AN ANALYSIS OF EARLY MIDDLE STONE AGE OCHRE FROM OLIEBOOMSPOORT ROCK SHELTER, SOUTH AFRICA

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Johannesburg, 2022

P L A G I A R I S M   D E C L A R A T I O N

I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

(Signature of candidate)

20th day of May 2022 at Johannesburg

A B S T R A C T

This study focuses on an analysis of ochre excavated from Olieboomspoort Rock Shelter (OBP), Limpopo, South Africa during the 2018/19 excavations. The MSA deposits from which this assemblage was excavated have been dated to approximately 150 ka. Macro and microscopic analysis was undertaken using established ochre analysis principles in order to investigate possible utilisation. Additionally, elemental analysis was undertaken in the form of semi-quantitative portable X-ray fluorescence in order to investigate geological characteristics. A comparison with the ochre assemblage from the 1954 excavations was also undertaken. The results of these analyses indicate that the most predominant raw material in the recent OBP assemblage is specular hematite (identical to that of the 1954 assemblage), which is unique in that it is exceptionally rare at other sites. Only 3% of pieces are definitely utilised, in contrast to the 14% utilised pieces of the 1954 assemblage. There is a preference for pieces with a red streak in both the utilised and unutilised assemblages, while red-purple and purple streak colours are also common. These results may provide support for the hypothesis that OBP was an accumulation site and possibly part of a wider ochre exchange network. If this hypothesis is correct, then this suggests that complex cognitive developments could have taken place even earlier than is commonly suggested (100 ka), around approximately 190-130 ka.

Keywords: Ochre, Olieboomspoort, Middle Stone Age, MIS 5, MIS 6

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CHAPTER 1: INTRODUCTION

Ochre, predominantly that which has been utilised, is one of the most widely consulted forms of evidence for inferring the presence or development of complex cognition and innovative behaviours in early *Homo sapiens* (Henshilwood & Lombard 2013; Dayet Bouillot *et al*. 2017: 20). The term “ochre” refers to a type of iron-rich rock usually containing hematite and/ or goethite (iron oxide and iron oxyhydroxide respectively), which can be used to produce a coloured streak (Watts 2002: 1; Wadley 2010: 267; Hodgskiss 2013b: 76). Ochre has been documented to have been (and is still) used for a wide variety of purposes, including as a natural sunscreen (Rifkin *et al*. 2015), insect repellent (Rifkin 2015), hafted tool adhesive ingredient (Wadley 2005a, b), physical adornment (Watts 2002), and as an ingredient in paint or as an art object itself (Henshilwood *et al.* 2002; 2009, see also Henshilwood *et al.* 2011). Most of these uses for ochre require deliberate forward thinking, communication, planning, and symbolic thought capabilities, and thus utilised (predominantly red) ochre has been shown to be indicative of the presence of complex cognitive abilities in its users in the deep past (Wadley 2003; Henshilwood & Lombard 2013; Wadley 2015).

The Middle Stone Age (MSA) began approximately 300 ka (Wadley 2015: 158). In sub-Saharan Africa, the MSA is widely considered to be the period during which *H. sapiens* began developing “complex cognition” – or thought patterns and behaviours similar to those of the humans of today (Wadley *et al.* 2009; Wadley 2010; Bernatchez 2012; Wadley 2013). Evidence for ochre collection and use is relatively common at MSA sites in southern Africa from around 100 000 years ago, and appears at the same time as numerous other innovative behaviours (Henshilwood & Lombard 2013: 114; Wadley 2015). Many of the sites which have produced the most compelling evidence for ochre use and its role in symbolic behaviours are located along or near the coast of South Africa – e.g., Pinnacle Point (Marean *et al.* 2007; Watts 2010), Blombos Cave (Henshilwood *et al.* 2009, 2011), Sibudu Cave (Hodgskiss 2013a, b), and Klasies River main site (d'Errico *et al.* 2012; Culey 2019). In an attempt to remedy this skewed geographical focus, this project undertakes a physical, followed by elemental analysis of an ochre assemblage recently excavated from the MSA levels of the inland site Olieboomspoort (OBP), located in Limpopo, South Africa. The excavations that produced the ochre analysed here were led by Dr Aurore Val in 2018 and 2019. Marine Isotope Stages 5 and 6 (MIS 5, 6) ochre use at OBP will also be compared to contemporaneous ochre assemblages from other inland and coastal sites.

1.1 Research Question and Aims

This research aims to establish which ochreous raw materials were collected at OBP and how ochre was utilised at the site during the MSA. It also aims to compare the results to broadly contemporaneous ochre use at other coastal and inland sites.

These aims will be achieved through the following objectives:

1. To quantify and describe, through macro- and microscopic examination, an assemblage of ochre pieces excavated from OBP in 2018 and 2019.
2. To investigate the elemental qualities of this ochre through portable X-ray fluorescence (XRF).
3. To compare results to the previously analysed Mason ochre assemblage from OBP housed in the Wits Archaeological collection.
4. To investigate ochre use and collection patterns at the site and in the broader landscape.
5. To compare the results of these analyses with those from previously analysed ochre from coastal (Pinnacle Point, Diepkloof Rock Shelter, Blombos Cave, Klasies River, and Hoedjiespunt) and inland (Wonderwerk Cave, Wonderkrater, Border Cave, Bushman Rock Shelter, Rose Cottage Cave, Cave of Hearths, and Mwulu’s Cave) sites.

1.2 Rationale

Well-known coastal sites such as Blombos Cave, Pinnacle Point, and Klasies River main site have been the focus of research into early innovative human behaviours (Val 2018: 2). At Blombos Cave, a MIS 5 ochre processing kit was discovered as well numerous engraved ochre pieces from Still Bay layers, one of which, it has been suggested, is the earliest example of art in the world (Henshilwood *et al.* 2009, 2011). Similarly engraved and scored pieces have also been found at Klein Kliphuis, Sibudu Cave, Pinnacle Point 13B and Klasies River main site (Mackay & Welz 2008; Watts 2010; d'Errico *et al.* 2012; Hodgskiss 2013b, 2014). The research on these assemblages has shown that the early humans who occupied these sites were capable of complex cognition and exercised symbolic behaviour. However, because this research focused on coastal or near coastal sites, relatively little is known about inland sites in comparison. The previously analysed MSA ochre assemblage from OBP, which was excavated in 1954, is unique in both raw material type and usage patterns, and thus has the potential to provide more information about ochre use in the interior region (Watts 1998, 2002). Analysing the 2018-2019 OBP ochre assemblage will contribute new information and understanding of ochre use in this area throughout the MSA. The ochre recovered from this site in the Mason assemblage is predominantly specular hematite, which is uncommon in other MSA assemblages (Watts 2002: 6) (Appendix 1). A complete analysis of the recently excavated ochre assemblage needs to be performed, including physical, microscopic, and elemental analyses to allow integration with the data from coastal sites. A detailed analysis of the OBP ochre may provide crucial insights into human behaviour and cognition and the various uses of ochre at this site, and more generally in the interior of South Africa at sites dating to the MIS 5/6/ MSA period.

CHAPTER 2: LITERATURE REVIEW

2.1 Background on Study Site: Olieboomspoort

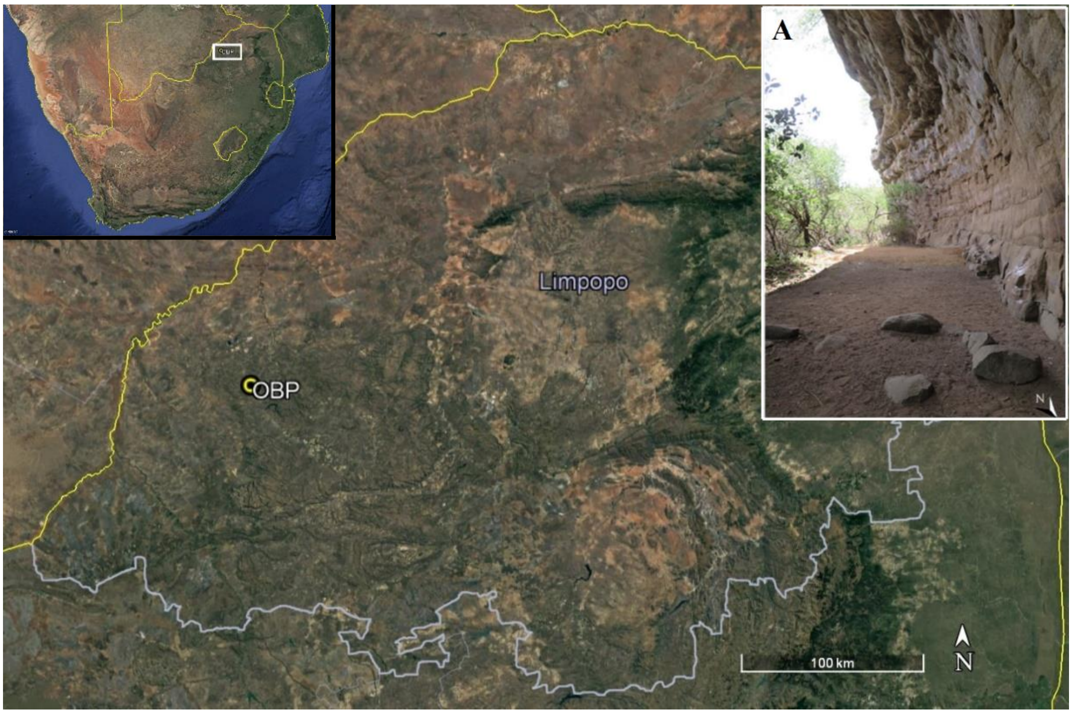

Figure 2.1. Location of OBP within South Africa (top left, indicated by white block), and Limpopo province. A: North view from inside OBP prior to the start of excavations in 2018 (photo D. Stratford).

OBP is a long, narrow red sandstone rock shelter in the Waterberg region of Limpopo Province, South Africa, which extends over an area of 70 metres, and is approximately 7 metres deep (van der Ryst 2006: 24, 48; Val 2018: 2) (Fig. 2.1). The shelter is located a few metres away from the generally perennial and shallow Riet Spruit, a tributary of the Mokolo River which runs across the Waterberg plateau (van der Ryst 2006: 24; Val 2018: 3). OBP today falls within the Savannah Biome and Summer Rainfall Zone (Val 2018: 3).

OBP contains approximately 50 metres of *in situ* archaeological surface deposit, which has provided evidence for sporadic human occupation from the beginnings of the Early Stone Age (ESA) to at least the Later Stone Age (LSA) (van der Ryst 2006: 48; Val 2018: 3). OBP is exceptional in that it is one of very few large rock shelter sites in the South African interior with such a long and relatively intact cultural sequence (e.g. Wonderwerk Cave, Bushman Rock Shelter). There is evidence for a very brief ESA presence, an MSA occupation spanning thousands of years, a long period of LSA use of the site, as well as more recent visits by a range of different groups of people (van der Ryst 2006: 23, 48; Val *et al.* 2021: 5; Val 2018: 3). During these occupations OBP was used as a rock art production site; typical San paintings, geometric Khoekhoe herder finger paintings, as well as geometric and animal depictions made by northern Sotho and Bantu language-speaking farmers are present (van der Ryst 2006: 229).

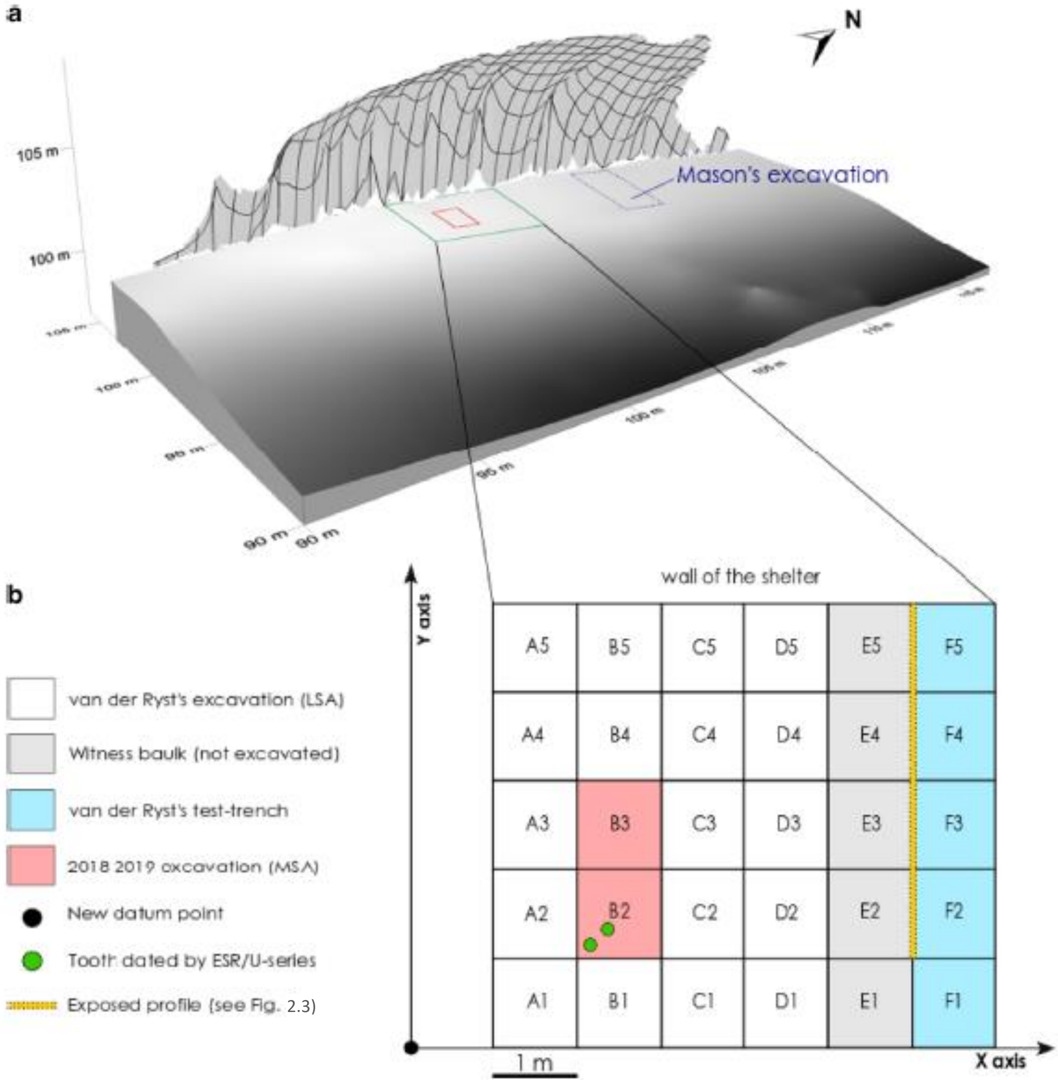

Figure 2.2. A: topographic map of OBP showing Mason's excavations in blue, van der Ryst's excavations in green, and Val's excavations in red (Val et al. 2021). B: 2018-2019 excavation area within van der Ryst's excavation, including the area in which the dated teeth were found and the profile seen in Fig. 2.3 (Val et al. 2021).

The name "Olieboomspoort" was used by the first Europeans who settled in the area to refer to the site, but it is also sometimes referred to as "Olieboompoort" in academic literature, particularly by Prof. Revil Mason (Mason 1962, 1988). The name derives from vernacular terms for either the exotic castor oil bush (*Ricinus* *communis*) or the thorn apple (*Datura stramonium*), joined with the Afrikaans word "poort" (van der Ryst 2006: 20-1). Both plants grow extensively around the site and are widely used in indigenous medicine (van der Ryst 2006: 21). OBP was first excavated by Prof. Revil Mason in 1954, followed by Dr Maria van der Ryst in 1997 (Val 2018: 2-5) (Fig. 2.2). The most recent excavations have been undertaken under the leadership of Dr Aurore Val in 2018 and 2019 (Val 2018: 2-5) (Fig. 2.2).

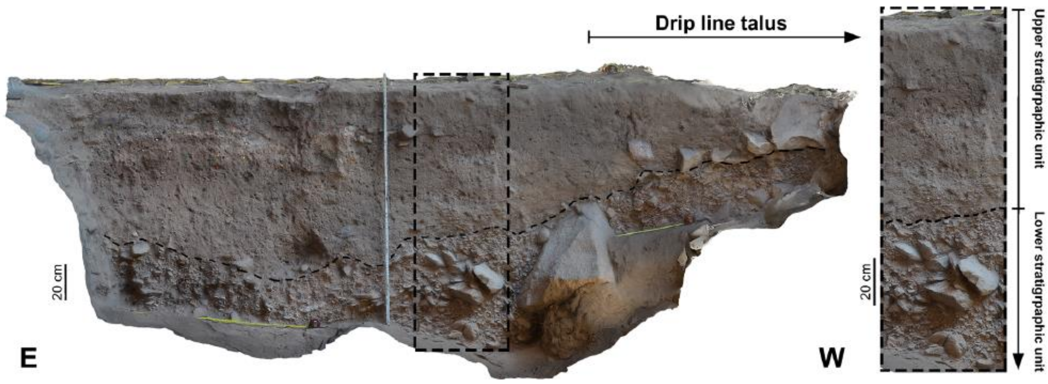

Figure 2.3. Exposed profile and representative stratigraphy (rectangle on the right-hand side expanded from profile image) (Val et al. 2021). The horizontal dotted line represents the contact between the upper (LSA) and lower (MSA) units (Val et al. 2021).

During Mason's excavations, the archaeological sequence was divided into four beds (Mason 1962). Bed 1, occurring at the bottom of the sequence, is dated to the ESA based on lithic types (Val *et al*. 2021: 8). Bed 2 is an MSA phase, the dating of which will be discussed below (Val *et al.* 2021: 8, 34). Bed 3 is an LSA phase, based on radiocarbon dating and lithic types, and Bed 4 an Iron Age surface layer (Val *et al.* 2021: 8). Beds 1 and 4 remain without more specific, definite dates (Mason 1962; Val 2018: 4; Val *et al*. 2021: 8). In 2018 Val's excavations of Bed 2, beginning where van der Ryst had removed the LSA levels (Fig. 2.2), differentiated sedimentary units based on Munsell chart colours and textures, owing to the lack of clearly defined stratigraphy (Fig. 2.3) (Val 2018: 9). Three MSA units were excavated in 2018/2019: Grey Sediment (GS), and Dark Reddish Grey sediment (DRG), and Yellow-Reddish Sand (YRS) (Val 2018: 4).

Bed 2 has been associated with the Middle Pietersburg industry, with an initial date of greater than 33 ka, extending beyond the range of radiocarbon dating (Mason 1962; van der Ryst 2006: 30; Val 2018: 7; Val *et al*. 2021: 8). The Middle

Pietersburg industry is a lithic techno-complex found at numerous South African sites, especially in the north, including Olieboomspoort, Cave of Hearths, Mwulu's Cave, Border Cave, and Bushman Rock Shelter (Val 2018: 2). Owing to the lack of more precise dating of this industry and the fact that it is defined on the basis of variations in tool type proportions as opposed to technological descriptions, it is less well-known than other southern African lithic industries such as Still Bay and Howiesons Poort (Val 2018: 2). It broadly corresponds, however, to other pre-Still Bay MIS 5 assemblages in South Africa (Wurz 2013; Mackay *et al.* 2014). Recent Uranium-series and Electro-Spin Resonance (ESR) dating on two fossilised equid teeth from the recently excavated GS unit in square B2 has provided an age estimate of approximately 150 ka for the MSA deposits at the site (Val *et al*. 2021: 21-22). This tentatively places these deposits, including the ochre assemblage from the GS and YRS units, within the range of the MIS 6 period (190 - 130 ka) (Val *et al*. 2021: 21-22) (see Appendix 2 for a brief summary of layers, dates, technocultural designation, and ochre pieces recovered).

2.2 Ochre Use at Inland and Coastal Sites during the MIS 6 and 5

There has been a marked discrepancy regarding the amount and resolution of data available on chronological sequences, technological/ cultural expressions, and subsistence strategies for MSA human populations on or near the coast versus contemporaneous human populations further inland (Val *et al.* 2021: 3). The experiences and activities of these early human populations at the coast cannot be assumed to have been similar to those of inland populations, taking the vastly different biomes, environmental conditions, and resources experienced by and available to them into account (Mitchell 2008: 58).

Considering the variations and similarities between coastal and inland sites in relation to ochre procurement and use can provide a better regional picture of ochre use in South Africa as a whole (Dayet Bouillot *et al*. 2017: 21). Variability in ochre use between western and eastern parts of the country has already been observed during the Howiesons Poort period, with the abundance and type of raw materials varying as a result of differing geological contexts and proximity to ochre sources (Dayet *et al*. 2013: 3503; Dayet Bouillot *et al*. 2017: 22). Raw material characteristics also dictate to some degree which processing and utilisation techniques will be effective (Dayet *et al.* 2013: 3503). A comprehensive list of South African sites with both ochre and ochre-related finds dated to the MIS 6 and MIS 5 periods can be found in Appendix 1. The focus of this research is the MIS 6 and 5 periods. At MIS 6 inland sites, geological classifications for ochre are not available with the same specificity as for MIS 5 assemblages (Appendix 1), with publications and excavation records often documenting only the presence of "ochre" nodules. Hematite and specularite are also noted (Appendix 1). Grinding and polish are the most common forms of use in the assemblages at these sites (Appendix 1). At the only coastal site with a known MIS 6 ochre assemblage, Pinnacle Point 13B, raw material described as "ochre" is also most common (Appendix 1). Grinding is the most common form of use in this assemblage, followed by scraping. At both inland sites and Pinnacle Point, red and variations of red are the most common colour (Appendix 1).

At MIS 5 inland sites, hematite and shale are the most common raw material in utilised assemblages, with iron oxide and specularite also present (Appendix 1). Grinding and rubbing, indicated by striations, polish, and smoothing are the most common forms of use at these sites. At coastal sites of the same period, siltstone and shale are the most common raw materials in utilised assemblages; iron oxide is not as frequent as at inland sites, and specularite is rare (Appendix 1). Grinding and rubbing are also the most frequent forms of use at MIS 5 coastal sites, indicated by striations, smoothing, grooves, and crayon-like shaped pieces, but incising and engraving occur more frequently at these sites than at those inland (Appendix 1). Red is the most common colour for utilised pieces at both inland and coastal sites (Appendix 1).

Observations made about ochre from well-known coastal sites thus cannot simply be extended to sites in the interior (Dayet Bouillot *et al.* 2017: 22). A more detailed investigation into the similarities/ differences between inland and coastal sites would also be beneficial in developing our understanding of MSA social and behavioural interactions. "Similarities in material culture across long distances" are often interpreted as being indicative of social interactions or trade, though similarities can also be caused by similar biomes and resource availability (though not by these alone) (Dayet Bouillot *et al.* 2017: 36). When comparing ochre from different sites, the obvious criteria on which comparisons are based are usually colour and raw material selection (Dayet Bouillot *et al.* 2017: 37). However, these criteria are limited in that they are too broad to allow for finer comparisons, and there is also a high variability of the geological context which impacts raw material choice (Dayet Bouillot *et al.* 2017: 37). A more comprehensive comparison of inland and coastal sites should include these aforementioned criteria *as well as* forms of use/ use-wear traces on ochre and how utilised pieces have been interpreted, in order to begin to build a more detailed picture of ochre use at inland and coastal sites. This will allow the details of each site to be taken into account while also providing an avenue for broader comparison. In Appendix 1, inland and coastal sites are compared using this more comprehensive set of criteria.

2.3 Background on MSA (MIS 6 and 5) Ochre Use in South Africa

The MSA is generally agreed to have begun at approximately 300 ka, and incorporates MIS 8-3 (Wadley 2015: 158). MIS 6 (190 – 130 ka) and 5 (130 – 84 ka) are most relevant to this study, given the estimated age of the study assemblage from OBP, as well as the fact that most of our understanding of early MSA ochre use is from MIS 5 assemblages (Fig. 2.4).

In South Africa, the only evidence for utilised ochre dated to the pre-MIS 6 period (approximately 500 – 200 ka) are five pieces of specularite, hematite, and specular hematite (four of which are utilised) from Kathu Pan (Watts *et al*. 2016: 293), two pieces of specularite, one of which is ground, from Canteen Kopje (Watts *et al.* 2016: 293), and a single piece of "pencil-like" hematite with signs of grinding from Nooitgedacht (Beaumont & Morris 1990; Barham 2002: 188). Even between 190 ka and 100 ka, evidence for ochre utilisation, particularly as a pigment, is rare (e.g., Marean *et al.* 2007; Dayet *et al.* 2013; Culey 2019).

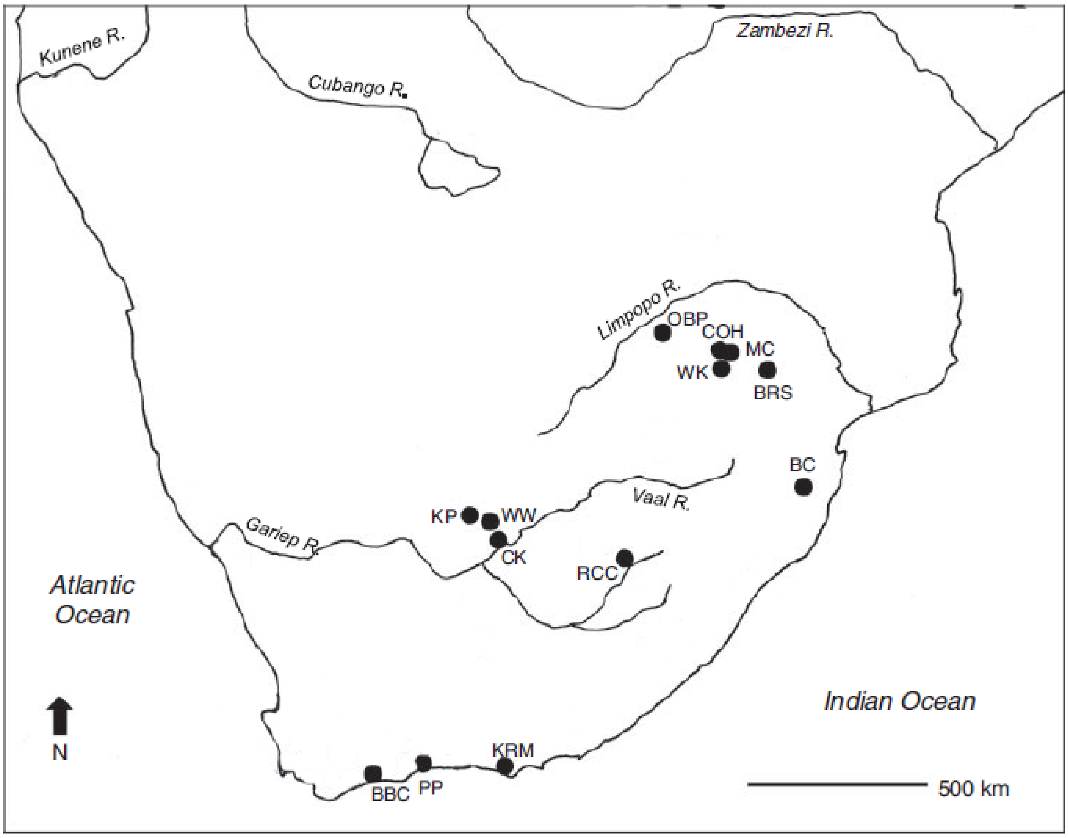

Figure 2.4. Location of sites mentioned in chpt. 2.3 (adapted from Wadley 2015). OBP: Olieboomspoort, COH: Cave of Hearths, MC: Mwulu's Cave, WK: Wonderkrater, BRS: Bushman Rock Shelter, BC: Border Cave, WW: Wonderwerk, KP: Kathu Pan, CK: Canteen Kopje, RCC: Rose Cottage Cave, BBC: Blombos Cave, PP: Pinnacle Point, KRM: Klasies River Main site.

For the period of 190 – 130 ka, geological description and interpretations of ochre are also not as detailed and specific as those that are available for later assemblages. Overlapping slightly with the pre-MIS 6 period, an assemblage of pigment pieces dated to between 227 ka – 144 ka has been recovered from Border Cave, but a very small percentage of these pieces appear to have been utilised (Watts 1998; Backwell *et al.* 2018: 4). Six incised ironstone slabs dated to 187 ka have been found at Wonderwerk Cave, though it is argued that these may not be part of the "engraving tradition" suggested for MIS 5 coastal sites (Chazan & Horwitz 2009). Possibly utilised pieces are also found in small quantities at Wonderkrater and Bushman Rock Shelter. Additionally, higher quantities of pigment pieces, with a higher percentage of them definitely utilised, have been found at the coastal site Pinnacle Point (Watts 2010).

For the period of 130 – 84 ka, ochre showing traces of deliberate, anthropogenic modification and use occurs more frequently (Watts 2002: 5,8; Dayet *et al.* 2013; Henshilwood & Lombard 2013: 114; Hodgskiss & Wadley 2017). Large amounts of worked and incised ochre pieces approximately dated to MIS 5 have been found at Blombos Cave, some of which are argued to have been part of a geometric engraving tradition which may have begun around 100 ka (Henshilwood *et al.* 2009: 45). Deliberately utilised pieces are also found at numerous inland sites including Border cave, Rose Cottage Cave, Bushman Rock Shelter, Cave of Hearths, and Mwulu's Cave, most of which are thought to have been ground in order to produce a pigment powder (Appendix 1). Many studies on utilised MIS 5 ochre share this powder production hypothesis, with some suggesting that this powder may have been used as a mastic component, for personal adornment, or as a paint component (Singer & Wymer 1982: 117; Watts 2009: 90; Henshilwood *et al.* 2011: 222; Hodgskiss & Wadley 2017: 16-18).

Ochre-related finds such as objects with staining or pigment residues, grindstones, and other ochre-processing objects are also a relatively rare occurrence in the archaeological record prior to and during the beginning of the MIS 5 period. These finds can also contribute to the understanding of how ochre was used in the past. No such ochre-related finds have been recovered thus far from MIS 6 layers at any South African sites, but rare examples are reported at other African MIS 6 sites, such as Twin Rivers in Zambia (Barham 2002) and Pomongwe in Zimbabwe (Beaumont & Bednarik 2013). Grindstones, bone tools, and lithics with ochre residues, as well as various types of shell beads with ochre staining, are generally found more frequently towards the end of MIS 5 and into MIS 4 (van der Ryst 2006: 180; Dayet *et al.* 2013: 3493). There are however some sites which have presented significant ochre-related finds, particularly grindstones, dated to the earlier MIS 5. A toolkit for processing ochre into pigment dated to 100 ka has been found at Blombos Cave, and includes ochre-stained grindstones and an abalone shell used as a container for the compound pigment mixture (Henshilwood *et al.* 2011: 219-22). Grindstones are also found at Klasies River (dated to 110 – 100 ka) and Mwulu's Cave (dated to >100 ka) (Watts 1998; Culey 2019).

2.4 Interpretations of MSA Ochre

In sub-Saharan Africa, the MSA is widely considered to be the period during which "complex cognition" or "modern human behaviour" developed (Henshilwood & Marean 2003; Wadley *et al.* 2009; Wadley 2013). In South Africa specifically, MSA levels at archaeological sites have produced a wealth of evidence for complex cognition, including ochre that has been utilised for both functional and non-functional purposes (some of which is outlined above) (Wadley 2015: 155).

