	Red	10R 5/6	Red	10R 5/6
L4	DKS	3	5cm	15.6	14.5	-1.1	-7.1	No	N/A	Red	10R 5/6	Red	10R 5/6

Figure 4.1.8: Ochre Samples Heated in Experimental Hearths #2 and #3

Before the samples were heated, they were all tested for magnetism and none of the samples exhibited any magnetic properties whatsoever. As shown in the accompanying table (figure 4.1.8), the majority of samples placed on the surface of the deposits in both hearths #2 and #3 became strongly magnetic (see samples number E7, B6, B10, V10, L6 in the table). The magnetic (or para-magnetic / ferro-magnetic) property as seen in ochre derives from the percentage of magnetite or maghemite present in the sample (Mooney, 2003). In the case of the Swartberg samples it seems likely that all of the haematite was transformed into magnetite or maghemite, which, in addition to a change in colour, would explain the strong ferro-magnetism exhibited in the heated samples. Of the Warmwaterberg geotite samples, Sample E7, from the surface of hearth #2, also became strongly ferro-magnetic and displayed the characteristic colour change to a Brown hue (Dark Yellowish Brown) indicative of the presence of magnetite or maghemite. Interestingly, sample E5 and E8 from Warmwaterberg both showed a clear colour change from Yellow to Red, yet neither of these samples exhibited any magnetic properties post-heating. It seems apparent therefore that the temperatures reached on the surface of these experimental hearths was sufficiently high to enable the transformation to magnetite and maghemite, whilst the temperatures at a depth of 5cm were insufficient to effect this change. Interestingly the two surface samples from the Diepkloof shale band (L6 – DKS and V10 – DRS#5) both also displayed strong ferro-magnetic properties post-heating with a less extreme colour change occurring.

It would seem apparent therefore from this data that ochres heated on the surface of prehistoric hearths are highly likely to have been heated to a sufficient temperature to enable the transformation to magnetite and maghemite. The implications for this on the archaeological assemblages is apparent in that one is able to determine, based on the magnetic properties of an ochre nodule, if it has been heated to a high enough temperature which is unlikely to occur in the landscape through natural fires. This does not necessarily imply any intentional heating, but in combination with other considerations, such as the utilisation of ochre, alluding to the intentional heating of ochres from archaeological contexts would be justifiable.

A final point to be discussed is the fact that two of the nodules placed on the surface of hearths #2 and #3, (B6 and B10), both dense haematite nodules from the Swartberg sample, exploded a short while after the fires were lit. One potential cause for this event is that the evacuation of the water particles, that is an integral part of the chemical transformation to haematite, magnetite and maghemite (Cornell & Schwertmann, 2003; de Faria & Lopes, 2007; Gianlanella, 2011; Pomiès *et al*, 1998, 1999; Wadley, 2009, 2010b; Watari *et al*, 1982), causes and expansion of the water vapour locked within the particles at a rate faster than than it can be expelled through the pores of the nodules, which causes a sharp build up of pressure within the material culminating in a small explosion. This hypothesis is based primarily on the heating experiments on silcrete samples to examine the potential heat treatment of silcretes for an improvement in their flaking qualities as described by Schmidt (2013). Whilst it is only hypothesised that the same causation may be true for ochre nodules, Schmidt (*personal communication*) agreed that this may be a potential cause. An additional possibility for this explosion is the inclusion of a trace element unique to the Swartberg samples called pyrophyllite as evidenced in the X-ray diffraction data. A further detailed chemical analysis of the process would be required to state with any certainty whether either of these potential causes are in fact responsible for the pieces exploding.

X-ray diffraction and Colorimetric analyses:

Some of the samples from the experimental hearths were examined at the Institut de Recherche sur les Archéomatériaux (IRAMAT-CRP2A) laboratory in Bordeaux, France, where X-ray diffraction analysis and colorimetric analysis was conducted. A list of all of the samples analysed is presented in the accompanying table (figure 4.1.9). The sample numbers are shown with their origin points; the heating conditions the samples were exposed to; whether or not X-ray diffraction analysis was carried out; and lastly the L.a.b (D65) averaged colour co-ordinates from the slide measurements are given. Only the samples labelled with an extra letter will be examined closely, (B, E, V, L, T), as these were the samples provided by the author for this study.

Samples Analysed at the IRAMAT-CRP2A Laboratory

Sample Number	Origin	h #	Hearth	°C	Y/N	L*(D65)	a*(D65)	b*(D65)
BDX 14696L-0	/	/	/	/	Y	55.37	19.12	19.45
BDX 14696L-3	/	2	10cm	218	Y	61.59	15.94	16.12
BDX 14696k-0	/	/	/	/	Y	62.52	14.09	31.3
BDX 14696k-1	/	2	Surface	535	Y	55.58	12.21	20.56
BDX 15206a-0	/	/	/	/	Y	55.63	18.61	19.34
BDX 15206a-1	/	2	Surface	535	Y	60.94	10.61	11.6
BDX 15206b-0	/	/	/	/	Y	54.99	18.56	20.25
BDX 15206b-3	/	2	10cm	218	Y	56.8	16.98	17.47
BDX 15207b-0	/	/	/	/	N	37.6	13.32	12.05
BDX 15207b-3	/	2	10cm	218	Y	36.88	12.99	12.22
BDX 15207a-0	/	/	/	/	Y	35.31	13.82	12.2
BDX 15207a-1	/	2	Surface	535	Y	30.57	5.03	4.39
BDX 14697j-0	/	/	/	/	Y	47.34	17.91	38.41
BDX 14697j-1	/	2	Surface	535	Y	32.45	19.43	20.25
BDX 14697k-0	/	/	/	/	Y	42.81	19.78	32.87
BDX 14697k-3	/	2	10cm	218	Y	44.45	18.78	36.17
BDX 14048-V1-0	DRS #5	/	/	/	Y	55.77	14.13	11.24
BDX 14048-V9-1	DRS #5	2	Surface	535	Y	57.61	13.01	11.19
BDX 14048-V5-2	DRS #5	2	5cm	337	Y	55.8	14.38	11.92
BDX 14048-V6-3	DRS #5	2	10cm	218	Y	56.29	15.39	12.64
BDX 14048-V10-1	DRS #5	3	Surface	615	Y	58.98	11.09	9.72
BDX 14048-V7-2	DRS #5	3	5cm	342	Y	56.8	14.24	11.35
BDX 15476-E1-0	Warmwaterberg	/	/	/	Y	62.16	13.01	40.31
BDX 15476-E7-1	Warmwaterberg	2	Surface	535	Y	40.2	15.72	21.17
BDX 15476-E5-2	Warmwaterberg	2	5cm	337	Y	38.37	23.24	16.43
BDX 15476-E4-3	Warmwaterberg	2	10cm	218	N	65.93	14.62	41.35
BDX 15476-E8-2a	Warmwaterberg	3	5cm	342	N	42.91	26.98	19.56
BDX 15476-E8-2b	Warmwaterberg	3	5cm	342	N	51.91	25.63	30.61
BDX 15476-E8-2c	Warmwaterberg	3	5cm	342	N	55.89	21.41	39.04
BDX 14055-L1-0	DKS	/	/	/	Y	48.21	21.19	17.63
BDX 14055-L6-1	DKS	2	Surface	535	Y	48.97	16.17	14.63
BDX 14055-L5-2	DKS	2	5cm	337	Y	48.22	20.43	16.06
BDX 14055-L7-3	DKS	2	10cm	218	N	46	20.91	16.33
BDX 14055-L4-2	DKS	3	5cm	342	N	48.28	19.92	14.41
BDX 14042-T1-0	DRS #1	/	/	/	Y	51.55	18.79	14.68
BDX 14042-T6-2	DRS #1	2	5cm	337	Y	51.78	13.66	10.71
BDX 14042-T4-3	DRS #1	2	10cm	218	Y	53.71	16.97	12.43
BDX 14042-T10-2	DRS #1	3	5cm	342	N	51.95	17.97	13.39
BDX 14042-T8-3	DRS #1	3	10cm	231	N	53.56	16.85	12.23
BDX 15504-B1-0	Swartberg	/	/	/	Y	44.61	23.71	19.5
BDX 15504-B6-1	Swartberg	2	Surface	535	Y	40.84	6.74	7.88
BDX 15504-B7-2	Swartberg	2	5cm	337	Y	44.55	21.23	16.98
BDX 15504-B12-3	Swartberg	2	10cm	218	N	45.21	25.92	22.13
BDX 15504-B10-1	Swartberg	3	Surface	615	N	42.33	11.05	14.32
BDX 15504-B8-2	Swartberg	3	5cm	342	N	43.43	19.14	15.36
BDX 15504-B11-3	Swartberg	3	10cm	231	N	44.69	23.34	19.06

Figure 4.1.9: Samples Analysed at the IRMAT-CRP2A Laboratory. X-Ray Diffraction & Colorimetric Data

The results of the colorimetric analyses will be detailed according to their sample origin, and the colour change effects of the heating process will be shown for each sample in turn. The two sources which are unrelated to the Diepkloof shale band, namely the Warmwaterberg and Swartberg samples, provide a useful control. Consequently, they will be examined first before moving on to the Diepkloof samples. The results of the X-ray diffraction analyses will then be presented in the same order. This will highlight the relationship between colour change and chemical composition.

Colorimetric Analyses:

The samples which were heated in the experimental hearth were examined by colorimetric methods. The observations made are in broad agreement with the colour classification assigned by the use of the Munsell Soil Colour Chart. Nevertheless, the colorimetric data gives an added layer of vindication to the described colour changes and their link to chemical changes within the ochre nodules.

As illustrated in the colour swatch (figure 4.1.10) shown for the Warmwaterberg sample, all of the heated samples and the unheated sample are depicted providing a clear illustration of the colour changes that occurred. E7, which as already described became strongly ferromagnetic, has clearly changed colour to an obvious brownish colour. E5, buried at 5cm below hearth #2, has transformed into a vibrant red and lastly sample E4, buried at 10cm below hearth #2, exhibits negligible colour change. Sample E8, buried 5cm below hearth #3, is of particular interest in that the colour transformation of the nodule was only partially completed, providing a clear gradient from red to yellow when seen in cross-section.

The Swartberg samples from hearths #2 and #3 mirror each other in terms of colour transformation as seen in the relevant colour swatch (figure 4.1.10) for the Swartberg samples. Samples B6 and B10, both of which exploded violently as already described, are very similar in terms of colouration, with only a slight shift being present on the L.a.b coordinates. Samples B7 and B8, buried at 5cm below hearth #2 and #3, respectively, are

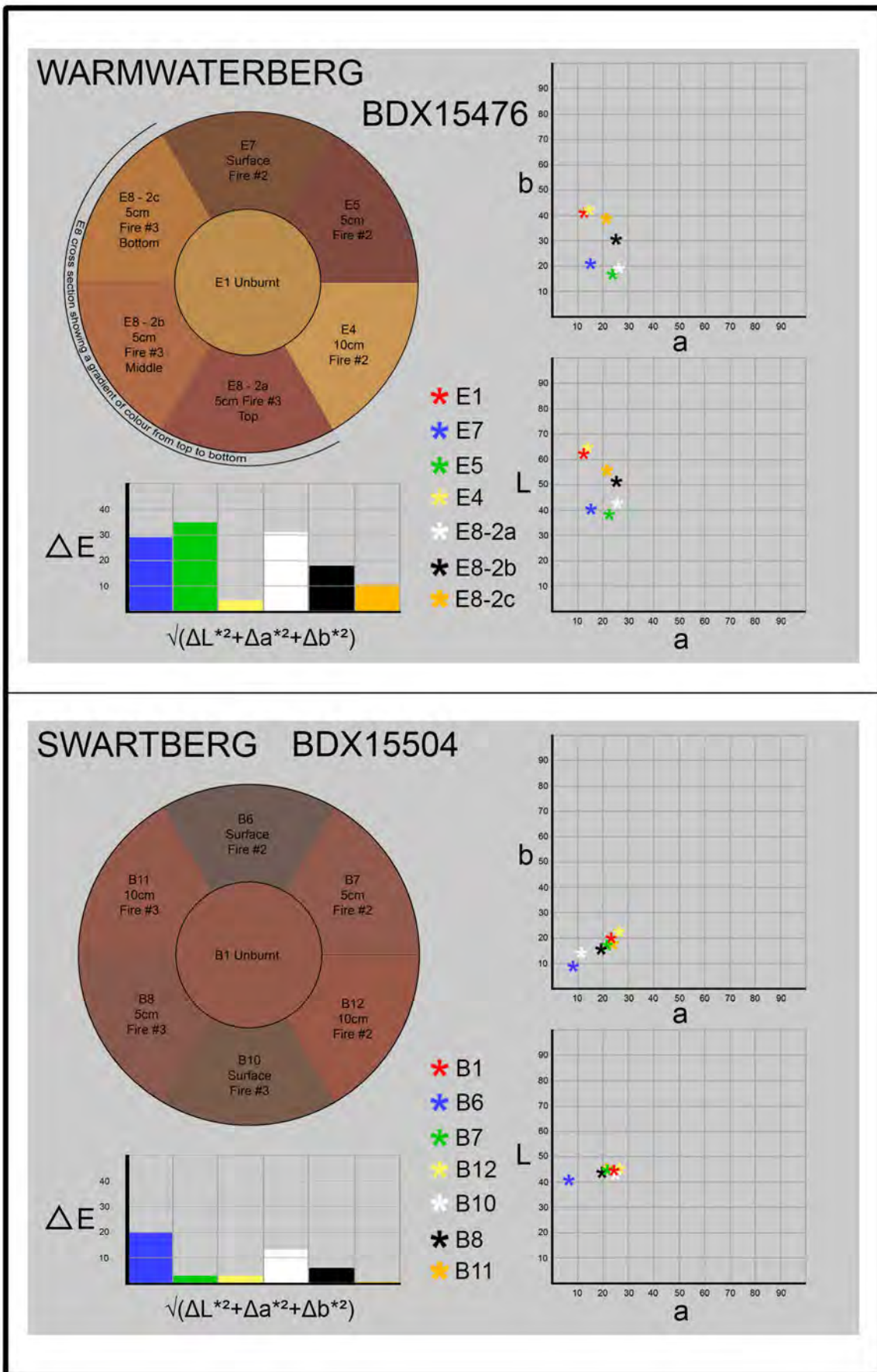


Figure 4.1.10: BDX15476 – Warmwaterberg and BDX15504 – Swartberg: Colour Swatch showing the Change in Colours from Induced Heating. Colorimetric data using the L.a.b (d65) system, and ΔE Showing the Extent of Colour Change.