It is difficult to infer a general pattern of behaviour regarding ochre exploitation during the earlier period of the MSA, dating to before 75 ka, as this requires more precisely detailed information from the relatively small ochre assemblages (Henshilwood *et al.* 2009: 29; Dayet Bouillot *et al.* 2017: 21), as well as a more well-developed theoretical basis (akin to that available for the later MSA period) (Watts *et al.* 2016). There are thus a wide variety of interpretations of the ochre record and the beginnings of so-called symbolic or complex behaviours (Henshilwood *et al.* 2009: 29; Watts *et al.* 2016; Dayet Bouillot *et al.* 2017: 21). This includes the symbolic use of red ochre pigment including as a form of personal adornment, engraved ochre, as well as the functional use of ochre as a compound adhesive, sunscreen, hide tanning agent, or the intentional heat treatment of ochre, for example (Watts 2002; Wadley 2003; Henshilwood *et al.* 2009; Wadley *et al.* 2009; Rifkin 2015; Rifkin *et al.* 2015; Wojcieszak *et al.* 2017). All of these activities require complex cognitive capabilities to complete successfully. Complex cognition can be defined as "a set of capabilities that include abstract thought, analogical reasoning, multi-tasking, and cognitive fluidity" (Wadley 2015: 156). Coolidge and Wynn (2016: 390) and Wadley (2021) also suggest that enhanced working memory enabled the significant cultural developments evident in the archaeological record during this period and was responsible for the more complex ways of thinking present in early *H. sapiens*. Similar to those identified by Wadley (2015), aspects of enhanced working memory include "organization in space and time, selective inhibition, response preparation, goal attainment, planning, and flexibility", as well as phonological, visuo-spatial storage capabilities (Coolidge & Wynn 2005: 6, 9).

Somewhat in contrast with this internalist school of thought, embodied cognition argues that cognitive functions do not evolve as a "complete package" completely contained within the mind (Garofoli 2019: 382-4). The embodied cognition school of thought also suggests that the mind and outside world are constructed simultaneously through their entanglement with one another, and that cognitive functions developed "through their hybridization with behavioural practices, artifacts, and other social forms" (Garofoli 2019: 382-4). Embodied cognition also includes material engagement theory, which suggests that artifacts themselves have the ability to shape the social world, which in turn stimulates cognitive transformations (Garofoli 2019: 383). Furthermore, symbolism is seen as "only one of many ways in which hominins exploited material things … to shape their own sociality", and thus does not indicate the appearance of "modern" cognition (Garofoli 2019: 383). These theories offer an avenue for interpretation of MSA ochre that more explicitly includes factors outside of the ochre pieces and users themselves, and allow for a broader view of the place of ochre within the suite of behavioural developments which suggest complex cognitive capabilities.

A large portion of both symbolic and functional interpretations of ochre use during the MSA is based upon analogy to ethnographic and modern uses of the material, as there is no written record or living memory available for the former period from which to draw. For example, there are numerous 18th, 19th, and 20th century ethnographic accounts documenting the use of ochre as a cosmetic material among the San, Tswana, Xhosa, and Khoe in southern Africa (Rifkin 2015: 65). In modern day Namibia and Angola, the OvaHimba grind chunks of red ochre in order to produce a powder, which is then mixed with clarified butter to form a compound which is applied to the hair, body, and jewellery/attire (Rifkin *et al.* 2015: 2). Apart from this cosmetic use as skin protection and social signifier, the ochre compound is also used in initiation ceremonies, and is applied to the deceased before burial (Rifkin 2015: 66). Furthermore, ochre is used for more functional purposes, as a sunscreen and insect (particularly mosquito) repellent (Rifkin 2015: 66). Ochre has also been observed to be used as a mineral supplement in some of these modern OvaHimba communities (Rifkin 2015: 66).

With regards to hide tanning, San in the Karoo are documented to have utilised a compound of fat and "red clay" during hide processing in the 1920s (Bleek 1928: 9). Ochre and fat were also used in a similar way by Bantu language-speaking agro-pastoralists during the mid-20th century (Schapera & Goodwin 1953: 147; Fehr 1968: 30). Additionally, specularite was used by Tswana groups who would grind this substance into a powder, mixing it with fat, and applying the resultant compound to their hair, similar to the OvaHimba use of red ochre (Robbins 2016: 118). Many accounts indicate that specularite was a highly valued cosmetic component (Thackeray *et al.* 1983: 17; Robbins 2016: 118-24). There are also accounts which suggest that specularite could have been used as a sunscreen, and that it was also used by the San in hairdressing (Thackeray *et al.* 1983: 17; Robbins 2016: 120-3). Although the use of ethnographic and modern analogies regarding ochre provide a means for us to begin to understand and interpret how ochre may have been used during the MSA, these analogies tend to overlook the diversity of ochre use within and between study groups (Pargeter 2014; Dayet Bouillot *et al.* 2017: 21). Using modern groups as an analogy for MSA peoples and practices also poses a danger in that it may present the former as not having "progressed" past the MSA (Mitchell 2012; Pargeter 2014). Analogies should be used cautiously and their limitations taken into account in order for them to be truly useful.

2.5 Previous Research on Ochre Use at Olieboomspoort

The ochre finds at OBP during the MSA are distinctive; the previously analysed assemblage from the site is one of the heaviest (approx. 12 kg) ochre assemblages excavated at any MSA site in southern Africa (Watts 1998; van der Ryst 2006: 172). Pigments such as ochre, hematite, and specularite generally occur fairly frequently at sites in the Waterberg region, but hematite in particular occurs most frequently at OBP, with specularite/ specular hematite appearing to be most abundant in the MSA levels (Watts 1998; van der Ryst 2006: 172; Watts 2002: 8).

A large proportion of the ochre pieces excavated by Mason exhibit use-traces in the form of striations, faceting, and polish (which is not to say that an unusually large proportion is utilised – about 13%, which is average for MIS 5 sites) (Watts 1998, 2002; van der Ryst 2006: 180). Most of the utilised ochre fragments appear to have been ground, and there also exists several ochre-stained possible grindstones from the MSA levels at the site that appear to confirm this (Mason 1962: 260; van der Ryst 2006: 180; Dayet *et al*. 2013: 3493). It is likely that the ochre fragments were ground against the grindstones in order to produce a powder (Mason 1962: 273). In terms of the possible uses for this powder, painting as well as cosmetic preparation are mentioned – "Transvaal Middle Stone Age people knew about colour and used it for painting red or yellow designs on their bodies, for at some sites like Olieboomspoort we found hundreds of haematite fragments, including many that show signs of being rubbed for reddish powder" (Mason 1962: 236).

Table 2.1. Comparison of data from Mason vs Watts analyses of OBP ochre.

BED 2	Ochre fragments	Raw material	Grindstones	Weight	% of ochre in total lithic and ochre assemblage
Mason (1962)	364	Hematite, ochre	5	/	18.19 %
Watts (1998)	304	Specular hematite	2	12 kg	8.22 %

These ochre fragments and grindstones occur in fairly large quantities. A total of 364 ochre and hematite fragments and five grindstones were recorded by Mason in Bed 2 (Table 2.1). At the time this was given an approximate date of greater than 33 000 B.P. (1962: 84, 273; Watts 1998: 702). In his re-examination of the Bed 2 material, Watts identified 304 pigment fragments and two grindstones (1998: 703, 707) (Table 2.1). The discrepancies in ochre and grindstone counts may be due to the loss of some material during its transfer to the University of the Witwatersrand and the curation process (Watts 1998: 707). In spite of this lower count, ochre still comprises 8.22% of the total combined (ochre and lithic) assemblage from Bed 2, with a total weight of 12 kg (ochre alone); both values are high enough to be considered anomalous compared to other assemblages of the same period (Watts 1998: 704-5; Table 2.1). In contrast to Mason's initial classification of these Bed 2 fragments as mostly hematite, Watts (1998: 704-5) identified the majority (98.69%) as specular hematite, whereas van der Ryst uses specularite to refer to the same raw material (Table 2.1). The fragments are frequently referred to as "pencils", based on the effects of grinding on their shape and appearance (Mason 1962).

Streak colours are somewhat dependant on mica content of the piece and range from deep red to metallic grey-red (Watts 1998: 704). Specularite at OBP is hard, generally with hardness readings of Mohs 5, which would make grinding more time consuming and labour intensive (Watts 1998: 706). Some of the ground pieces display a reflective finish/ polish, and Watts (1998:706) raises the question whether this finish might have been a goal of grinding. Both utilised nodules and nodules with no signs of modification are widespread in most, if not all, excavated assemblages and time periods from sites in the Waterberg, suggesting that this area may have been a centre of sorts for a broad range of ochre related activities (Watts 1998; van der Ryst 2006: 173).

A likely local source of the (unutilised) hematite common in both the MSA and LSA levels of OBP has been identified as the Bushveld Complex (van der Ryst 2006: 178). The Bushveld Complex contains mafic rocks and granites, and includes "ferric oxide or hematite of igneous origin in the form of hematite conglomerates in pebbles and rollstones, crystal matrices and sheets of specularite", all of which frequently occur in the OBP ochre assemblage (van der Ryst 2006: 178). This apparent preferential collection (but not use) of this hematite at OBP suggests it was collected specifically for a certain purpose, but this remains to be seen. The bulk and mass of hematite obtained from these levels may also suggest capabilities for advance planning in the original gatherers of this ochre (van der Ryst 2006: 179).

With regards to specularite, a possible source is in the area nearby the vicinity of Thabazimbi iron ore deposits, which are part of the Penge formation (Watts 1998: 705). Watts further states that "the intensity of the ferruginisation within the ore bodies is directly correlated with the brecciation of the Pengue formation due to karstic collapse" of the underlying Frisco formation dolomites, and that sinkholes in the dolomites may contain soft specularite-rich ores (1998: 705-6). The "pebbley and nodular nature" of some of the specularite found at OBP may have been caused by a process of brecciation (Watts 1998: 706). It has been suggested further (based partly on the anomalously high quantities of this heavy material present) that OBP could have been a "special purpose" or "factory" site, where brilliant materials such as this were collected, processed, and/or used, (Watts 1998: 706; van der Ryst 2006: 174, 9). Some of the specularite was likely transported, possibly as part of a regional trade network (Watts 1998: 706).

CHAPTER 3: METHODS

3.1 Assemblage

The study assemblage consists of 452 pieces of ochre (excluding pieces <10 mm in length) excavated in 2018 and 2019 at OBP (Appendix 3). The pieces are from the layers Yellow-Reddish Sand (YRS), Grey Sediment (GS), and Dark Reddish Grey (DRG). Layer GS consists of *décapages* 1 – 32 and 34, DRG consists of *décapages* 2 and 4, and YRS consists of *décapages* 1 – 14. A handful of pieces are also from the test trench and profile cleaning; these are classified as “other” layers. All pieces are from squares B2 and B3 (Fig. 2.2).

a) Cleaning

Figure 3.1. Piece OBP-3653-1, recovered from YRS dec. 8, before (left) and after (right) acid cleaning.

Owing to the fact that most pieces in the assemblage were covered in calcium carbonate concretions, some almost entirely, acid treatment was undertaken to remove these residues before analysis could be done (Fig. 3.1). In order to test the efficacy of the acid solution and to ensure it would not damage the pieces, an initial test was performed on eight sample pieces including hard hematite, soft shales, and snuffbox shale, as well as two concreted pieces from the study assemblage which did not show any visible indications of use. Four samples were placed in 10% acid solution, and four in 20% acid solution, and left for approximately 40 minutes. Both solutions were equally effective, with the 20% solution working more quickly. They were then removed from the solution and rinsed with water. This test indicated that this method of cleaning would not cause significant damage to hard pieces, of which most of the assemblage is comprised.

Pieces were chosen for acid cleaning based on the presence of concretions to the extent that it inhibited accurate size and weight measurement, surface feature visibility, as well as streak tests and raw material identification. Pieces that were of an overall shape/ surface shape that may indicate use (e.g. flat surfaces may suggest grinding), or that had concretions obscuring a part of the piece which may potentially exhibit use-wear were also chosen. Pieces were not cleaned if measurement, weighing, streak tests, and raw material identification could be accurately performed as is, or if the piece was of a soft/ crumbly raw material or of an irregular shape which did not suggest use. Prior to cleaning the study assemblage, details of the pieces to be cleaned were put into an excel sheet in order to record the percentage solution being used, the period the piece was submerged for, and any other relevant notes (Appendix 4).

The number of pieces in each bag before cleaning was noted, as well as the number of times each piece was submerged and whether spot cleaning occurred. Photographs were taken before and after cleaning with a scale and the label for the piece. Each section of the containers used for cleaning was labelled and the corresponding pieces placed inside. Containers were also marked with the percentage solution to be used in those containers to ensure no pieces were mistakenly cleaned with the incorrect solution. Twenty percent solution was used for pieces with significant concretions, especially to the point where the piece was almost entirely obscured. For pieces with less concretions that were still partially obscured, ten percent solution was used. Spot treatment was used for pieces where only a particular area of the piece needed to be cleaned, and for pieces with signs of use in order to avoid submerging the areas with possible use. Cleaning was avoided where possible for these pieces which already showed possible signs of use, but in some cases it could not be avoided. These pieces were marked on the excel sheet and on the cleaning containers so extra care could be taken. The respective solutions were poured into the containers and a timer started. Pieces were continually observed, then removed when there was no longer a reaction/ when the concretions had dissolved. Pieces were then placed into another container of clean water to be rinsed, and placed on paper towels with their labels to dry overnight.

Given the lack of literature presently available on cleaning methods for ochre, particularly those involving acid, the above methods can be considered experimental. Given this, there is an opportunity for more formal experiments concerning ochre cleaning methods which can be addressed in future research.

b) Sourcing trip

Figure 3.2. Some of the pieces collected from areas surrounding OBP.

In May of 2021, several pieces were collected from around the site and neighbouring areas of Thabazimbi and Lephalale, for the purposes of discerning a possible source of the ochre in the study assemblage and understanding the different raw material types present within it (Fig. 3.2). These pieces were placed in a database with the same categories as those in the database used to record the characteristics of ochre in the study assemblage (discussed below in sections 3.2 a and c) and photographed. The pieces collected during the sourcing trip were then informally experimented with, being utilised (ground against a flat rock) to test their colouring abilities, specularity, etc (Fig. 3.3). These experiments allowed for a better understanding of the raw material and how use-traces form on the pieces during specific activities.

Figure 3.3. Streaks produced by pieces collected during the sourcing trip from around OBP.

3.2 Analysis

A combination of predominantly non-destructive methods was used, namely macro and microscopic analyses, as well as elemental (pXRF) analyses, which are enhanced with experimental and actualistic data. This allows for more detailed and precise information about the study assemblage (Popelka-Filcoff *et al.* 2007; d'Errico *et al.* 2012; Dayet Bouillot *et al*. 2017; Hodgskiss & Wadley 2017; Wojcieszak *et al*. 2017). The methods used in this study are discussed below in sub-paragraphs a-d.

a) Macroscopic analysis

All pieces were given individual numbers and packaged individually in sealable plastic bags, with piece numbers referring to the bucket number with which the piece was associated during excavation. A standard set of criteria including streak colour, hardness, approximate size and weight, grain size, raw material, specularity, and metallic lustre (discussed in section 3.2. b) was used to macroscopically analyse each piece (Hodgskiss 2010; Hodgskiss 2012: 103-6; Hodgskiss 2013b: 77; Hodgskiss & Wadley 2017: 7). A "general shape" category was also included, with each piece being classified as either "irregular" or "nodule". The details of these criteria are described below in sections i-vi.

i) Streak colour

It is acknowledged that colour classification by way of streak tests presents a risk, in that it cannot be done without damaging the surface of the piece and thus compromising any use traces that may exist in the area of the piece where the test is done (Dayet Bouillot *et al*. 2017: 24). In spite of this, streak tests are a fairly accurate way of determining the colour of a piece, as the outside colour may not necessarily be the same as the colour produced when the piece is utilised. This is especially the case with specular hematite, which is often black on the outside. Streak tests are also useful for determining whether the piece can actually be classified as ochre. Streak tests were thus performed using only the unutilised/ least likely to be utilised surfaces of each piece against a pale-coloured matte porcelain tile (Hodgskiss 2012: 105; Velliky *et al.* 2018: 9-10). The colour of the streak produced was then given a corresponding Munsell code. These codes have been refined to basic colour groups in the database, in order to allow for a more easily understandable analysis of colour throughout the entire assemblage (Appendix 3).

ii) Hardness

Hardness is also difficult to test accurately without damaging the piece (Dayet Bouillot *et al.* 2017: 24). In order to minimize potential damage, hardness tests were performed at the same time as streak tests, and thus were also only performed on unutilised/ the least likely to be utilised surfaces. These tests consisted of the piece being scraped firmly against various samples in the Mohs hardness test kit – this was done on the same area used for streak tests. Each piece was then assigned to a level on the Mohs hardness scale. These have been been grouped in the database to s (soft), m (medium), and h (hard) (Appendix 3). These categories correspond to Mohs scale: s = levels 1 and 2, m= levels 3, 4, and 5, and h= levels 6 and 7.

iii) Size and weight

The approximate width, length, and breadth of each piece was taken in millimetres using a digital calliper. For weight measurements (in grams), a digital scale was used.

iv) Grain size

Grain sizes were assigned based on relative size categories utilised by Hodgskiss (2012: 105): clayey (diameter <4 μm), silty (diameter 4–50 μm) and sandy (diameter ~50 μm–2 mm), and are appraised on a sliding scale (Velliky *et al.* 2018: 9). In the database, these have been given numerical codes: 1 (silty), 2 (clayey), 3 (sandy), 4 (clayey/ silty), and 5 (silty/ sandy) (Appendix 3).

v) Specularity and metallic lustre

Specularity is a glittery, sometimes crystalline quality which is visible macroscopically. Specularity is differentiated from metallic lustre by the fact that individual, reflective "grains" are more visible and give a sparkling effect, while metallic lustre is a metallic sheen on the piece.

vi) Raw material

Pieces were also identified by geological/ raw material categories. These were determined through analysis of macroscopic characteristics including structural variability, grain size, hardness, mica inclusions, specularity, and metallic lustre. The details of each raw material type are discussed in section 3.2. b.

vii) General shape

Angular, chunky pieces which do not have a uniform shape and which in some cases appear to have been broken off from a larger piece/ nodule are classified as "irregular". "Nodule" refers to pieces which have a generally smooth and rounded appearance.

b) Raw materials

In order to avoid ambiguity and to clarify what the terminology used in this study means, a description of and type specimen for each raw material type present in the analysed assemblage is provided. These descriptions are general, and there are variations within each raw material type. The terms "specularite", "specular hematite”, and “hematite” are often used interchangeably, leading to confusion in how these raw materials are grouped and classified. As briefly stated in chapter 2, section 2.5., Mason (1962) uses the term hematite, Watts (1998) uses the term specular hematite, and van der Ryst (2006) uses the terms specularite or specular hematite interchangeably for the material from OBP – all referring to the same or similar types of ochre from the same assemblage. Comparisons with methods and terminology used by Watts (1998; 2002) were also considered as a basis, though the terminology in this study does differ from Watts’ work. Furthermore, the type specimen is a piece which exemplifies the described characteristics, but not every piece of that raw material will resemble the type specimen closely. When referring to analyses by other authors, the terminology they use has been retained. Additionally, although they are terms often used by other authors to describe ochre, “pigment” or “colouring material” will not be used unless it can be said with certainty that the ochre in question was used for colouring purposes (Hodgskiss 2010: 3344-45). Sections i-v below illustrate the main raw material types found in the Val ochre assemblage from OBP.

i) Specular hematite

Figure 3.4. Specular hematite Type 1 type specimen OBP-3341-1, recovered from YRS dec. 5.

There is noticeable variation within this raw material type, which incorporates two main sub-types. Specular hematite is sometimes referred to simply as specularite by other authors. The two sub-types (specular hematite and specularite) will be discussed together as specular hematite in chapter four.

Type 1: The first and most predominant form of specular hematite is medium to hard with a dark black, sometimes silvery grey metallic outer colour (Watts 1998: 178) (Fig. 3.4). Given the fairly hard and dense nature of this type of specular hematite, it is relatively difficult to produce a streak. Most streaks are a dark, almost black purple or dark red colour, sometimes including visible specular particles which produce a glittery effect (Barham 2002: 183-4; Velliky *et al*. 2018: 9). Crushed or ground specular hematite can sometimes produce a glittery black or red powder (Watts 1998: 178). Pieces of this raw material are always specular, some very clearly so, particularly on edges/ faces which have been broken and the inside of the piece exposed (Fig. 3.4). Some pieces also shed specular particles when being handled. This type of specular hematite is predominantly fine-grained, with most pieces having small grain sizes – silty (4-50 μm), clayey (< 4 μm), or a combination of the two.

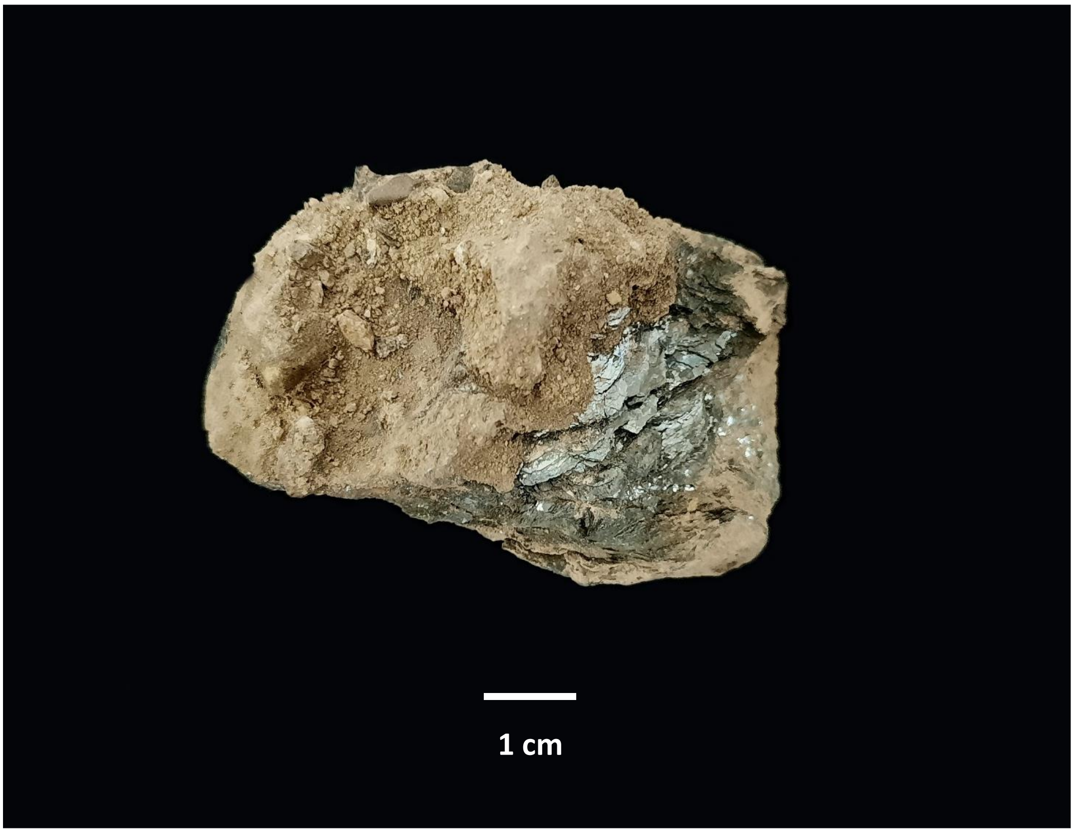

Figure 3.5. Specular hematite Type 2 type specimen OBP-1744-1, recovered from GS dec. 12.

Type 2: This less common specular hematite type has the highest levels of specularity, but is also not as suitable for colouring purposes as Type 1 owing to its flakey, highly micaceous structure (Fig. 3.5). The streak produced by this type ranges from dark red to dark purple, and can contain flakes from the piece. This type also tends to visibly shed more specular micaceous particles than type one. The outer colour is the same as Type 1 – metallic grey (Fig. 3.5). Type 2 specular hematite has a silty (4-50 μm) or clayey (< 4 μm) grain size, and hardness ranges from medium to hard.

ii) Hematite

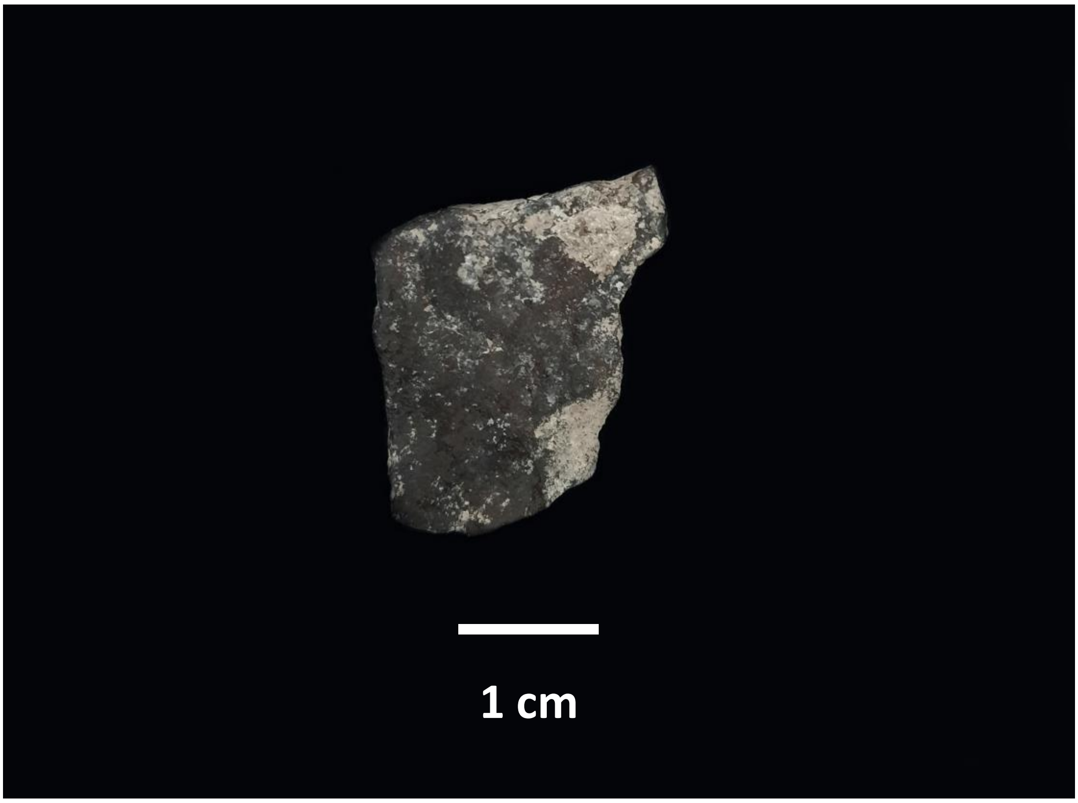

Figure 3.6. Hematite type specimen OBP-4708-2, recovered from DRG dec. 2.

This raw material, although broadly similar to specular hematite, is differentiated predominantly by the fact that it is not specular, and generally does not contain shiny, micaceous particles (Fig. 3.6). Hematite is a medium to hard raw material with a dark/ black surface colour (Fig. 3.6). This raw material is predominantly of clayey (< 4 μm) and clayey/ silty (< 4-50 μm) grain size; it is slightly coarser-grained than Type 1 specular hematite. It is also difficult to produce a streak with this material. Streak colours generally range between red, dark red, dark purple, and dark red purple.

iii) Ferricrete conglomerate

Figure 3.7. Ferricrete conglomerate type specimen OBP-321-2, recovered from GS dec. 3.

This raw material is the most coarse-grained in the assemblage from OBP, with grain sizes ranging from clayey/ silty (< 4-50 μm) to silty/ sandy (4 μm-2 mm) (Dayet *et al.* 2013: 3497; Henshilwood *et al.* 2014: 294). The wide variation in the texture of these heterogonous ferricrete conglomerates generally makes them unsuitable for use as a colouring material, though the pieces in this assemblage do produce a streak, predominantly of a dark purple/ red colour (Watts 1998: 182). Specularity occurs, but metallic lustre is never present (Fig. 3.7). Ferricrete conglomerate pieces are of medium hardness (Henshilwood *et al.* 2014: 294), and often have visible inclusions of quartz; they are "material cemented by iron minerals" (Watts 1998: 181) (Fig. 3.7).

iv) Mudstone

The mudstone from OBP generally exhibits a clayey (< 4 μm) grain size, and is also much softer than specular hematite, with pieces categorised as soft to medium (Watts 2002: 4; Watts 1998: 179). Mudstone pieces tend to be crumbly in texture, and produce a fine powder when streak tests are performed. While this raw material does exhibit some specular qualities, metallic lustre is not present (Fig. 3.8). Mudstone also has the most vibrant and most easily produced streak out of all the raw materials, predominantly a dark red colour.

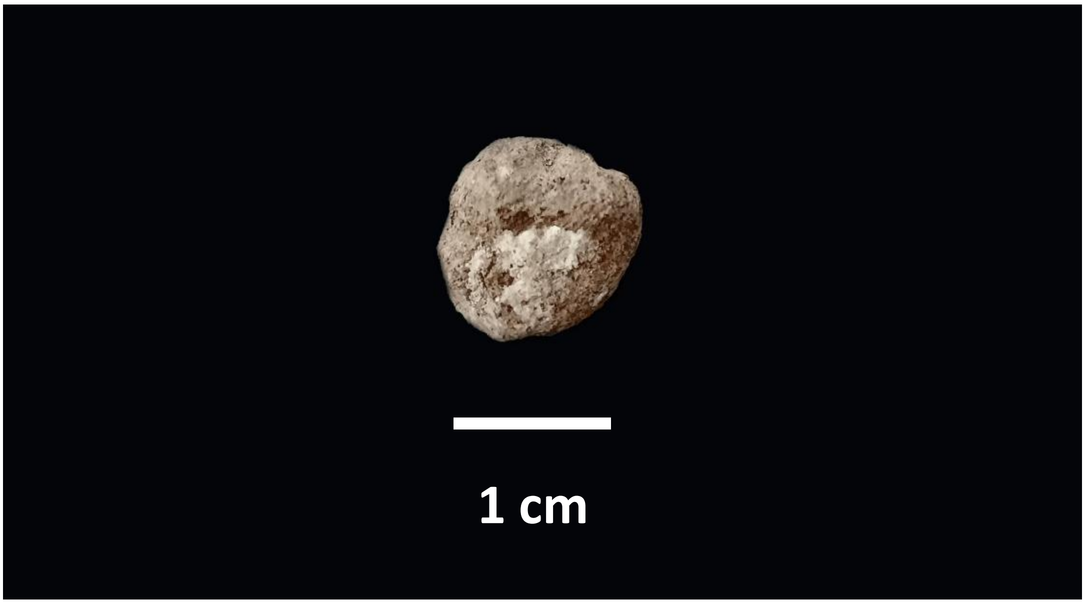

Figure 3.8. Mudstone type specimen OBP-1120-2, recovered from GS dec. 10.

v) Shale

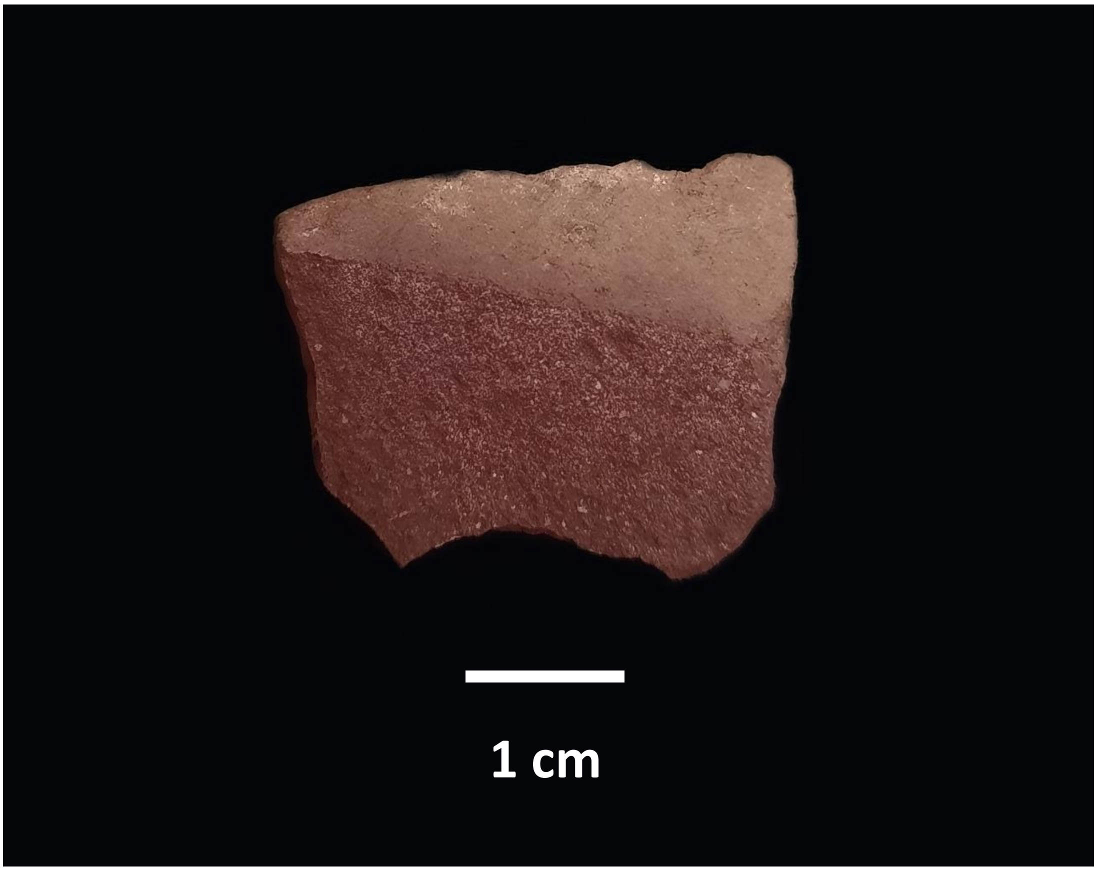

Figure 3.9. Shale type specimen OBP-3290-4, recovered from YRS dec. 4.

Shale from OBP is fine-grained, predominantly silty (4-50 μm), with a fissile structure (i.e. a structure which allows it to be fairly easily broken along the natural platy structure of the grain). Most pieces are specular, but none have metallic lustre (Fig. 3.9). This raw material has a medium hardness; is not as soft as mudstone, but not as hard as Type 1 specular hematite. There is a visible difference between the cortex and the interior of some of these pieces, with the former being a brown-grey colour and the latter a deep burgundy red (Fig. 3.9). Shales from OBP commonly produce a dark red streak. Streaks from the shale in this assemblage are generally not as richly pigmented as those of mudstone, and sometimes produce a dry, grainy powder.

c) Microscopic analysis

Following macroscopic analysis, each piece was microscopically analysed using an Olympus SC50/ SZ61 reflected light microscope fitted with an Olympus EP50 camera, using a variety of magnification levels from 0.67x to 4.5x in the Archaeology division at the University of the Witwatersrand. Possible use-wear traces not fully visible macroscopically, such as microstriations, were identified/ confirmed during this stage of analysis. The details of each of these use-wear traces are discussed below in sections i-vi. Pieces were placed into definite signs of use, possible signs of use, and unutilised categories, and where possible assigned to use-wear activity categories (such as grinding and rubbing, discussed in sections vii and viii). Pieces with use-traces which could not have been the result of anything but anthropogenic modification are categorised as utilised. Pieces with possible use-traces, which may have resulted from anthropogenic modification *or* natural processes, are categorised as possibly utilised. Pieces with no use-traces are classified as unutilised. The identification of use-traces and the subsequent inferences about which anthropogenic actions may have caused them are based predominantly on experimental ochre use studies (e.g. Hodgskiss 2010; Rifkin 2012).

Use-traces

i) Grooves

A groove is a narrow, linear incision, striation, or scratch which is generally visible macroscopically (Hodgskiss 2010: 3346-7; Rifkin 2012: 177) (Fig. 4.19). Various attributes of grooves are recorded in the database. The first of these is orientation and grouping, or the position of the grooves to each other (parallel or erratic) and whether they appear individually or in a cluster as striations (Hodgskiss 2010: 3347). Placement refers to the position of the grooves in relation to the edge of the piece (Hodgskiss 2010: 3347). Profile shape refers to the shape of the groove indentation when viewed at a cross section, and includes V, U, and _/ (trough) shapes (Hodgskiss 2010: 3347). The nature of the ends of the grooves is described, i.e., frayed or unfrayed, to help determine if the grooves were made by single or multiple strokes (Hodgskiss 2010: 3347).

ii) Microstriations

These are multiple, generally parallel striations which are often only visible microscopically (Hodgskiss 2010: 3347; Rifkin 2012: 177) (Fig. 4.18, 4.19, 4.20). This includes internal microstriations, which occur within the profile of larger grooves, and external microstriations, which occur on their own on the surface of the piece (Hodgskiss 2010: 3347).

iii) Chipping

This refers to tiny missing flakes along the edges of the piece or on the sides of grooves (Hodgskiss 2010: 3347).

iv) Polish

Homogenously shiny, light reflective areas of a piece are recorded as polish (Hodgskiss 2010: 3347; Rifkin 2012: 177) (Fig. 4.20). Polished areas also sometimes contain small microstriations as a result of the same friction which produces polish.

v) Smoothing

Smoothing refers to homogenous surfaces that display few natural features in relation to other surfaces of the same piece (Hodgskiss 2010: 3347; Rosso *et al*.

2016: 12) (Fig. 4.20). This does not necessarily imply a flat surface shape or polished qualities, though this is sometimes the case (Hodgskiss 2010: 3347).

vi) Scratches

Scratches are shallow grooves which occur in a more random and erratic orientation or placement than grooves or microstriations (Hodgskiss 2010: 3347). The nature and placement of these marks suggest that less deliberate intention was involved in their creation, or that they were produced by natural or post-depositional processes (Hodgskiss 2010: 3347).

Use-wear categories

vii) Grinding

Grinding involves moving a raw material piece (i.e., ochre) back and forth against a second flat, hard raw material. This activity generally produces the clearest use-traces in the form of parallel striations which often extend to the edges of the piece (Hodgskiss 2010: 3357; Velliky *et al*. 2018: 10). These can have a variety of profile shapes and contain internal microstriations (Hodgskiss 2010: 3357; Velliky *et al*. 2018: 10). The ground surface of a piece where striations occur is always flat (Hodgskiss 2010: 3357).

viii) Rubbing

Rubbing consists of moving a raw material against a second, softer raw material. This produces less conspicuous use-traces than grinding, especially when the piece has a hardness value over Mohs 4 (Hodgskiss 2010: 3354). Rubbed pieces exhibit smoothing, rounded edges, and polish most frequently, all of which generally occur on the elevated surfaces of the piece (Hodgskiss 2010: 3357; Velliky *et al.* 2018: 10). Grooves and microstriations also sometimes occur, but not as frequently as on ground pieces (Hodgskiss 2010: 3357).

d) Elemental analysis (pXRF)

Portable XRF analyses were performed in order to obtain qualitative information about the geological composition of study pieces. Analyses were done with a Niton XL3t Analyser GOLDD+ (Thermo Scientific) in the Earth lab at the School of Geography, Archaeology, and Environmental Studies at Wits University. Portable

XRF analyses are best undertaken on pieces with clean, flat, > 10 mm surface areas for the most accurate results, and readings should be taken on multiple areas of the piece for consistency (d'Errico *et al.* 2012: 946-7; Dayet 2021). A total of 24 pieces underwent pXRF analysis (Table 4.10). An effort was made to include at least one piece from all recorded raw material types; however, suitable pieces were not present for several types. One specular hematite piece with concretion remnants was used as a control piece, in order to discern the geological composition of the concretions themselves in order to more clearly detect and rule these out on other pieces. One reading of 240 seconds was taken on every piece.

e) Statistical analysis

Fisher's exact tests were used in order to determine whether relationships between certain variables (such as streak colour and use, raw material choice and use, and general piece shape and use) are non-random (where values are lower than 5) (Rosso *et al.* 2014: 91). Chi-square tests were also used for the same purpose where values are higher than 5.

CHAPTER 4: RESULTS

This chapter presents the results of macro and microscopic analyses, as well as pXRF analysis, of the ochre from the GS, YRS, and DRG layers at OBP. The study assemblage is divided into three sub-assemblages based on the identification of surface features: unutilised pieces, possibly utilised pieces, and utilised pieces. When the full assemblage is referred to, this includes data from all of these sub-assemblages.

4.1 Macroscopic Analysis

There are 452 pieces in the full assemblage, with a total weight of almost 5 kg (4706.8 g). There are 14 pieces in the utilised assemblage, with a total weight of 0.4 kg (364.7 g) (Table 4.1). There are 40 possibly utilised pieces with a total weight of 0.7 kg (737.2 g). The unutilised assemblage consists of 398 pieces with a weight of almost 4 kg (3604.9 g).

Table 4.1. Total number of pieces and their weight in the full assemblage and each sub-assemblage.

Unutilised assemblage		Possibly utilised assemblage		Utilised assemblage		Full assemblage	
n	weight (g)	n	g	n	g	n	g
398	3604.9	40	737.2	14	364.7	452	4706.8

a) Colour

Within the full assemblage, red is the most common streak colour, comprising 47% (n = 213) of the assemblage (Table 4.2, Appendix 3). Red-purple is the second most common streak colour (n = 97), followed by purple (n = 89). As a whole, red varieties (colours which contain red but are not solely red in hue) are relatively common; red-purple, red-orange, red-brown, and red-pink constitute 29% (n = 131) of the full assemblage. Black, orange, black-purple, pink, and red-pink occur the least frequently (n = 16) (Table 4.2). Within the full assemblage, four pieces produced hardly any streak and thus have not been assigned a colour. These are still included in the analysed assemblage because they are of the same ochreous raw material as other pieces which are capable of producing a streak, but are simply harder.

Within the utilised assemblage, red is by far the most common streak colour, comprising 79% (n = 11) of the assemblage (Table 4.2). The only other colours that appear in the utilised assemblage are red-purple and purple (n = 2). Fisher's exact test statistic value is 0.0139, showing that there is a significant correlation between red streak colour and utilisation ($p < 0.05$). Red-purple and purple occur in all the assemblages, and increase in frequency in the possibly utilised and unutilised assemblages; in other words, there are more pieces with a red-purple or purple streak colour in the possibly utilised (n = 10) and unutilised assemblages (n = 174) than in the utilised assemblage (n = 2) (Table 4.2). Within the possibly utilised assemblage, red is also the most common streak colour, comprising 63% (n = 25), so is less prevalent in the possibly utilised assemblage than in the utilised assemblage. This is followed by red-purple (n = 6) and purple (n = 4) (Table 4.2). Black, red-orange, and red-brown are less frequent (n = 5), and red-pink, black-purple, orange, and pink do not occur at all in the possibly utilised assemblage (Table 4.2). Within the unutilised assemblage, red is the most common colour, comprising 45% (n = 177) of the pieces, followed by red purple (n = 90) and purple (n = 84) (Table 4.2). Red-orange (n = 15) and red-brown (n = 16) also occur relatively frequently compared to the other colours.

*Table 4.2. The colours present in the full assemblage and all sub-assemblages (utilised, possibly utilised, and unutilised). The three most common colours in each assemblage are indicated in light grey. *has: pieces which produced hardly any streak, so no colour could be assigned.*

	Unutilised assemblage		Possibly utilised assemblage		Utilised assemblage		Full assemblage	
Colour	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Red	177	44.5	25	62.5	11	78.6	213	47.1
Red-purple	90	22.6	6	15.0	1	7.1	97	21.5
Red-orange	15	3.8	1	2.5	0	0	16	3.5
Red-brown	16	4.0	1	2.5	0	0	17	3.8
Red-pink	1	0.3	0	0	0	0	1	0.2
Purple	84	21.1	4	10.0	1	7.1	89	19.7
Black-purple	3	0.8	0	0	0	0	3	0.7
Black	3	0.8	3	7.5	0	0	6	1.3
Orange	4	1.0	0	0	0	0	4	0.9
Pink	2	0.5	0	*0*	0	0	2	0.4
***has**	*3*	*0.8*	*0*	*0*	*1*	*7.1*	*4*	*0.9*
Total	398	100	40	100	14	100	452	100

b) Raw material

Specular hematite is by far the most common raw material in the full assemblage, accounting for 79% (n = 355) of the assemblage (Table 4.3). Hematite (n = 66) and ferricrete conglomerate (n = 15) are second and third most common, and shale (n =

9) and mudstone (n = 7) occur less frequently. Within the utilised assemblage, specular hematite is the most common raw material at 71% (n = 10), followed by shale (n = 2) and hematite (n = 2) (Table 4.3). Fisher's exact test statistic value is 0.5248, indicating no significant relationship between specular hematite and use ($p < 0.05$). Specular hematite decreases in frequency from the possibly utilised, full, and unutilised assemblages to the utilised assemblage, where it occurs in the lowest relative frequency (Table 4.3). Within the unutilised assemblage, specular hematite is also most common, accounting for 78% (n = 310) of the assemblage, followed by hematite (n = 61) and ferricrete conglomerate (n = 14) (Table 4.3). With regards to specularity (which sometimes occurs in other raw material types apart from specular hematite), 79% (n = 11) of pieces in the utilised assemblage are specular (Appendix 3), the most out of all three sub-assemblages, while a lower number of pieces are specular in the unutilised assemblage (78%, n = 310).

Table 4.3. Raw materials present in the full assemblage and all sub-assemblages. The most common raw materials are indicated in light grey.

	Unutilised assemblage		Possibly utilised assemblage		Utilised assemblage		Full assemblage	
Raw material	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Specular hematite	310	77.9	35	87.5	10	71.4	355	78.5
Hematite	61	15.3	3	7.5	2	14.3	66	14.6
Mudstone	6	1.5	1	2.5	0	0	7	1.5
Shale	7	1.8	0	0	2	14.3	9	2.0
Ferricrete conglomerate	14	3.5	1	2.5	0	0	15	3.3
Total	398	100	40	100	14	100	452	100

c) Weight and size

Within the full assemblage, 67% (n = 302) of pieces fall within the 1.1 – 10.0 g weight category (Table 4.5). Within the utilised assemblage, heavier pieces are most common (within the 30.1 – 40.0 g category). The occurrence of pieces within the higher weight categories such as 130.1 – 140.0 g and 140.1 – 150.0 g also tends to be more frequent within the possibly utilised and utilised assemblages (Table 4.5). Most pieces fall within the 10.1 – 20.0 g and 20.1 – 30.0 g weight categories (Table 4.5). The heavier pieces (in each size category) tend to be specular hematite; this raw material is generally heavier than others. In terms of size, most pieces fall within the 11 – 40 mm categories, across all assemblages (Table 4.4). Chi-square tests show there is a significant relationship between the weight of pieces and utilisation (X2 = 7.610; df = 1; p = 0.006), with heavier pieces more prevalent in the utilised assemblage.

Table 4.4. Size categories based on maximum length of each piece in the full assemblage. Categories with the highest number of pieces are indicated in light grey.

	Unutilised assemblage		Possibly utilised assemblage		Utilised assemblage		Full assemblage	
Size (mm)	n	%	n	%	n	%	n	%
1 - 10	0	0	0	0	0	0	0	0
11 - 20	219	55.0	14	35.0	5	35.7	238	52.7
21 - 30	147	36.9	15	37.5	3	21.4	165	36.5
31 - 40	25	6.3	8	20.0	5	35.7	38	8.4
41 - 50	6	1.5	3	7.5	1	7.1	10	2.2
51 - 60	1	0.3	0	0	0	0	1	0.2
Total	398	100	40	100	14	100	452	100

Table 4.5. Weight categories. Categories with highest number of pieces within each assemblage are indicated in light grey.

	Unutilised assemblage		Possibly utilised assemblage		Utilised assemblage		Full assemblage	
Weight (g)	n	%	n	%	n	%	n	%
0.10 - 1.0	14	3.5	0	0	0	0	14	3.1
1.1 - 10.0	280	70.4	17	42.5	5	35.7	302	66.8
10.1 - 20.0	68	17.1	11	27.5	4	28.6	83	18.4
20.1 -30.0	20	5.0	6	15.0	1	7.1	27	6.0
30.1 - 40.0	9	2.3	4	10.0	2	14.3	15	3.3
40.1 - 50.0	4	1.0	0	0	0	0	4	0.9
50.1 - 60.0	0	0	0	0	1	7.1	1	0.2
60.1 - 70.0	0	0	0	0	0	0	0	0
70.1 - 80.0	0	0	1	2.5	0	0	1	0.2
80.1 - 90.0	0	0	0	0	0	0	0	0
90.1 - 100.0	0	0	0	0	0	0	0	0
100.1 - 110.0	1	0.3	0	0	0	0	1	0.2
110.1 - 120.0	1	0.3	0	0	0	0	1	0.2
120.1 - 130.0	1	0.3	0	0	0	0	1	0.2
130.1 - 140.0	0	0	1	2.5	0	0	1	0.2
140.1 -150.0	0	0	0	0	1	7.1	1	0.2
Total	398	100	40	100	14	100	452	100

d) Chronological changes

The study assemblage was recovered from three main layers – YRS (occurring at the bottom of the sequence), DRG (occurring above YRS in square B3), and GS (occurring at the top of the sequence). Pieces from the "other" category were recovered from the test trench and profile cleaning. Each of these main layers are divided into a number of *décapages* (Table 4.6). Two *Equus* teeth from GS *décapages* 11 and 13 in square B2C have been dated to MIS 6 (130 – 191 ka), providing a tentative date for the ochre from this layer, and an indication of the possible age of pieces from the DRG and YRS layers (Val *et al.* 2021). In the full assemblage, 69% of pieces (n = 310) are from GS, 27% (n = 124) from YRS, 3% (n = 14) from other units, and 1% (n = 4) from DRG. A higher number of pieces (in the full assemblage) come from the GS layer, *décapages* 14, 15, 16, and 17, than any other *décapage* (Table 4.6). Altogether, 24% of pieces (n = 107) were found in these *décapages*. Most of the utilised assemblage comes from the GS layer (57%, n = 8), while 43% (n = 6) comes from the YRS layer. No pieces in the utilised assemblage were found in the DRG layer or "other" units. In the utilised assemblage, there is no predominant layer or *décapage*, and no layer or *décapage* produced more than two pieces – implying consistent use of ochre throughout the sequence, albeit rare (Table 4.6). Within the possibly utilised assemblage, 70% (n = 28) of pieces are from GS, 23% (n = 9) from YRS, 5% (n = 2) from other units, and 3% (n = 1) from DRG. This assemblage has a higher number of pieces from *décapages* 14 and 16 (GS), with no other layer or *décapage* producing more than two pieces (Table 4.6). In the unutilised assemblage, 69% (n = 275) of pieces come from GS, 27% (n = 107) from YRS, 3% (n = 12) from other units, and 0.8% (n = 3) from DRG. Pieces predominantly come from *décapages* 14, 16, and 17 (GS) (Table 4.6).

Table 4.6. Number of pieces found in each layer and décapage. Units which produced the highest number of pieces within each assemblage are indicated in light grey.

Layer/ *déc.*	Unutilised assemblage	Possibly utilised	Utilised assemblage	Full assemblage
GS (*déc.* 1)	4	0	0	4
GS (*déc.* 2)	9	1	0	10
GS (*déc.* 3)	13	1	0	14
GS (*déc.* 4)	10	1	0	11
GS (*déc.* 5)	1	1	2	4
GS (*déc.* 6)	3	1	1	5
GS (*déc.* 7)	8	0	1	9
GS (*déc.* 8)	3	0	0	3
GS (*déc.* 9)	3	2	0	5
GS (*déc.* 10)	12	1	0	13
GS (*déc.* 11)	9	1	0	10
GS (*déc.* 12)	13	1	0	14
GS (*déc.* 13)	17	0	1	18
GS (*déc.* 14)	28	5	0	33
GS (*déc.* 15)	15	2	2	19
GS (*déc.* 16)	18	4	0	22
GS (*déc.* 17)	30	2	1	33
GS (*déc.* 18)	16	1	0	17
GS (*déc.* 19)	16	0	0	16
GS (*déc.* 20)	7	1	0	8
GS (*déc.* 21)	1	1	0	2
GS (*déc.* 22)	4	0	0	4
GS (*déc.* 23)	8	0	0	8
GS (*déc.* 24)	5	1	0	6
GS (*déc.* 25)	2	0	0	2
GS (*déc.* 26)	2	0	0	2
GS (*déc.* 27)	4	0	0	4
GS (*déc.* 28)	3	0	0	3
GS (*déc.* 29)	3	0	0	3
GS (*déc.* 30)	3	0	0	3
GS (*déc.* 31)	2	1	0	3
GS (*déc.* 32)	1	0	0	1
GS (*déc.* 34)	1	0	0	1
DRG (*déc.* 2)	2	1	0	3
DRG (*déc.* 4)	1	0	0	1
YRS (*déc.* 1)	7	1	0	8
YRS (*déc.* 2)	7	2	0	9
YRS (*déc.* 3)	12	0	0	12
YRS (*déc.* 4)	14	0	2	16
YRS (*déc.* 5)	9	1	0	10
YRS (*déc.* 6)	7	0	0	7
YRS (*déc.* 7)	6	1	0	7
YRS (*déc.* 8)	7	2	1	10
YRS (*déc.* 9)	14	0	1	15
YRS (*déc.* 10)	17	0	0	17
YRS (*déc.* 11)	6	1	2	9
YRS (*déc.* 12)	2	0	0	2
YRS (*déc.* 13)	1	0	0	1
YRS (*déc.* 14)	0	1	0	1
Total	398	40	14	452

i) Colour, raw materials, and specularity through time

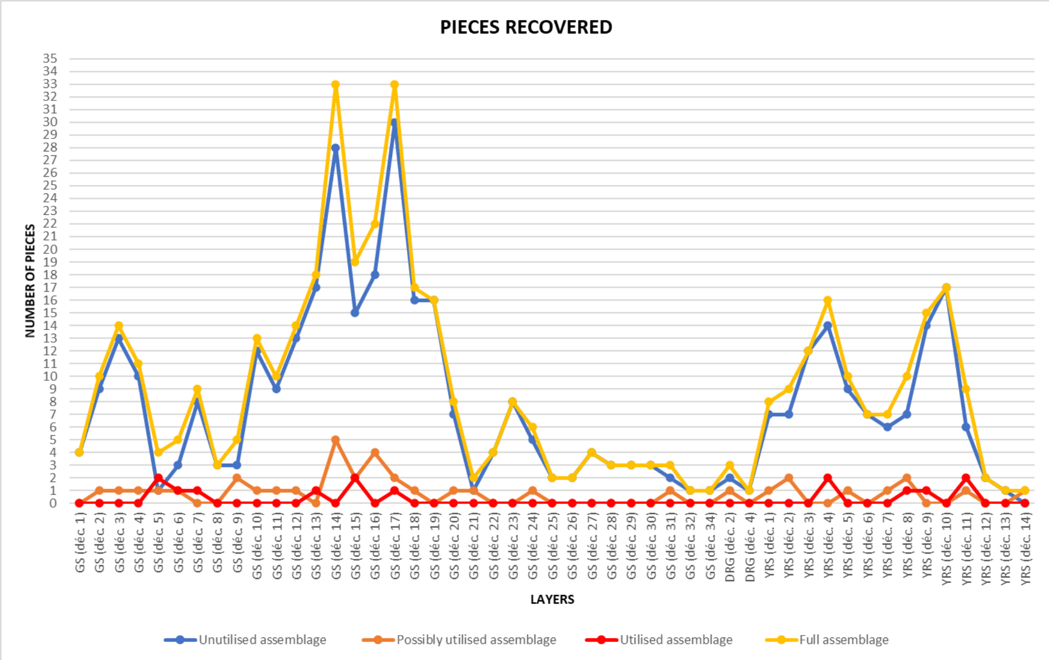

Figure 4.1. Graph showing the number of pieces recovered from each layer and décapage.

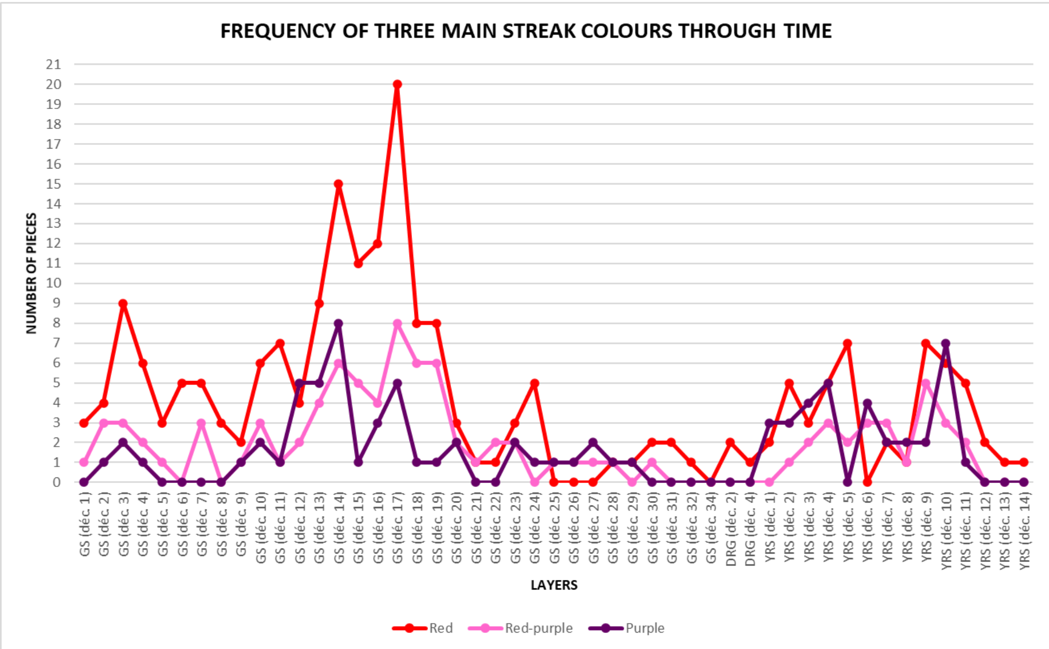

Figure 4.2. Graph showing number of pieces in the full assemblage with each streak colour in every layer and décapage.

The frequency of recovered pieces is relatively high in the lowermost YRS layer, then decreases towards the DRG layer, and increases again from the GS layer, peaking in the range of GS *décapages* 14 and 18, particularly in the full and unutilised assemblages (Fig. 4.1). The frequency of pieces increases again within the topmost part of the GS layer (Fig. 4.1). This information seems to suggest that layers and *décapages* from which larger amounts of pieces were recovered are representative of intensified site occupations, while layers and *décapages* where few or no pieces were recovered represent brief or no occupations. This is, however, complicated by the fact that units at OBP are distinguished based on sedimentary composition and therefore may not necessarily represent occupational phases, but site formation processes (Val 2021 pers. comm.). This pattern is broadly repeated in streak colour, raw material, and specularity frequencies. In the full assemblage, red, red-purple, and purple streak colours occur most frequently in the GS *décapage* 14-17 range (Fig. 4.2).

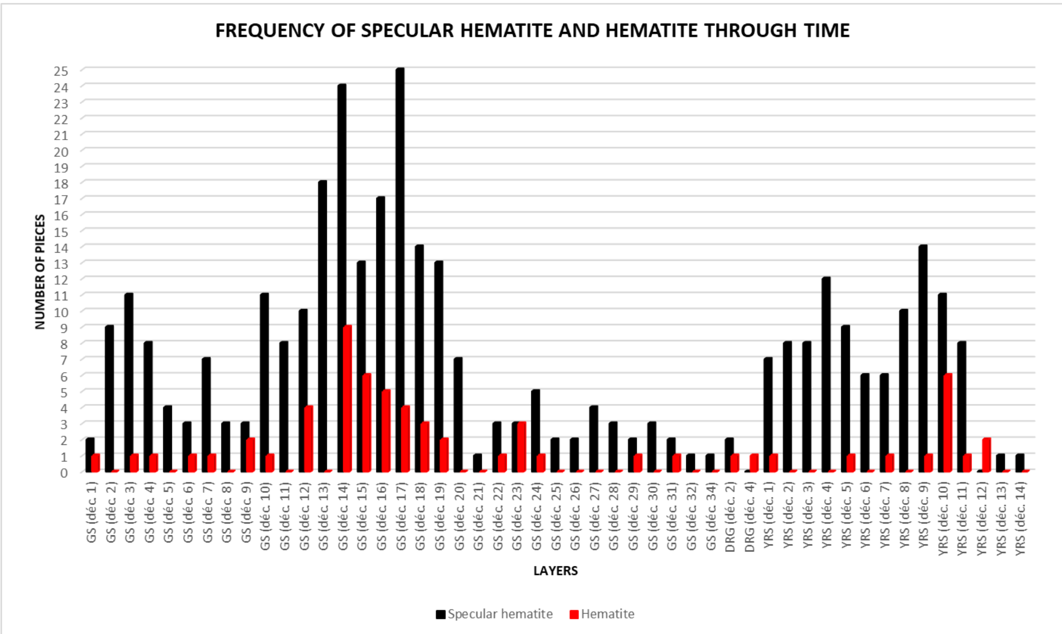

Figure 4.3. Graph showing amount of specular hematite and hematite in the full assemblage recovered from every layer and décapage.

Specular hematite and hematite are most frequent in the same range; hematite also occurs in relatively high quantities in YRS *décapage* 10 (Fig. 4.3). Specular hematite is lowest in DRG *décapage* 4 and YRS *décapage* 12 (Fig. 4.3). In terms of streak colour in the utilised assemblage, red pieces are found most frequently in GS *décapages* 5 and 15, as well as YRS *décapages* 4 and 11 (Fig. 4.4). Red-purple utilised pieces only occur in GS *décapage* 7, and purple only occurs in GS *décapage* 17 (Fig. 4.4). Streak colours in GS *décapages* 14-17 do not appear to be very different from those in other layers and *décapages*, apart from the appearance of purple.