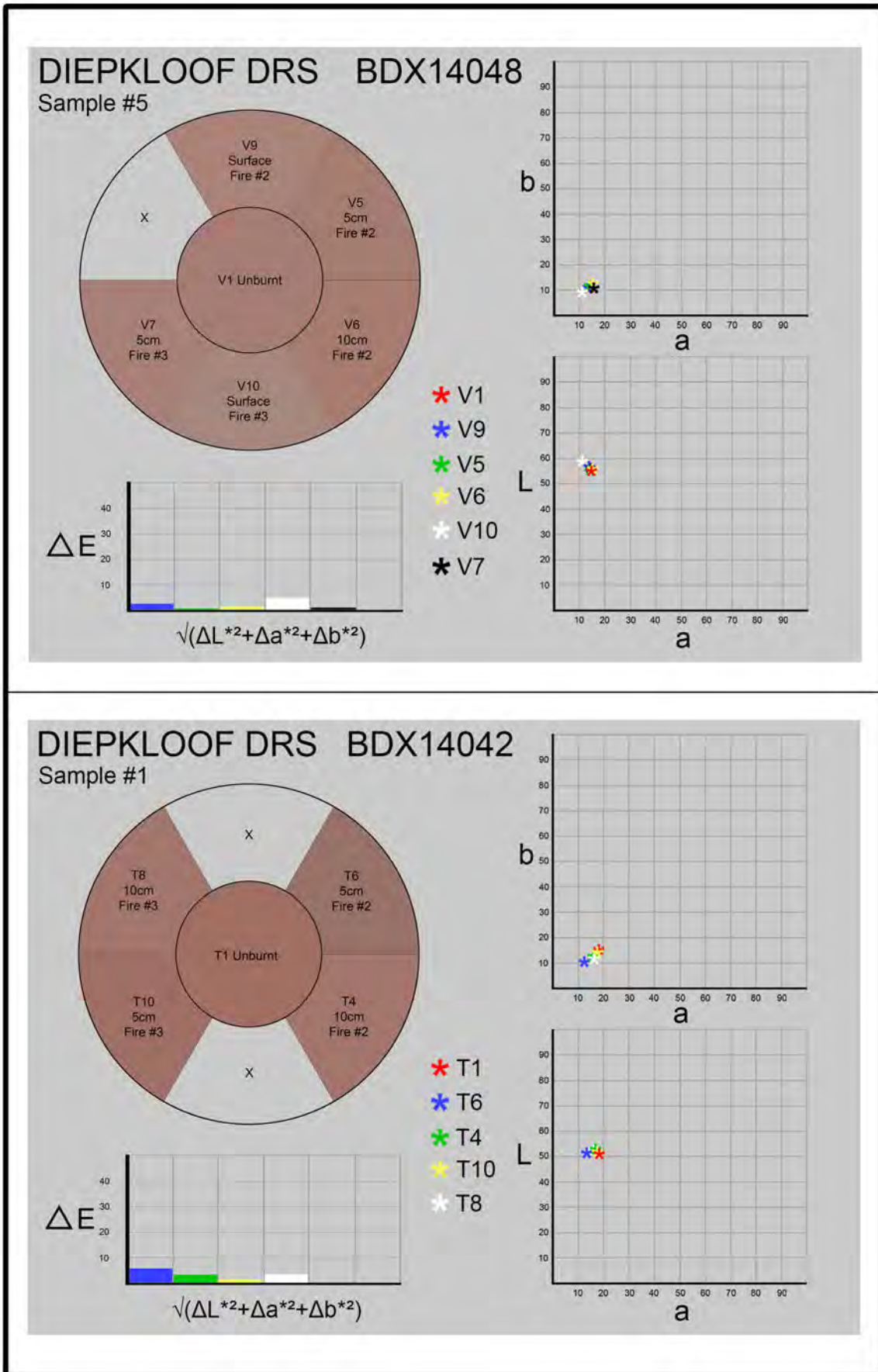


Figure 4.1.11: BDX14048 DRS Sample #5 & BDX14041 DRS Sample #1: Colour Swatch showing the Change in Colours from Induced Heating. Colorimetric data using the L.a.b (d65) system. and ΔE Showing the Extent of Colour Change

nearly identical and show only the slightest shift away from the unheated sample. B11 and B12 were both buried at a depth of 10cm and show no discernible change in colouration. This again largely agrees with the Munsell determinations as shown in the previous section.

The two samples shown from Diepkloof Rock Shelter (samples V and T) and the one from Diepkloof Kraal Shelter (sample L) are of particular interest in that they show a negligible colour change throughout (refer to figures 4.1.11 & 4.1.12). The lack of colour change is largely indicative of a lack of chemical transformation of these samples when heated. Of additional interest are samples V10 and L6, which both gained ferro-magnetic properties whilst being subjected to the surface temperatures of the hearth experiments.

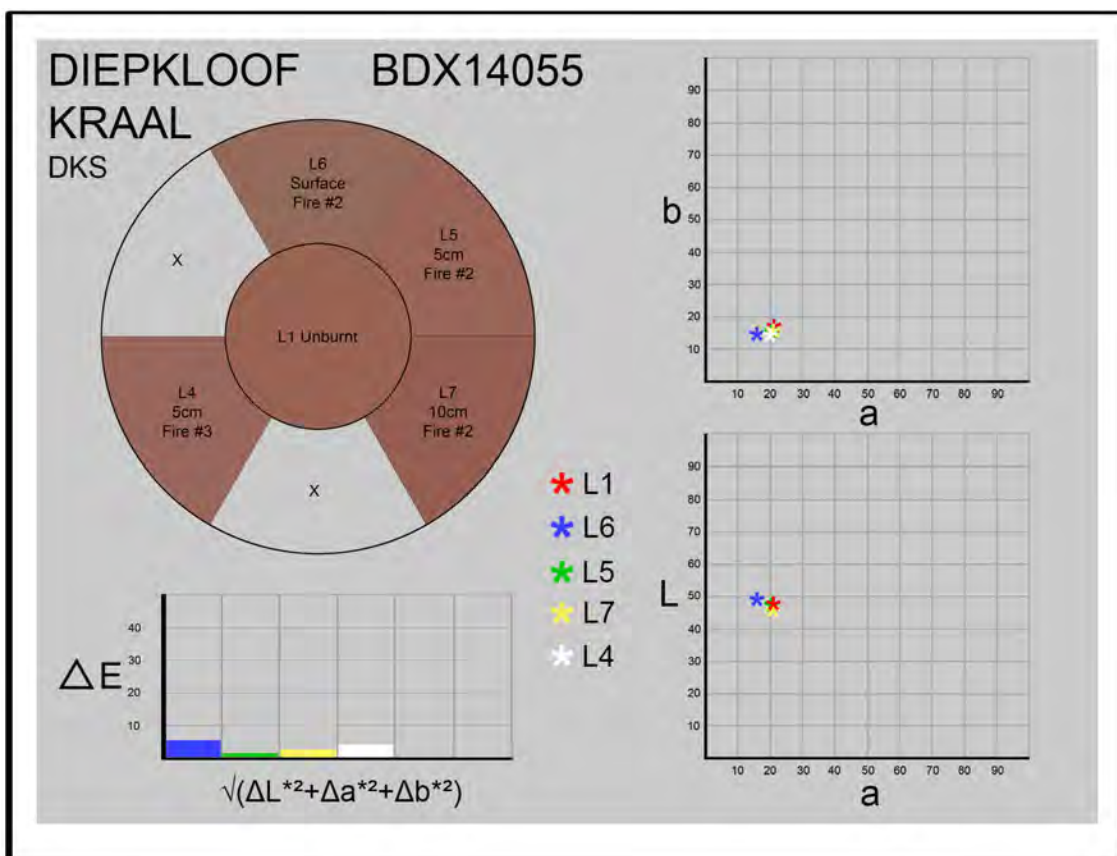


Figure 4.1.12: BDX14055 DKS: Colour Swatch showing the Change in Colours from Induced Heating. Colorimetric data using the L.a.b (d65) system. and ΔE Showing the Extent of Colour Change

X-ray Diffraction Analyses:

In this section the results of the XRD scans are discussed. The chemical composition, and change thereof, will be made apparent. The corresponding colorimetric data for the samples is drawn upon to highlight the intrinsic link between colour and chemical composition. Additionally, any notable changes that were unforeseen or contrary to expectations are also discussed. The X-ray diffraction graphs are not presented in this chapter as the significance of the X-ray diffraction analysis is not of vital importance to the arguments presented in this thesis as a whole, and they are therefore placed in to the appendices should they wish to be examined. Some of the potential findings from the X-ray diffraction analyses are, however, outlined briefly. It is hoped that a more comprehensive description of these analyses may form part of a joint future publication with Laure Dayet and the Author of this thesis.

Three of the Warmwaterberg samples were run through the X-ray diffraction process. These were E1 (unheated), E7 (surface of hearth #2) and E5 (5cm below hearth #2). E1, as the unmodified sample in its original state, represents the base or source for purposes of comparison with the remaining two samples from the same source after they were subjected to heating. The signal from E1 shows very fine peaks of geotite as its primary constituent. The vibrant yellow colour is characteristic of ochres with a high concentration of geotite. In E7, placed on the surface of hearth #2, there was a chemical change from the source, geotite, to maghemite (with some possible traces of magnetite). This change occurs only at high temperatures for a sustained duration. The colour changes from yellow to brown, and, as the names suggest, gives the material a magnetic quality. Sample E5, buried at a depth of 5cm below hearth #2, also underwent a chemical change, but at lower temperatures it changed from geotite to haematite. Prior work suggests that it is possible to differentiate natural haematite from haematite that forms from heated geotite (Pomies, 1998). The evidence for this is based upon the shape of the haematite peaks within the given material. Haematite formed by heated geotite will have a wide main haematite peak (at point #104 in the spectrum). This will be followed by alternating narrow and wide peaks along the spectrum. The signal given by E5, however, provided a slightly ambiguous pattern despite

the fact that we know for certain that it is heated geotite. E5 displays peaks that closely resemble natural haematite, but not to a sufficient extent to make it untraceable as a heated geotite nodule.

Of the Swartberg samples, all taken from a single source, three were scanned by X-ray diffraction, namely B1 which was the unheated control, B6 which was placed on the surface of hearth #2 and lastly B7 which was placed at a depth of 5cm below hearth #2. B1 is clearly rich in haematite, which has a characteristic red hue. Other constituents include quartz, muscovite, illite and kaolinite. Amongst the trace elements is a compound called pyrophyllite, which is unique to the Swartberg samples. B6 exploded over the surface of hearth #2, with a near identical explosion occurring in sample B10 on the surface of hearth #3. The Swartberg samples were the only samples that exploded in this manner. This could potentially be due to the presence of the pyrophyllite compound that remained present in B6 after heating in addition to the potential cause already examined regarding the expansion of water vapours present within the material. B6 was also strongly magnetic after heating, and this is clearly illustrated by the X-ray diffraction scan which shows that the haematite has been almost completely transformed into maghemite (see Appendix: 15504-B6). Maghemite is characterised by a brown hue, as illustrated with the colorimetric analysis. Lastly, sample B7 remained largely unchanged, with only a slight decrease in the quantity of clay mineral components.

Diepkloof sample #5, labelled V, supplied the greatest volume of material to be used in the hearth experiments. In order to obtain a maximum of data relating to the site of Diepkloof, all 6 possible samples were scanned by X-ray diffraction. The control sample V1 consists primarily of haematite, quartz, a mix of muscovite and illite and traces of kaolinite. The heated samples V9, V5, V6 and V7 were heated under a range of conditions with differences in depth and placement in both hearths #2 and #3. Despite this, these four samples are nearly identical in chemical composition to the control sample V1. This means that, regardless of hearth conditions, the base material is not subject to alteration with heat treatment. This finding is potentially very significant to understanding possible ochre processing, or lack

thereof, by historic people at Diepkloof specifically. The only sample which deviates from this pattern is sample V10, which was placed on the surface of hearth #3. Yet even V10 is almost identical with only one major difference in that the kaolinite component is no longer present. Kaolinite is a compound which sometimes may undergo change when heated. This difference in V10 may not, however, be due to the heat treatment. An examination of photographs taken prior to the hearth experiments shows that sample V10 does have a different appearance to the rest, and as such, the chemical differences may have been present prior to heating. The chemical similarity of the samples is mirrored in the colorimetric data which shows a negligible amount of colour change.

The Diepkloof Kraal samples, labelled L, display a very similar pattern to Diepkloof sample #5 in its negligible chemical change. L1 is comprised of haematite, illite, muscovite and kaolinite with traces of sanidine. Sample L5, from 5cm below hearth #2, is virtually identical in its diffraction pattern. The only apparent change occurs in L6, which was placed on the surface of hearth #2. In L6 there is significantly less kaolinite present. This chemical similarity is yet again mirrored by the colorimetric data.

Diepkloof sample #1, labelled T, also replicates this pattern. T1 consists of weak haematite, quartz, anatase and sanidine with a very strong clay mineral component. The clay component is clearly visible with even a cursory look at the samples. Samples T6 and T4, placed at 5cm and 10cm below hearth #2 respectively, show negligible chemical change. Unsurprisingly, this matches the colorimetric data once again.

In summary therefore, the results of the X-ray diffraction analyses, confirm that the change in colour between heated and unheated samples is indicative of an underlying chemical change. In the case of the Diepkloof samples, the negligible colour and chemical change, means that the excavated ochre nodules from this source will not have changed significantly due to post-depositional heating.

Ochre Processing Experiments:

A cursory experiment was conducted to examine the efficacy of two alternate ochre processing strategies which are of significance to this thesis. These two strategies are firstly the grinding of ochre by hand on an upper or lower grindstone, creating striated nodules of ochre as a by-product of the process, and, secondly, the pulverising of an ochre nodule by means of crushing it between an upper and lower grindstone. The second method is argued by the author to be responsible for the complete utilization of ochre nodules so that they might be entirely absent from excavated assemblages.

Nodule A. (as depicted in figure 4.1.13) was ground on an upper and a lower grindstone in order to create a fine-grained powder. The evidence for this method is present in the archaeology of both Later Stone Age and Middle Stone Age deposits alike. As can be seen in the diagram, the process created faceted platforms covered in directionally orientated striations reminiscent of those from archaeological contexts. A nodule such as this found in an excavation would not be out of place.

The second method, that of pulverisation as shown with ochre nodule B., creates a pattern that closely resembles a lithic flaking pattern as may be seen on stone artefacts, although their orientation may seem comparatively random. The initial striking of the nodule between the upper and lower grindstones produced a collection of small flaked chips which could then be easily milled into a fine-grained powder. Samples such as this are often overlooked in the examination of archaeological assemblages, which may be a significant error when defining utilised ochres.

An important factor when determining the efficacy of these two methods is the amount of time required to reduce an ochre nodule into a substantial volume of fine-grained powder. It should be noted, then, that the grinding process was a time-consuming exercise that produced a fine-grained powder, but required considerable effort to do so. The pulverising procedure, by comparison, was far more expedient and produced a greater volume of

Grinding and Pulverising Experiment



A. Grinding Nodule B. Pulverised Nodule

Figure 4.1.13: Ochre Nodules after Ochre Processing Experiment

equally fine-grained quality powder in substantially less time. The only major drawback of the pulverising technique was that many small chips of ochre would become projectiles fired away from the processing grindstones. Should the ochres have been excessively rare and be held as a prized commodity, such a process may be unnecessarily wasteful in these circumstances.

In the archaeological samples examined in this thesis, flaked ochre nodules were not found, yet by using this method ochre nodules could easily have been used in their entirety and would thus not be present in archaeological deposits. As discussed, in light of the evidence from the ochre assemblages and the rock paintings this method is proposed by the author in the subsequent section as being the likely primary method of ochre processing.

* * *

Having presented the archaeological findings from all three sites, various links were seen to be missing in the possible sequence of events relating to the usage of ochre. The experimental chapter has then dealt extensively with a few possible transformations and detailed their influence on the archaeological ochre assemblages. These two avenues of research are now synthesised in order to construct a few key points regarding ochre and its eventual inclusion into the rock art.

5. Discussion



Discussion

Before exploring some of the observations and arguments drawn from the analyses already presented, it is important at this point to provide a clear visualisation of the human agency and range of action that are applicable to ochre use. The ultimate goal of any archaeological research must be to attempt to link the artefactual remains with the activities surrounding its function and even its very presence in an archaeological site. It is easy to lose sight of this fundamental principle under the weight of observations, analyses, and statistical data that are inherent to any analytical archaeological research. The short story by Lesley Beake presented in the prologue to this thesis is provided in order to remind readers and researchers alike that, whilst archaeologists work with the artefactual remains of pre-historic peoples, their daily lives and perceptions were very different from our own. The following description (with reference to figure 5.1.1) serves to provide a clear picture for the array of variables that might define the 'life-path' of an ochre nodule from its origin in the landscape to its final utilisation or its excavation and subsequent curation into an archaeological assemblage.

To begin with, people moving across the landscape would have undoubtedly been well aware of the many potential sources of ochre available to them, as one of many important raw materials. It would seem likely that, whilst specific trips may have been embarked upon with the express intention of collecting ochre, it would more likely have been part of a general series of movements through the landscape if they were following a seasonal pattern, or as part of a multifaceted resourcing trip. Hypothetically, a situation such as this may be possible: “today we will walk to point X in the next valley to collect ochre; the route we will take will pass close to point Y, where we can collect silcrete (a lithic raw material); the season should be right to collect the bulbs of a certain plant which should be abundant there this time of year”. In addition to trips such as these, it is probable that people would have kept a keen eye to the ground looking for an array of valuable items including ochre as part of their daily movements. From the ochre assemblage from the various sites it would seem apparent that the collection of ochre was by no means a precise activity, in that the amount of inferior quality ochre brought to the sites was relatively substantial. All of the collected

Ochre Transformation Sequences

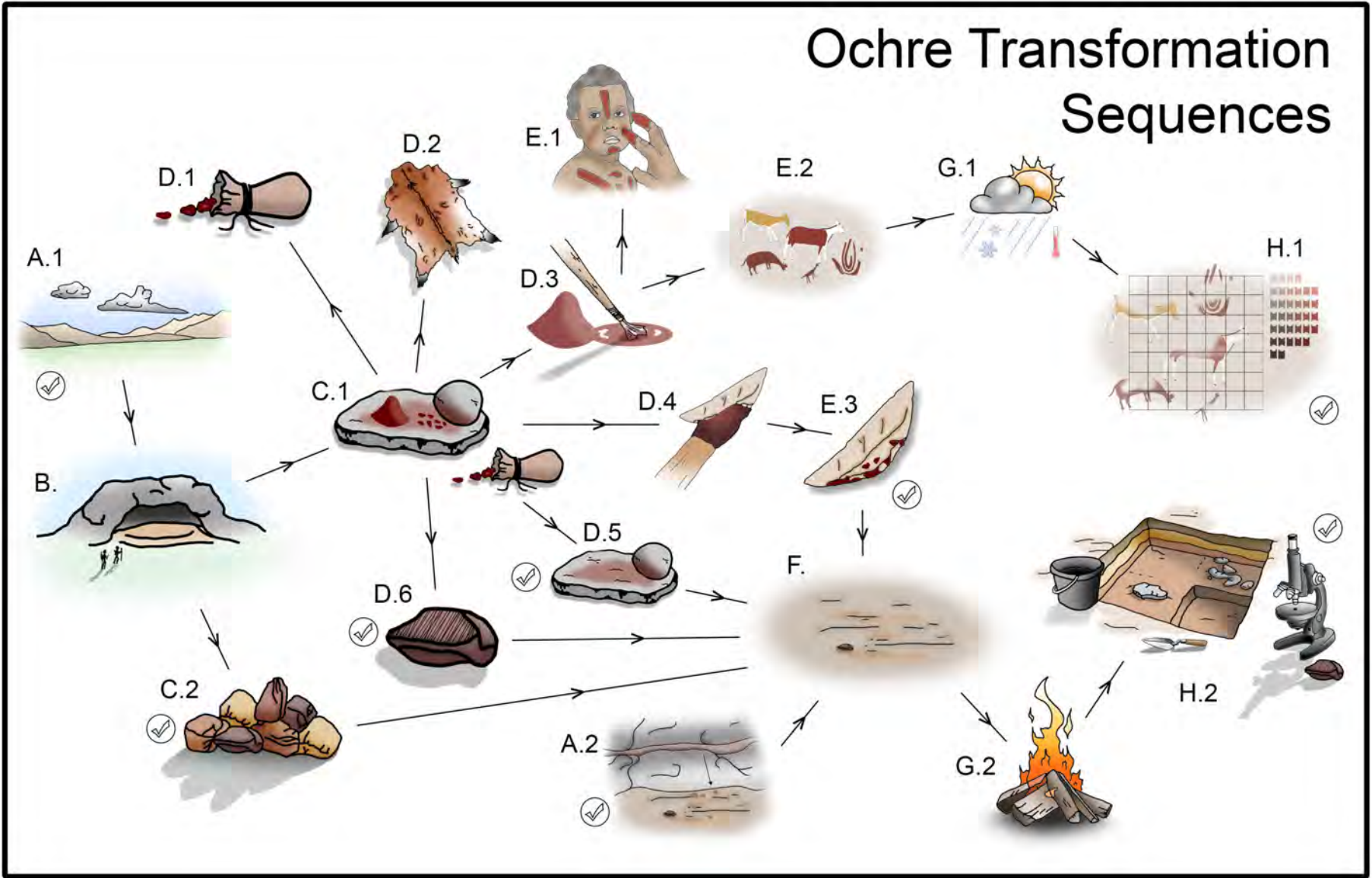


Figure 5.1.1: Ochre Transformation Sequences

Ochre Transformation Sequences: Key			
A.1	Landscape <ul style="list-style-type: none"> ● 	D.6	Striated Ochre
A.2	Geological Ochre Seepage <ul style="list-style-type: none"> ● 	E.1	Painting (not used in rock art)
B.	Rock Shelter During Habitation	E.2	Rock Art (as painted)
C.1	Ochre Grinding Process	E.3	Stone Tool with Ochre Residue
C.2	Discarded Ochre	F.	Deposit (as laid down)
D.1	Ochre Carried Away from Site	G.1	Weathering (physical and chemical)
D.2	Hide Preservative or Colouring	G.2	Post-Depositional Processes (e.g. hearths)
D.3	Paint Making Process	H.1	Rock Art (as recorded) <ul style="list-style-type: none"> ●
D.4	Mastic and Hafting	H.2	Excavation and Analysis of Assemblage <ul style="list-style-type: none"> ●
D.5	Upper and Lower Grindstones		

Contain an aspect of natural causation
 These are instances which remain in the archaeological record
 Represent the instances where archaeological examinations are possible

Figure 5.1.2: Ochre Transformation Key

ochre was then brought back to the site they were inhabiting at that time. This is presented in the accompanying diagram as points A.1 and B.

The second phase in the 'life-path' of ochre occurs once the ochre has already been brought to the site. The collected ochre was then sorted according to deciding factors such as colour and streaking quality. The motivation behind these choices may have depended largely upon the eventual function for which the ochre was used. Some of these options will be highlighted later as part of this description. A large proportion of these ochres was then ground to a powder and used for a variety of functions (this is represented on the diagram as point B. - C.1). Some of the ochres, however, were deemed undesirable for any purpose and these nodules were discarded and dropped on the surface of the deposit; the bulk of these make their way into the excavated assemblage for any given site (on the diagram this

is represented by the path B. - C.2 – F).

The next phase pertains to those ochre pieces which, having been actively selected, were then utilised in a manner which resulted in traces being present in the deposit at each site. This point at which the ochre is processed is in many regards a pivotal juncture in the 'life-path' of an ochre nodule in that it is at this point where the ochre is utilised for a specific function. Before looking further into this, there are several traces of the grinding process for which there is archaeological evidence. We find in many excavations upper and lower grindstones which are frequently stained with ochre on their grinding surfaces. Some of the selected ochres are only partially used, dropped into the deposits and subsequently found in excavations as striated ochre nodules. (These are shown in the diagram as paths C.1 – D.5 – F for the grindstones, and C.1 – D.6 - F for the striated ochre).

At this point we have dealt with the archaeological ochre by-products or waste, up until their inclusion into the deposits of a given site. There is at least one circumstance leading to traces of powdered ochre being found in the deposit. Careful examination of an array of stone tools has shown that ochre powder may have been a vital ingredient in the creation of mastics with which to haft stone tools (Lombard, 2006, 2007; Wadley, 2005, Wadley *et al*, 2009). It has been illustrated that the inclusion of ochre powders would serve to strengthen the mastic, making it less brittle and vulnerable to breakage (Wadley, 2005). The finished tool, hafted onto a stick or some form of wooden handle, was then used until it eventually broke in a manner which was unfixable. Many of these would have broken and been left in the general landscape. Some, however, would have been brought back to the site in order to be removed from the hafting and then discarded into the deposit (this is shown in the diagram as the path C.1 – D.4 – E.3 – F).

Before returning to the other uses for powdered ochres, the sequence of events described so far should be taken to its conclusion. There is a particular case which should be mentioned here in brief but will be examined in greater detail later. This is the issue of geological ochre seepage into the deposits at Diepkloof Rock Shelter from the ferruginous

shale band that extends the width of the site (the path for this on the diagram being A.2 – F). It should be noted that the deposit, as shown in the diagram, is no longer available for direct examination. The reason for this is that it represents the deposit as it was when any given artefact was dropped at the site and not the deposit as excavated. This distinction is made because there are numerous taphonomic processes which occur between the discard of an ochre nodule and its excavation. The most important of these with regard to ochre studies is that of post-depositional heating whereby a series of subsequent hearths during later occupations of a site can chemically alter the ochre at depths of up to 10cm below a hearth. This was first described by Wadley (2009, 2010b) and is supported by the author's own experimental hearths as well as other research (Bensten, 2012, 2013). The deposit is then excavated by archaeologists, recorded and analysed, this final step being the moment at which archaeologists first have access to those ochres which are not purely geological. (This is represented on the diagram by the path F – G.2 – H.2).

We now return to the juncture at which the ochres were selected and some were ground into powders. Whilst some of the striated nodules were dropped into the deposit at the site, it is quite probable that some of the ochres in preferred colours were taken with people as they moved from site to site. They may have been transported as ochre nodules or as ready-made ochre powder, and carried with people as they moved across the landscape. This is one cause for some of the under-representation of preferred ochres in the deposits of the examined sites (the illustrated path for this is C.1 – D.1). Of the potential uses for ochre, another which has been proposed (Rifkin, 2011; Watts, 2002) is that ochre may have been used for the preservation and/or colouration of animal hides. (This is shown by the path C.1 – D.2).

A vitally important point with regards to the research presented in this thesis centres around the powdered ochres which are made into paints. At this point the ochre powder is mixed with other substances which act as additives, binders and extenders in the creation of paints. The exact composition of these additives is unknown, but there has been work done attempting to ascertain what these additives were. Some of the likely substances suggested

by ethnographic accounts and subsequently tested include: animal fats, vegetable fats, urine, blood, bile, water, milk, eggs, plant sap, gum, honey, saliva, salt, beeswax and gelatine (Rudner, 1982, 1983, Johnson, 1957). The exact compounds or recipes used are still uncertain. There are, however, many technical advances that are making such research attainable (Hoerlé *et al*, 2010, Arocena, 2008, Hall, 2007). Ochre paints may have been used in a variety of possible ways, the two most prominent ones being for rock art, which will be dealt with separately, and body painting (the path for this being C.1 – D.3 – E.1). There have been ethnographic accounts documenting this, such as those detailing the Himba of Namibia (Rudner, 1982), and some work describing its possible function as sun-protection (Summers *et al*, 2012).

The last and most important area for this research relating to the use of ochre-based paints is in the rock art adorning the walls of the rock shelters. The rock art undergoes various weathering processes and is in time recorded (in figure 5.1.1 this path is represented by E.2 – G.1 – H.1). There are a variety of potential causes for the weathering of the rock art. These include: sun fading, wind and sand abrasion, abrasion by physical anthropogenic means, water and associated dissolution and/or deposition of salts and compounds, heat and humidity variation (Hall *et al*, 2007; Meiklejohn *et al*, 2009; Arocena *et al*, 2008), bird droppings and lastly hyrax urine (Prinsloo, 2007). All of these factors can have an impact on the preservation of rock art, with obvious implications for the precision of rock art and colour analyses such as those conducted in this thesis. The exact effects of the various actions are difficult to fully ascertain; however, it is important to bear in mind that, despite an image being faint, it could still have a dark and vibrant hue, as noted in the observations made in this thesis. The faintness is a result of a lower density of paint present on the rock surface as opposed to a change in the paint's colour. In some instances, however, the rock art was so faint as to be impossible to record with any degree of clarity or precision.

As illustrated in figure 5.1.1, with the accompanying description, it is clear that the points in the 'life-path' of ochre at which archaeologists are able to make observations are limited. As shown in the diagram, the only instances where observations can be made are in the

landscape (A.1), from the seepage of geological ochre specific to Diepkloof (A.2), in the recording of rock art post- weathering (H.1) and, lastly, from the excavated assemblage of a given site (H.2). It is important to stress that the majority of the processes and transformations which ochre undergoes from its source to its final inclusion in rock art or in the deposits are primarily anthropogenic. In other words, almost all of the intermediary steps are due to human agency and action. It is regarding some of these choices made by pre-historic peoples that this research aims to provide some insight.

Discussion Points:

With both the archaeological and experimental results being presented, there is a substantial body of data from which to draw. With so much data, actively selecting and compiling the relevant information is a challenge in itself. With the broad multifaceted approach used in this research the potential for new findings is high, but the evidence collected is at best circumstantial. Many of these findings would require a more intensive and focused analysis in order to provide sufficient evidence to make any strong argument. These circumstantial findings do, however, give sufficient motivation for future study and examination.

In this section a few key findings will be discussed where there is sufficient evidence, or justification, found in the analyses to substantiate the claims. Some of these points are site specific, whilst others may provide a new angle with which to view ochre use and selection regardless of time period or place. It must be stressed that these points do not provide a complete picture but rather target specific features which became apparent during the analyses. In several instances the multifaceted approach or methodology propounded in this thesis enabled some interesting observations that would otherwise have been impossible.

1. The excavated ochre represents only those pieces that were discarded; the actual ochre processed for paint-making is inherently absent from the excavated assemblage.

Whilst this point may seem somewhat simplistic, it is crucial in the examination of ochre and rock art. The physical ochre which constitutes the paint present on the walls at a site is

ochre which has been ground down into a powder and processed into paint and is therefore not present as an ochre nodule in the deposit.

There are a few instances where the circumstances are different. In the analyses of every site there is a percentage of ochre which shows clear signs of grinding and of use in the production of powders. These pieces of ochre represent the only instance where an ochre nodule may have a direct link with a rock art image. The frequency of these utilised nodules, however, is very low, and cannot even begin to account for the volume of paint required to produce the rock art. The rest of the ochre used is therefore not represented in the archaeological deposits.

As stated, this observation might seem simplistic, but its implications for the study of ochre and its use are significant. If the frequency of striated ochre is comparatively low but there is evidence of greater use of ochre at the site, then it is likely that a substantial percentage of similar ochres was used up. In Middle Stone Age ochre studies where there is a complete absence of rock art, there may at a given site be substantial evidence of other ochre use, whether symbolic (Watts, 1997) or practical like hafting (Lombard, 2006, 2007), and yet the volume of striated ochre may be very low. In an instance such as this, the potential for ochre volume to be largely under-represented in the archaeological excavation is a distinct possibility.

Archaeological ochre holds a great deal of information relating to what is absent in an assemblage as compared to what is present. In the manufacture of lithic artefacts the production sequence is largely preserved, and can to a certain extent be reconstituted by careful examination of formal tools in conjunction with the associated debitage. Striated ochre nodules could be considered the debitage of the ochre powder-manufacturing process. There is an important exception, however, in that ochre, unlike stone, can be completely used up and therefore large quantities will have no archaeological remains. To give the concept a loose term, one might think of it as “ghost ochre”.

2. The colours represented in excavated ochre and the ochreous rock art do not correlate, which has implications for ochre use. Referring back to the analyses for each of the three sites, this observation is quite clear (Figures 3.1.10 - 3.2.14 - 3.3.14). With regard to colours, there is a rather marked disparity between the volumes of ochre present in any of the assemblages and the surface area of the rock art. A substantial number of researchers working in the Later Stone Age have disregarded the significance of ochre within their assemblages, and consequently correlations between rock art and ochre have been based largely upon assumption. It may be assumed that the ochre present in the excavated assemblage will bear some correlation to the rock art of the same site. The use of ochres for paint-making is well established in an array of ethnographic accounts (Marshall, 1962, 1969, 1976; Rudner, 1982, 1983). So, when archaeologists, with other research priorities, encountered ochre in the assemblages of rock art bearing shelters, the link between ochre and paint appeared to be self-evident.

There is a strong preference shown in the rock art for colours tending toward the 10R Munsell hue, especially in 10R 4/6 and 4/8-Red and 10R 5/6 and 5/8-Red. When referring back to the analyses for Andriesgrond and Diepkloof, the strength of this observation is startling, with almost 50% of the rock art at Diepkloof being in the 10R 4/6 and 4/8-Red category alone, and approximately 60% of the rock art at Andriesgrond being spread between the two 10R-Red categories. That being said, however, it is important to note that the overall colour profiles in the rock art at these sites, whilst displaying similar trends, do not match each other all that closely. So, whilst a preference for these hues is apparent, it must have been mitigated by a range of variables, most notably availability.

De Hangen is a clear example of a site where a preference for the 10R-Reds is visible, but the recorded value is lower than that of the accompanying 2.5YR-Reds. The survey conducted around De Hangen did not yield a single piece of usable ochre. All the haematite-bearing nodules in the region resemble the underlying geology, as they are comprised of the same quartzitic sandstone. This material, blatantly unsuitable as a pigment due to its hardness and numerous gritty quartz inclusions, is entirely absent from the excavated assemblage.

A brief look at the geology of the region shows a uniformity that makes the likelihood of a nearby ochre source highly improbable. Whilst a distant ochre source of a preferred hue, such as 10R-Red, may not result in its absence in the rock paintings it may lead to a more limited representation of that colour. In other words, a limited source of preferred ochre may force an alternate strategy in ochre use. Whilst not the only plausible explanation, based on the observations from all three sites this is the most probable one.