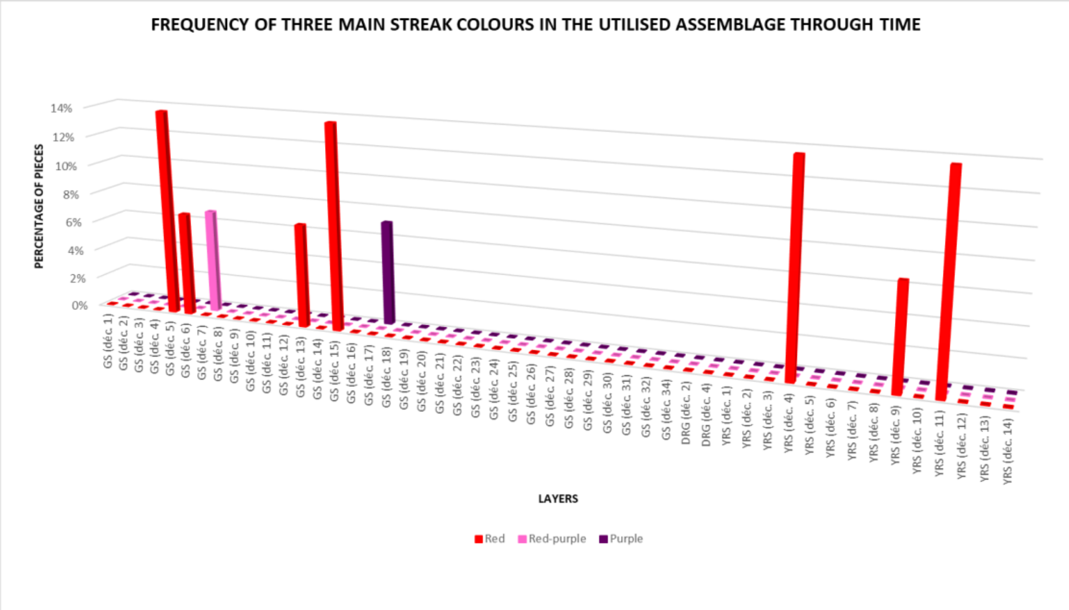

Figure 4.4. Graph showing frequency of every streak colour through time in the utilised assemblage alone.

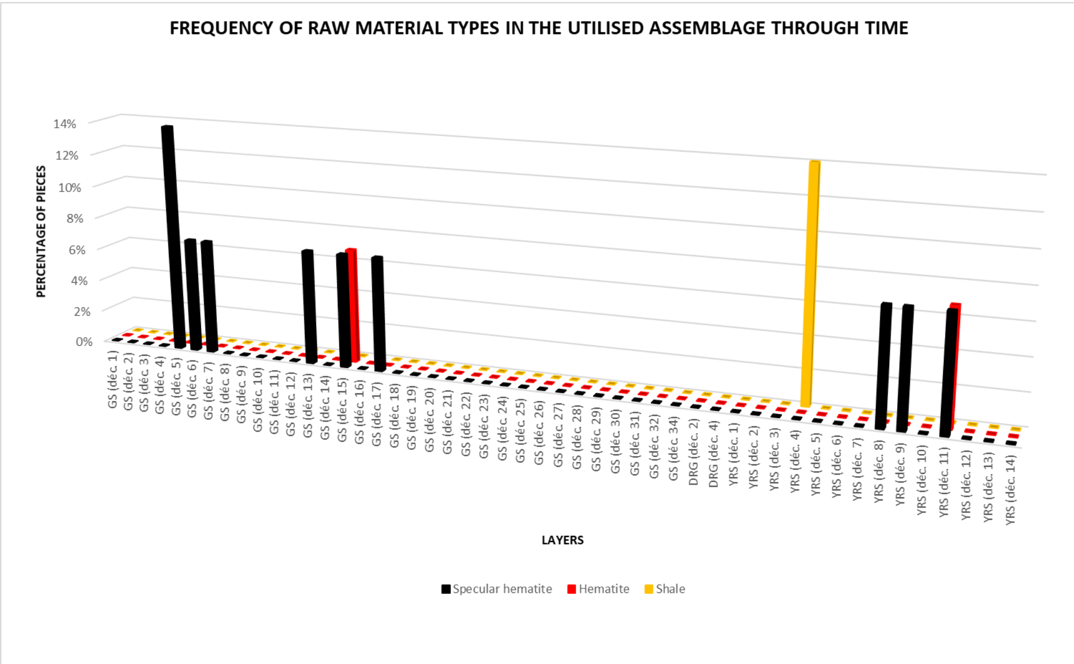

Figure 4.5. Graph showing amount of three main raw materials in the utilised assemblage recovered from each layer and décapage.

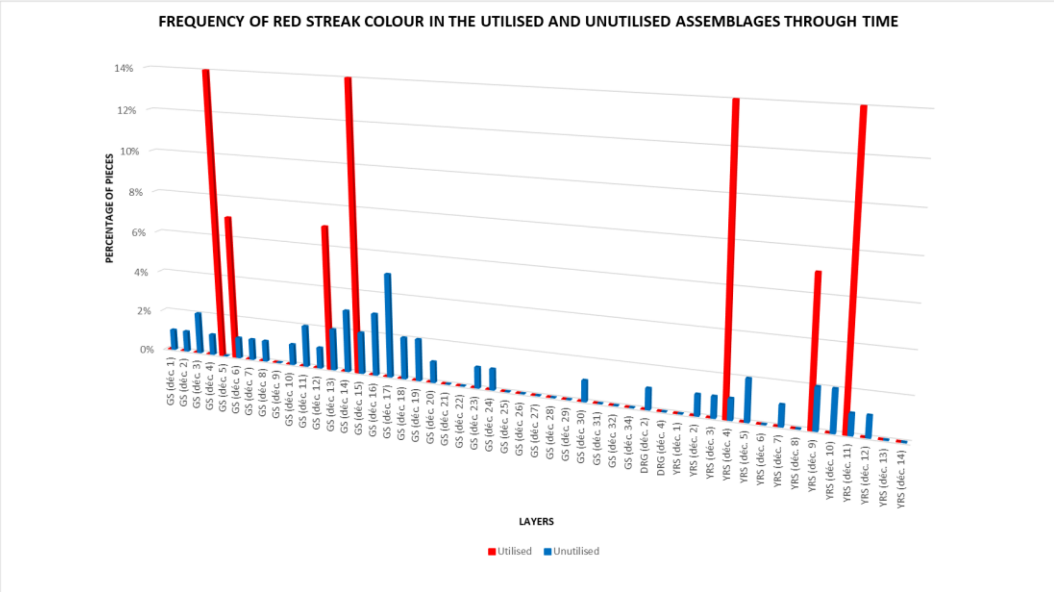

Figure 4.6. Graph showing frequency of red streak colour in utilised and unutilised assemblages.

When comparing the utilised and unutilised assemblages, red streak colour is clearly more frequent in the utilised assemblage (Fig. 4.6). Both shale and red streak colour increase in YRS *décapage* 4 (Fig. 4.4, 4.5). This is the only layer or *décapage* in which shale occurs (in the utilised assemblage).

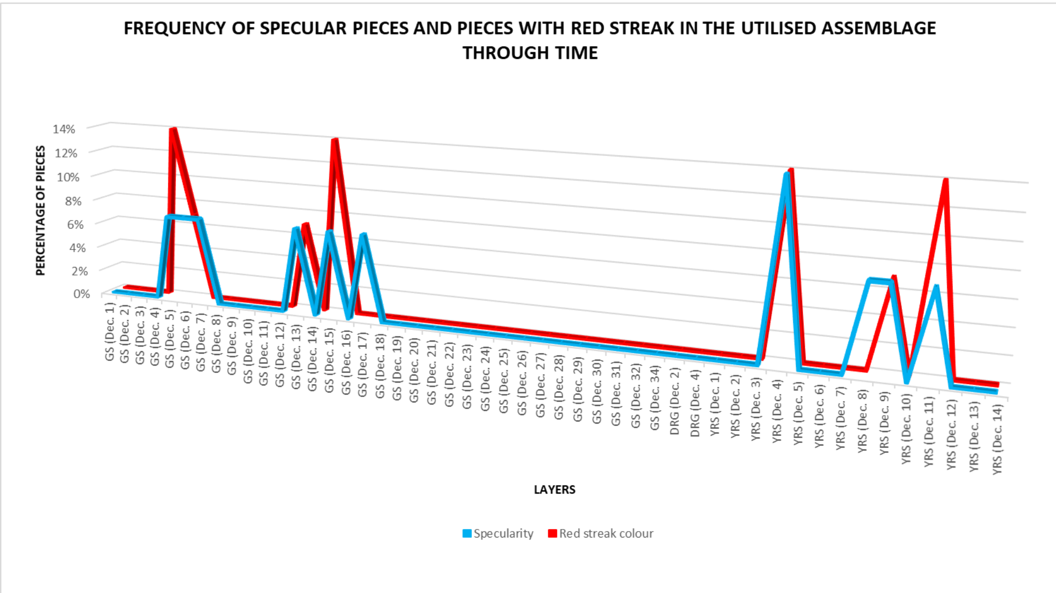

Figure 4.7. Graph showing number of pieces in the utilised assemblage with specular qualities in each layer and décapage.

Most specular pieces in this assemblage are also from YRS *décapage* 4 (Fig. 4.7). YRS *décapage* 4 and GS *décapage* 13 are also the only units in which specularity and red streak colour directly correspond to one another (i.e., both are present in exactly the same quantities), apart from where they are not present (Fig. 4.7). Specular pieces never appear at a higher frequency than pieces with a red streak colour, which could suggest that a red streak was more important for the users than specular qualities (Fig. 4.7). There is no significant relationship between specularity and red streak ($X2 = 1.676$; $df = 1$; $p = 0.195$) nor between the frequency of specular red pieces and specular non-red pieces in the utilised and unutilised assemblages (Fishers exact 0.0657; $p < 0.05$). However, 79% of pieces are specular, so this was still an important attribute. Specular hematite is most frequent at the start of the GS layer, particularly in *décapage* 5 (Fig. 4.5).

e) General shape

All pieces were categorised as either irregular pieces or nodules. Some of the irregular pieces appear to have been broken, perhaps intentionally in order to obtain a smaller, more useable piece or to check the internal colour. There is no significant correlation between the shape of pieces (irregular or nodules) and utilisation (Fishers exact 0.446; $p < 0.05$). Within the full assemblage, irregular pieces are by far the most common, accounting for 82% ($n = 369$) (Table 4.7). Within the unutilised assemblage, irregular pieces are also the most common by a larger margin than that of the full assemblage at 85%. Within the possibly utilised assemblage, nodules account for more than half of the pieces, while in the utilised assemblage their frequency decreases again and irregular pieces once again become more common (Table 4.7).

Table 4.7. General shape categories. Most common general shape in each assemblage are indicated in light grey.

	Unutilised assemblage		Possibly utilised assemblage		Utilised assemblage		Full assemblage	
Gen. shape	n	%	n	%	n	%	n	%
Irregular	340	85.4	18	45.0	11	78.6	369	81.6
Nodule	58	14. 6	22	55.0	3	21.4	83	18.4
Total	398	100	40	100	14	100	452	100

4.2 Microscopic Analysis

Most pieces, apart from those which did not exhibit obvious potential signs of use during macroscopic analysis, were microscopically analysed. Only the possibly utilised and utilised assemblages are discussed at length here. There is little evidence of obvious post-depositional wear such as scratches or scuffmarks, possibly owing to the hardness of most of the raw material. It is, however, difficult to determine whether the smoothing and polish on the pieces is natural, post-depositional, or anthropogenic, hence the need for a possibly utilised category. Once wear traces were identified and described, utilised pieces were placed into use-wear activity categories.

a) Use-wear

Possibly utilised pieces are categorised as such because the surface features may not be the result of use, but rather of natural processes. The utilised pieces have use-traces, in the form of grooves, microstriations, polish, and smoothing (Table 4.8) (see chapter 3.2. c for a description of these). Grooves, most in the form of parallel striations, are most common, found on 86% of pieces, while microstriations and smoothing also occur frequently, each on 71% of pieces (Table 4.8). These use-traces suggest the most common way these pieces were used was by grinding against a hard stone surface (Hodgskiss 2010: 3348-9). Grinding and rubbing together, where the grinding striations become smooth when the piece is rubbed against a soft material (Hodgskiss 2010: 3349-50), also occurs (Table 4.9).

Table 4.8. Number of pieces in utilised assemblage with each use-trace. Totals do not correlate with the number of pieces in each assemblage because pieces often have more than one use-trace. Most frequent use-traces are indicated in light grey.

	Utilised assemblage (n= 14)	
Use-traces	**n**	**%**
Grooves	12	85.7
Microstriations (internal & external)	10	71.4
Chipping	0	0
Polish	5	35.7
Smoothing	10	71.4
Scratches	0	0
Scuffmarks	0	0
Total	37	264

Table 4.9. Use-wear categories.

	Utilised assemblage (n= 14)	
Use-wear	**n**	**%**
Rubbing	0	0
Rubbing or grinding	2	14.3
Rubbing & grinding	6	42.9
Scoring	0	0
Grinding	6	42.9
Total	14	100

b) Utilised assemblage

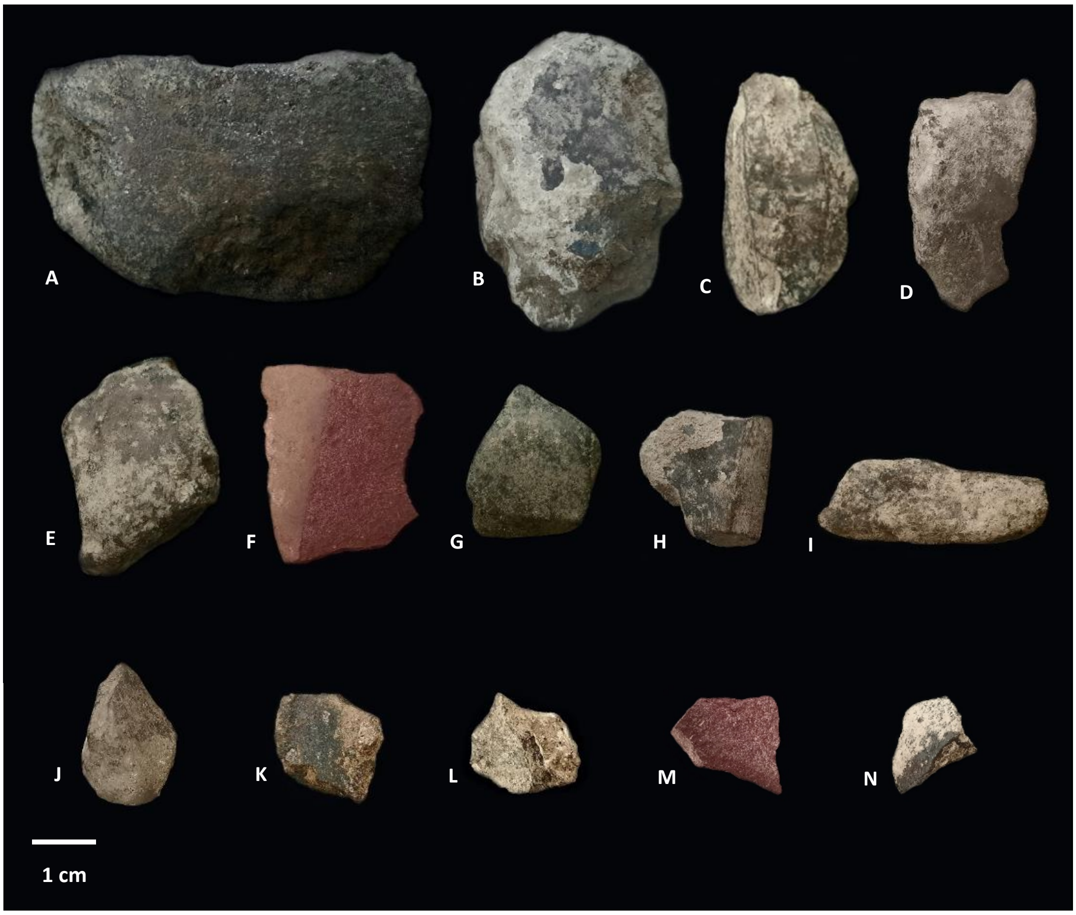

Figure 4.8. All the ochre pieces in the OBP utilised assemblage. A: OBP-656-1. B: OBP-831-2. C: OBP-582-1. D: OBP-4310-1. E: OBP-605-1. F: OBP-3290-4. G: OBP-3820-1. H: OBP-1783-7. I: OBP-2238-1. J: OBP-4267-1. K: OBP-3646-8. L: OBP-2042-3. M: OBP-3290-3. N: OBP-2408-2. Details of each piece can be found in Appendix 3.

There are a total of 14 utilised pieces, from two layers – YRS and GS (Table 4.6, Fig. 4.8). As stated before, there are no predominant *décapages*/ layers in this assemblage (i.e. which have produced a notably higher amount of pieces compared to other layers). Parallel grooves are the most common use-trace in this assemblage and are present on 86% of pieces, predominantly to one or more edges of the utilised surface (Appendix 3). The profile shape of grooves is not visible on most of the pieces which have them, and in cases where this is visible, only V and U-shaped grooves occur (Appendix 3). Microstriations are fairly common in this assemblage, present on 71% of pieces (Table 4.8). Piece OBP-4310-1, found in YRS *décapage* 11, shows very fine microstriations along a portion of the flat surface of the piece

(Fig. 4.9). Piece OBP-831-2, found in GS *décapage* 7, also exhibits microstriations as well as grooves on a flat surface (Fig. 4.10).

Polish is relatively uncommon, occurring on 36% of pieces (Table 4.8). Most of these pieces also have grooves and microstriations. Piece OBP-4267-1, found in YRS *décapage* 11, is entirely smoothed and polished, and microstriations are present as well. (Fig. 4.11). The edges of the pieces in this sub-assemblage are predominantly faceted from use (n = 9), while partially rounded (n = 3) and rounded (n = 2) edge shapes are less common (Appendix 3). The most frequent surface shape is flat (n = 11), with some surfaces also being classified as unchanged (n = 3). Smoothing is also present on most pieces, but it is difficult to tell whether this is from anthropogenic use or natural processes.

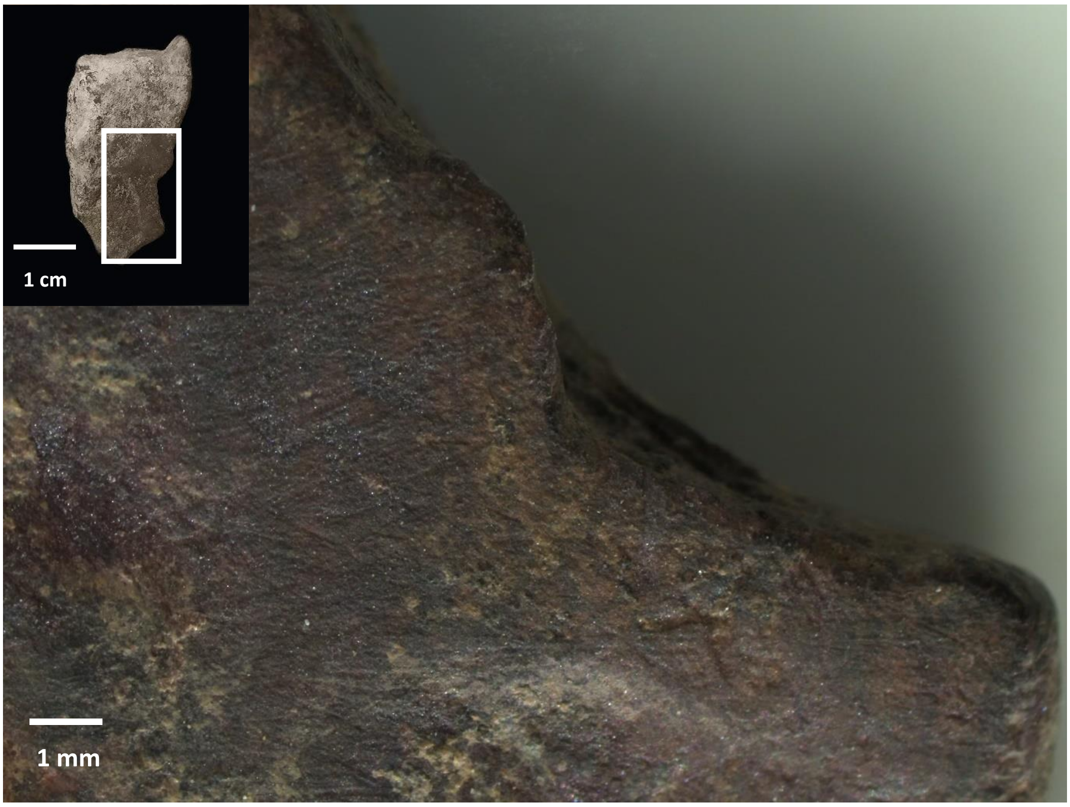

Figure 4.9. Piece OBP-4310-1, found in YRS décapage 11. Microstriations on flat surface.

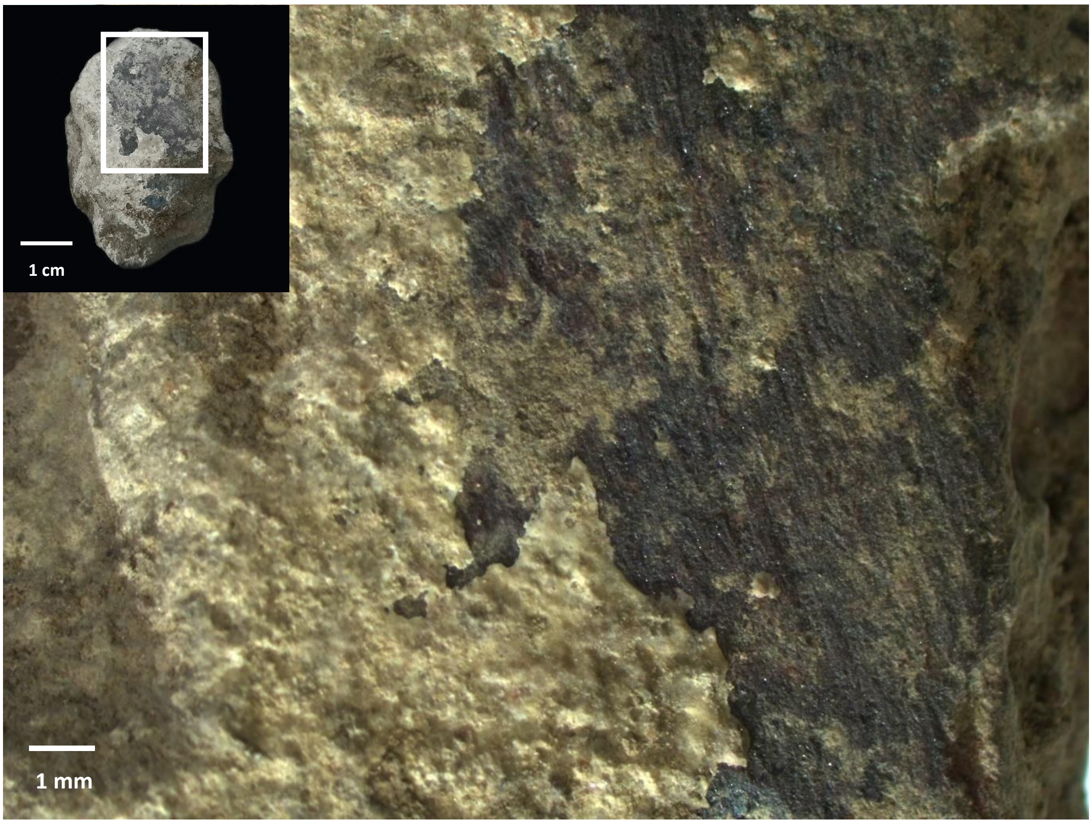

Figure 4.10. Piece OBP-831-2, found in GS décapage 7. Microstriations and grooves.

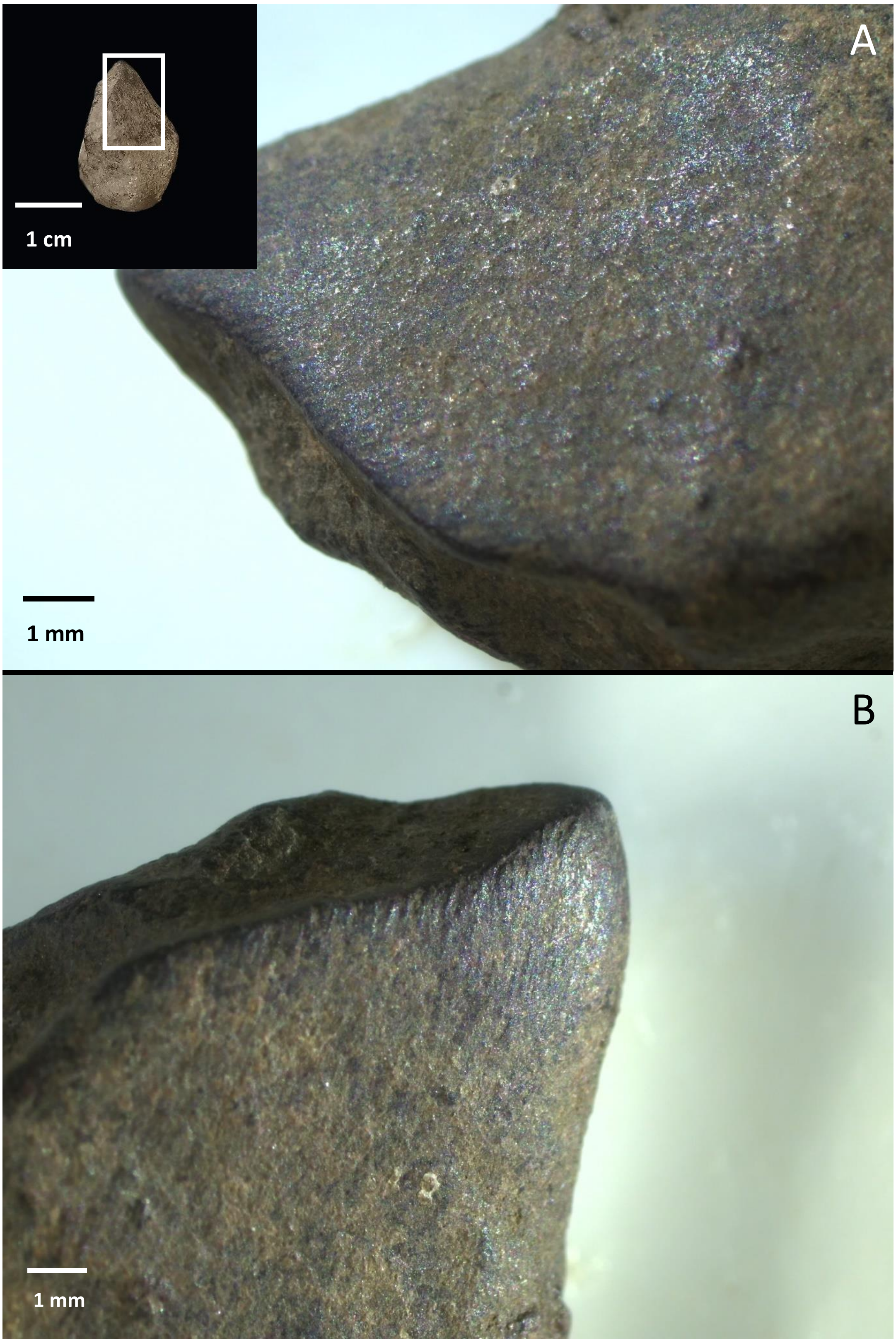

Figure 4.11. Piece OBP-4267-1, found in YRS décapage 11. A: Smoothing and polishing. B: Microstriations.

c) Possibly utilised assemblage

Figure 4.12. All the pieces in the possibly utilised assemblage. A: OBP-3726-1. B: OBP-4630-1. C: OBP-1080-1. D: OBP-4235-1. E: OBP-2042-1. F: OBP-2660-1. G: OBP-2241-4. H: OBP-1096-2. I: OBP-3462-2. J: OBP-2688-1. K: OBP-321-1. L: OBP-2892-2. M: 565-1. N: OBP-3006-1. O: OBP-694-1. Details of each piece can be found in Appendix 3.

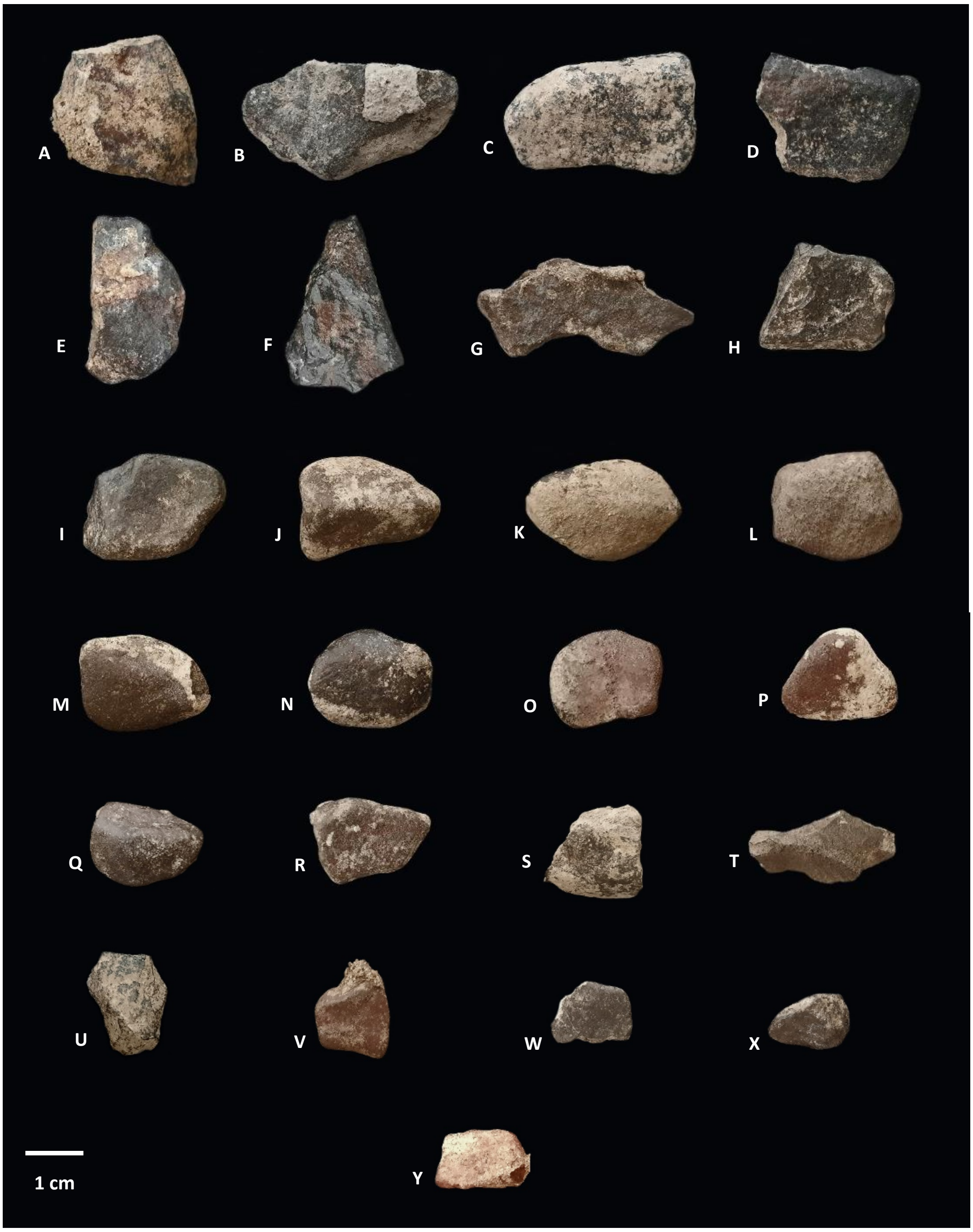

Figure 4.13: Possibly utilised pieces continued. A: OBP-4708-1. B: OBP-4050-1. C: OBP-4301-2. D: 200-1. E: OBP-1648-1. F: OBP-4736-1. G: OBP-1899-4. H: OBP-2245-10. I: 1221-1. J: OBP-3723-2. K: OBP-2455-1. L: OBP-3302-1. M: OBP-1896-4. N: OBP-1330-1. O: OBP-1334-1. P: OBP-2243-4. Q: OBP-2245-4. R: OBP-1901-1. S: OBP-2042-2. T: OBP-2986-2. U: 4667-1. V: OBP-2791-2. W: OBP-1899-1. X: OBP-1899-3. Y: OBP-2409-5.