Whilst the dominance of a certain colour in the rock art shows a preference for it, the opposite is true for the ochre present in the deposits. Excavated ochre, with the notable exception of striated nodules, represents only those pieces that were discarded. Whilst it is unlikely that every piece of ochre was discarded intentionally, it is fair to assume that the majority must have been. The analyses of the streaking quality and the corresponding colour of the ochre in each of the assemblages supports this hypothesis. Ochre of a Poor or Average Streak Quality is dominated by those colour categories that fall between the 2.5YR-Reds and the 10YR-Yellow hues. The ochres that fall between the 2.5YR-Reds and the 10R Munsell hues are, in contrast, primarily of a Good or Excellent Streak Quality. Whilst this observation is possible at each of the three sites analysed, Diepkloof provides the most conclusive evidence for this pattern (refer to figures 3.3.3 & 3.3.4).

At Diepkloof (refer to figure 3.3.2), it is clear that ochre in the colour categories from the two central 2.5YR-Red to the Yellows dominate the excavated assemblage. It is also true that the majority of this ochre has a Poor or Average Streak Quality, whilst the nodules in the colour categories tending toward the 10R Munsell hues have a better streaking quality. With the bulk of the rock art being represented in the 10R-Reds and a minimal quantity of corresponding ochre, it is clear that the missing ochre was either used up, or removed from the site by the inhabitants as they moved through the landscape.

We now return to the concept of “Ghost Ochre.” If one were able to study the entire ochre assemblage comprised of every nodule that entered a site, it is clear that ochre in those preferential colours would be more prevalent than it currently is. Ochre studies to date have

invested a lot of interest in the importance of striated ochres and its production strategies. Hodgekiss (2013) discusses how the methods required in order to process ochre in the Middle Stone Age at Sibudu help to provide strong evidence for advanced cognition. This thesis argues that striated ochre may in fact be subsidiary to ochre processing by means of flaking, pounding and grinding with an upper and lower grindstone. In the Later Stone Age, the rock art provides a useful measure of which pigments were eventually used, at least for that purpose. The comparison, as presented here, shows that the ochre signal for the examined sites is incongruent with the rock art, suggesting that a large percentage of the ochre assemblage was either carried away from the site, or that ochre nodules were used in their entirety.

In the cursory ochre grinding experiments by the author, it was quickly noted that producing ochre powder by rubbing an ochre nodule against a grindstone was effective in producing patterns and striations reminiscent of those seen in archaeological ochres (Refer to experimental chapter). The process was, however, somewhat slow and time-consuming for powder production. A far more efficient method was to pound the ochre nodules between the upper and lower grindstone, first creating a small pile of ochre flakes and chips, which could then be ground into a fine powder with the grindstones. This would enable complete consumption of a given ochre nodule into a powdered form in significantly less time than the method of striating the ochre. The very low frequencies of striated ochre in the deposits, coupled with the concept of 'ghost ochre' or under-represented ochres in preferential colour categories, provides strong circumstantial evidence that this may have been the preferred means of production. The major flaw in the argument, incidentally also its justification, as indicated, is that there is no direct evidence of this method in the archaeological assemblage.

It should be reiterated that a finding such as this is not possible when working in the Middle Stone Age as the evidence for missing ochre from any assemblage is largely inaccessible. The rock art analyses in this study provide a window through which to view ochres that may have been brought to the site and were subsequently used up or removed.

3. Based on this research, there is a correlation between pigment colour and streaking quality. As previously discussed, there is a definite preference at all three sites analysed in this thesis for colours tending toward the 10R Munsell hue to be dominant in the rock art. This preference has even meant that portions of the ochre assemblage have been used in their entirety to the point where they are all but absent from the excavated assemblage. It is not surprising therefore that the ochres found in these colours would be of better streaking quality. This link may not be as simple as that however.

There has been a great deal of work done on the ochre of the Middle Stone Age. Frequently it has been used as a marker for symbolic thought (Watts, 1997,2002, 2009; d'Errico *et al*, 2010; Henshilwood *et al*, 2009, 2011). Watts (1997) mentions that there is a clear preference for “saturated reds” and that these colours may have been actively selected. Working on Later Stone Age ochres has provided a similar picture. The saturated reds, in this thesis generally referred to as those colours tending toward the 10R Munsell hue, appear most frequently in the rock art. They are also the colours most dominant in the utilised ochre component of each site. So one might argue that there is an active selection process for high quality ochre in these colours, but the evidence from the entire ochre assemblages points to a different conclusion.

Excavated ochres are present in the deposit of any site for the simple reason that they were transported there by its inhabitants (Diepkloof may be a rare exception to this rule). If the streaking quality and pigmentation of the ochre were not inherently linked, then one would expect, when examining the Poor or Average Streak Quality ochre, that there would be equal volumes in all of the colour categories. In fact, if colour was the primary concern, and the link to quality not fundamental, one would expect the assemblage to have a large volume of Poor or Average Streak Quality ochre in these saturated 10R-Reds. This is not the case however, as seen with reference to the streaking quality graphs for each of the analysed sites in this thesis.

The strong correlation between streak quality and colour is therefore inherent. The

physical attributes of ochre, especially particle size and hardness, have a direct effect on its pigmentation (Cornell & Schwertmann, 2003). The evidence for this is especially strong when examining the ochre from Diepkloof due to its large sample size (refer to figures 3.3.3 & 3.3.4). Whilst one would be hard-pressed to say that the colour choices for rock art were less important than the streaking quality of ochres, the link between streaking quality and pigmentation is undeniable.

With this in mind, even rock art analyses could be affected. The ochres used for a polychrome eland such as those seen in the Drakensberg Mountains cannot be viewed from any other point than that of colour significance. In other words the range of colours was the most important consideration. The same may not be true for all rock paintings however. The colour choice for handprints for example may not hold as much significance as the quality of the ochre powder needed to create the paint. The possibility that handprints were done as part of an initiation ceremony as suggested by Manhire (1998) might mean that choices made were for the creation of a large volume of high quality paint in order to create a string of handprints. So even in rock art there is the possibility that certain circumstances may make the hue a subsidiary choice to streaking quality.

The implications of this when examining ochre assemblages from the Middle Stone Age should not be underestimated. The strong correlation between streak quality and colour goes a long way towards removing a symbolic interpretation of ochre based solely upon colour choice. Ochre use has been linked to a range of different activities such as hide preservation (Watts, 2002; Rifkin, 2011), as an ingredient for mastic in the hafting of lithic implements (Wadley, 2005; Wadley *et al*, 2004, 2009; Lombard, 2006, 2007), or even perhaps as body paint. In each of these circumstances the streaking quality of the ochre would likely have been of primary concern rather than the hue. In recent studies such as those conducted by Hodgekiss (2013), these considerations are already becoming of importance, and, in fact, she also highlights this link between pigmentation and the physical attributes of ochre. She looks toward the means of production as a marker for cognition rather than symbolic thought based on colour choice (Hodgekiss, 2013).

* * *

The discussion now shifts focus from generalised points on the relationship that exists between ochre and rock art to specific observations pertaining to unique circumstances at individual sites.

Andriesgrond:

A closer examination of the Yellow Hartebeest and the ochre assemblage.

At Andriesgrond the line of yellow hartebeest are unique amongst the rock art examined in this thesis in that they represent the only significant quantity of yellow paintings. When examining the ochre assemblage from Andriesgrond there was no yellow ochre within the deposits. As already discussed, this thesis presents the concept of 'ghost ochres', or the under-representation of ochre in preferential colours, from the deposits of Later Stone Age sites. This hypothesis is substantiated by observations made on the rock art. There are circumstances, however, whereby similar under-representation can occur with different potential causes. The absence of yellow ochres from the Andriesgrond deposits may present one such circumstance.

Whilst yellow ochre nodules brought to the site in order to make the paintings and being used up in their entirety and for that reason being absent from the excavated assemblage, would fit well within the hypothesis of so called 'ghost ochre', it has already been well established that yellow ochres can be transformed into reds and browns by heating (Wadley, 2009, 2010b; Pomies, 1998, 1999). This colour change is a representation of a change on the chemical level whereby yellow goetite nodules are dehydrated and transformed into red haematite nodules often with traces of magnetite and/or maghemite (Pomies, 1999).

A significant by-product of this chemical change is that the ochre nodules may gain para-magnetic, also known as ferro-magnetic, properties (magnetic attraction). Based on the observations made in this study from the survey work, the experimental hearths and the laboratory analyses conducted at the IRMAT-CRP2A lab, only ochres containing magnetite

or maghemite, likely induced by heating, can have magnetic properties. Of the ochre samples that were included in the experimental hearths, only certain samples gained magnetism through the heating process, whilst others that were heated in the same conditions did not become magnetic. Notably, of the ochres sampled during the landscape surveys, none of the ochre had magnetic properties. Whilst this area of research is still only in its formative stages, the indication thus far is that if a piece of ochre is para-magnetic, then it has been heated either within, or underneath, a hearth. This does not mean, however, that if a nodule of ochre is not magnetic, that it has not been heated, as the process relies upon a chemical transition which may not occur in all ochres. Importantly, this does not necessarily point to any intentionality behind the heating of the nodules, as serendipitous heating underneath a hearth would have the same result (Wadley, 2009, 2010b). The only means by which intentionality might be proved was if there was a significant correlation between magnetic ochres and their utilisation; no such correlation was found however, a major factor in this being the low sample sizes for utilised ochre from the sites.

An examination of the magnetic properties of the Andriesgrond assemblage showed that ochres in some of the colour categories for which there was little or no rock art had several pieces of magnetised striated ochre. There are three notable colour categories which are indicative of the presence of magnetite or maghemite from induced heating: Dark Reddish Brown had ten pieces of Weakly Magnetic ochre of which three had Definitely been modified; Reddish Brown had eight pieces of weakly magnetic ochre of which two had Definitely been modified; and, lastly, Yellowish Red had four pieces of Strongly Magnetic ochre of which three had Definitely been modified. (There was also one Definitely modified nodule which was Strongly Magnetic that was two-toned - a quality often present in heated ochres - the two colours being Yellowish Red and 2.5YR 4/6-Red). These three colour categories represent some of the possible hues to which yellow goetite may change due to being heated. Importantly, these ochre nodules were not concentrated in one place but were scattered throughout the excavation.

These pieces of ochre from the excavated assemblage may therefore represent the yellow

ochres which were brought to the site in order to make the paint for the yellow hartebeest. These nodules would have been partially used, and then dropped into the deposit of the site. Later, in entirely unrelated events, hearths may have been made above these ochre nodules thereby changing their colour. At present this hypothesis is untested and is merely hinted at by the magnetic evidence and colour evidence. It is, however, possible to ascertain via X-Ray Diffraction whether or not a nodule of haematite has undergone this heat transformation from goetite by a widening of the haematite peaks (Pomies, 1998, 1999; Watari, 1982). Whether or not the non-destructive methods available would provide sufficient precision in order to make the same observation is uncertain.

The examination of the magnetic properties of ochre is therefore an area which requires attention as it has not been extensively explored yet. Mooney (2003) used magnetism in order to attempt to characterise the provenance of ochre sources at the site of Puritjarra in Australia. The examination of the link between magnetism and heating is in its infancy and the possibility to prove or disprove intentional heating of ochre is an inviting area for future research in ochre studies.

Diepkloof:

Geological Ochre Seepage:

At the majority of rock shelters the excavated ochre assemblages are comprised entirely of ochre nodules transported to the site by people. At De Hangen for example the absence of any potential ochre source for some distance around the site means that every single ochre nodule present in the excavated assemblage had to have been collected and transported there by its inhabitants. At Andriesgrond the situation is only slightly different in that there is a potential rich source of ochre nearby at Patrysberg. Patrysberg is situated in the middle of a small outcrop of Bokkeveld Shale, and the entire area is rich in ochre nodules of varying colour and quality. So for Andriesgrond, the source may be closer, but the basic action is the

same in that the ochre had to have been collected and transported to the site. At Diepkloof, however, there is an ochre bearing shale band that runs the width of the site (it is in fact a bedding plane that appears to run through the entire kopje). This has a direct impact on the ochre found during excavations.

This shale band was sampled at several intervals along its width by Laure Dayet and the author. Dayet (2013), conducting X-Ray Diffraction scans on the Middle Stone Age ochre assemblage from the site, as well as a provenance study of ochre sources in the region, concluded that much of the excavated assemblage was comprised of ochre nodules which came directly from this shale band. It is apparent therefore that much of the MSA assemblage owes its origin to this source. What remains unclear in the MSA, however, is whether the ochre was intentionally removed from the back of the site, or if it bears no archaeological significance and represents a purely geological occurrence. The evidence gathered from the Later Stone Age ochre assemblage at the site suggests that the ochre from this shale band was unused by its inhabitants with the only possible exception occurring in the colonial era.

Four of the five geological samples collected from Diepkloof Rock Shelter were classified with the use of the Munsell chart as being Light Red, with the remaining sample (sample #4), being classified as Reddish Yellow. It is therefore no surprise that these two colour classifications represent a substantial proportion of the excavated assemblage (as seen in figure 3.3.2). The volume of ochre in these two colour classifications from the LSA context implicates the shale band as the source. This is consistent with the X-Ray Diffraction analyses conducted by Dayet on the MSA assemblage (2013), where she provides strong evidence for the chemical similarity between the sampled shale band and ochre nodules excavated from MSA contexts.

The next point to consider is whether or not the ochre nodules from the shale band were sourced intentionally or if they merely eroded out from the rear wall of the site. One possible

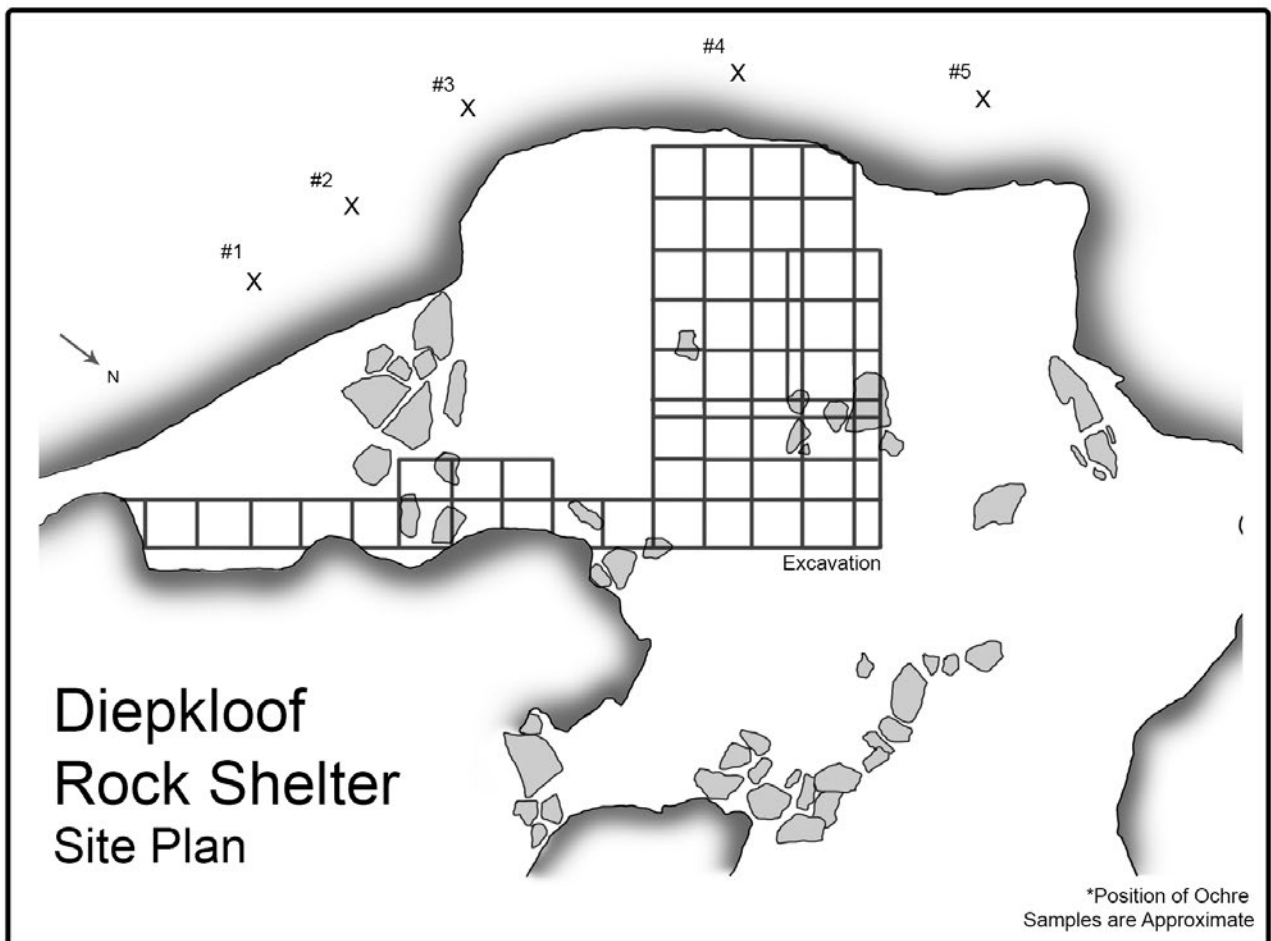


Figure 5.1.3: Diepkloof Rock Shelter Site Plan. Showing Geological Ochre Sampling Points.

approach to answer this question is to examine the ochre assemblages of other sites to see how much ochre in these two colours is present. In the accompanying table the counts, and percentage values that they represent, are given for the colour categories in question; with the addition of 2.5YR 4/6 and 4/8-Red to serve as a comparison. It is immediately apparent that Reddish Yellow (23%) and Light Red (16%) are substantially more prevalent at Diepkloof than at Andriesgrond (5% & 1%) or De Hangen (2% & 1%). In fact, Andriesgrond and De Hangen provide very similar values across all three colour categories presented here, and as such may show a standard pattern that may be consistent with other sites, though to say this categorically would require the addition of many more examined assemblages. (As mentioned previously, ochre present in the deposits of both Andriesgrond and De Hangen would have had to have been transported there by the inhabitants). The deviation from this pattern at Diepkloof, coupled with the presence of an immediate ochre source in these two colours is suggestive of their having a geological explanation rather than an anthropogenic one.