There are a total of 40 pieces in this assemblage (Fig. 4.12, 4.13). The possibly utilised pieces have minimal potential use-traces, predominantly in the form of smoothing, polish, and microstriations, which may be the result of anthropogenic or natural processes. Pieces come from a variety of different layers and *décapages*, with the highest frequency of pieces being found in GS (*décapages* 16 and 14) (Table 4.6). Piece OBP-3726-1 (Fig. 4.14), found in YRS *décapage* 8, has relatively high specularity compared to other possibly utilised pieces, particularly on the surface which shows possible use in the form of microstriations. However, owing to the unusual placement of these striations on a single small edge of the piece, it is difficult to discern whether they are anthropogenic or part of the geological formation of the piece (Fig. 4.14). Microstriations are the predominant potential use-trace on the surfaces of the pieces, which has resulted in their inclusion in the possibly utilised assemblage. Piece OBP-1648-1, found in GS *décapage* 12, exhibits a single groove, which may have red residue in it (Fig. 4.15). The streak colour for this piece is not the same red, but rather very dark purple. Given the nature of the groove edges, and lack of internal microstriations, it is not possible to determine whether this is a natural feature or the result of deliberate anthropogenic modification.

The majority of pieces also show polish (n = 23; 58% of the possibly utilised assemblage), mainly on the whole piece, while some have polish on edges and on some surfaces of the piece. Smoothing is another common feature on the possibly utilised pieces and is present on 38 pieces, mostly on the entire piece. For some of these this is what primarily placed them in the possibly utilised category. Piece OBP-2688-1, with no layer/ unit attributed, is entirely polished and smoothed, with a circular, likely natural hole on one side (Fig. 4.16). Piece OBP-4667-1, found in GS *décapage* 31, is highly polished on one surface, with some possible microstriations near this polished surface (Fig. 4.17). Although grooves do not occur as frequently as these other forms of use, a few pieces exhibit grooves which should be noted, such as piece OBP-2892-2, found in YRS *décapage* 1, which exhibits grooves that were possibly made anthropogenically (Fig. 4.18).

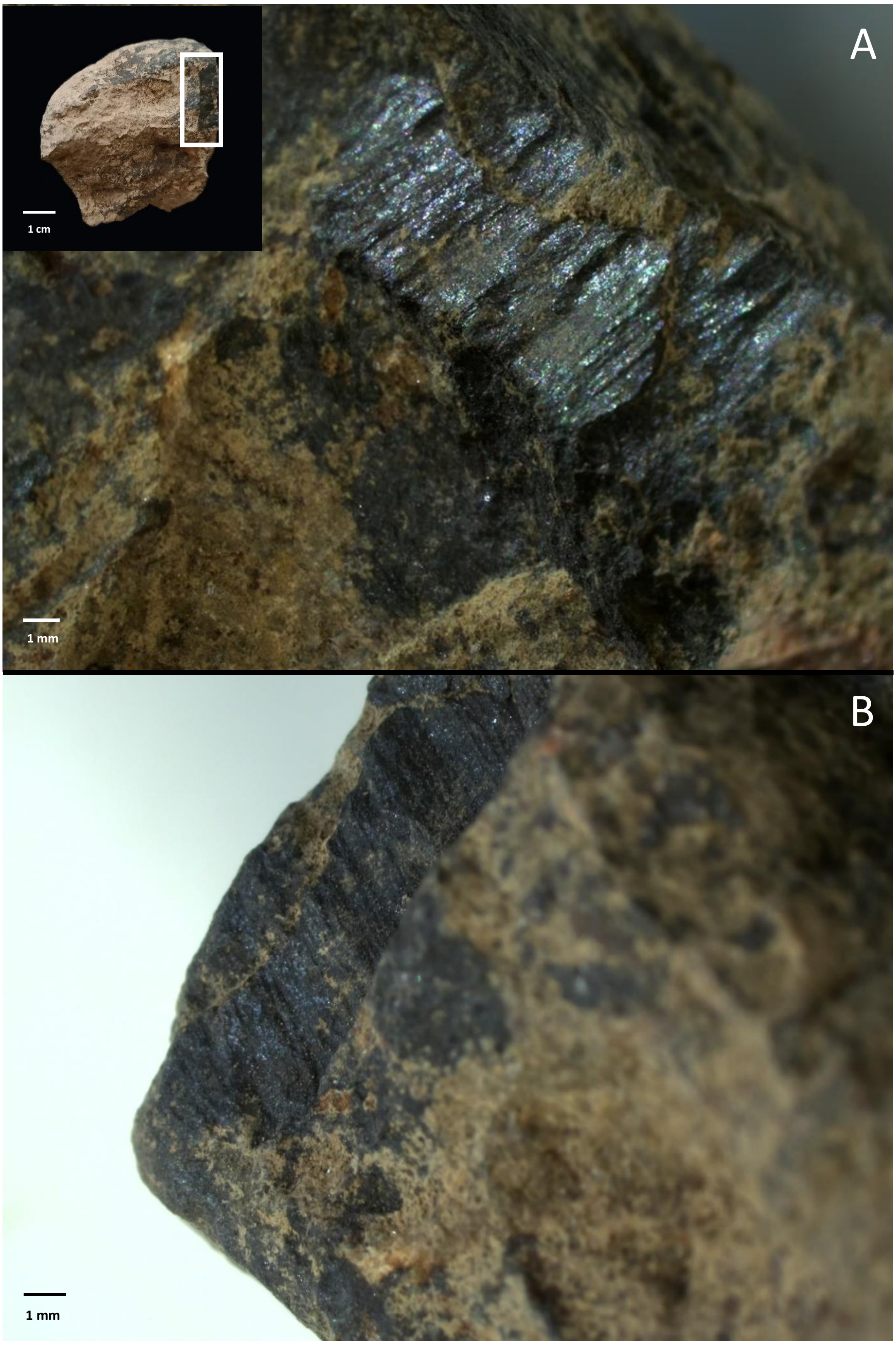

Figure 4.14. Piece OBP-3726-1. A: High specularity on the edge of the piece which shows possible microstriations. B: Possible microstriations.

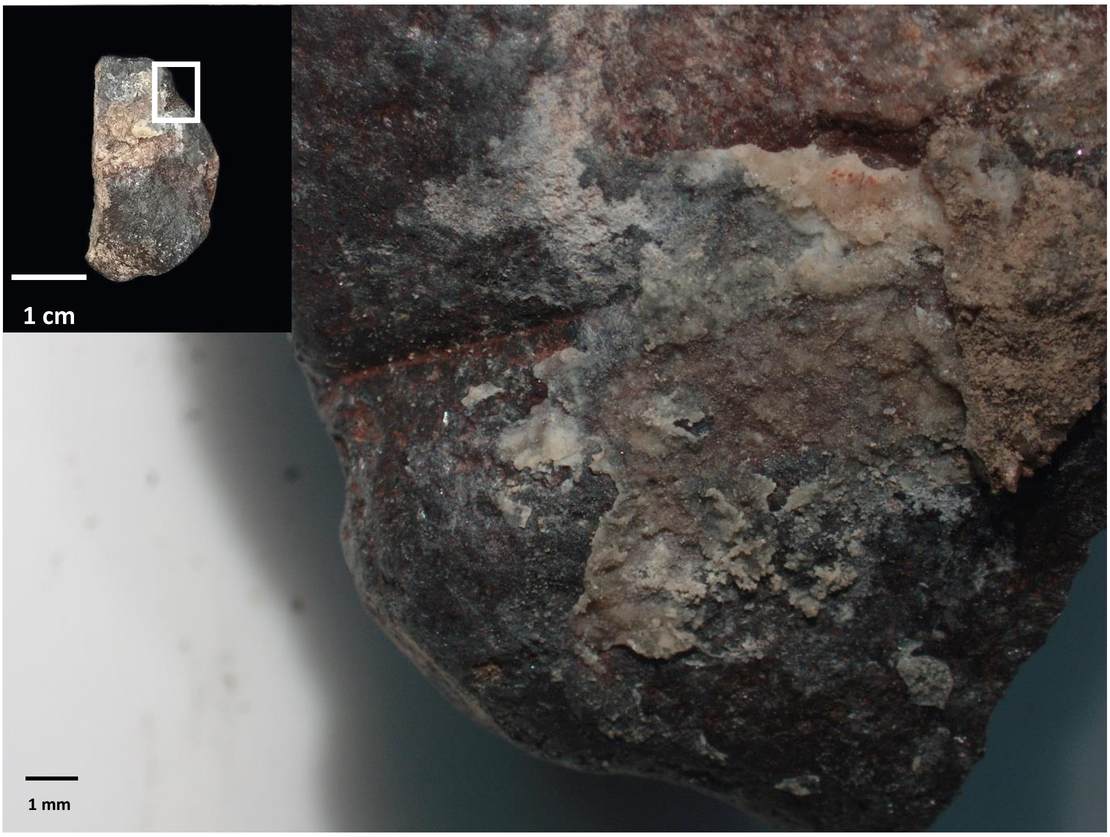

Figure 4.15. Piece OBP-1648-1, possible groove to one edge of the piece.

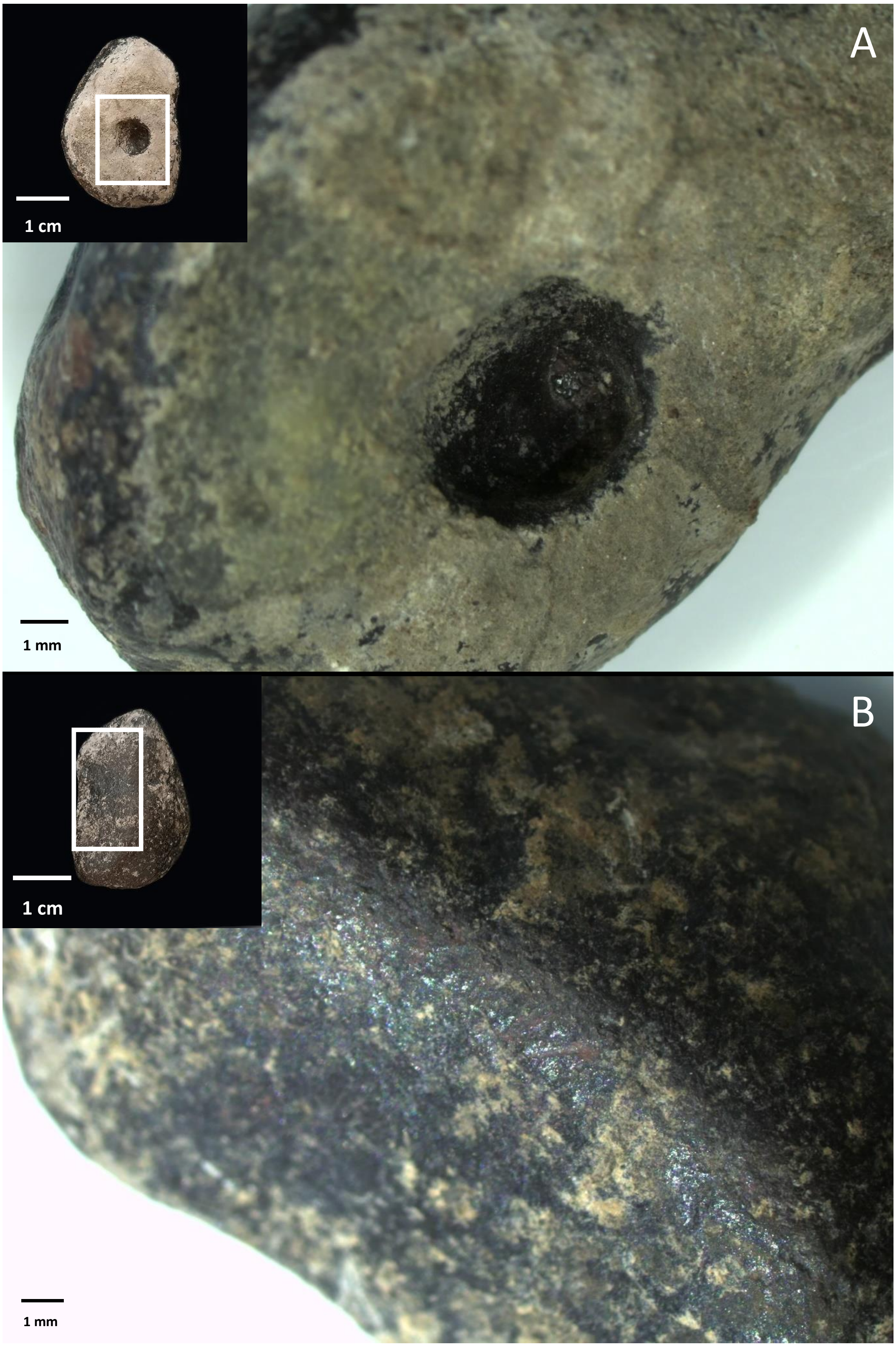

Figure 4.16. Piece OBP-2688-1. A: Natural hole on one side of piece. B: Smoothing and polishing on other side of piece.

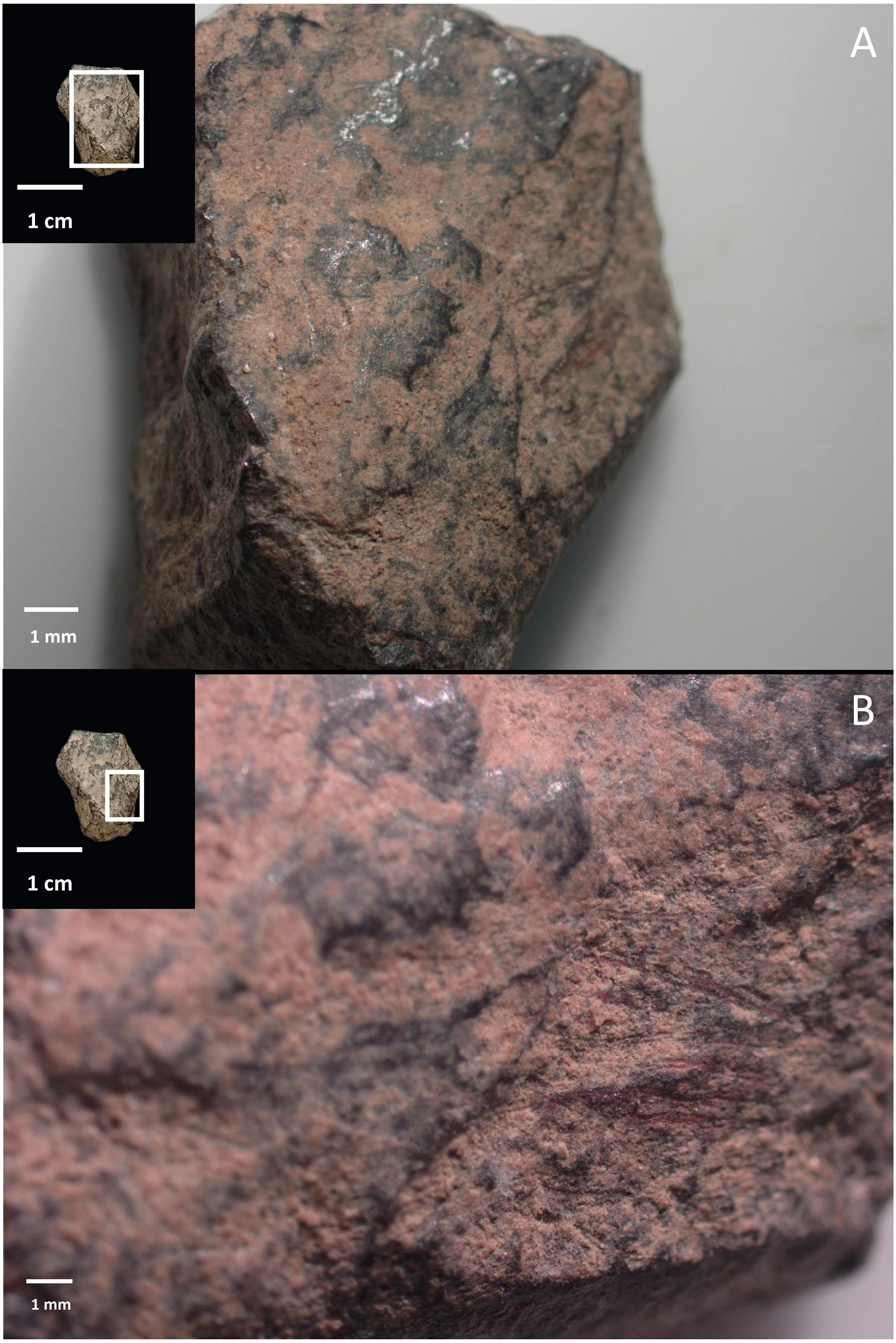

Figure 4.17. Piece OBP-4667-1. A: Polishing on one surface of piece. B: Possible microstriations.

Figure 4.18. Piece OBP-2892-2, possible grooves.

4.3 Elemental Analysis

Portable XRF analyses were undertaken with a Niton XL3t Analyser GOLDD+ (Thermo Scientific) on 24 pieces (Table 4.10). This includes one piece from the previously analysed Mason assemblage as well as one control piece with concretions. Fifteen of the pXRF analysed pieces are categorised as possibly utilised, four utilised, and four unutilised (Table 4.10) to determine qualitative and semi-quantitative mineral composition. Owing to the fact that many pieces in the study assemblage lacked the required uniform surface and size, as well as the residual concretions left on the surface of some pieces even after cleaning, few pieces could be analysed with accurate results. Readings were taken from one point on each piece for approximately 240 seconds. Pieces chosen for pXRF analysis are predominantly specular hematite (n = 16); there are also two ferricrete conglomerate, two shale, one iron oxide, one mudstone, and two hematite pieces (one of which was classified as such by Mason) (Table 4.10).

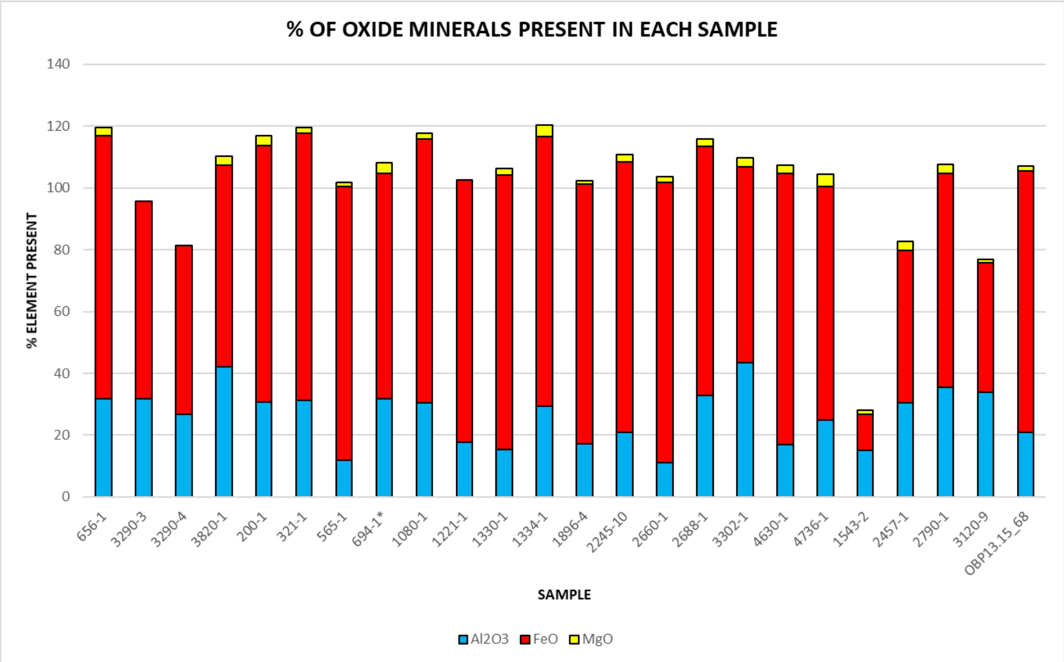

Figure 4.19. Graph showing relative percentage of oxide minerals present in analysed samples. Al2O3: Aluminium Oxide, FeO: Iron Oxide, MgO: Magnesium Oxide.

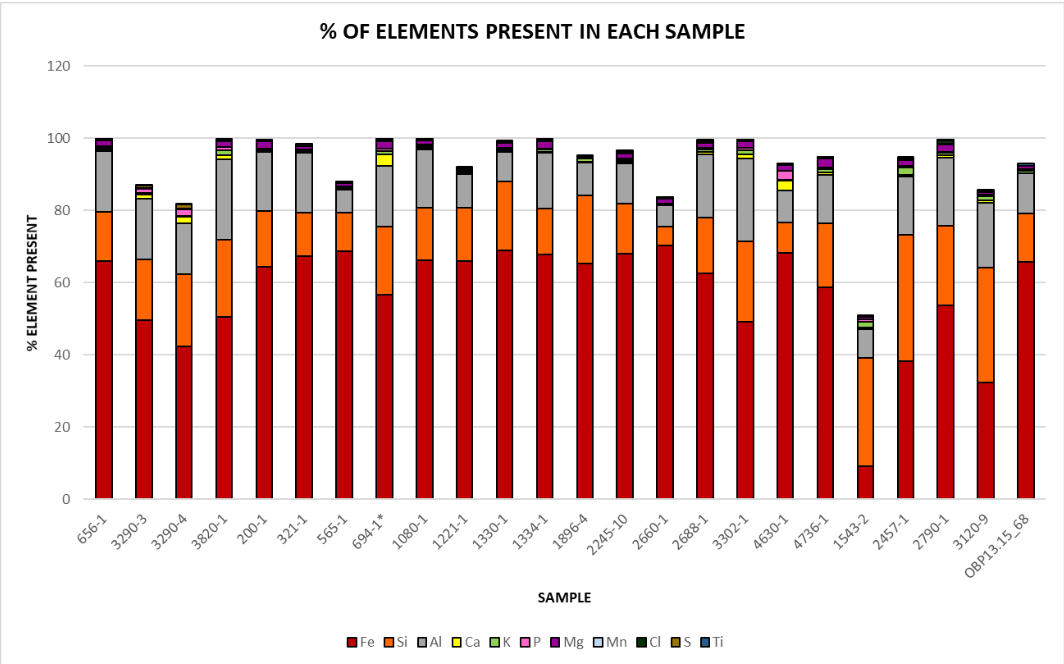

Figure 4.20. Graph showing percentage of elements present in analysed samples. Fe: Iron, Si: Silicon, Al: Aluminium, Ca: Calcium, K: Potassium, P: Phosphorus, Mg: Magnesium, Mn: Manganese, Cl: Chlorine, S: Sulphur, Ti: Titanium.

This qualitative and semi-quantitative analysis showed that the elements generally present in the highest percentages across all analysed samples include Fe (iron) and Si (silica) (Table 4.10, Fig. 4.19, Fig. 4.20), with Al2O3 (aluminium oxide) and

FeO (iron oxide) minerals occurring in the highest proportions. Specular hematite piece OBP-2660-1 has the highest levels of FeO and Fe in the analysed assemblage, and is also specular (Table 4.10, Fig. 4.19, Fig. 4.20). Specular pieces and non-specular pieces generally do not appear to be significantly distinct from each other in terms of FeO and Fe levels (Table 10). Piece OBP-1543-2, a hematite nodule, has an unusually high percentage of Si, and the lowest percentage of FeO and Fe, when compared with the other analysed pieces (Table 4.10, Fig. 4.19, Fig. 4.20). This may be due to the fact that it is from a different source than the other piece of hematite (Table 4.10). The elemental composition of this piece may also explain why it is the only piece with a pink streak colour in the analysed assemblage – also suggesting a different raw material source. In terms of colour, specular hematite pieces with a dark red streak have higher levels of FeO and Fe than shale, mudstone, and ferricrete conglomerate pieces with the same colour streak (Table 4.10). The pXRF analysis on the concreted piece, Piece OBP-694-1, shows the highest percentage of Ca (calcium) among the analysed pieces, which supports the hypothesis that the concretions are calcium carbonate (Table 4.10).

It must be stated that because there is such wide variability in the geological composition of ochre, calibrations available on conventional pXRF instruments are rarely robust enough to provide the most accurate characterization of this material (Dayet 2020 pers. comm.; Popelka-Filcoff & Zipkin 2022: 4-5). Given this, the results of the elemental analysis presented here, while providing a basis for some possible conclusions about the basic geological composition of the analysed pieces (Popelka-Filcoff & Zipkin 2022: 4), should be taken as preliminary.

*Table 4.10. Results of XRF analysis (represented by percentage of main elements) for each sample piece. Pieces highlighted in orange are possibly utilised, pieces highlighted in yellow are utilised. Green indicates the three elements present in the highest levels for each piece, and blue indicates the element present in the lowest levels for each piece. * indicates the control piece used to discern the components of the concreted residue.*

Sample	Layer	Raw material	Streak colour	Specular	Al2O3	FeO	Fe	Si	Al	Ca	K	P	Mg	MgO	Mn	Cl	S	Ti
656-1	GS (Dec.) 6	Specular hematite	dark red	Y	31,916	84,872	65,971	13,704	16,891	0,321	0,536	0,451	1,638	2,716	0,065	0,092	0,072	0,072
3290-3	YRS 4	Shale	dark red	Y	31,701	64,013	49,758	16,647	16,777	1,227	0,356	1,261	_	0	0,193	0,097	0,608	0,263
3290-4	YRS 4	Shale	dark red	Y	26,781	54,625	42,46	19,819	14,174	1,743	0,348	1,761	_	0	0,164	0,099	1,094	0,32
3820-1	YRS 9	Specular hematite	red	Y	42,246	65,139	50,633	21,276	22,358	1,114	1,237	0,958	1,703	2,824	0,069	0,032	0,065	0,318
200-1	GS (Dec.) 2	Specular hematite	black	Y	30,714	82,944	64,472	15,486	16,255	0,252	0,487	0,156	2,022	3,351	0,04	0,182	0,05	0,102
321-1	GS (Dec.) 3	Specular hematite	dark red	Y	31,192	86,584	67,302	12,217	16,508	0,136	0,46	0,274	0,999	1,656	0,059	0,146	0,071	0,127
565-1	GS (Dec.) 5	Specular hematite	dark red purple	Y	12,028	88,34	68,667	10,83	6,366	0,209	0,253	0,266	0,911	1,51	0,103	0,173	0,057	0,067
694-1*	GS (Dec.) 6	Specular hematite	dark red	Y	31,853	72,859	56,634	18,858	16,858	3,287	0,77	0,73	2,104	3,489	0,189	0,192	0,068	0,158
1080-1	GS (Dec.) 9	Specular hematite	dark red	Y	30,546	85,214	66,237	14,609	16,166	0,353	0,53	0,306	1,185	1,964	0,057	0,112	0,063	0,069
1221-1	GS (Dec.) 10	Specular hematite	dark red	Y	17,645	84,851	65,955	14,901	9,338	0,326	0,534	0,411	_	0	0,043	0,176	0,046	0,314
1330-1	GS (Dec.) 4	Specular hematite	red	Y	15,431	88,641	68,901	19,207	8,167	0,342	0,582	0,236	1,333	2,21	0,055	0,201	0,11	0,082
1334-1	GS (Dec.) 11	Specular hematite	dark red	Y	29,311	87,342	67,891	12,677	15,512	0,184	0,684	0,167	2,158	3,578	0,176	0,13	0,042	0,175
1896-4	GS (Dec.) 14	Specular hematite	red	Y	17,245	83,948	65,253	18,911	9,127	0,156	0,866	0,231	_	1,066	0,142	0,168	0,259	0,07
2245-10	GS (Dec.) 16	Specular hematite	dark purple	Y	21,012	87,411	67,945	13,99	11,121	0,354	0,66	0,32	1,401	2,323	0,157	0,235	0,178	0,376
2660-1	GS (Dec.) 18	Specular hematite	dark red	Y	11,221	90,464	70,318	5,16	5,939	0,16	0,255	0,175	1,244	2,063	0,038	0,258	0,059	0,097
2688-1	Unknown	Specular hematite	dark red	N	32,838	80,651	62,691	15,396	17,379	0,68	0,858	0,403	1,426	2,364	0,267	0,101	0,095	0,248
3302-1	YRS 5	Specular hematite	red	Y	43,369	63,328	49,225	22,19	22,953	1,073	1,224	0,674	1,883	3,121	0,124	0,045	0,078	0,269
4630-1	YRS 14	Specular hematite	dark red	N	17,071	87,719	68,184	8,414	9,035	2,563	0,335	2,485	1,519	2,518	0,141	0,129	0,095	0,176
4736-1	A spit 1	Iron oxide	purple	N	24,941	75,579	58,748	17,816	13,2	0,888	0,843	0,469	2,378	3,942	0,02	0,201	0,153	0,118
1543-2	GS (Dec.) 12	Hematite	pink	N	15,104	11,77	9,149	30,077	7,993	0,307	1,653	0,604	0,768	1,274	0,017	0,073	0,074	0,309
2457-1	GS (Dec.) 17	Ferricrete conglomerate	dark red	N	30,485	49,368	38,374	34,803	16,134	0,549	2,123	0,311	1,762	2,92	0,12	0,29	0,075	0,341
2790-1	GS (Dec.) 20	Ferricrete conglomerate	red purple	N	35,601	69,086	53,7	22,004	18,841	0,675	0,788	0,323	1,833	3,038	0,357	0,82	0,066	0,225
3120-9	YRS 3	Mudstone	dark red	Y	33,928	41,797	32,489	31,715	17,956	0,657	1,179	0,422	0,711	1,179	0,064	0,159	0,065	0,306
OBP13.15_68	15/68	Hematite	_	Y	21,027	84,546	65,718	13,403	11,128	0,173	0,654	0,332	0,847	1,404	0,023	0,133	0,043	0,557

CHAPTER 5: DISCUSSION AND CONCLUSION

The aim of this research has been to establish the frequency and type of ochre collected at OBP and how it was utilised during the MIS 6 and 5 periods, and to compare this with the same data from other contemporaneous coastal and inland ochre assemblages. This analysis included the quantification and description of the OBP ochre assemblage and preliminary qualitative elemental analysis of a sample of pieces (presented in chapters 3 and 4). The comparison of the analysed assemblage with the Mason assemblage from OBP and assemblages from other contemporaneous inland and coastal sites (reviewed in chapter 2) and raw material procurement strategies will be discussed below.