Table 5.1.1. Comparison of Three Colour Categories Between All Sites			
	Diepkloof n=1093	Andriesgrond n=215	De Hangen n=200
Reddish Yellow	255 - (23%)	12 - (5%)	4 - (2%)
Light Red	182 - (16%)	3 - (1%)	2 - (1%)
2.5YR 4/6 and 4/8 Red	150 - (13%)	61 - (28%)	51 - (26%)
*2.5YR 4/6 and 4/8-Red is included to provide a comparison			

Table 5.1.1: Comparison of three colour categories between all sites.

The argument presented above does not sufficiently account for inter-site variability and it is therefore important to provide justification based upon the Diepkloof assemblage. Referring back to figure 3.3.2, ochre present in Reddish Yellow and Light Red at Diepkloof are primarily of poor or average streaking quality. Reddish Yellow and Light Red are predominant amongst the Poor and Average Streak Quality classifications, and by contrast are only minimally represented in the Good Streak Quality ochre and entirely absent from the Excellent Streak Quality ochre. By implication these ochres are unsuitable for powder production and therefore undesirable as a resource. The presence of ochre in these colours in the excavated assemblage is therefore unlikely to be related to human action.

When assessing whether the ochre in these colours present in the assemblage owe their origin to geological means over anthropogenic ones, one can also examine how many of the nodules show signs of potential utilisation, and also their relative number in relation to the total counts for each colour. In the Reddish Yellow category only three pieces were described as being Possibly/Probably modified out of the 255 pieces from the excavation, and in the case of Light Red ten pieces were described as being Possibly/Probably modified out of the 182 pieces present. Furthermore no pieces could be classified as being Definitely modified. By comparison, of the 150 pieces of ochre classified as 2.5YR 4/6 and 4/8-Red three were Possible/Probably modified and notably 11 were observed to be Definitely modified. Additionally the average nodule size for the Red ochre was larger (2.54g) than for Reddish Yellow (1.27g) and Light Red (1.51g).

Referring back to the five ochre samples taken from the shale band, as previously stated, four of the five were classified as Light Red with the remaining sample (#4) being classified

as Reddish Yellow. If the shale band is the primary contributor of ochre nodules in these two colours, then it might be expected that ochres in Light Red should outnumber those in Reddish Yellow, which is not the case. However, sample #4 was also collected closest to the excavated area, as seen in figure 5.1.3. This proximity to the given excavated area would explain why more nodules in Reddish Yellow are present than in Light Red.

This combination of observations points strongly toward the shale band as the primary origin for the excavated ochres in these two colours. The chemical analyses, comparative examples and the specifics of the ochre from the assemblage itself all point toward this explanation. The multiple lines of evidence are in agreement as to the origin of the Reddish Yellow and Light Red ochre. This finding would not have been possible without the multifaceted approach taken in this thesis whereby different lines of evidence enable the construction of a comparatively strong argument when the argument based on only one series of observations may have been somewhat tenuous.

Evidence suggests that at least some of the colonial era rock art was done on an ad hoc basis:

Ochres used in the production of fine line paintings and handprints may have been sourced at great distances from the shelters where they were eventually used. Referring back to the description of the rock art at Diepkloof, it was shown that the colours used in the fine line imagery and the handprints were broadly similar, yet the colour range for the handprints was more limited than for the fine line imagery. By contrast the colonial era images, depicting European settlers and some geometric forms, do not share the same colour range. This deviation in colour selection may reflect a difference in strategies surrounding the painting process. Whilst the colour choice for the fine line paintings and for the handprints are indicative of a deliberate and intentional plan that involves potentially distant ochre sources, the colonial era paintings are not produced from ochres of comparable quality.

The colours represented in the colonial imagery are divided into four main categories: Dark

Reddish Brown, Light Red, 2.5YR 5/6-Red and Reddish Brown. As already described, this is in contrast to the saturated 10R-Reds that are so dominant in the fine line and handprint traditions. If these colonial images were painted in ochre which is ultimately, for some painters, less suitable for rock art, in terms of either colour or its inherent correlation with streaking quality, then it may suggest that the intention behind the colonial images errs towards an ad hoc approach.

During the survey of the surrounds of Diepkloof, it was noted that the area was almost entirely devoid of ochre, with two exceptions; firstly a few scattered hematite nodules were found on the slopes between the site and the Verlorenvlei, and, secondly, a relative abundance of ochre was found on the kopje to the immediate south-east of Diepkloof. The ochre sampled here was all classified as having a Reddish Brown streak. It may lend support to the ad hoc painting idea therefore that this ochre source should occur in clear view of the Diepkloof Kraal Shelter where some of the colonial era paintings are present in the same colour. One may imagine the scenario where people travelling along the Verlorenvlei toward the ocean passed by the Diepkloof shelter. Their first clear view of the Diepkloof Kraal Shelter would be from this neighbouring kopje, and perhaps upon seeing it, people decided not only to explore it, but to paint in the shelter. At this point the ochre strewn on the ground may have been picked up, carried to the site and then used to create these images. Whilst largely hypothetical, this may be an accurate chain of events on a handful of occasions, which is all that would be required to produce the relevant images at the site.

This line of evidence is somewhat circumstantial, a frequent situation in most archaeological research, but the pivotal feature that must be stressed is that detailed examination of the colours present in the rock art within each of the traditions may provide a wealth of information. The argument presented would not be possible without a detailed colour analysis of each individual image, recording colour as well as motif, in addition to a comprehensive survey of the immediate vicinity. There is even a tempting avenue of research into examining the colours in which certain motifs are painted. One may find that across the Cederberg handprints and fine line images may be in different colours, or that elephants are painted in

different hues to eland. The initial step outlined in this section may provide subject matter for a wealth of future research in this regard.

6. Conclusion



6. Conclusion

This thesis explores an area of research which has not received due attention before. It bridges several gaps in the discourse surrounding ochre and rock art analyses and, additionally, it highlights some implications for Middle Stone Age ochre research. A new methodology is developed with which to make quantitative observations and correlations between the ochre assemblages and the rock paintings in the corresponding archaeological sites and has used experimental archaeology to further the arguments based on these observations. This quantification is based on the examination of the total mass of the ochre in the component colour categories with the surface area of the rock art in those same colour categories. With those observations made, experimental research was used to examine some of the transformations which ochre may undergo from its source in the landscape to its final use. The results of these experiments were then used to fill in some of the omissions that are apparent from looking at the archaeological data in isolation. Presented here are several broad interrelated conclusions that have been drawn out of this process.

An examination of the rock paintings has revealed that there was a definite preference for saturated reds tending toward the 10R Munsell hues in both the fine line and handprint traditions. The careful selection and sourcing of a very limited colour range as seen in the fine line and handprint traditions, implies a targeted sourcing strategy which may involve substantial distances, and implies a specific motivation for painting. This same preference does not exist, however, in the colonial era or farmer paintings that are painted in a wider range of colours that suggests a different strategy and/or motivation. It has been shown that in some instances colonial era rock art may have been painted on a largely ad hoc basis.

In the context of this ad hoc interpretation for the colonial era paintings, the issue of geological ochre seepage into the site of Diepkloof has been examined. Some of the paintings do seem to have a nearby source for their ochre and the adjacent kopje proved a more likely source than the shale band at the site responsible for the geological seepage, but the latter was not

excluded as a possibility. The examination of the geological shale band also showed that the ochre assemblage was altered by its presence and that it introduced a considerable number of non-archaeological ochre nodules into the deposit of the site.

There is a disparity between the colours present in the excavated ochre assemblages and the colours in the rock art. Whilst the dominance of a certain colour in the rock paintings shows a preference for it, the opposite is true for the ochre present in the deposits. The excavated ochre, with the exception of striated nodules, represents only those pieces of ochre that were discarded in addition to those of a geological origin. By implication a large proportion of the potential assemblage at the site during its occupation is absent from the deposits as excavated by archaeologists.

A correlation has been shown to exist between the colour of an ochre nodule and its streaking quality, based on its physical properties. This correlation has implications for assessing potential motives for ochre selection and use, relating not only to the Later Stone Age, but the Middle Stone Age as well. The implication is that the active selection for one attribute necessitates a passive selection for the other. In other words, an active selection of an ochre nodule based on its colour means a secondary passive selection for its streaking quality and vice versa.

The concept of “ghost ochre” has been proposed as a means of explaining the volume of ochre which was brought to an archaeological site by its inhabitants and then used up in its entirety and is therefore absent in the excavated assemblages. Evidence of this missing or “*ghost ochre*” can be seen clearly by the observations made regarding the colours represented in the rock paintings. These same colours are frequently under-represented in the corresponding archaeology from the same sites. This implies that the ochre processing strategy employed was one which may have involved complete utilisation of ochre nodules.

A hypothesis for the processing strategy given in this thesis is that of ochre pulverisation takes preference over ochre grinding. Pulverising ochre nodules between upper and lower

grindstones followed by a 'milling action' was an effective reduction strategy that produced greater quantities of fine-grained powders in significantly less time than ochre grinding. An additional consequence of this process is that ochre nodules would have been utilised in their entirety which would account for the "*ghost ochre*" phenomenon as described above.

Finally, and perhaps most importantly, this thesis has illustrated beyond any doubt that the relationship between ochre and rock art is far more complex than was previously assumed by many researchers. It has also shown that the relationship is an inconsistent one displaying a significant amount of inter-site variation. The specifications of individual sites impact on the ochre sources available and on the ultimate utilisation of ochre.

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7. References



7. References

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8. Appendix



All Rock Art and Ochre Colour Observations

MUNSELL CODE	MUNSELL DESCRIPTION	DRS Counts	DRS Mass (g)	DRS Ochre mass %	DKS Rock Art cm2	DKS Rock Art %	DRS Rock Art cm2	DRS Rock Art %	DRS + DKS Rock Art cm2	DRS + DKS Rock Art %	AG1 Counts	AG1 Mass (g)	AG1 Ochre Mass %	AG1 Rock Art cm2	AG1 Rock Art %	DeH Counts	DeH Mass (g)	DeH Ochre Mass %	DeH Rock Art cm2	DeH Rock Art %
10R 3/3 / 10R 3/4 / 2.5YR 3/2	Dusky Red				385	4.68	41	0.50	426	2.60	14	33.70	5.06	1041	7.86					
10R 3/6	Dark Red	5	8.76	0.44	2	0.02	29	0.35	31	0.19	3	15.30	2.30	1149	8.67	2	10.50	1.85	34	0.53
10R 4/3 / 10R 4/4 / 10R 5/4 / 2.5YR 4/2	Weak Red	12	20.99	1.06	51	0.62	321	3.93	372	2.27	14	21.30	3.20	174	1.31					
10R 4/6 / 10R 4/8	Red	17	30.16	1.52	4314	52.41	3576	43.73	7890	48.09	16	80.10	12.03	3420	25.82	6	18.90	3.34	1316	20.71
10R 5/6 / 10R 5/8	Red	5	3.75	0.19	485	5.89	1586	19.40	2071	12.62	9	25.00	3.76	4796	36.20				438	6.89
2.5YR 2.5/4 / 2.5YR 3/3 / 2.5YR 3/4 / 5YR 3/3 / 5YR 3/4	Dark Reddish Brown	11	75.36	3.80	170	2.07	16	0.20	186	1.13	14	41.5	6.23			8	15.8	2.79	230	3.62
2.5YR 3/6	Dark Red	12	57.72	2.91			190	2.32	190	1.16	7	73.00	10.97			16	38.10	6.73	97	1.53
2.5YR 4/3 / 2.5YR 4/4 / 2.5YR 5/3 / 2.5YR 5/4 / 5YR 4/3 / 5YR 4/4 / 5YR 5/4	Reddish Brown	77	189.59	9.56	508	6.17	79	0.97	587	2.94	10	35.10	5.27			4	5.80	1.02	79	1.24
2.5YR 4/6 / 2.5YR 4/8	Red	150	381.13	19.21	287	3.49	685	8.38	972	5.92	61	207.40	31.16	413	3.12	51	244.90	43.23	2084	32.79
2.5YR 5/6 / 2.5YR 5/8	Red	138	254.11	12.81	1523	18.50	1527	18.67	3050	18.59	23	36.00	5.41	444	3.35	28	76.10	13.43	1919	30.19
2.5YR 6/6 / 2.5YR 6/8 / 2.5YR 7/6 / 2.5YR 7/8 / 10R 6/6 / 10R 6/8	Light Red	181	272.26	13.73	490	5.95	0	0.00	490	2.99	3	3.20	0.48	85	0.64	2	18.80	3.32	159	2.50
5YR 4/6 / 5YR 5/6 / 5YR 5/8	Yellowish Red	89	201.17	10.14							9	39.00	5.86	58	0.44	31	90.60	15.99		
5YR 6/6 / 5YR 6/8 / 5YR 7/6 / 5YR 7/8 / 7.5YR 6/6 / 7.5YR 6/8 / 7.5YR 7/6 / 7.5YR 7/8	Reddish Yellow	235	323.96	16.33			89	1.09	89	0.54	12	17.00	2.55	112	0.85	4	2.60	0.46		
7.5YR 4/2 / 7.5YR 4/3 / 7.5YR 4/4 / 7.5YR 5/3 / 7.5YR 5/4 / 10YR 4/3 / 10YR 5/3	Brown	18	41.48	2.09												4	4.70	0.83		
7.5YR 4/6 / 7.5YR 5/6 / 7.5YR 5/8	Strong Brown	8	13.76	0.69	16	0.19			16	0.10				101	0.76	15	28.40	5.01		
10YR 7/3 / 10YR 7/4 / 10YR 8/3 / 10YR 8/4	Very Pale Brown	25	23.69	1.19																
10YR 7/6 / 10YR 7/8 / 10YR 8/6 / 2.5Y 7/6 / 2.5Y 7/8 / 2.5Y 8/8	Yellow	18	12.55	0.63			38	0.46	38	0.23				1455	10.98					
Excluded Colours	/	63	73.15	3.69							6	38.10	5.72			7	11.30	1.99		
Total		1064	1983.59	100	8231	100	8177	100	16408	99	201	665.70	100	13248	100	178	566.5	100	6355.5	100

ANDRIESGROND OCHRE COLOUR , MAGNETISM , UTILIZATION

MUNSELL CODE	MUNSELL DESCRIPTION	Not Magnetic / Very Weak Magnetism						Weak Magnetism						Strong Magnetism						Totals				
		Counts	Mass	% of this Colour	% of all Colours in Mag group	Un	P / P	Def	Counts	Mass	% of this Colour	% of all Colours in Mag group	Un	P / P	Def	Counts	Mass	% of this Colour	% of all Colours in Mag group	Un	P / P	Def	Count	Mass (g)
10R 3/3 / 10R 3/4 / 2.5YR 3/2	Dusky Red	10	25.30	71.4	7.4	9	1	0	4	8.40	28.6	7.5	1	1	2	0	0.00	0.0	0.0	0	0	0	14	33.70
10R 3/6	Dark Red	2	1.10	66.7	1.5	2	0	0	1	14.20	33.3	1.9	1	0	0	0	0.00	0.0	0.0	0	0	0	3	15.30
10R 4/3 / 10R 4/4 / 10R 5/4 / 2.5YR 4/2	Weak Red	10	16.50	71.4	7.4	8	0	2	4	4.80	28.6	7.5	2	2	0	0	0.00	0.0	0.0	0	0	0	14	21.30
10R 4/6 / 10R 4/8	Red	14	63.50	87.5	10.3	10	2	2	2	16.80	12.5	3.8	2	0	0	0	0.00	0.0	0.0	0	0	0	16	80.10
10R 5/6 / 10R 5/8	Red	8	23.90	88.9	5.9	3	3	2	1	1.10	11.1	1.9	1	0	0	0	0.00	0.0	0.0	0	0	0	9	25.00
2.5YR 2.5/4 / 2.5YR 3/3 / 2.5YR 3/4 / 5YR 3/3 / 5YR 3/4	Dark Reddish Brown	4	6.20	28.6	2.9	3	1	0	10	35.30	71.4	18.9	6	1	3	0	0.00	0.0	0.0	0	0	0	14	41.50
2.5YR 3/6	Dark Red	5	39.90	71.4	3.7	5	0	0	2	33.10	28.6	3.8	2	0	0	0	0.00	0.0	0.0	0	0	0	7	73.00
2.5YR 4/3 / 2.5YR 4/4 / 2.5YR 5/3 / 2.5YR 5/4 / 5YR 4/3 / 5YR 4/4 / 5YR 5/4	Reddish Brown	2	6.00	20.0	1.5	1	1	0	8	29.10	80.0	15.1	6	0	2	0	0.00	0.0	0.0	0	0	0	10	35.10
2.5YR 4/6 / 2.5YR 4/8	Red	52	197.40	85.2	38.2	41	6	5	6	7.70	9.8	11.3	4	0	2	3	2.30	4.9	25.0	3	0	0	61	207.40
2.5YR 5/6 / 2.5YR 5/8	Red	15	19.50	65.2	11.0	12	0		5	11.80	21.7	9.4	3	1	1	3	4.70	13.0	25.0	3	0	0	23	36.00
2.5YR 6/6 / 2.5YR 6/8 / 2.5YR 7/6 / 2.5YR 7/8 / 10R 6/6 / 10R 6/8	Light Red	1	2.9	33.3	0.7	1	0	0	2	0.30	66.7	3.8	2	0	0	0	0	0.0	0.0	0	0	0	3	3.20
5YR 4/6 / 5YR 5/6 / 5YR 5/8	Yellowish Red	4	27.70	44.4	2.9	3	0	1	1	3.50	11.1	1.9	1	0	0	4	7.80	44.4	33.3	1	0	3	9	39.00
5YR 6/6 / 5YR 6/8 / 5YR 7/6 / 5YR 7/8 / 7.5YR 6/6 / 7.5YR 6/8 / 7.5YR 7/6 / 7.5YR 7/8	Reddish Yellow	7	11.00	58.3	5.1	6	1	0	3	2.30	25.0	5.7	3	0	0	2	3.70	16.7	16.7	2	0	0	12	17.00
7.5YR 4/2 / 7.5YR 4/3 / 7.5YR 4/4 / 7.5YR 5/3 / 7.5YR 5/4 / 10YR 4/3 / 10YR 5/3	Brown	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00
7.5YR 4/6 / 7.5YR 5/6 / 7.5YR 5/8	Strong Brown	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00
10YR 7/3 / 10YR 7/4 / 10YR 8/3 / 10YR 8/4	Very Pale Brown	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00
10YR 7/6 / 10YR 7/8 / 10YR 8/6 / 2.5Y 7/6 / 2.5Y 7/8 / 2.5Y 8/8	Yellow	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00
Excluded Colours	/	2	19.2	33.3	1.5	1	0	1	4	18.9	66.7	7.5	1	1	2	0	0	0.0	0.0	0	0	0	6	38.10
Totals	/	136	460.1	67.7	100.0	105	15	13	53	187.1	26.4	100.0	35	6	12	12	18.5	6.0	100.0	9	0	3	201	665.70

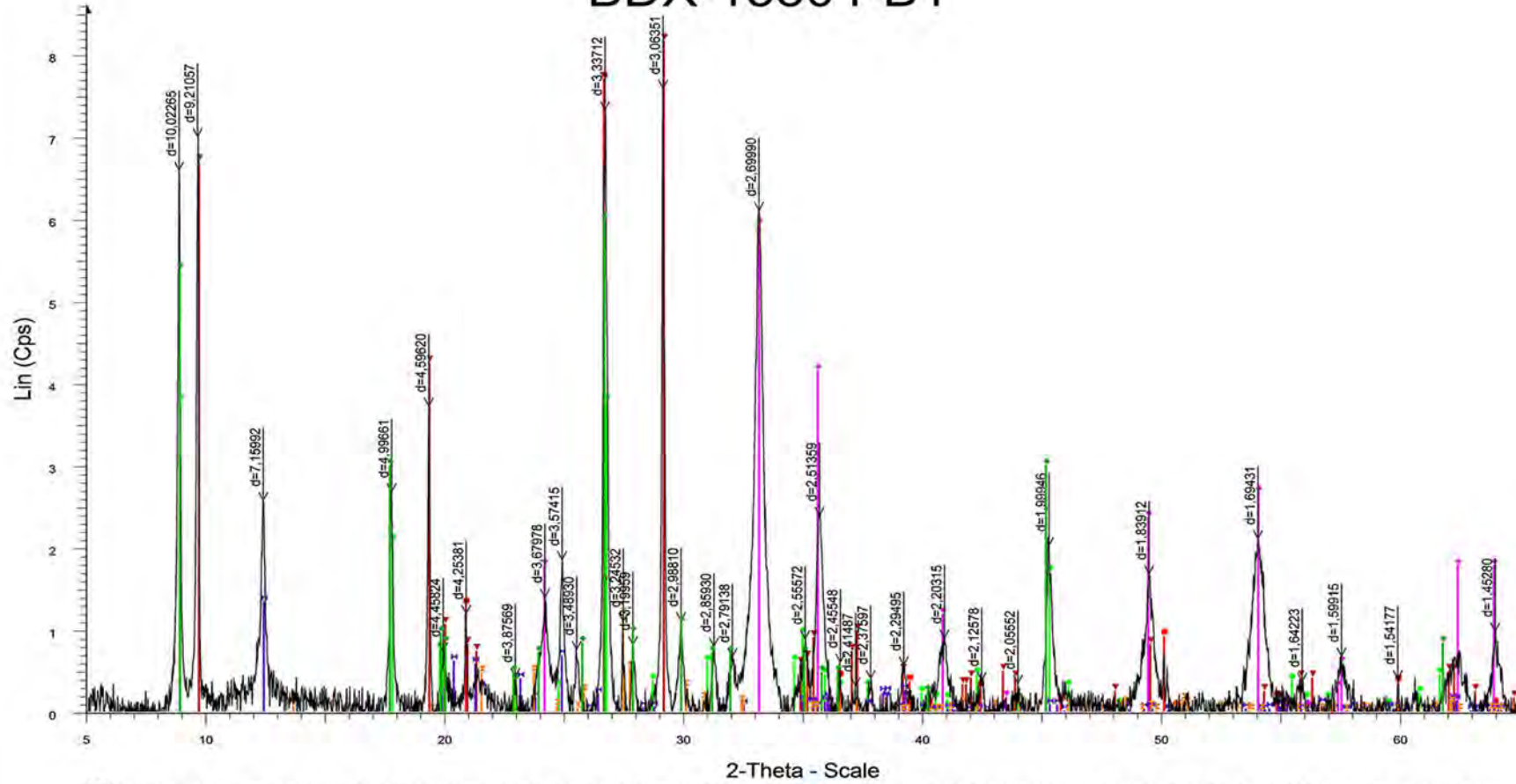
DIEPKLOOF OCHRE COLOUR , MAGNETISM , UTILIZATION

MUNSELL CODE	MUNSELL DESCRIPTION	Not Magnetic / Very Weak Magnetism						Weak Magnetism						Strong Magnetism						Totals				
		Counts	Mass	% of this Colour	% of all Colours in Mag group	Un	P / P	Def	Counts	Mass	% of this Colour	% of all Colours in Mag group	Un	P / P	Def	Counts	Mass	% of this Colour	% of all Colours in Mag group	Un	P / P	Def	Count	Mass (g)
10R 3/3 / 10R 3/4 / 2.5YR 3/2	Dusky Red	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	0	0
10R 3/6	Dark Red	1	2.56	20.0	0.2	1	0	0	2	2.66	40.0	0.8	1	1	0	2	3.54	40.0	1.6	2	0	0	5	8.76
10R 4/3 / 10R 4/4 / 10R 5/4 / 2.5YR 4/2	Weak Red	2	5.31	16.7	0.3	2	0	0	7	15.08	58.3	2.9	5	0	2	3	0.60	25.0	2.4	3	0	0	12	20.99
10R 4/6 / 10R 4/8	Red	9	19.60	52.9	1.4	7	1	1	6	9.01	35.3	2.5	5	0	1	2	1.55	11.8	1.6	2	0	0	17	30.16
10R 5/6 / 10R 5/8	Red	5	3.75	100.0	0.8	2	2	1	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	5	3.75
2.5YR 2.5/4 / 2.5YR 3/3 / 2.5YR 3/4 / 5YR 3/3 / 5YR 3/4	Dark Reddish Brown	3	26.48	27.3	0.5	2	0	1	5	36.75	45.5	2.1	4	0	1	3	12.13	27.3	2.4	2	1	0	11	75.36
2.5YR 3/6	Dark Red	6	13.35	50.0	0.9	5	0	1	4	18.04	33.3	1.7	2	2	0	2	26.33	16.7	1.6	2	0	0	12	57.72
2.5YR 4/3 / 2.5YR 4/4 / 2.5YR 5/3 / 2.5YR 5/4 / 5YR 4/3 / 5YR 4/4 / 5YR 5/4	Reddish Brown	18	57.30	23.4	2.8	16	1	1	32	89.46	41.6	13.4	29	0	3	27	42.83	35.1	22.0	27	0	0	77	189.59
2.5YR 4/6 / 2.5YR 4/8	Red	72	210.80	48.0	11.3	61	2	9	55	96.65	36.7	23.0	52	1	2	23	73.68	15.3	18.7	23	0	0	150	381.13
2.5YR 5/6 / 2.5YR 5/8	Red	97	186.46	70.3	15.2	94	2	1	33	44.03	23.9	13.8	29	3	1	8	23.62	5.8	6.5	6	1	1	138	254.11
2.5YR 6/6 / 2.5YR 6/8 / 2.5YR 7/6 / 2.5YR 7/8 / 10R 6/6 / 10R 6/8	Light Red	173	264.4	95.1	27.1	164	9	0	9	11.06	4.9	3.8	8	1	0	0	0	0.0	0.0	0	0	0	182	275.46
5YR 4/6 / 5YR 5/6 / 5YR 5/8	Yellowish Red	37	107.34	42.0	5.8	35	2	0	21	45.91	23.9	8.8	20	1	0	30	47.52	34.1	24.4	28	1	1	88	200.77
5YR 6/6 / 5YR 6/8 / 5YR 7/6 / 5YR 7/8 / 7.5YR 6/6 / 7.5YR 6/8 / 7.5YR 7/6 / 7.5YR 7/8	Reddish Yellow	172	267.10	73.2	26.9	170	2	0	51	45.47	21.7	21.3	51	0	0	12	11.39	5.1	9.8	11	1	0	235	323.96
7.5YR 4/2 / 7.5YR 4/3 / 7.5YR 4/4 / 7.5YR 5/3 / 7.5YR 5/4 / 10YR 4/3 / 10YR 5/3	Brown	0	0.00	0.0	0.0	0	0	0	11	28.10	61.1	4.6	11	0	0	7	13.38	38.9	5.7	7	0	0	18	41.48
7.5YR 4/6 / 7.5YR 5/6 / 7.5YR 5/8	Strong Brown	2	4.23	25.0	0.3	2	0	0	2	7.55	25.0	0.8	2	0	0	4	1.98	50.0	3.3	3	1	0	8	13.76
10YR 7/3 / 10YR 7/4 / 10YR 8/3 / 10YR 8/4	Very Pale Brown	24	21.40	96.0	3.8	23	1	0	1	2.29	4.0	0.4	1	0	0	0	0.00	0.0	0.0	0	0	0	25	23.69
10YR 7/6 / 10YR 7/8 / 10YR 8/6 / 2.5Y 7/6 / 2.5Y 7/8 / 2.5Y 8/8	Yellow	18	12.55	100.0	2.8	17	1	0	0	0.00	0.0	0.0	0	0	0	0	0.00	0.0	0.0	0	0	0	18	12.55
Excluded Colours	/	38	32.11	60.3	5.9	33	2	0	22	35.02	34.9	9.2	17	3	2	3	5.92	4.8	2.4	3	0	0	63	73.05
Totals	/	639	1202.63	63.8	100.0	601	23	15	239	452.06	23.9	100.0	220	9	10	123	258.55	12.3	100.0	116	5	2	1001	1913.24