5.1 Use

a) Percentage of utilised pieces

In the analysed assemblage from OBP, only 3% of pieces are definitely utilised. Compared to other ochre assemblages from the MIS 6 and 5 periods, where there is data available on how many pieces out of the total recovered are definitely utilised, this is a low number (Appendix 1). The percentage of utilised pieces in MIS 6 and 5 assemblages from other sites in South Africa more typically falls in the teens and twenties. Mwulu's Cave, an inland site, also in Limpopo, is the only site that has an assemblage (dated to MIS 5) where a smaller percentage of pieces are definitely utilised – 2% (de la Peña *et al*. 2018) (Appendix 1). Diepkloof Rock Shelter has also produced an assemblage where a low number of pieces have been utilised – 6% (Porraz *et al.* 2020) (Appendix 1). One site with a MIS 5 ochre assemblage has a very high percentage of utilised pieces – the 1947 excavation of Mwulu's Cave (54%). This is starkly different from the Mwulu's Cave assemblage where only 2% of pieces are utilised, presumably due to different excavation and artefact collection protocols in 1947 compared to 2017 (Watts 1998; de la Peña *et al*. 2018) (Appendix 1). There does not appear to be a pattern or trend between coastal and inland sites regarding percentage of utilised pieces, but this is largely owing to the fact that for many sites there is no information about how many pieces *out of the total excavated ochre assemblage* are utilised, given that often only the utilised pieces themselves are published and discussed. Additionally, for assemblages excavated in the 1950s and 60s, only large pieces, which were often utilised, were kept, while others were likely discarded.

Raw material and streak colour should also be taken into account when considering why there are so few utilised pieces in the analysed assemblage from OBP compared to other sites. In the OBP assemblage, 71% of utilised pieces are specular hematite, with a red, red-purple, or purple (often glittery) streak (Table 4.2). Results of statistical analysis suggest an insignificant relationship between use and specular hematite, since it is also prevalent in the unutilised assemblage. So it may not have been the case that this material was preferred for “special” purposes (i.e. not purely functional) on account of its specular qualities. Based on ethnographic and contemporary use, (Watts 1998) specular varieties may have been chosen for special uses whereas non-specular pieces could have been chosen for functional purposes. In the utilised assemblage at OBP, specularity never occurs at a higher frequency than a red streak colour (Fig. 4.7), which suggests that the latter was a more important quality for the users/ collectors than specularity. Again, there does not appear to have been a statistically significant relationship between specularity and red streak colour, yet a majority of the pieces have both qualities. It is possible then that pieces which were specular *and* had a red streak were desired, but where only one of these qualities could be had, a red streak took preference. It has been suggested that both redness and specularity were key characteristics which were preferentially selected, in this and some other MSA ochre assemblages (Watts 2002: 10).

Another reason for the low utilised percentage of ochre at OBP may be related to Watts’ theory that this was a procurement and caching site (1998: 705; 2002:8). A nearby source could have been mined for specular hematite in large quantities, which were then taken to the site, lightly utilised to test their quality, and stored before eventually being transported (perhaps as part of a trade network) to other sites and used there. This hypothesis may also explain the lack of statistical indications of preferential selection of specular hematite – this raw material may not have been specially selected for use at OBP, but there is still a very large quantity of it. It is unlikely the collectors would have gone to the effort of obtaining such anomalously high amounts of specular hematite to not use it to create a powder, so it must have been intended for use elsewhere, or in ways which did not modify the surface. This then raises the question of *which* other sites this specular hematite would have been taken to and used at. Bushman Rock Shelter and Mwulu's Cave are the only other known sites in Limpopo with MIS 6 and 5 assemblages in which specular hematite occurs (Appendix 1). It is of course possible that it was simply all used up; the large quantities at OBP certainly suggest a substantial demand for this raw material. Possible sources are discussed further in 5.2.

b) Use-traces and use-wear

In the utilised assemblage from OBP, parallel striations from grinding occur in the highest frequencies (on 86% of pieces). Microstriations and smoothing occur on 71% of pieces, polish on 36% of pieces, and chipping, scratches, and scuffmarks on no pieces. Grinding ochre to produce a powder, which results in the formation of parallel grooves or striations on the ochre piece, is one of the most predominant use-wear activities among ochre assemblages from both coastal and inland South African sites (Appendix 1). Grinding is the most likely method of producing pigment powder at OBP, considering that the specular hematite in this assemblage is hard and more difficult to crush than other softer ochreous raw materials.

Most pieces in the utilised assemblage have one utilised surface; only three pieces have two utilised surfaces (Appendix 2). Two of the pieces with two utilised surfaces, OBP-2042-3 and OBP-1783-7 (Fig. 4.8), have faceting as a result of more intensive grinding (supported by the fact that there are striations on the facets of these pieces). Piece OBP-582-1 also has faceting, but because this faceting does not have the smooth, rounded quality of the faceting present on the aforementioned pieces, or grinding striations on the facets, it is more likely that this is the result of knapping rather than grinding (Fig. 4.8). Furthermore, only three pieces in this assemblage have a nodular shape (Appendix 2). It thus seems that the ochre at OBP was mostly utilised only once, or a handful of times, only making use of one surface, before being discarded. This corresponds with the idea that it was perhaps only utilised to test its quality, and further may suggest that the raw material was available in abundant enough quantities that the users could afford not to make full use of all the pieces. Additionally, many pieces may have been broken open to check the type/ colour/ specularity of the ochre, causing the irregular shape. Irregular-shaped pieces are most common in the utilised, unutilised, and full assemblages, but in the possibly utilised assemblage nodules are most common, because a nodular shape (and the smoothing which often accompanies this) is often the main characteristic which placed these pieces in the possibly utilised assemblage.

c) Natural wear vs anthropogenic use

It is complicated to distinguish between traces of anthropogenic use, such as rubbing, and traces resulting from natural processes, such as river smoothing. Many of the pieces collected during the May 2021 sourcing trip from around the site resemble excavated pieces quite closely in terms of shape and surface features such as polish and smoothing (Fig. 3.2). It is unlikely that these pieces were utilised. This suggests that some level of natural processes may be at play in the smoothed or polished appearance of the pieces in the study assemblage, and that smoothing may be a less reliable category for determining use in this case. Given the proximity of the site to the Riet Spruit (approx. 20 m) it is probable that a certain percentage of the smoothing may have been the result of natural processes of water abrasion. Some pieces in the study assemblage could have been deposited by the stream when it swelled. Val and colleagues (2021:12) mention that it is likely that flooding played a role in the weathering of material excavated from the lower units. Additionally, many pieces from the lithic assemblage also "exhibit clear evidence of rounding, which could indicate that this part of the sequence [GS and YRS] represents a secondary deposit" (Val *et al.* 2021: 13). River/ stream deposits generally exhibit natural smoothing and sometimes polish (Val *et al.* 2021: 9), which may be the cause of these features on many pieces at OBP. In years when rainfall has been exceptionally high, "a floodplain develops from bank overflows so that the water extends almost to the base of the talus" (van der Ryst 2006: 24).

During the sourcing trip, ochre and lithics were also found in abundance just below the dripline of the shelter, which may suggest flooding.

d) Use-trace comparison with other MIS 6 and 5 ochre assemblages from inland and coastal sites

i) Inland sites

Table 5.1. Abridged information on forms of use/ use-wear traces, raw material, and colour in ochre assemblages from MIS 6 inland and coastal sites. Unabridged table in Appendix 1.

(MIS 6) Site and assemblage	Forms of use/ use-wear traces	Raw material	Colour
Inland Sites			
Wonderwerk Cave (Chazan & Horwitz 2009)	Incising	Ironstone	N/A
(Chazan *et al.* 2020)	"Abrasion" from possible use or incision	Piece described only as "ocher"	N/A
(Beaumont & Vogel 2006)	N/A	Specularite associated with MUs 1-2, hematite associated with MUs 1-7	Red
Wonderkrater (Backwell *et al*. 2014)	Slightly polished	Piece described only as "ochre"	Deep red
Border Cave (Watts 1998)	Possible polish on one piece	Iron oxide and hematite	Poppy, orange-red
(Watts 1998)	Grinding	Predominantly described only as "ochre", "fine grained ferruginous material" also present, some hematite and iron oxide	Orange-red, poppy
Bushman Rock Shelter (Watts 1998)	Grinding- though on one piece this may be natural	"Shaley mudstone", "ochre", specularite, hematite	"Blood red", orange/brown/light /dark reds, yellow brown
Coastal Sites			
Pinnacle Point (Cave 13B) (Marean *et al.* 2007)	Of the definitely utilised pieces, 8 are ground and 2 are scraped	"iron-rich fine-grained sedimentary materials", all pieces can be considered "red ochre"	Red-brown, red

Specific use-traces are generally not as well defined for the MIS 6 period as they are for the MIS 5 period at most sites, partly because ochre assemblages dated to the former are smaller and generally do not contain as many utilised pieces. The most common use-traces in the OBP utilised assemblage – grooves, microstriations, and smoothing – are not mentioned in analyses of MIS 6 ochre from other inland sites (Appendix 1; Table 5.1). However, while these are not explicitly mentioned, an inspection of the available images of the ochre in these other assemblages indicates that microstriations may indeed be present on pieces from Wonderwerk Cave (Beaumont & Vogel 2006; Chazan & Horwitz 2009). Incising and grinding are the most frequent use-wear forms reported in these other assemblages, from sites such as Wonderwerk Cave, Border Cave, and Bushman Rock Shelter (Watts 1998; Chazan & Horwitz 2009; Chazan *et al.* 2020) (Appendix 1; Table 5.1). Grinding is also one of the most common use-wear forms found on ochre in the OBP assemblage, but incising does not occur. In assemblages from inland sites such as Wonderkrater and Border Cave, dated to the MIS 6 period, polish occurs more frequently than other use- traces mentioned in analyses (Appendix 1; Table 5.1). There is a possibility that this may also be related to natural polish. No images are available of these polished pieces to review these use-traces. Within the utilised assemblage from OBP, polish is the third most frequently occurring use-trace, found on 36% of utilised pieces.

For the MIS 5 period, striations, polish, and smoothing are the most common use-traces present in analysed ochre assemblages from inland sites, such as Border Cave and Mwulu's Cave (Appendix 1; Table 5.2). The assemblage from OBP broadly follows this pattern. The forms of use in the OBP ochre assemblage also align with broader use trends at inland sites during this period – grinding as well as rubbing. Raw material types may have played a role in this, but this requires further investigation.

Table 5.2. Abridged information on forms of use/ use-wear traces, raw material, and colour in ochre assemblages from MIS 5 inland and coastal sites. Unabridged table in Appendix 1.

(MIS 5) Site and assemblage	Forms of use/ use-wear traces	Raw material	Colour
Inland Sites			
Border Cave (Watts 1998)	Striations, some polishing and smoothing Grinding	Predominantly hematite, some iron oxide	Red/ "poppy", some orange-red pieces
Rose Cottage Cave (Hodgskiss & Wadley 2017)	Grooves, some infrequent scoring Rubbing, some pieces are also ground, and some are both ground and rubbed	Shale	Bright red
Bushman Rock Shelter (Watts 2002)	Grinding	Shale, hematite, mudstone	Red
(Porraz *et al*. 2018)	N/A	Described only as "ochre"	N/A
Cave of Hearths (Mason 1988; Watts 1998)	N/A	Described only as "ochre"	Red and yellow
Mwulu's Cave (Watts 1998)	Faceting, crayon-like shape, polish Grinding	Grindstones quartzite, quartzitic sandstone, pigment specularite, hematite	Red, pink-red, orange-brown
(de la Peña *et al.* 2018)	Microstriations, smoothing, polish Rubbing	Utilised pieces iron oxide, 1 mudstone	All utilised pieces red
Coastal Sites			
Pinnacle Point (Cave 13B) (Watts 2010)	Grinding	Siltstone, iron oxide, sandstone, shale	Red, red-brown
Diepkloof Rock Shelter (Dayet *et al*. 2013)	Knapping, grinding, faceting Grinding most common	Shale, some ferricrete	No streak tests
(Porraz *et al*. 2020)	Grinding	Shale and ferricrete	N/A
Blombos cave (Henshilwood *et al*. 2009)	Incised	Siltstone; shale, sandstone and hematite also occur	Pieces are of a variety of colours
(Watts 2009)	Grinding	Shale, siltstones	Red, yellow-brown
(Henshilwood *et al.* 2011)	Grinding, rubbing	Two types of ferruginous siltstone	All staining, the compound, and individual ochre pieces are red
Klasies River (d'Errico *et al.* 2012)	Grooves, striations Engraving, rubbing, scraping	N/A	No streak tests
(Singer & Wymer 1982)	Smoothing, scratching, crayon-like shape, some pieces show possible incising	Sandstone, soft hematite	Red, yellow, pink
(Culey 2019)	Grooves, striations Rubbing, grinding	Grindstones quartzite, nodule shale	Red
Hoedjiespunt (Will *et al.* 2013)	Parallel striations, pencil-like shape Grinding	N/A	Red, reddish brown

ii) Coastal sites

Only one coastal site has produced an ochre assemblage dated to MIS 6: Pinnacle Point 13B (Marean *et al.* 2007) (Appendix 1; Table 5.1). In this assemblage, specific use-traces are not mentioned, but inspection of the images of the assemblage do show striations, grooves, and some smoothed-rounded edges (Marean *et al.* 2007: 906; Watts 2010). Grinding is the most prevalent form of use, also similar to the analysed assemblage from OBP (Marean *et al*. 2007: 906; Watts 2010).

In MIS 5 ochre assemblages from coastal sites, striations and grooves are the most prevalent use-traces, with common descriptions of “crayon” or “pencil” shaped pieces – implying intensive grinding utilisation (Appendix 1; Table 5.2). Polish appears to be much less common in these assemblages than in those from inland sites. While grooves and striations are also most common in the utilised assemblage at OBP as well, an irregular shape is more common than nodular. At coastal sites of this period, grinding and rubbing are also the most frequent forms of use, again the same as at OBP (Appendix 1; Table 5.2).

5.2 Raw Material

a) Specular hematite

At OBP, specular hematite is most common in the possibly utilised assemblage, and least common in the utilised assemblage (although it does still overwhelmingly dominate the full assemblage). There is also a correspondence in piece shape – nodules are more common in the possibly utilised assemblage than in the utilised assemblage. It is possible that many of the possibly utilised pieces were not utilised at all, but rather picked up opportunistically already in nodule form. Nodule-shaped, smoothed specular hematite can be commonly found around OBP today. That specular hematite is lowest in the utilised assemblage compared to the possibly utilised, unutilised, and full assemblages (though it does still make up the majority of this assemblage) may indicate that it was widely available and could be collected from a nearby source.

b) Shale and ferricrete conglomerate

Shale comprises 14.3% of the utilised assemblage, but is present in much lower quantities in the unutilised assemblage. Shale is a soft raw material which is common in many utilised ochre assemblages because it can generally produce a very richly pigmented streak compared to other raw materials. However, this is not the case for the type of shale present in the study assemblage, which is dry and crumbly and does not produce a very pigmented streak. In fact, the mudstone pieces in this assemblage produce the strongest pigmented streak. It is possible that the shale in the utilised assemblage at OBP was chosen by people who had prior experience, and success, with this raw material, but upon attempting to utilise it, it became clear that this particular type of shale would not be suitable for their purposes. Ferricrete conglomerate is most common in the unutilised assemblage compared to other assemblages. This raw material is generally not suitable for pigment/ colouring purposes, given its highly varied texture and poor streak production (Watts 1998: 182). It is thus not likely to have been chosen for these purposes or even attempts at them, as it was probably immediately clear from looking at the ferricrete conglomerate pieces that they would not yield successful results. Specific types of ochre may have been preferentially selected based on geological characteristics in addition to physical, macroscopically visible characteristics such as colour or specularity.

c) Source of raw materials

OBP is located within the Mogalakwena formation, which includes "conglomerates, sandstones, and some shale" (van der Ryst 2006: 26). Specular hematite and hematite nodules are incorporated into the sandstones surrounding the site. The sediment colours in the area range from reds, browns, and purple-browns, with purple sediments indicating the presence of what van der Ryst refers to as hematite (2006: 26). This points to a nearby source of the specular hematite at OBP. The area of Lephalale, 20 km away from the site, was thought to be abundant in iron ore/ hematite in the past, so the source may have been here (van der Ryst 2006: 178). It is possible that the extensive modern commercial mining of iron deposits in the Lephalale area would have destroyed any traces of earlier mining (van der Ryst 2006: 179), if these had not already been exhausted by mining during the deep past to keep up with the hypothesised high levels of demand for specular hematite. Additionally, Dr Paloma de la Peña, Zubair Jinah and Dineo Masia embarked on a lithic sourcing trip in the area in September 2021 and discovered possible sources of banded ironstone and specular hematite within 10km from OBP, between the site and Lephalale. This opens the opportunity for future ochre raw material sourcing studies related to the site.

With regards to possible sources further away from the site, Thabazimbi, about 80-100 km away, is also abundant in iron ore, which is mined commercially (Brandl 1996). A prehistoric specular iron ore mine has also been noted on the side of the Spitzkopje mountain in the Soutpansberg (van der Ryst 2006: 178-9). However, this distance would certainly have been too great to travel on foot for this to be considered a local source, as would Thabazimbi (and Lephalale). Van der Ryst also notes an "exceptionally rich source of iron oxides in a wide range of ochre hues" in the vicinity of a hill near the Lephalale River (2006: 179), although this source was not located during the provenance trips in the area. The significantly high volume (approx. 12 kg) of this heavy specular hematite recovered from OBP in previous excavations (most of which is unutilised) led Watts (2002:8) to conclude that an ochre source was near the site, which, given the present evidence, must have been the case. It must also be noted that if a source was near OBP, it is possible that the specular hematite may be the most abundant raw material not because there was a preference for it, but because it was what was available. However, that ethnographic sources indicate that specular hematite was historically valued above other raw materials (discussed in chapter 2.4) suggests otherwise.

d) Raw material comparison with other MIS 6 and 5 ochre assemblages from inland and coastal sites

i) Inland sites

Specularite, or specular hematite as it has been referred to in this analysis, overwhelmingly dominates the OBP assemblage, followed by hematite. For several MIS 6 ochre assemblages from inland sites, such as Wonderwerk Cave (Chazan *et al.* 2020), Wonderkrater (Backwell *et al.* 2014), Border Cave (Watts 1998), and Bushman Rock Shelter (Watts 1998), pieces are described only as "ochre", which makes it difficult to compare these assemblages to others on the basis of raw material (Appendix 1; Table 5.1). Apart from this, hematite is also mentioned relatively frequently, for example in one assemblage from Wonderwerk Cave, at Border Cave, and Bushman Rock Shelter, as is specularite, in the same assemblage from Wonderwerk Cave, and at Bushman Rock Shelter (Appendix 1; Table 5.1).

Specular hematite appears more frequently within MIS 6 assemblages than those dated to MIS 5, which may suggest an earlier preference for this raw material, which was later gradually abandoned, perhaps for softer ochre varieties.

In terms of raw material, OBP differs from other MIS 5 inland sites in the dominance of specular hematite. This material only occurs within one other MIS 5 ochre assemblage, from Mwulu's Cave (where it is referred to as "specularite"), which is about 100km away from OBP (Watts 1998: 778; de la Peña *et al*. 2018) (Appendix 1; Table 5.2). Here, utilised specularite pieces are associated with grindstones, which, in combination with the predominance of grinding as a form of use in this assemblage, indicates that the selection of specularite/ specular hematite for pigment powder production occurred at this site as well as at OBP. Why this raw material was seemingly not used at other inland sites during the MIS 5 likely has something to do with its source and availability. The apparent absence of specularite/ specular hematite at other MIS 5 inland sites may also be the result of how researchers have chosen to classify pieces, as discussed in previous chapters. Hematite generally occurs most frequently in MIS 5 assemblages from inland sites. Specularity is rarely mentioned, so it might not necessarily be the case that the pieces are specular but just called hematite as a general classification. Shale is also relatively frequent. In the OBP assemblage, hematite is the second most common raw material, and shale is rare but is found in the highest percentage in the utilised assemblage.

ii) Coastal sites

At MIS 6 coastal sites, raw materials are also not referred to with the same specificity as later assemblages. The pieces in the Pinnacle Point assemblage are fine-grained and iron rich "ochre" (Marean *et al*. 2007: 906) (Appendix 1: Table 5.1). The predominant raw material at OBP is also significantly different when compared to those at MIS 5 coastal sites, where shale and siltstone are most common (Appendix 1; Table 5.2). This again is likely the result of specular hematite simply not being available at a source near the site, or of a lack of hypothetical trade or cross-regional movement (or at least none that reached coastal regions).

5.3 Colour

a) Predominant colours in the OBP ochre assemblage

Various shades of red are often the most predominant colour in many (utilised) MSA ochre assemblages through time (Appendix 1). In the OBP ochre assemblage, red-purple and purple are also relatively common (Table 4.2). Many reasons for this apparent preference for red have been hypothesised, many of them based on the idea that red held symbolic meaning. This includes the use of red ochre as a cosmetic or body paint, which often relies on ethnographic information, particularly from Khoisan communities (Watts 2002: 2, 2010; Hovers *et al*. 2003; Marean *et al.* 2007). Many ethnographic accounts based on southern African hunter-gatherer societies in the last few hundred years refer to the use of red to represent fertility or blood, and the fact that redness and glittering qualities are associated with ideas of supernatural potency and coming-of-age rituals in many of these societies (Watts *et al*. 2016: 300). It should, however, be noted that red is not always associated with menstruation in contemporary societies (Hovers *et al.* 2003: 510), and that there is no evidence of ochre being used in such a manner in the MSA. The Female Cosmetic Coalition (FCC) hypothesis suggests that human encephalization meant babies required more investment from mothers after birth (Watts 2009: 71). There would have been a loss of investment from males, and it is hypothesised that this may have encouraged women to use red pigment in order to simulate menstruation and regain male investment (Watts 2009: 71). Red ochre powder is also a component in the compound mixture found in abalone shells at Blombos Cave, which may have had a cosmetic, decorative, or symbolic purpose (Henshilwood *et al*. 2011). Some red ochre pieces from different sites have also been engraved with geometric patterns which may have served a symbolic function, and which are suggested to have been part of a wider engraving tradition (Henshilwood *et al.* 2009; d'Errico *et al.* 2012).

In terms of the functional use of red ochre, in many experimental studies it is often not clear if the *colour* of ochre is of any functional significance, but it may have acted as an indicator of the geological composition of pieces. Studies have shown that some varieties of red ochre have higher SPF values than other colours (yellow and grey specifically), so may have been preferred for use as a sunscreen (Rifkin *et al.* 2015: 3). Red ochre can also be used as an aggregate in adhesives for hafting lithics, which may be down to the fact that this colour generally indicates higher levels of iron oxide, which is a key ingredient in adhesives, and aids the cementation process (Wadley 2005a: 597; Wadley *et al.* 2009; Kozowyk *et al*. 2016, 2020). It is possible then that red ochre is so ubiquitous in MSA contexts because it served both functional and symbolic purposes more successfully than other colours, with colour being the key characteristic for symbolic use, and elemental composition the key characteristic for functional use. While symbolic use could explain the predominance of red in the study assemblage, purple and red-purple do not occur nearly as frequently as red in the broader assemblages of ochre from other sites, and so there are no theories regarding its selection and use. It may be that specular hematite/ hematite pieces were chosen with the intention of producing a red colour (there is a significant relationship between red streak colour and use), but that some of them simply ended up producing a more purple colour.

With both specular hematite and hematite, there is little indication of the exact colour streak they will produce from the exterior of the piece; this only becomes clear once the pieces have been utilised. This could also explain why red occurs in the highest frequency in the utilised assemblage, while red purple and purple occur in higher frequencies in the possibly utilised assemblage (Table 4.2). Pieces in the possibly utilised assemblage could have been very gently utilised to test the colour they would produce, and then perhaps discarded if they did not produce red, while pieces in the utilised assemblage could have undergone the same test, then utilised more intensively because they did produce a red streak. This process may have allowed the users to develop their knowledge of the raw material to the point where they could identify which pieces would produce a purple streak based only on their appearance, and discard them without testing them. This may be why red purple and purple occur in the highest frequencies in the unutilised assemblage.

b) Colour comparison with other MIS 6 and 5 ochre assemblages from inland and coastal sites

i) Inland sites

With regards to streak colour from MIS 6 inland ochre assemblages, red is most common (Appendix 1; Table 5.1). Streak colours at OBP also fall within this pattern, with red being most common, especially among utilised pieces. Although pieces with a red streak comprise the majority of the assemblage, these are followed by red-purple and purple pieces, which appear to diverge from the red trend. These colours seemingly do not occur in other MIS 6 inland assemblages at all. Red is also predominant in MIS 5 inland assemblages.

ii) Coastal sites

Most pieces from Pinnacle Point 13B MIS 6 layers have a red-brown streak, and some have a red streak (Marean *et al.* 2007: 906; Watts 2010: 399). The OBP assemblage thus bears only a little resemblance to the Pinnacle Point assemblage, in relation to the form of use and streak colour of some pieces.

As at inland sites, red is the most common colour in analysed MIS 5 assemblages (Appendix 1; Table 5.2), and pieces at OBP broadly align with this, except for the fact that red streaks at OBP appear to be darker and more purple than those described from other coastal sites.

5.4 Comparison with the Mason Assemblage

While Mason did briefly discuss ochre finds from OBP in his 1962 publication on the history of the Transvaal, Watts's 1998 re-examination of this material is used here as the basis for comparison between the Mason and Val ochre assemblages as it provides more detailed information obtained through more up-to-date methods of ochre analysis. Use-traces noted by Watts on pieces recovered from Bed 2 (dated to the MSA) include faceting, pencil-like shape, smoothing, and striations (Watts 1998: 711-14; Val *et al.* 2021). These are all consistent with use-traces prevalent in the utilised 2018/19 assemblage. Many pieces from the Mason assemblage are definitively classified as having been ground (Watts 1998: 711-14), again consistent with the predominant form of use in the recent assemblage. Additionally, some of the specular hematite in the Mason assemblage is noted as having a “near mirror finish”, which is taken to suggest that “a very fine-grained abrasive surface was used” to grind the pieces into pigment powder (Watts 1998: 706) (or this may be a natural feature). Though Watts classifies this as grinding, it could also be classified as rubbing. Although a fine-grained surface could have been used, this was not vital to powder production; coarser abrasive surfaces could also have been used successfully (Watts 1998: 706). Pieces from the Val assemblage generally do not seem to exhibit the mirror-like quality described by Watts. Many pieces do have a high degree of smoothing, and a slightly shiny finish as a result of this or natural abrasion, but not to the extent that they could fit this description. Watts identified 132 unutilised, 4 possibly utilised, and 22 definitely utilised pieces from Bed 2 (1998: 714). Based on these numbers, 14% of this assemblage is utilised, in contrast to the 3% of utilised pieces in the 2018/19 assemblage. This is probably partly due to different ways of quantifying/ classifying pieces and excavator bias – where only larger pieces were kept during older excavations.

With regards to raw material, the Mason assemblage seems to be identical to the Val assemblage: comprised of 99% dense, heavy, specular hematite “pebbles” (called specularite and specular hematite interchangeably by Watts) of both fine and coarse-grained varieties, with the fine-grained variety being more common (Watts 1998: 704). It is thus reasonable to assume that the main source of the specular hematite at OBP did not change dramatically during the period in which these two assemblages were initially obtained and utilised.

5.5 Behavioural/ Cognitive Implications

In order to glean information from the physical ochre pieces in the recent OBP assemblage about the behaviours and cognitive capabilities of the users, each behavioural stage in the suggested activity processes must be identified (Lombard & Haidle 2012; Hodgskiss 2014: 407). This can be done through constructing operational sequences and cognigrams, which separate actions and cognitive prerequisites for these actions into clearly defined sequences. This helps to establish the number of behavioural and cognitive steps required during an activity, and the cognitive requirements for each task, such as forward planning, cognitive fluidity, or abstract thought (Wadley 2013; Hodgskiss 2014:407).

The hypothesis suggested here is that the ochre in the Val assemblage was obtained from a local (as yet unknown) source with a preference for red and possibly specular pieces. These pieces were brought back to OBP and possibly accumulated. There is currently no physical evidence of any area in the site being used to cache pieces or of any archaeologically visible storage method, but the large amounts of specular hematite found at the site suggest at least some form of accumulation was happening. Some of the pieces were utilised (ground), and some were utilised only briefly perhaps to test their quality and suitability for the intended purpose, after which the ochre may have been transported to other sites at some point and utilised more intensively there. There is scant evidence to indicate that the OBP ochre assemblage is incomplete or that OBP was not the end destination. Yet, given that there is a good chance that specular hematite had some form of heightened value (as suggested by ethnographic accounts and other preferences shown in other archaeological assemblages), it is unlikely that so much ochre would have been collected and brought to the site and then not used at all, unless it was going to be used elsewhere. Watts's accumulation hypothesis is not meant to be presented here as definite or without its flaws (some of which have been discussed), but rather as a plausible explanation for the findings of the research presented here. The exploration of the cognitive requirements/implications which is presented below is intended to begin a discussion of the plausibility of this hypothesis from a cognitive perspective. There is little research on ochre transportation and storage strategies during the MSA from which to draw. It is thus more practical at this stage to begin thinking through the cognitive requirements of the processes suggested in the aforementioned hypothesis by way of an operational and cognitive inferential sequence (Fig. 5.1). Future and ongoing sourcing studies at other MSA sites in Limpopo may shed light on this topic.

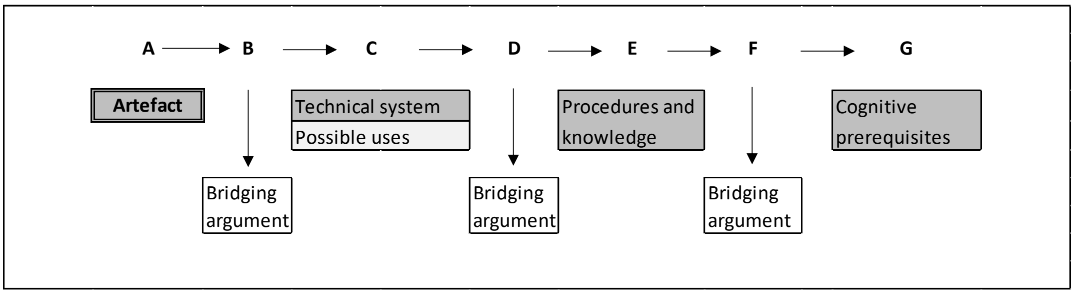

Figure 5.1. Structure of a schematic operational and cognitive inferential sequence (adapted from Hodgskiss 2014).