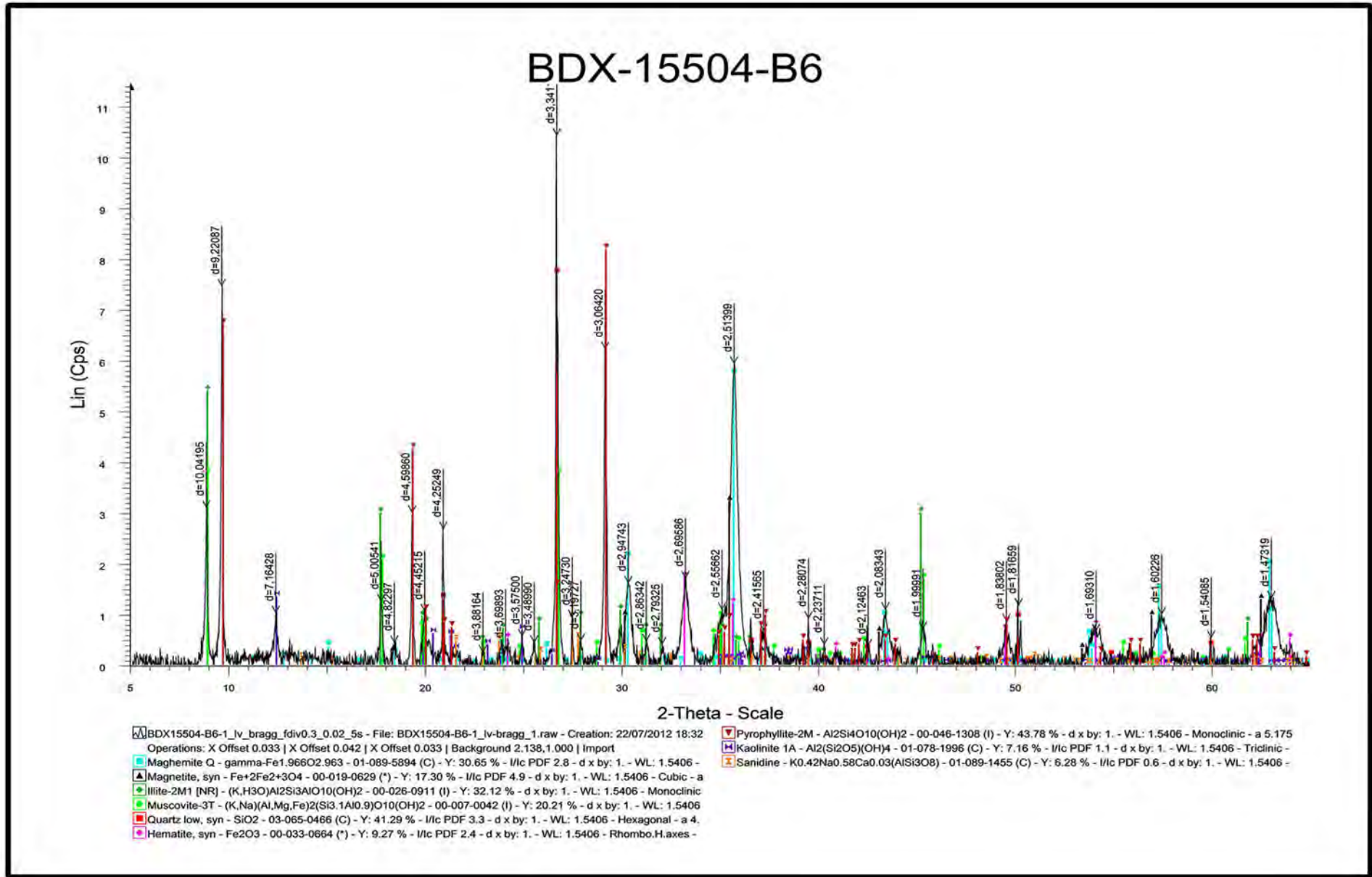
Examples of Ochre Streak Plates



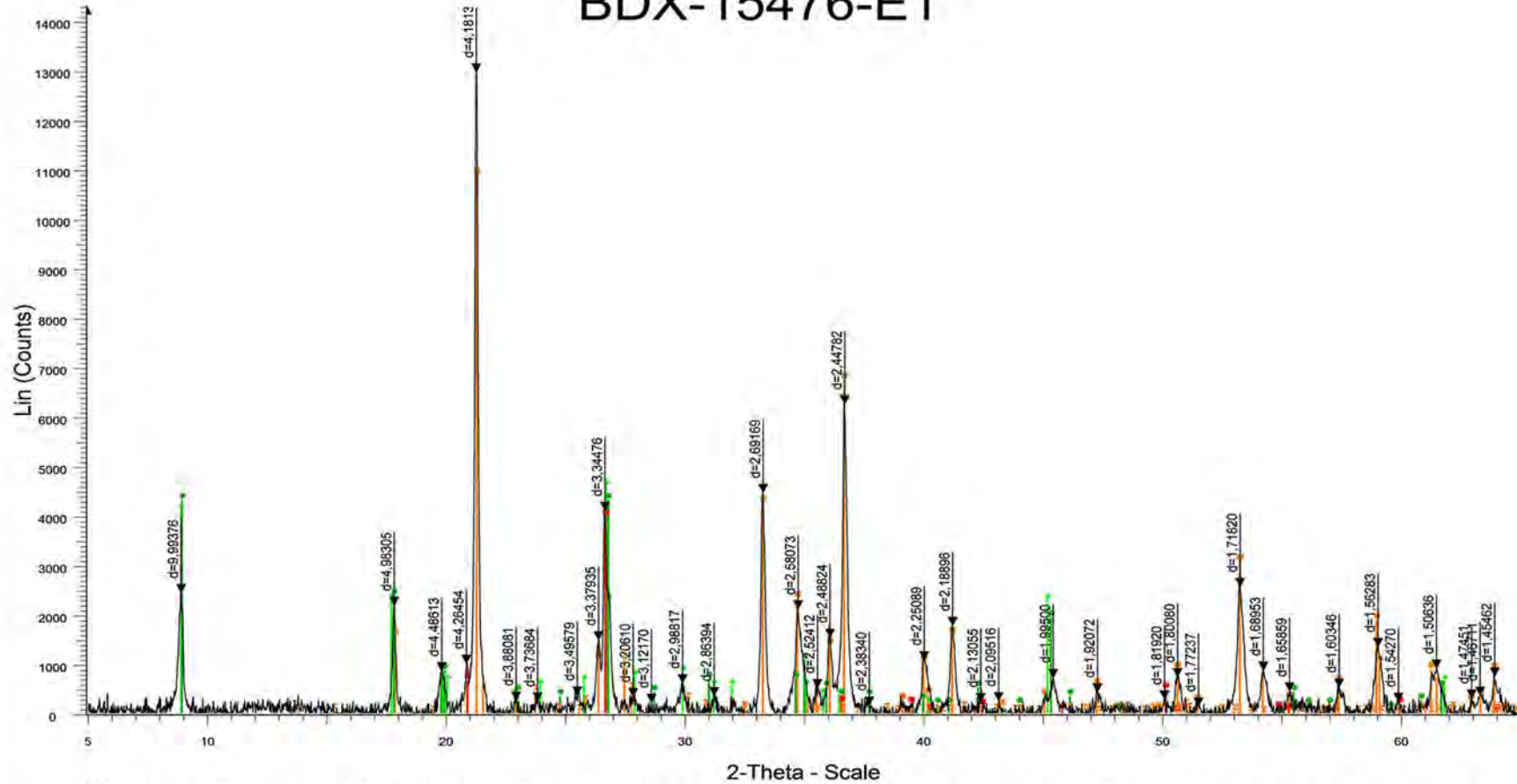
BDX-15504-B1



■ BDX15504-B1-0_iv_bragg_fdiv0.3_0.02_5s - File: BDX15504-B1-0_iv_bragg_1.raw - Creation: 22/07/2012 14:10
 Operations: Background 2.138,1.000 | Import
■ Illite-2M1 [NR] - (K,H3O)Al2Si3AlO10(OH)2 - 00-026-0911 (I) - Y: 37.36 % - d x by: 1. - WL: 1.5406 - Monoclinic
■ Muscovite-3T - (K,Na)(Al,Mg,Fe)2(Si3.1Al0.9)O10(OH)2 - 00-007-0042 (I) - Y: 23.51 % - d x by: 1. - WL: 1.5406
■ Quartz low, syn - SiO2 - 03-065-0466 (C) - Y: 48.03 % - I/Ic PDF 3.3 - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.
■ Hematite, syn - Fe2O3 - 00-033-0664 (*) - Y: 36.95 % - I/Ic PDF 2.4 - d x by: 1. - WL: 1.5406 - Rhombo.H.axes -
■ Pyrophyllite-2M - Al2Si4O10(OH)2 - 00-046-1308 (I) - Y: 50.92 % - d x by: 1. - WL: 1.5406 - Monoclinic - a 5.175
■ Kaolinite 1A - Al2(Si2O5)(OH)4 - 01-078-1996 (C) - Y: 8.33 % - I/Ic PDF 1.1 - d x by: 1. - WL: 1.5406 - Triclinic -

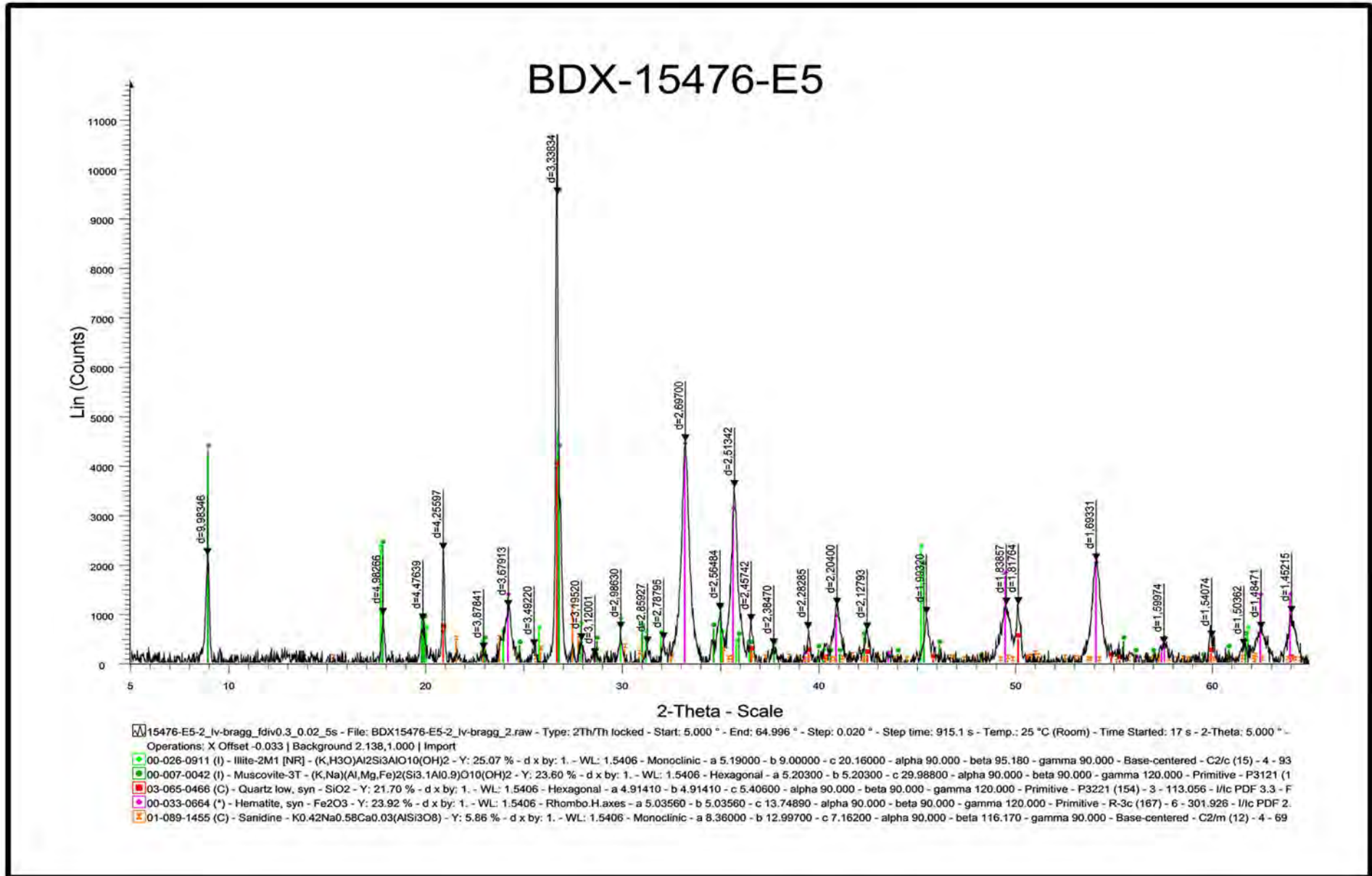


BDX-15476-E1

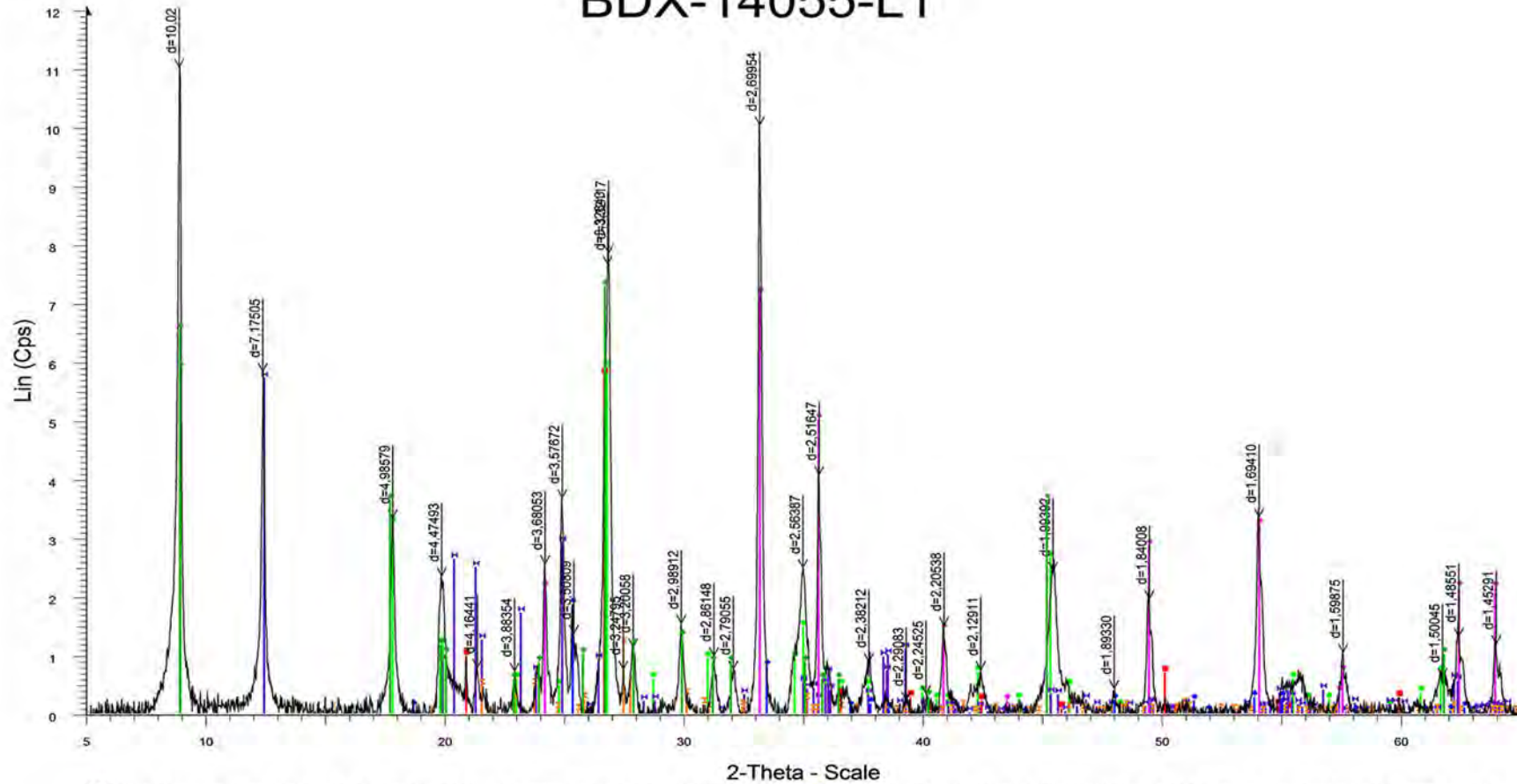


15476-E1-0_lv-bragg_fdiv0.3_0.02_5s - File: BDX15476-E1-0_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.000 ° - End: 64.996 ° - Step: 0.020 ° - Step time: 915.1 s - Temp.: 25 °C (Room) - Time Started: 16 s - 2-Theta: 5.000 ° -
 Operations: X Offset -0.067 | X Offset -0.033 | Background 1.445,1.000 | Import

- 01-081-0464 (C) - Goethite, syn - FeO(OH) - Y: 53.04 % - d x by: 1. - WL: 1.5406 - Orthorhombic - a 4.60480 - b 9.95950 - c 3.02300 - alpha 90.000 - beta 90.000 - gamma 90.000 - Primitive - Pbnm (62) - 4 - 138.639 - I/c PDF 2.7 -
- 00-026-0911 (I) - Illite-2M1 [NR] - (K,H3O)Al2Si3AlO10(OH)2 - Y: 22.34 % - d x by: 1. - WL: 1.5406 - Monoclinic - a 5.19000 - b 9.00000 - c 20.16000 - alpha 90.000 - beta 95.180 - gamma 90.000 - Base-centered - C2/c (15) - 4 - 93
- 00-007-0042 (I) - Muscovite-3T - (K,Na)(Al,Mg,Fe)2(Si3.1AlO.9)O10(OH)2 - Y: 21.03 % - d x by: 1. - WL: 1.5406 - Hexagonal - a 5.20300 - b 5.20300 - c 29.98800 - alpha 90.000 - beta 90.000 - gamma 120.000 - Primitive - P3121 (1
- 03-065-0466 (C) - Quartz low, syn - SiO2 - Y: 19.34 % - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.91410 - b 4.91410 - c 5.40600 - alpha 90.000 - beta 90.000 - gamma 120.000 - Primitive - P3221 (154) - 3 - 113.056 - I/c PDF 3.3 - F
- 01-089-1455 (C) - Sanidine - K0.42Na0.58Ca0.03(AlSi3O8) - Y: 5.22 % - d x by: 1. - WL: 1.5406 - Monoclinic - a 8.36000 - b 12.99700 - c 7.16200 - alpha 90.000 - beta 116.170 - gamma 90.000 - Base-centered - C2/m (12) - 4 - 69