The cognitive inferential sequence begins with the physical artefacts: out of 452 total ochre pieces, 14 are utilised, and 398 are unutilised (Fig. 5.2 A). The use-traces present on the utilised pieces primarily match those obtained during grinding (Fig. 5.2 B). It is therefore clear that most utilised pieces were ground to produce a pigment powder. When comparing the number of utilised pieces with the number of unutilised pieces, it is obvious that a very small percentage of pieces in the fairly large study assemblage are utilised (Fig. 5.2 B). One of the reasons suggested for this is that OBP functioned as a storage or "factory" site (Watts 1998, 2002). Considering that there is no archaeologically visible evidence for storage, as mentioned above, the term "accumulation" is used here instead. Some of the uses of pigment powder (and some of the purposes for which the OBP ochre may have been ground) include as an ingredient in adhesives (Wadley 2005a, 2015), a sunscreen (Rifkin *et al.* 2015), an insect repellent (Rifkin 2015), as a component in ritual behaviours/ practices (Watts 2002, 2010, 2014; Lombard 2012), as a symbolic element (Watts 2002; Hovers *et al.* 2003; Rifkin 2012; Wadley 2015), and as a cosmetic (Watts 2009; Rifkin 2012; Robbins 2016) (Fig. 5.2 C). Use as a sunscreen, insect repellent, and cosmetic all involve the application of ochre to the body. Furthermore, use as a ritual component necessitates symbolic meaning being ascribed to the ochre. It must be noted that many of these uses, in particular those with ritual/ symbolic/ cosmetic functions, are ascribed to *red* ochre specifically. With regards to the purpose of all the unutilised pieces, it is possible that they were collected and taken to OBP to form part of an exchange network or relationship with other groups, or that the intention was to use these pieces at a later point (Fig. 5.2 C).

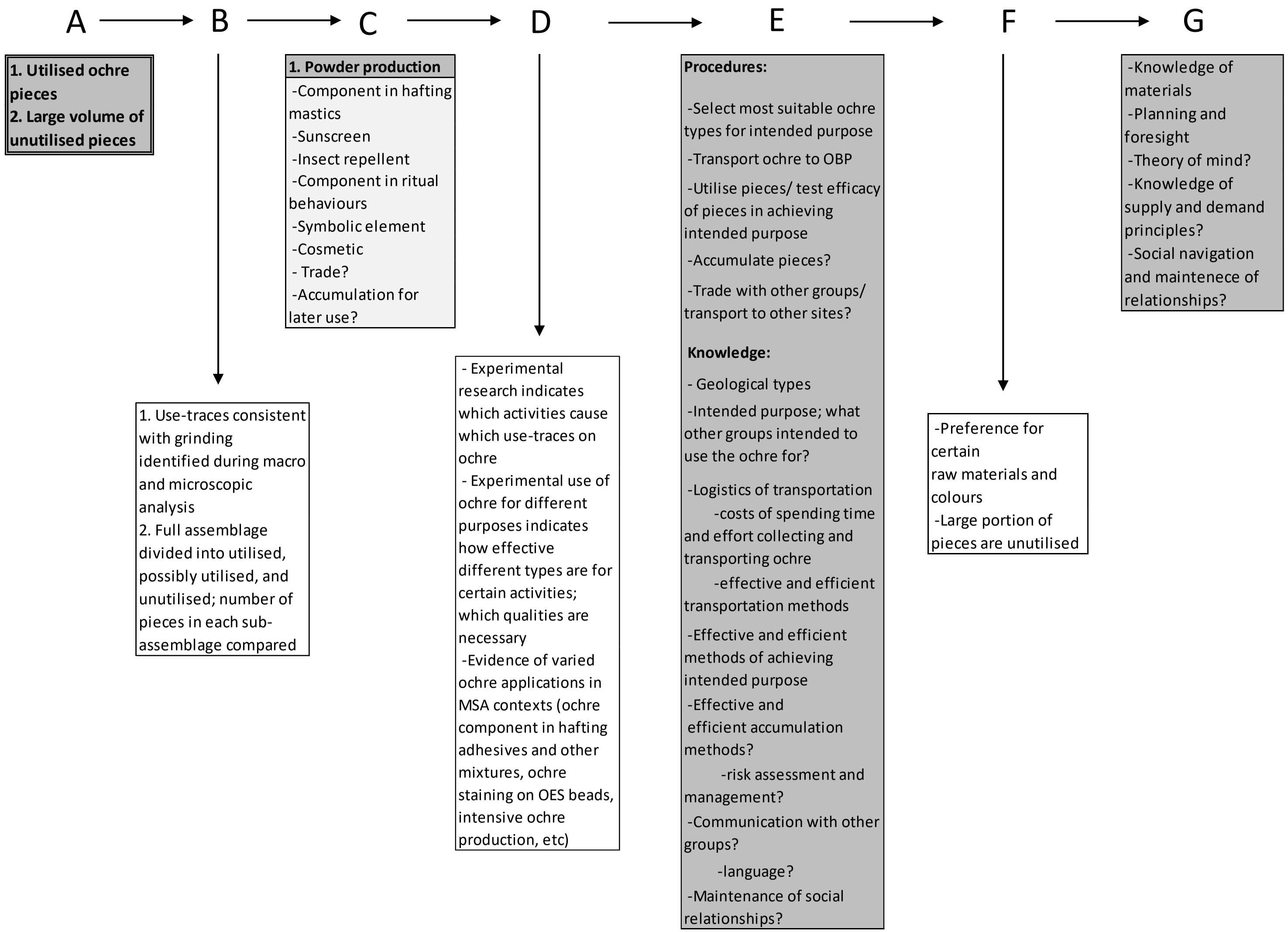

Figure 5.2. Operational and cognitive inferential sequence for the suggested theory of ochre procurement, transport, and use at OBP.

Experimental research has, in addition to showing which use-traces are left by different activities, also showed which characteristics are necessary for certain purposes and suggested which procedures were followed in successfully achieving these purposes (Hodgskiss 2010, 2013b, 2014; Rifkin 2012) (Fig. 5.2 D). There is also firm evidence for a variety of different uses of ochre during the MSA: as an ingredient in hafting adhesives as evidenced by its presence on lithics from Rose Cottage Cave and Sibudu Cave (Wadley 2005a), as a body paint/ decorative element as evidenced by its presence on ostrich eggshell beads from Apollo 11 Cave (Vogelsang 1998; Watts 1998, 2002: 8) and marine shell beads from Blombos Cave and Sibudu Cave (d'Errico *et al.* 2005; 2008), and as a component in the ochre processing workshop at Blombos, which could have been used for an as yet undefined symbolic or utilitarian purpose (Henshilwood *et al.* 2011).

In collecting the ochre, the collectors would have had to have a pre-formed idea of what they were looking for based on what they planned to use the pieces for (i.e. planning and foresight capabilities), which requires knowledge of different geological types and their beneficial and detrimental characteristics (Hodgskiss 2010) (Fig. 5.2 E). In transporting the ochre to OBP, considerations would have to be made concerning the energetic and social costs of this, as well as devising and utilising an effective transportation strategy which efficiently managed these costs and achieved the goal of getting the ochre to the site. When it comes to utilising the pieces, the users would similarly have required knowledge of energy and time efficient methods of achieving their end goal, which, in the case of producing powder by grinding, requires the use of appropriate tools (Hodgskiss 2010). Given that the process of grinding an ochre piece to obtain powder is relatively well understood, a thought and action sequence has been provided to illustrate this process (Fig. 5.3).

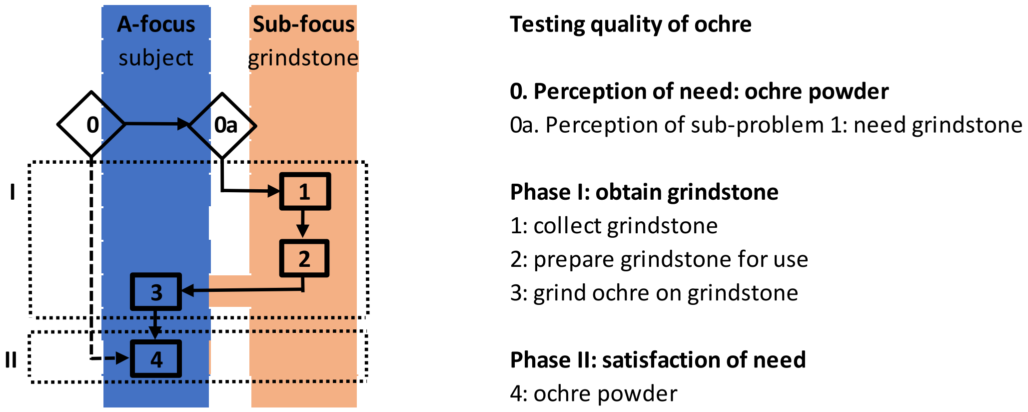

Figure 5.3. Thought and action sequence for grinding ochre (adapted from Hodgskiss 2014).

5.6 Conclusion

In summary, the results of this analysis of the ochre excavated from OBP in 2018/19 indicate red is the most common streak colour in the full OBP ochre assemblage as well as the utilised, possibly utilised, and unutilised assemblages, followed by red-purple and purple. Specular hematite is the most common raw material, followed by hematite in the utilised and unutilised assemblages. Softer shales are more common in the utilised assemblage than in the other assemblages. Most pieces are heavy, falling within the 1.1 – 10.0 g weight category, and 11 – 30 mm size categories. The highest number of pieces are found within GS *décapage* 17 and 14 units, except in the case of the utilised assemblage, where no unit is predominant. Given that the size of the utilised assemblage is very small, it is difficult to see any statistically significant patterning. The lack of clear patterning or trends with regards to layers/ units is likely reflective of the fact that units at OBP are distinguished based on sedimentary composition and thus probably do not represent occupational phases, but rather site formation processes (Val 2021 pers. comm.).

An irregular piece shape is most common, except within the possibly utilised assemblage, where nodules are more common. Grooves, microstriations, and smoothing are the most common use-traces seen on utilised pieces, indicating that rubbing and grinding, sometimes together, are the most common forms of use. In terms of elemental composition of analysed pieces, Al_2O_3, FeO, Fe, and Si are present in the pieces in the highest quantities. Pieces with dark red streaks generally tend to have higher levels of Fe and FeO than those with lighter coloured streaks.

In terms of future research, the topic of ochre cleaning methods would benefit from more detailed and experimental research, especially concerning the use of potentially damaging cleaning agents. Further research into procurement strategies and elemental make-up of the ochre from OBP is required, to fully understand the processes involved in the hypothesised ochre use process and to infer definitive cognitive abilities and developments based on these. Inductively coupled plasma mass spectrometry (ICP-MS) as well as destructive XRF analyses are set to be performed by Dr Tammy Hodgskiss in 2022 on the ochre obtained during the sourcing trip in the OBP area led by Dr Paloma de la Peña. These analyses should help to build a more robust and accurate picture of the geological/ elemental composition of local ochre types and provide more information about a possible source of the ochre analysed in this study. It is hoped that similar elemental analyses can be performed on the ochre in the study assemblage and from sites in the wider geographical area in the future, to further understand the use and movement of ochre around the landscape as well as the broader social landscape during this period of the past.

It is suggested here that the ochre in the analysed assemblage was obtained from a local source with a preference for pieces with a red streak, then taken to OBP and accumulated, with a very small number of pieces being utilised, perhaps to either test their quality or to fulfil a functional or ritual purpose. Ethnographic accounts indicate that specular hematite has long been a highly valued component in cosmetics, and the specular hematite found at OBP may have been collected and used for a purpose similar to this. Following this, the bulk of collected pieces may have been transported to other sites, possibly as part of an exchange network. If OBP was indeed an accumulation site and part of a larger network of ochre collection and use, this points to a complex range of cognitive prerequisites, including the assessment of risks and the development of storage methods to mitigate these, communication with other groups, and the navigation and maintenance of social relationships (Fig. 5.2. G). This may also include a sophisticated "theory of mind", i.e., the ability to imagine the thoughts or intentions of others (Bering 2002). When considering the earliest possible date for the OBP ochre, 190-130 ka (MIS 6), it is possible that these cognitive developments could have occurred earlier than is commonly suggested (around 100 ka).

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Appendix 1 – MIS 5 and 6 Ochre Assemblages

MIS 5 inland sites- basic (location, dating, layer, quantity, finds) information

(MIS 5) Sites	Location	Approximate dating	Dating method	Layers/ units	Quantity analysed	Approximate weight	Relevant finds
Inland Sites							
Border Cave	KwaZulu-Natal	168ka -113ka (Backwell *et al*. 2018: 4)	ESR (Backwell *et al*. 2018: 4)	Layers 1, 6, and 7 (Member 4WA) (Watts 1998: 1110; Backwell *et al*. 2018: 4)	36 ochre pieces (Watts 1998: 1110)	0.11kg (Watts 1998: 1128)	4 pieces definitely utilised (Watts 1998: 1112)
Rose Cottage Cave	Free State	96ka - 30ka (Hodgskiss & Wadley 2017: 3)	OSL and TL (Hodgskiss & Wadley 2017: 3)	Pre-HP, HP, and post-HP layers (Hodgskiss & Wadley 2017: 9)	529 pieces (Hodgskiss & Wadley 2017:9)	2.75 kg (Hodgskiss & Wadley 2017: 9)	59 definitley utilised pieces, 42 pieces with possible signs of use (Hodgskiss & Wadley 2017: 9)
Bushman Rock Shelter	Limpopo	97ka - 73ka (Porraz *et al*. 2018: 35)	OSL (Porraz *et al*. 2018: 35)	N/A (See additional details column)	58 pieces (Watts 2002: 5)	0.02 kg (Watts 2002: 5)	58 pieces classified as "potential pigment" (Watts 2002: 5)
		97 - 73ka (Porraz *et al.* 2018: 35)	OSL (Porraz *et al.* 2018: 35)	SU Go- to SU Gi-; 12 SUs in total, correlated to Eloff's layers 27 to 30 (Porraz *et al*. 2018: 34)	39 pieces (Porraz *et al.* 2018: 6)	N/A	39 pieces (Porraz *et al*. 2018: 6)
Cave of Hearths	Limpopo	100ka - 50ka (Mason 1988:262)	Relative dating from study site as well as other MSA cave sites in the area (Mason 1988: 276, 338)	Beds 6-9 (Mason 1988: 322)	4 pieces (Mason 1988:331; Watts 1998: 587)	N/A	4 ochre fragments (Mason 1988: 331; Watts 1998: 587)
Mwulu's Cave	Limpopo	90ka (Feathers *et al.* 2020)	Luminescence (Feathers *et al.* 2020)	Grindstones and pigments from Beds I, II, and III (Mason 1962; Watts 1998:778)	13 pieces, 4 grindstones (Mason 1962; Watts 1998: 778)	0.48 kg (total pigment pieces) (Watts 1998: 778)	7 utilised pigment pieces, 4 possible grindstones (also used as hammerstones) (Watts 1998: 778)
		130ka - 84ka (de la Peña *et al.* 2018: 26)	Techno-typological comparison with other sites in area (de la Peña *et al*. 2018: 26)	Most pieces from Units I and II (de la Peña *et al*. 2018: 14). Utilised pieces from Units I, II, and IV (de la Peña *et al*. 2018: 14)	137 pieces (de la Peña *et al.* 2018: 14)	0.17 kg (de la Peña *et al*. 2018: 14)	3 pieces utilised (de la Peña *et al.* 2018: 14).

MIS 5 inland sites- additional (use, raw material, colour, interpretation) information

(MIS 5) Sites	Forms of use/ use-wear traces	Raw material	Colour	Additional details
Inland Sites				
Border Cave	Striations, some polishing and smoothing also present (Watts 1998: 1135-8). Grinding most predominant form of use (Watts 1998: 1135-8, 1112)	Predominantly hematite, some iron oxide (Watts 1998: 1135-8)	Red/ "poppy", some orange-red pieces (Watts 1998: 1135-8)	It is likely that utilised pieces were ground to produce a powder (Watts 1998: 1112).
Rose Cottage Cave	Grooves are present on 32 of the definitely utilised pieces (Hodgskiss & Wadley 2017: 11). Scoring is very infrequent (Hodgskiss & Wadley 2017: 11). Rubbing is the most common form of use; some pieces are also ground, and some are both ground and rubbed (Hodgskiss & Wadley 2017: 11).	Shale (Hodgskiss & Wadley 2017: 11)	Bright red (Hodgskiss & Wadley 2017: 11)	Rubbed pieces may have been used to apply pigment to soft surfaces such as skin or hides (Hodgskiss & Wadley 2017: 16). Ground pieces were most likely used to produce a powder, which may have been used as an adhesive ingredient for hafted lithics, though the powder may also have been used for another, perhaps less functional purpose that is no longer visible in the archaeological record (Hodgskiss & Wadley 2017: 16-18).
Bushman Rock Shelter	Grinding (Watts 2002: 8)	Shale, hematite, mudstone (Watts 2002: 6)	Red (Watts 2002: 9)	Pieces were probably ground to produce powder (Watts 2002: 8). Watts (1998) states that 55 pieces of "shaley mudstone" were found in level 51, level 34, and from level 31 onwards, but these do not fall into Volman's classification of layers 19-30 as MSA2.
	N/A	Described only as "ochre" (Porraz *et al*. 2018: 6)	N/A	The variation in density and frequency of archaeological remains, including ochre, within this excavation is reflective of similar variability in "the accumulative processes and nature of the activities performed at the site" (Porraz *et al.* 2018: 35).
Cave of Hearths	N/A	Described only as "ochre" (Mason 1988: 331: Watts 1998: 587)	Red and yellow (Watts 1998: 587)	Ochre fragments may have been used by inhabitants of the cave for "painting themselves as a prelude to painting designs on rock surfaces (Mason 1988: 334). No specific use-wear is mentioned, but it can be assumed that there were indications of use which led Mason to suggest this.
Mwulu's Cave	Faceting, crayon-like shape, polish (Watts 1998: 778-9, 796-7). Grinding most predominant form of use (Watts 1998: 778-9, 796-7)	Grindstones quartzite, quartzitic sandstone, pigment specularite, hematite (Watts 1998: 778)	Red, pink-red, orange-brown (Watts 1998: 796-7)	N/A
	Microstriations, smoothing, polish (de la Peña *et al*. 2018: 14). Rubbing most predominant form of use, one piece shows evidence of grinding (de la Peña *et al.* 2018: 14)	Utilised pieces iron oxide, 1 mudstone (de la Peña *et al.* 2018: 14). Of entire assemblage, shale most common, mudstone and siltstone also present, iron oxide least frequent with only 4 pieces, 2 of those utilised (de la Peña *et al.* 2018: 14)	Of entire assemblage, yellow, orange and red present; all utilised pieces red (de la Peña *et al*. 2018: 14)	This assemblage differs significantly from other MSA ochre assemblages, as well as previous assemblages from the same site (de la Peña *et al.* 2018: 25). Grinding is not the primary form of use, and yellow and orange colours appear more frequently than at other sites (de la Peña *et al*. 2018: 14, 25). The small size of pieces across the entire assemblage and abundance of softer, clayey-silty ochre types may suggest that the preferred method of powder production was crushing (de la Peña *et al*. 2018: 25). The utilised pieces may have been rubbed against a soft material, such as a hide (de la Peña *et al.* 2018: 14).

MIS 5 coastal sites- basic information

(MIS 5) Sites	Location	Approximate dating	Dating method	Layers/ units	Quantity analysed	Approximate weight	Relevant finds
Coastal Sites							
Pinnacle Point (Cave 13B)	Western Cape	115ka - 92ka (Watts 2010: 397)	U-series, OSL (Marean *et al.* 2007: 906)	LC-MSA deposits, 2 pieces from a crevice above these deposits (Watts 2010: 397)	380 pieces (Watts 2010: 402-3).	1.08 kg (Watts 2010: 392)	48 pieces definitely utilised, 15 probably utilised (Watts 2010: 402-3).
Diepkloof Rock Shelter	Western Cape	109ka - 52ka (Dayet *et al*. 2013)	OSL and TL (Dayet *et al*. 2013)	SU Mike - Claude, excluding SU Eve (Dayet *et al*. 2013: 3495, 3501)	558 pieces (Dayet *et al.* 2013: 3495)	1.9 kg (Dayet *et al*. 2013: 3495)	Ochre pieces, ochre residues on quartzite slabs and some silcrete flakes (Dayet *et al.* 2013: 3495).
		100 - 77ka (Porraz *et al*. 2020: 5)	OSL (Porraz *et al*. 2020: 5)	SU Lynn (Porraz *et al.* 2020: 12)	51 "fragments of ochre pieces" (Porraz *et al.* 2020: 12)	N/A	3 utilised pieces (Porraz *et al*. 2020: 12)
Blombos cave	Western Cape	100ka - 76ka (Henshilwood *et al.* 2009: 28)	OSL and TL (Henshilwood *et al.* 2009: 28)	The majority of pieces found in layers CH/ CI, pieces also found in CFB/CFC, CG/CF, and CJ (Henshilwood *et al.* 2009: 31)	13 pieces (Henshilwood *et al.* 2009)	N/A	13 pieces of incised ochre (Henshilwood *et al.* 2009)
		143ka - 70ka (Watts 2009: 82)	OSL (Jacobs *et al*. 2006)	Pigment most common in layers CJ - CH, especially in layer CI (Watts 2009: 83).	1500 pieces pigment (Watts 2009: 83)	5.6 kg (Watts 2009: 83)	307 definitely utilised pieces (Watts 2009: 90)
		100ka(Henshilwood *et al.* 2011)	Single grain OSL and U-series (Henshilwood *et al*. 2011: 219)	Layer CP (Henshilwood *et al*. 2011)	2 grindstones, 2 pieces of ochre, 5 quartz flakes, 2 shells (Henshilwood *et al*. 2011: 219)	N/A	Ochre processing workshop including ochre stained quartzite grindstones and flakes, an abalone shell containing an ochre compound, and individual ochre pieces (Henshilwood *et al*. 2011: 219-21).
Klasies River	Eastern Cape	100ka - 85ka (d'Errico *et al.* 2012)	Uranium-thorium (d'Errico *et al.* 2012: 944)	MSA II (d'Errico *et al*. 2012: 943)	13 pieces (d'Errico *et al.* 2012)	N/A	12 rubbed pieces, 1 engraved piece (d'Errico *et al*. 2012)
		120ka - 80ka (Singer & Wymer 1982: 42)	Radiocarbon, aspartic acid racemization, oxygen isotope (Singer & Wymer 1982: 42)	16 pieces from MSA I, 46 from MSA II (Singer & Wymer 1982:117; d'Errico *et al*. 2012: 945)	62 pieces (Singer & Wymer 1982: 117; d'Errico *et al*. 2012: 945)	N/A	62 ochre pieces, unclear how many utilised (Singer & Wymer 1982: 117; d'Errico *et al.* 2012: 945)
		110ka - 100ka (Culey 2019)	Uranium-thorium, TL, OSL, AAR (d'Errico *et al*. 2012: 944)	SMONE, BOS 1-3, and SBLS (Culey 2019: 11). Pieces with signs of use are from SMONE, BOS 2 and 3 layers (Culey 2019: 14)	14 pieces (Culey 2019)	0.55 kg (Culey 2019: 14)	3 pieces with signs of use, including one nodule and 2 grindstones (Culey 2019)

MIS 5 coastal sites- basic information (cont.), additional information

(MIS 5) Sites	Location	Approximate dating	Dating method	Layers/ units	Quantity analysed	Approximate weight	Relevant finds
Hoedjiespunt	Western Cape	130ka - 100ka (Will *et al*. 2013: 520-1)	IRSL, ESR, U-series (Will *et al.* 2013: 520)	24 pieces from AH I, 26 from AH II, 20 from AH III (Will *et al.* 2013: 531). Of the modified pieces, 18 are from AH I and II (Will *et al.* 2013: 531)	70 pieces (Will *et al.* 2013: 530)	0.8 kg (Will *et al.* 2013: 530)	20 pieces with signs of modification (Will *et al*. 2013: 530)

(MIS 5) Sites	Forms of use/ use-wear traces	Raw material	Colour	Additional details
Coastal Sites				
Pinnacle Point (Cave 13B)	Grinding (Watts 2010: 403)	Siltstone, iron oxide, sandstone, shale (Watts 2010:399)	Red, red-brown (Watts 2010: 408-9)	There appears to have been a preferrential selction for red, as this is the most common colour among utilised pieces (Watts 2010: 408-9). The use of red is also suggested to be consistent with the female cosmetic coalition hypothesis regarding the development of early symbolic culture (Watts 2010: 409).
Diepkloof Rock Shelter	Knapping, grinding, faceting (Dayet *et al*. 2013: 3499-500). Grinding most common (Dayet *et al*. 3500-2)	Shale, some ferricrete (Dayet *et al*. 2013: 3498)	No streak tests, additionally colour may have been altered by heating anyway (Dayet *et al*. 2013: 3497).	Shale likely ground on quartzite slabs for the purpose of powder production (Dayet *et al*. 2013: 3500-2). Several pieces appear to have been heated, either intentionally or post-depositionally (Dayet *et al.* 2013: 3502).
	Grinding (Porraz *et al*. 2020: 12)	Shale and ferricrete; all utilised pieces rich in iron oxide (Porraz *et al*. 2020: 12)	N/A	Due to the fact that there are no red residues on lithic artefacts from the same layer, as well as the preferential selction of "fine-grained iron rich materials" for use, it is unlikely that ochre was ground for use as a "loading agent" (Porraz *et al*. 2020: 28). Additionally, the spectrum of ochre indicates its probable use as pigment, but there is no evidence for symbolism (Porraz *et al*. 2020: 28). A continous "tradition" of ochre grinding from the pre-Still Bay to the post-Howiesonspoort is suggested (Porraz *et al*. 2020: 28).
Blombos cave	Incised (Henshilwood *et al.* 2009)	Siltstone is the most common; shale, sandstone and hematite are also represented (Henshilwood *et al*. 2009).	Pieces are of a variety of colours, with no preference for a certain colour apparent (Henshilwood *et al*. 2009).	Pieces were deliberately incised, possibly with "representational intent" (Henshilwood *et al*. 2009: 45). It is suggested that these pieces constitute part of a geometric engraving tradition beginning from at least 100ka (Henshilwood *et al*. 2009: 45).
	Grinding (Watts 2009: 90)	Shale, siltstones (Watts 2009: 83)	Red, yellow-brown (Watts 2009: 86)	Saturated red pieces are most frequently utilised and more likely to be used mutliple times, indicating a preference for this colour (Watts 2009: 90). It is suggested that red ochre could have been used at this site during this period as a ritualistic/ symbolic personal adornment in the form of body paint (Watts 2009: 90). It is also suggested that this forms part of a cultural tradition beginning as far back as 200ka-150ka (Watts 2009: 90).
	Grinding, rubbing (Henshilwood *et al.* 2011)	Two types of ferruginous siltstone (Henshilwood *et al*. 2011: 219-21).	All staining, the compound, and individual ochre pieces are red (Henshilwood *et al.* 2011: 219-21).	It is likely that some pieces were rubbed to produce powder, and others were knapped with quartzite flakes to produce ochre chips, which were then crushed with grindstones (Henshilwood *et al*. 2011: 222). Ochre powder was then combined with other ingredients in the shell (Henshilwood *et al.* 2011: 222). No ingredients in the compound indicate that it could have been used for hafting, so it may have been used as a paint (Henshilwood *et al*. 2011: 222). This "deliberate planning, production, and curation of a compound" is indicative of abilities associated with complex cognition (Henshilwood *et al.* 2011: 222).

MIS 5 coastal sites- additional information (cont.)

(MIS 5) Sites	Forms of use/ use-wear traces	Raw material	Colour	Additional details
Coastal Sites				
Klasies River	Grooves, striations (d'Errico *et al.* 2012: 947-9). Engraving, rubbing, scraping most predominant forms of use (d'Errico *et al*. 2012)	N/A	No streak tests	Twelve pieces appear to have been rubbed with the aim of producing powder, or shaped against a grindstone to produce a "crayon" (d'Errico *et al*. 2012: 949). The engraved piece may have come from a different geological source than the others (due to its manganese-rich raw material and brown colour), and may therefore have been specifically selected for its purpose (d'Errico *et al.* 2012: 949). An "engraving tradition" is also suggested (d'Errico *et al*. 2012: 949).
	Smoothing, scratching, crayon-like shape, some pieces show possible incising (Singer & Wymer 1982: 117).	Sandstone, soft hematite (Singer & Wymer 1982: 117)	Red, yellow, pink (Singer & Wymer 1982: 117)	Soft hematite may have been imported to the area (Singer & Wymer 1982: 117). Utilised pieces may have been used for pigment production, with a preference for red (Singer & Wymer 1982: 117). The use of this pigment as a paint component is suggested, possibly for personal adornment (Singer & Wymer 1982: 117).
	Grooves, striations (Culey 2019: 51-2). Rubbing, grinding most predominant forms of use (Culey 2019: 38)	Both grindstones are quartzite, and the nodule constitutes the only shale in the assemblage (Culey 2019: 14).	Red (Culey 2019: 34)	The nodule as well as residues on the grindstones are all red, suggesting preferential selection (Culey 2019: 34). Nodule appears to have been rubbed as well as ground, suggesting the production of ochre powder- the possible grindstones also support this (Culey 2019: 38).
Hoedjiespunt	Parallel striations, pencil-like shape (Will *et al*. 2013: 531). Grinding most predominant form of use (Will *et al.* 2013: 531)	N/A	Red, reddish brown (Will *et al*. 2013: 531) It is unclear if these colours are based on streak tests.	Layer AHII (dated to 130ka-100ka) has the highest amount of ochre both modified and unmodified, followed by layers AHIII and AHI (Will *et al*. 2013: 531). The source of the ochre is unknown, but because no ochre is found locally, it is likely it was imported into the area (Will *et al*. 2013: 531).