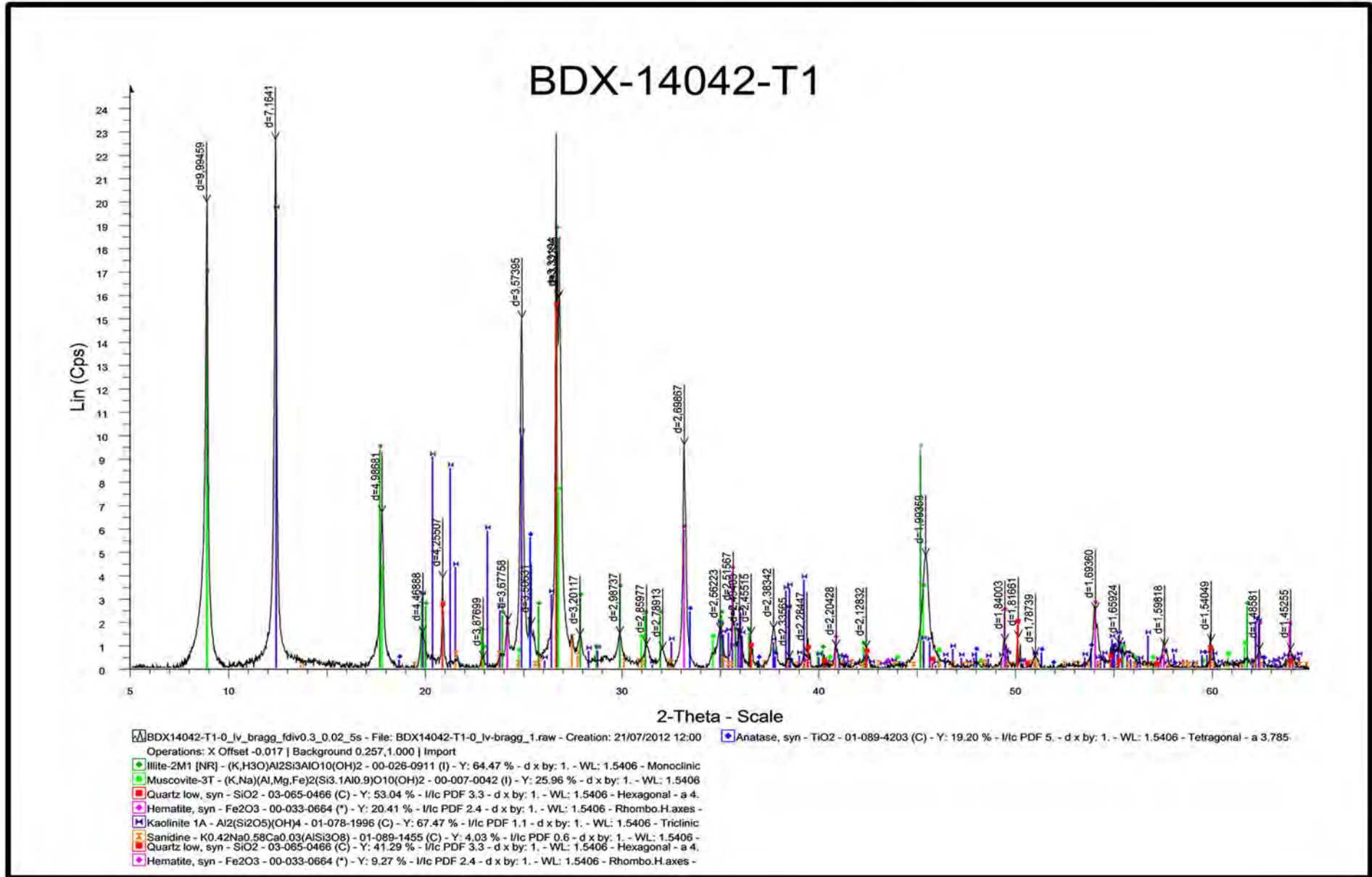
BDX-14055-L1



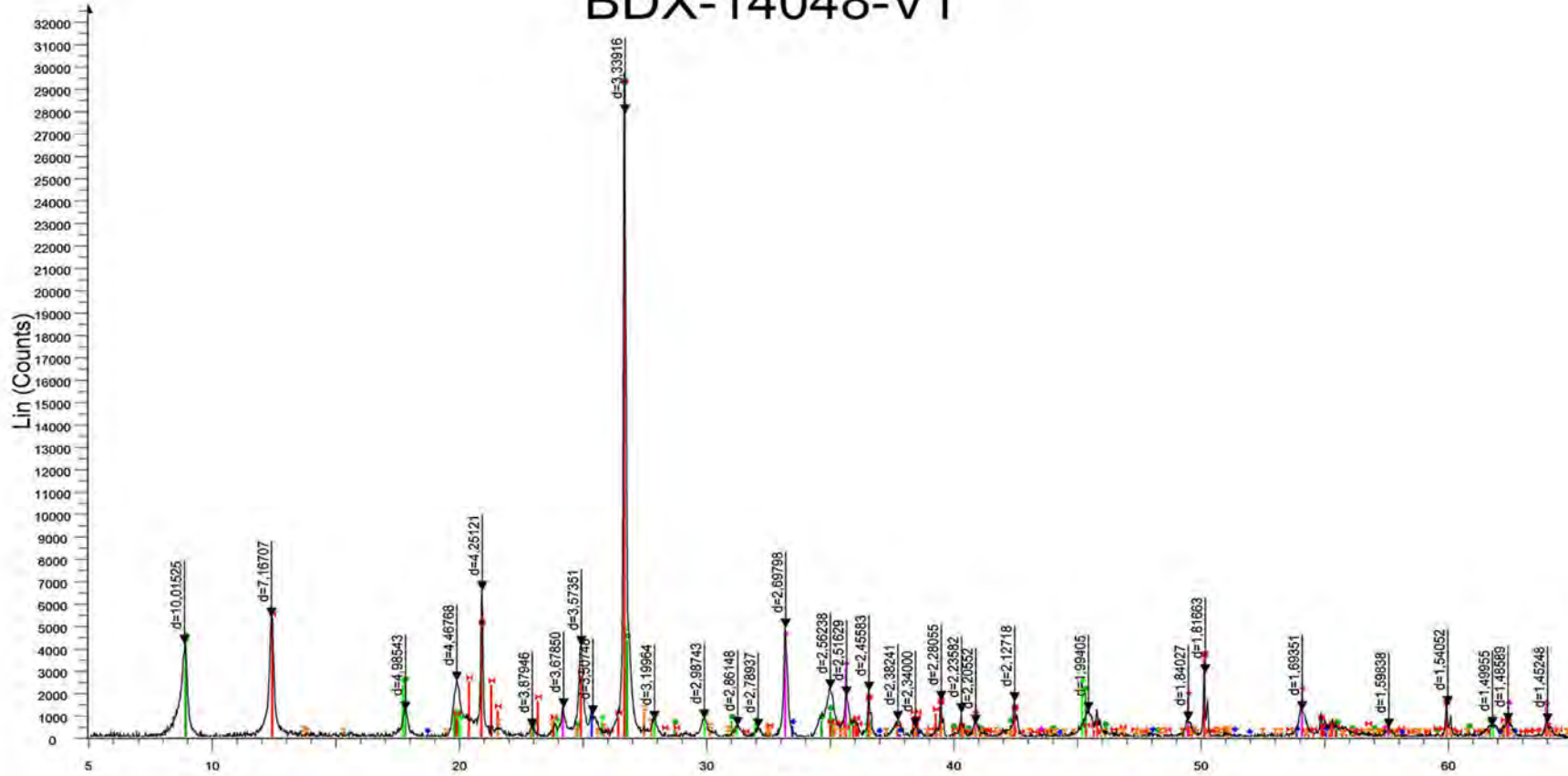
BDX14055-L1-0_lv_bragg_fdiv0.3_0.02_5s - File: BDX14042-L1-0_lv-bragg_1.raw - Creation: 22/07/2012 01:05; Anatase, syn - TiO2 - 01-089-4203 (C) - Y: 10.37 % - I/c PDF 5. - d x by: 1. - WL: 1.5406 - Tetragonal - a 3.785

Operations: Background 2.138,1.000 | Import

- Illite-2M1 [NFR] - (K,H3O)Al2Si3AlO10(OH)2 - 00-026-0911 (I) - Y: 40.58 % - d x by: 1. - WL: 1.5406 - Monoclinic
- Muscovite-3T - (K,Na)(Al,Mg,Fe)2(Si3.1Al0.9)O10(OH)2 - 00-007-0042 (I) - Y: 32.83 % - d x by: 1. - WL: 1.5406
- Quartz low, syn - SiO2 - 03-065-0466 (C) - Y: 32.20 % - I/c PDF 3.3 - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.
- Hematite, syn - Fe2O3 - 00-033-0664 (*) - Y: 39.90 % - I/c PDF 2.4 - d x by: 1. - WL: 1.5406 - Rhombo.H.axes -
- Kaolinite 1A - Al2(Si2O5)(OH)4 - 01-078-1996 (C) - Y: 31.85 % - I/c PDF 1.1 - d x by: 1. - WL: 1.5406 - Triclinic
- Sanidine - K0.42Na0.58Ca0.03(AlSi3O8) - 01-089-1455 (C) - Y: 6.52 % - I/c PDF 0.6 - d x by: 1. - WL: 1.5406
- Quartz low, syn - SiO2 - 03-065-0466 (C) - Y: 41.29 % - I/c PDF 3.3 - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.
- Hematite, syn - Fe2O3 - 00-033-0664 (*) - Y: 9.27 % - I/c PDF 2.4 - d x by: 1. - WL: 1.5406 - Rhombo.H.axes -



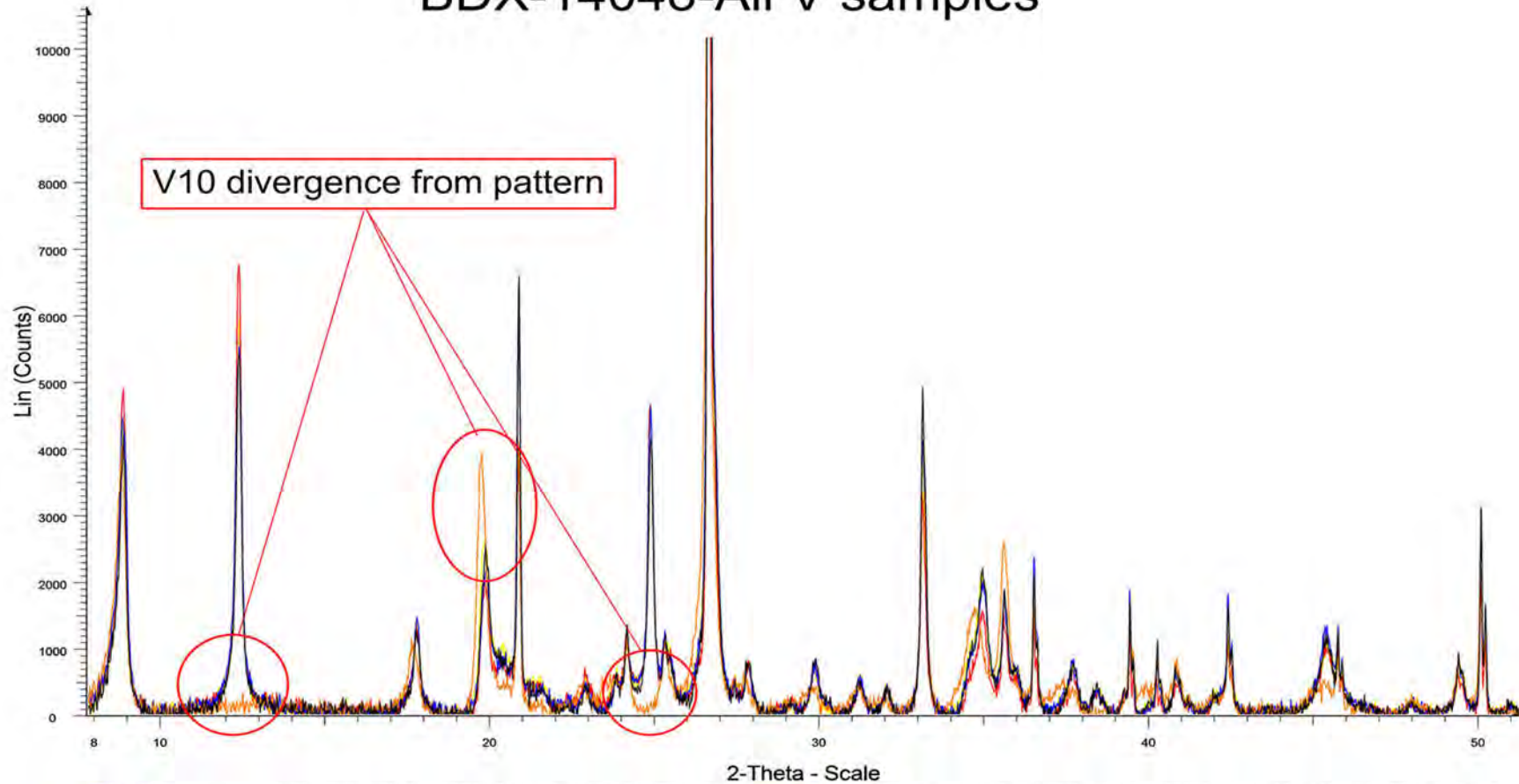
BDX-14048-V1



2-Theta - Scale

- 14048-V1-0_lv-bragg_fdiv0.3_0.02_5s - File: BDX14048-V1-0_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.0
 Operations: X Offset -0.042 | Background 0.977,1.000 | Import
- 00-026-0911 (I) - Illite-2M1 [NR] - (K,H3O)Al2Si3AlO10(OH)2 - Y: 13.63 % - d x by: 1. - WL: 1.5406 - Monoclinic
 - 00-007-0042 (I) - Muscovite-3T - (K,Na)(Al,Mg,Fe)2(Si3.1Al0.9)O10(OH)2 - Y: 12.83 % - d x by: 1. - WL: 1.5406
 - 03-065-0466 (C) - Quartz low, syn - SiO2 - Y: 86.54 % - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.91410 - b 4.91
 - 00-033-0664 (*) - Hematite, syn - Fe2O3 - Y: 13.00 % - d x by: 1. - WL: 1.5406 - Rhombo.H.axes - a 5.03560 - b
 - 01-078-1996 (C) - Kaolinite 1A - Al2(Si2O5)(OH)4 - Y: 15.66 % - d x by: 1. - WL: 1.5406 - Triclinic - a 5.15540 -
 - 01-089-1455 (C) - Sanidine - K0.42Na0.58Ca0.03(AlSi3O8) - Y: 3.19 % - d x by: 1. - WL: 1.5406 - Monoclinic - a
 - Kaolinite 1A - Al2(Si2O5)(OH)4 - 01-078-1996 (C) - Y: 67.47 % - I/Ic PDF 1.1 - d x by: 1. - WL: 1.5406 - Triclinic
 - Sanidine - K0.42Na0.58Ca0.03(AlSi3O8) - 01-089-1455 (C) - Y: 4.03 % - I/Ic PDF 0.6 - d x by: 1. - WL: 1.5406 -
 - Quartz low, syn - SiO2 - 03-065-0466 (C) - Y: 41.29 % - I/Ic PDF 3.3 - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.
 - Hematite, syn - Fe2O3 - 00-033-0664 (*) - Y: 9.27 % - I/Ic PDF 2.4 - d x by: 1. - WL: 1.5406 - Rhombo.H.axes -
 - 01-089-4203 (C) - Anatase, syn - TiO2 - Y: 3.16 % - d x by: 1. - WL: 1.5406 - Tetragonal - a 3.78500 - b 3.78500

BDX-14048-All V samples



- 14048-V9-1_lv-bragg_fdiv0.3_0.02_5s - File: BDX14048-V9-1_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.0
 Operations: X Offset -0.050 | Background 0.550,1.000 | Import
- 14048-V10-1_lv-bragg_fdiv0.3_0.02_5s - File: BDX14048-V10-1_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.0
 Operations: X Offset -0.050 | Background 0.537,1.000 | Import
- 14048-V1-0_lv-bragg_fdiv0.3_0.02_5s - File: BDX14048-V1-0_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.0
 Operations: X Offset -0.042 | Background 0.977,1.000 | Import
- 14048-V5-2_lv-bragg_fdiv0.3_0.02_5s - File: BDX14048-V5-2_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.0
 Operations: X Offset -0.058 | Background 0.550,1.000 | Import
- 14048-V6-3_lv-bragg_fdiv0.3_0.02_5s - File: BDX14048-V6-3_lv-bragg_1.raw - Type: 2Th/Th locked - Start: 5.0
 Operations: X Offset -0.067 | Background 0.550,1.000 | Import
- Kaolinite 1A - Al₂(Si₂O₅)(OH)₄ - 01-078-1996 (C) - Y: 67.47 % - I/Ic PDF 1.1 - d x by: 1. - WL: 1.5406 - Triclinic
- Sanidine - K_{0.42}Na_{0.58}Ca_{0.03}(AlSi₃O₈) - 01-089-1455 (C) - Y: 4.03 % - I/Ic PDF 0.6 - d x by: 1. - WL: 1.5406 -
- Quartz low, syn - SiO₂ - 03-065-0466 (C) - Y: 41.29 % - I/Ic PDF 3.3 - d x by: 1. - WL: 1.5406 - Hexagonal - a 4.
- Hematite, syn - Fe₂O₃ - 00-033-0664 (*) - Y: 9.27 % - I/Ic PDF 2.4 - d x by: 1. - WL: 1.5406 - Rhombo.H.axes -