MIS 6 inland sites- basic information

(MIS 6) Sites	Location	Approximate dating	Dating method	Layers/ units	Quantity analysed	Approximate weight	Relevant finds
Inland Sites							
Wonderwerk Cave	Northern Cape	187ka (Chazan & Horwitz 2009: 529)	Uranium/ thorium (Chazan & Horwitz 2009: 529)	N/A	6 "slabs" (Chazan & Horwitz 2009: 533-4)	N/A	6 banded/incised "slabs" (Chazan & Horwitz 2009: 533-4)
		240 - 150ka (Chazan *et al.* 2020)	Luminescence (Chazan *et al*. 2020: 310-11)	Stratum 2, excavation 2 (Chazan *et al*. 2020: 314)	1 "slab" (Chazan *et al*. 2020: 314)	N/A	1 possibly utilised slab (Chazan *et al*. 2020: 314)
		780ka - 0.9ka (Beaumont & Vogel 2006: 219-21)	Radiocarbon, uranium/ thorium (Beaumont & Vogel 2006: 219)	MU 1-7 (Beaumont & Vogel 2006: 217)	N/A	N/A	Unknown number of pigment pieces (Beaumont & Vogel 2006: 217)
Wonderkrater	Limpopo	138ka (Backwell *et al.* 2014: 50)	OSL (Backwell *et al*. 2014: 50)	Grit/sand, Area C (Backwell *et al*. 2014: 50)	1 piece (Backwell *et al*. 2014: 50)	N/A	1 piece of ochre (Backwell *et al*. 2014: 50)
Border Cave	KwaZulu-Natal	227ka - 183ka (Backwell *et al.* 2018: 4)	ESR (Backwell *et al.* 2018: 4)	Member 5WA, spits 1, 2, and 3 (Watts 1998: 1110, 1132)	3 pieces (Watts 1998: 1110, 1132)	0.06 kg (Watts 1998: 1132)	3 pigment pieces (Watts 1998: 1110, 1132)
		161ka - 144ka (Backwell *et al.* 2018: 4)	ESR (Backwell *et al*. 2018: 4)	Member 5BS, predominantly from spit 2, followed by spits 7, 3, 4, 5, and L29 (Watts 1998: 1133-5)	30 pieces (Watts 1998: 1133-5; Watts 2014: 219-20)	0.07 kg (Watts 1998: 1133-5)	30 pigment pieces (Watts 1998: 1133-5; Watts 2014: 219-20)
Bushman Rock Shelter	Limpopo	190ka - 130ka (Watts 2014: 221; Volman 1981: 96)	Geomorphological dating (Watts 2014: 221)	6 pieces from level 31, 3 from levels 32, 34, and 36 (Watts 1998: 754-6)	9 pieces (Watts 1998: 754-6)	0.04 kg (Watts 1998: 754-6)	9 pigment pieces (Watts 1998: 754-6)

MIS 6 inland sites- additional information

(MIS 6) Sites	Forms of use/ use-wear traces	Raw material	Colour	Additional details
Inland Sites				
Wonderwerk Cave	Incising (Chazan & Horwitz 2009: 534)	Ironstone (Chazan & Horwitz 2009: 533-4)	N/A	The ironstone slabs may be classified as ochre due to their soft surface (Chazan & Horwitz 2009: 533). The incised lines are most likely the result of anthropogenic modification rather than geological abrasion, and the slabs may have been used or made for a non-utilitarian purpose (Chazan & Horwitz 2009: 534). The incisions lack the clear geometric patterning and representational intent seen in incised pieces from coastal sites, and therefore they may not be part of the "engraving tradition" suggested for these (Chazan & Horwitz 2009: 534)
	"Abrasion" from possible use or incision (Chazan *et al*. 2020: 314)	Piece described only as "ocher" (Chazan *et al*. 2020: 314)	N/A	There does not appear to be any evidence for symbolic behaviour within the lithic and faunal assemblages from this excavation, apart from the single piece of "ocher" (Chazan *et al.* 2020: 329). Given this, it suggested that the "aspects of the MSA archaeological record associated with early modern humans-- including incised patterns on ocher" only "develop long after the first appearance of modern humans" (Chazan *et al.* 2020: 330).
	N/A	Specularite associated with MUs 1-2, hematite associated with MUs 1-7 (Beaumont & Vogel 2006: 222)	Red (unclear if based on streak tests) (Beaumont & Vogel 2006: 217)	It is unclear how many pieces were found in which layers, so they cannot be divided into a less broad time period. It is also unclear if these pieces are even utilised.
Wonderkrater	Slightly polished (Backwell *et al.* 2014: 50)	Piece described only as "ochre" (Backwell *et al.* 2014: 50)	Deep red (Backwell *et al.* 2014: 50)	N/A
Border Cave	Possible polish on one piece (Watts 1998: 1132)	Iron oxide and hematite (Watts 1998: 1132).	Poppy, orange-red (Watts 1998: 1132)	Piece with possible signs of use likely of "exotic" origin (Watts 1998: 1132)
	Only one piece visibly utilised-ground (watts 1998: 1133)	Predominantly described only as "ochre", "fine grained ferruginous material" also present, some hematite and iron oxide (Watts 1998: 1133-5)	Orange-red, poppy (Watts 1998: 1133-5)	Some fragments specular- may suggest origin from "the Ngwenya Ridge area where Lion Cavern is located" (Watts 1998: 1133)
Bushman Rock Shelter	Only 2 pieces show possible signs of use- both grinding- though on one piece this may be natural (Watts 1998: 754-6)	"Shaley mudstone", "ochre", specularite, hematite (Watts 1998: 754-6)	"Blood red", orange/brown/light/dark reds, yellow brown (Watts 1998: 754-6)	N/A

MIS 6 coastal sites- basic and additional information

(MIS 6) Sites	Location	Approximate dating	Dating method	Layers/ units	Quantity analysed	Approximate weight	Relevant finds
Coastal Sites							
Pinnacle Point (Cave 13B)	Western Cape	164ka - 91ka (Marean *et al*. 2007: 905)	OSL (Marean *et al.* 2007: 905)	Pieces predominantly from LC-MSA Lower (Marean *et al.* 2007: 906)	57 pigment pieces (Marean *et al*. 2007: 906)	0.09 kg (Marean *et al.* 2007: 906)	10 definitely utilised pieces, 2 probably utilised (Marean *et al*. 2007: 906)

(MIS 6) Sites	Forms of use/ use-wear traces	Raw material	Colour	Additional details
Coastal Sites				
Pinnacle Point (Cave 13B)	Of the definitely utilised pieces, 8 are ground and 2 are scraped (Marean *et al*. 2007: 906). Both probably utilised pieces are ground (Marean *et al.* 2007: 906)	46 pieces classified as "iron-rich fine-grained sedimentary materials", all pieces can be considered "red ochre" (Marean *et al*. 2007: 906)	Majority of pieces have red-brown streak, 7 pieces have saturated red streak (Marean *et al*. 2007: 906)	Saturated red pieces are more common in the definitely and probably utilised groups, and therefore may have been preferentially selected (Marean *et al*. 2007: 906). These pigments may have been used for body painting and "colouring of other organic surfaces" (Marean *et al.* 2007: 907)

Appendix 2 – Table showing no. of ochre pieces excavated from each layer in Bed 2, dates, and technocultutral designation

Layer	Date	Techno/cultural designation	No. of ochre pieces
GS	150 ka	Middle Pietersberg	310
DRG	150 ka	Middle Pietersberg	4
YRS	150 ka	Middle Pietersberg	124

Appendix 3 – OBP 2018/19 Ochre Database (utilised and possibly utilised pieces only)

Piece #	Stratigraphic Unit	Square	Approx. Size (mm)	Approx. Weight (g)	Raw Material	Specular	Grain Size	Streak Colour	Hardness
OBP-1783-7	GS déc. 13	B2C	20(l), 16(b), 15(w)	14.3	Specularite	Y	1	dark red	m-h
OBP-2042-3	GS déc. 15	B2B	18(l), 15(b), 11(w)	5.6	Hematite	N	1	dark red	m
OBP-2238-1	GS déc. 15	B2A	27(l), 15(b), 10(w)	10.1	Specularite	Y	1	dark red	m
OBP-2408-2	GS déc. 17	B3D	17(l), 13(b), 10(w)	3.7	Specularite	Y	1	very dark purple	m
OBP-582-1	GS déc. 5	B2D	35(l), 20(b), 20(w)	32.3	Specularite	N	2	dark red	m-h
OBP-605-1	GS déc. 5	B2D	35(l), 25(b), 20(w)	36.5	Specularite	Y	4	dark red	m-h
OBP-656-1	GS déc. 6	B2C	50(l), 38(b), 30(w)	149.0	Specularite	Y	4	dark red	m-h
OBP-831-2	GS déc. 7	B2D	40(l), 30(b), 20(w)	52.6	Specularite	Y	4	dark red-purple	m-h
OBP-4267-1	YRS déc. 11	B2C	22(l), 14(b), 16(w)	8.3	Specularite	Y	2	dark red	m-h
OBP-4310-1	YRS déc. 11	B2	36(l), 17(b), 12(w)	22.8	Hematite	N	4	dark red	m-h
OBP-3646-8	YRS déc. 8	B2D	13(l), 12(b), 14(w)	5.0	Specularite	Y	1	has	m
OBP-3820-1	YRS déc. 9	B2D	25(l), 19(b), 8(w)	11.8	Specularite	Y	2	red	m-h
OBP-3290-3	YRS déc. 4	B2D	20(l), 16(b), 6(w)	2.0	Shale	Y	1	dark red	m
OBP-3290-4	YRS déc. 4	B2D	34(l), 26(b), 7(w)	10.7	Shale	Y	1	dark red	m

Piece #	Use-wear	Approx no. of sides	Grooves	Orientation	Placement	Profile shape	Terminations	Chipping	Placement	Polish	Placement
OBP-1783-7	Y	6 (2 UT)	Y	Parallel	To some edges			N	_	N	_
OBP-2042-3	Y	4 (2 UT)	Y	Parallel	To all edges	_	_	N	_	Y	2 surfaces
OBP-2238-1	Y	5 (1 UT)	Y	Parallel	To all edges	_	_	N	_	N	_
OBP-2408-2	Y	4 (1 UT)	Y	Parallel	To all edges	_	_	N	_	N	_
OBP-582-1	Y	6 (2 UT)	Y	Erratic	To no edges			N	_	Y	To some edges
OBP-605-1	Y	6 (1 UT)	Y	Erratic	To some edges	_	_	N	_	N	_
OBP-656-1	Y	5	Y	Parallel	To some edges	_	_	N	_	Y	Edges
OBP-831-2	Y	4 (1 UT)	Y	Parallel	To some edges	_	_	N	_	N	_
OBP-4267-1	Y	3 (1 UT)	Y	Parallel	To all edges	_	_	N	_	Y	Edges
OBP-4310-1	Y	4 (1 UT)	N	_	_	_	_	N	_	Y	UT surface
OBP-3646-8	Y	5 (1 UT)	Y	_	_	_	_	N	_	N	_
OBP-3820-1	Y	5 (1 UT)	N	_	_	_	_	N	_	N	_
OBP-3290-3	Y	6 (1 UT)	Y	Parallel	To all edges	_	_	N	_	N	_
OBP-3290-4	Y	6 (1 UT)	Y	Parallel	To all edges	_	_	N	_	N	_

Utilised pieces (cont.)

Piece #	Smoothing	Placement	External Microstriations	Placement	Edges	Surface Shape	Scratches	General shape
OBP-1783-7	Y	To some edges	N	_	Faceted	Flat	N	Irregular
OBP-2042-3	Y	2 surfaces	Y	2 surfaces	Faceted	Unchanged	N	Irregular
OBP-2238-1	Y	Whole piece	Y	To some edges	Faceted	Flat	N	Irregular
OBP-2408-2	N	_	Y	To some edges	Faceted	Flat	N	Irregular
OBP-582-1	Y	To some edges	N	_	Faceted	Flat	N	Irregular
OBP-605-1	Y	To some edges	Y	2	Rounded	Flat	N	Nodule
OBP-656-1	Y	Edges and edge of grinding surface	Y	To some edges	Partially rounded	Flat	N	Irregular
OBP-831-2	Y	Edges and edge of grinding surface	Y	To some edges	Faceted	Flat	N	Irregular
OBP-4267-1	Y	Edges	Y	To some edges	Partially rounded	Flat	N	Nodule
OBP-4310-1	Y	Most of piece	Y	1 surface	Partially rounded	Flat	N	Irregular
OBP-3646-8	N	_	P	To some edges	Faceted	Flat	N	Irregular
OBP-3820-1	Y	Whole piece	Y	1 surface	Rounded	Flat	N	Nodule
OBP-3290-3	N	_	N	_	Faceted	Unchanged	N	Irregular
OBP-3290-4	N	_	N	_	Faceted	Unchanged	N	Irregular

Piece #	Notes	Use-wear category
OBP-1783-7	May have been part of larger nodule. Magnetic	Grinding
OBP-2042-3	Concretions obsure the use-traces	Grinding and possible rubbing
OBP-2238-1	Magnetic	Grinding and possible rubbing
OBP-2408-2	Magnetic	Grinding
OBP-582-1		Rubbing, possibly knapped
OBP-605-1	Use-wear on red, softer area	Ground and rubbed
OBP-656-1	Strong streak. May have been part of larger nodule	Grinding and possible rubbing
OBP-831-2	May have been part of larger nodule	Grinding and possible rubbing
OBP-4267-1	Strong streak	Grinding
OBP-4310-1	Strong streak	Rubbing or possible grinding
OBP-3646-8		Grinding
OBP-3820-1	Piece is hard, unlikely to have surface shape change caused just by rubbing	Grinding and rubbing
OBP-3290-3		Grinding
OBP-3290-4		Grinding

Possibly utilised pieces

Piece #	Stratigraphic Unit	Square	Approx. Size (mm)	Approx. Weight (g)	Raw Material	Specular	Grain Size	Streak Colour	Hardness
OBP-2688-1	?	B2A	30(l), 19(b), 15(w)	18.3	Specularite	N	2	dark red	m-h
OBP-4736-1	A spit 1	G3A	25(l), 18(b), 12(w)	12.5	Iron oxide	N	4	purple	m-h
OBP-1221-1	GS déc. 10	B2A	27(l), 15(b), 12(w)	13.8	Specularite	Y	1	dark red	m-h
OBP-1334-1	GS déc. 11	B2C	18(l), 13(b), 12(w)	7.6	Specularite	Y	2	dark red	m
OBP-1648-1	GS déc. 12	B2B	30(l), 16(b), 12(w)	16.5	Specularite	Y	1	very dark purple	m
OBP-1896-4	GS déc. 14	B3C	23(l), 17(b), 9(w)	7.8	Specularite	Y	1	red	m-h
OBP-1899-1	GS déc. 14	B2B	13(l), 9(b), 9(w)	2.3	Specularite	Y	2	red-orange	m-h
OBP-1899-3	GS déc. 14	B2B	14(l), 10(b), 6(w)	1.7	Specularite	Y	4	dark red	m-h
OBP-1899-4	GS déc. 14	B2B	32(l), 12(b), 13(w)	6.9	Hematite	Y	4	red	m
OBP-1901-1	GS déc. 14	B2D	20(l), 14(b), 10(w)	8.2	Specularite	Y	2	dark red	m-h
OBP-2042-1	GS déc. 15	B2B	44(l), 23(b), 13(w)	31.6	Specularite	Y	1	dark red-purple	m-h
OBP-2042-2	GS déc. 15	B2B	16(l), 16(b), 10(w)	6.2	Hematite	N	2	dark red-purple	m
OBP-2241-4	GS déc. 16	B3A	38(l), 27(b), 13(w)	15.9	Specularite	Y	2	dark red-purple	m-h
OBP-2245-10	GS déc. 16	B2A	19(l), 17(b), 14(w)	10.5	Specularite	Y	1	dark purple	m
OBP-2245-4	GS déc. 16	B2A	19(l), 14(b), 9(w)	5.3	Specularite	Y	2	dark red	m
OBP-2455-1	GS déc. 17	B3B	20(l), 18(b), 11(w)	6.8	Specularite	Y	2	dark red	m-h
OBP-2660-1	GS déc. 18	B2D	35(l), 29(b), 22(w)	36.8	Specularite	Y	2	dark red	m
OBP-200-1	GS déc. 2	B3A	26(l), 19(b), 13(w)	20.5	Specularite	Y	2	black	m
OBP-2791-2	GS déc. 20	B2B	15(l), 12(b), 6(w)	3.3	Specularite	Y	2	red	m
OBP-321-1	GS déc. 3	B2D	28(l), 24(b), 11 (w)	25.5	Specularite	Y	2	dark red	m-h
OBP-1330-1	GS déc. 4	B3B	19(l), 15(b), 12(w)	7.6	Specularite	Y	1	red	m
OBP-565-1	GS déc. 5	B2C	40(l), 25(b), 13(w)	17.2	Specularite	Y	4	dark red-purple	m
OBP-694-1	GS déc. 6	B2D	26(l), 25(b), 16(w)	22.0	Specularite	Y	2	dark red	m
OBP-1080-1	GS déc. 9	B2D	40(l), 23(b), 10(w)	34.9	Specularite	Y	1	dark red	m
OBP-1096-2	GS déc. 9	B2D	30(l), 17(b), 10(w)	21.4	Specularite	Y	1	very dark purple	m
OBP-4050-1	GS déc. 21	B3C	33(l), 16(b), 13(w)	10.7	Ferricrete conglomerate	N	5	dark red	m
OBP-4235-1	GS déc. 24	B2	40(l), 24(b), 14(w)	36.0	Specularite	Y	2	dark red	m-h
OBP-4667-1	GS déc. 31	B2A	18(l), 14(b), 10(w)	5.3	Specularite	Y	1	dark red	m-h
OBP-2986-2	YRS déc. 2	B2D	22(l), 12(b), 10(w)	4.4	Specularite	Y	4	dark red	m-h
OBP-2243-4	GS déc. 16	B3C	21(l), 16(b), 10(w)	7.2	Specularite	Y	1	dark red	m
OBP-2892-2	YRS déc. 1	B2C	17(l), 7(b), 8(w)	1.2	Specularite	Y	4	dark red	m
OBP-4301-2	YRS déc. 11	B2	30(l), 19(b), 7(w)	15.1	Specularite	N	1	dark red-purple	m
OBP-4630-1	YRS déc. 14	B2	50(l), 40(b), 21(w)	84.3	Specularite	N	2	dark red	m-h
OBP-3006-1	YRS déc. 2	B2C	30(l), 19(b), 12(w)	17.0	Specularite	Y	4	dark red	m
OBP-3302-1	YRS déc. 5	B2C	19(l), 17(b), 11(w)	9.9	Specularite	Y	1	red	m-h
OBP-3462-2	YRS déc. 7	B2C	38(l), 20(b), 10(w)	22.4	Specularite	Y	2	dark red-purple	m-h
OBP-2409-5	GS déc. 17	B2A	16(l), 10(b), 7(w)	2.0	Mudstone	Y	2	dark red	s-m
OBP-4708-1	DRG déc. 2	B3C	30(l), 23(b), 15(w)	23.5	Specularite	Y	1	dark red-brown	m-h
OBP-3723-2	YRS déc. 8	B2D	24(l), 13(b), 11(w)	11.5	Specularite	Y	2	black	m-h
OBP-3726-1	YRS déc. 8	B2D	48(l), 38(b), 45(w)	132.8	Specularite	Y	2	black	m-h

Possibly utilised pieces (cont.)

Piece #	Use-wear	Approx no. of sides	Grooves	Orientation	Placement	Profile shape	Terminations	Chipping	Placement	Polish	Placement
OBP-2688-1	P	4	N	_	_	_	_	N	_	Y	Whole piece
OBP-4736-1	P	5	N	_	_	_	_	N	_	Y	Whole piece
OBP-1221-1	P	6	N	_	_	_	_	N	_	Y	Whole piece
OBP-1334-1	P	4	N	_	_	_	_	N	_	N	_
OBP-1648-1	P	4	N	_	_	_	_	N	_	Y	Whole piece
OBP-1896-4	P	2	N	_	_	_	_	N	_	Y	Whole piece
OBP-1899-1	P	4 (1 P UT)	N	_	_			N	_	Y	To some edges
OBP-1899-3	P	4	N	_	_	_	_	N	_	Y	To some edges
OBP-1899-4	P	5 (1 P UT)	N	_	_	_	_	N	_	N	_
OBP-1901-1	P	4	N	_	_	_	_	N	_	N	_
OBP-2042-1	P	4 (1 P UT)	N	_	_	_	_	N	_	Y	most of piece
OBP-2042-2	P	4 (2 P UT)	N	_	_	_	_	N	_	Y	2 surfaces
OBP-2241-4	P	4 (1 P UT)	N	_	_	_	_	N	_	N	_
OBP-2245-10	P	7	N	_	_	_	_	N	_	Y	Whole piece
OBP-2245-4	P	6	N	_	_	_	_	N	_	Y	To some edges
OBP-2455-1	P	5	N	_	_	_	_	N	_	Y	To some edges
OBP-2660-1	P	5	N	_	_	_	_	N	_	Y	Whole piece
OBP-200-1	P	6	N	_	_	_	_	N	_	Y	Whole piece
OBP-2791-2	P	4	N	_	_	_	_	N	_	Y	Whole piece
OBP-321-1	P	6	N	_	_	_	_	N	_	Y	Whole piece
OBP-1330-1	P	4	N	_	_	_	_	N	_	Y	Whole piece
OBP-565-1	P	7 (1 P UT)	N	_	_	_	_	N	_	N	_
OBP-694-1	P	6 (4 P UT)	N	_	_	_	_	N	_	N	_
OBP-1080-1	P	3 (1 P UT)	N	_	_	_	_	N	_	N	_
OBP-1096-2	P	5	N	_	_	_	_	N	_	N	_
OBP-4050-1	P	5 (1 P UT)	Y	Parallel	To some edges	U?	Frayed?	N	_	N	_
OBP-4235-1	P	3	N	_	_	_	_	N	_	Y	Whole piece
OBP-4667-1	P	7 (1 P UT)	N	_	_	_	_	N	_	Y	Edges, mostly 1 surface
OBP-2986-2	P	5 (1 P UT)	N	_	_	_	_	N	_	N	_
OBP-2243-4	P	4 (1 P UT)	Y	Parallel	To some edges	_	_	N	_	N	_
OBP-2892-2	P	6	Y	Erratic	To some edges	U, V	Some frayed	N	_	N	_
OBP-4301-2	P	4	N	_	_	_	_	N	_	Y	Whole piece
OBP-4630-1	P	6 (1 P UT)	N	_	_	_	_	N	_	Y	Edges
OBP-3006-1	P	5 (3 P UT)	Y	Parallel	To all edges	_	_	N	_	N	_
OBP-3302-1	P	6	N	_	_	_	_	N	_	N	_
OBP-3462-2	P	5 (3 P UT)	N	_	_	_	_	P	To some edges	Y	Edges
OBP-2409-5	P	5 (2 P UT)	Y	Parallel	To some edges	_	_	N	_	N	_
OBP-4708-1	P	6 (1 P UT)	N	_	_	_	_	N	_	Y	1 surface
OBP-3723-2	P	5	N	_	_	_	_	N	_	N	_
OBP-3726-1	P	5	N	_	_	_	_	N	_	N	_

Possibly utilised pieces (cont.)

Piece #	Smoothing	Placement	External Microstriations	Placement	Edges	Surface Shape	Scratches	General shape
OBP-2688-1	Y	Whole piece	N	_	Rounded	Concave	N	Nodule
OBP-4736-1	Y	Whole piece	N	_	Faceted	Unchanged	N	Irregular
OBP-1221-1	Y	Whole piece	Y	_	Rounded	Flat	N	Nodule
OBP-1334-1	Y	Whole piece	N	_	Rounded	Flat and curved	N	Nodule
OBP-1648-1	N	_	P	To one edge	Rounded	Unchanged	N	Irregular
OBP-1896-4	Y	Whole piece	N	_	Rounded	Flat	N	Nodule
OBP-1899-1	Y	To some edges	Y	1 surface	Partially rounded	Flat	N	Irregular
OBP-1899-3	Y	To some edges	N	_	Partially rounded	Unchanged	N	Nodule
OBP-1899-4	Y	1 surface	N	_	Faceted	Flat	N	Irregular
OBP-1901-1	Y	Whole piece	N	_	Rounded	Flat	N	Nodule
OBP-2042-1	Y	redder surface	Y	1 surface	Rounded	Unchanged	N	Nodule
OBP-2042-2	Y	2 surfaces	N	_	Faceted	Unchanged	N	Irregular
OBP-2241-4	Y	1 surface	P	1 surface	Faceted	Flat	N	Irregular
OBP-2245-10	Y	Whole piece	N	_	Faceted	Flat	N	Irregular
OBP-2245-4	Y	To all edges	Y	To no edges	Rounded	Flat	N	Nodule
OBP-2455-1	Y	Whole piece	N	_	Rounded	Flat	N	Nodule
OBP-2660-1	Y	Whole piece	N	_	Partially rounded	Flat	N	Nodule
OBP-200-1	Y	Whole piece	N	_	Rounded	Flat	N	Irregular
OBP-2791-2	Y	Whole piece	N	_	Rounded and faceted	Convex	N	Nodule
OBP-321-1	Y	Whole piece	Y	1 side	Rounded	Flat	N	Nodule
OBP-1330-1	Y	Whole piece	N	_	Rounded	Flat	Y	Nodule
OBP-565-1	Y	1 side	Y	1 side	Partially rounded	Unchanged	N	Irregular
OBP-694-1	Y	Some surfaces	N	_	Partially rounded	Unchanged	N	Nodule
OBP-1080-1	Y	To some edges	N	_	Rounded	Flat	N	Nodule
OBP-1096-2	Y	Whole piece	N	_	Partially rounded	Flat	N	Nodule
OBP-4050-1	Y	Most of piece	N	_	Faceted	Unchanged	N	Irregular
OBP-4235-1	Y	Whole piece	N	_	Rounded	Flat	N	Nodule
OBP-4667-1	Y	To some edges	P	To no edges	Faceted	Flat	N	Irregular
OBP-2986-2	Y	1 surface	Y	_	Faceted	Unchanged	N	Irregular
OBP-2243-4	Y	Whole piece	N	_	Rounded	Flat	N	Nodule
OBP-2892-2	Y	most of piece	Y	To some edges	Faceted	Unchanged	N	Irregular
OBP-4301-2	Y	Whole piece	N	_	Rounded	Flat	N	Nodule
OBP-4630-1	Y	Edges	P	1 surface	Faceted	Flat	N	Irregular
OBP-3006-1	N	_	Y - grinding?	_	Faceted	Unchanged	N	Irregular
OBP-3302-1	Y	Piece	N	_	Rounded	Unchanged	N	Nodule
OBP-3462-2	Y	Whole piece	Y	To some edges	Rounded	Flat	N	Nodule
OBP-2409-5	Y	Whole piece	N	_	Faceted	Flat	N	Irregular
OBP-4708-1	Y	1 surface	N	_	Faceted	Unchanged	N	Irregular
OBP-3723-2	Y	_	N	_	Rounded	Unchanged	Y	Nodule
OBP-3726-1	Y	Edges	P	To some edges	Partially rounded	Unchanged	N	Irregular

Possibly utilised (cont.)

Piece #	Notes	Use-wear category
OBP-2688-1	Circular hole on one side of piece. Likely natural	_
OBP-4736-1		_
OBP-1221-1	Similar to pieces from Mason ass.	_
OBP-1334-1		_
OBP-1648-1	Broken, may have been part of larger nodule. Strong streak	_
OBP-1896-4		_
OBP-1899-1	May have been part of larger nodule	_
OBP-1899-3		_
OBP-1899-4		_
OBP-1901-1	Strong streak	_
OBP-2042-1	Redder, softer section possibly utilised	_
OBP-2042-2	May have been part of larger nodule	_
OBP-2241-4	Magnetic	_
OBP-2245-10	Magnetic	_
OBP-2245-4		_
OBP-2455-1	Covered in concretions hiding surface	_
OBP-2660-1		_
OBP-200-1	May have been part of larger nodule	_
OBP-2791-2		_
OBP-321-1		_
OBP-1330-1	Some irregular grooves. Appearance due to natural causes?	_
OBP-565-1		_
OBP-694-1	Glittery streak, may have been part of larger nodule	_
OBP-1080-1		_
OBP-1096-2		_
OBP-4050-1		_
OBP-4235-1		_
OBP-4667-1		_
OBP-2986-2		_
OBP-2243-4		_
OBP-2892-2		_
OBP-4301-2		_
OBP-4630-1		_
OBP-3006-1	Strong streak. 3 faceted edges. Crayon-shaped.	_
OBP-3302-1		_
OBP-3462-2		_
OBP-2409-5	Strong streak	_
OBP-4708-1		_
OBP-3723-2	Almost completely covered in compacted residue. Magnetic	_
OBP-3726-1	May have been part of larger nodule	_

Appendix 4 – OBP 2018/19 Ochre Cleaning Record

Pieces OBP-2408 to OBP-3633 first and second submersion information

Key

Key	
(green)	Sample piece
(orange)	Possible utilisation
(yellow)	Definite utilisation
*	Main initial bag. Pieces with the same bag no. (e.g. OBP-**4220**) were all initially in this bag together and cleaned together. An extra number is given for each individual piece when they are seperated and bagged and cleaned individually (e.g. OBP-4220-**1**).

				First submersion			Second submersion		
Piece #	**Layer**	**Square**	**Date of Excavation**	**% solution**	**Period**	**No. of pieces cleaned**	**% solution**	**Period**	**No. of pieces cleaned**
OBP-2408	GS déc. 17	B3D	2018	20	18 mins	4	-	-	-
OBP-2420	GS déc. 17	B3C	2018	20	1 hr	1	-	-	-
OBP-2407	GS déc. 17	B3C	2018	20	10 mins	4	-	-	-
OBP-2406	GS déc. 17	B2A	2018	20	6 mins	3	-	-	-
OBP-2409	GS déc. 17	B2A	2018	20	14 mins	4	-	-	-
OBP-2479	GS déc. 17	B3B	2018	20	24 mins	1	-	-	-
OBP-2495	GS déc. 17	B3D	2018	20	1 hr 20 mins	1	-	-	-
OBP-2410	GS déc. 17	B2B	2018	20	1 hr 24 mins	3	-	-	-
OBP-2405	GS déc. 17	B3B	2018	20	21 mins	3	-	-	-
OBP-2598	GS déc. 17	B2A	2018	20	1 hr 41 mins	1	-	-	-
OBP-3341	YRS déc. 5	B2D	2018	20	53 mins	1	-	-	-
OBP-2975	YRS déc. 1	B2D	2018	20	24 mins	1	-	-	-
OBP-3125	YRS déc. 3	B2C	2018	20	1 hr 8 mins	1	-	-	-
OBP-3048	YRS déc. 2	B2D	2018	20	54 mins	1	-	-	-
OBP-3203	YRS déc. 3	B2D	2018	20	35 mins	1	-	-	-
OBP-2892*	YRS déc. 1	B2C	2018	20	32 mins	4	-	-	-
OBP-2892-2	YRS déc. 1	B2C	2018	20	32 mins		20	2 hrs 31 mins	1
OBP-2893	YRS déc. 1	B2D	2018	20	1 hr 11 mins	2	-	-	-
OBP-3575	YRS déc. 7/1?	B2D	2018	20	1 hr 6 mins	1	-	-	-
OBP-2790	GS déc. 20	B2A	2018	20	1 hr 3 mins	2	-	-	-
OBP-3384	YRS déc. 6	B2C	2018	20	1 hr 10 mins	1	-	-	-
OBP-3653	YRS déc. 8	B2C	2018	20	1 hr 45 mins	1	-	-	-
OBP-3840	YRS déc. 9	B2C	2018	20	21 mins	1	-	-	-
OBP-3723	YRS déc. 8	B2D	2018	20	18 mins	1	-	-	-
OBP-3757	YRS déc. 9	B2D	2018	20	24 mins	9	-	-	-
OBP-3646*	YRS déc. 8	B2D	2018	20	37 mins	9	-	-	-
OBP-3646-8	YRS déc. 8	B2D	2018	20	37 mins		10	1 hr 16 mins	1
OBP-3841	YRS déc. 9	B2C	2018	20	1 hr 8 mins	1	-	-	-
OBP-3633	YRS déc. 7	B2D	2018	20	26 mins	1	-	-	-

Pieces OBP-2408 to OBP-3633 third submersion and spot cleaning information, notes

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-2408	-	-	-	-	-	-
OBP-2420	-	-	-	-	-	-
OBP-2407	-	-	-	-	-	-
OBP-2406	-	-	-	-	-	-
OBP-2409	-	-	-	-	-	-
OBP-2479	-	-	-	-	-	-
OBP-2495	-	-	-	-	-	-
OBP-2410	-	-	-	20	1	-
OBP-2405	-	-	-	-	-	-
OBP-2598	-	-	-	-	-	-
OBP-3341	-	-	-	-	-	-
OBP-2975	-	-	-	20	1	-
OBP-3125	-	-	-	-	-	-
OBP-3048	-	-	-	-	-	-
OBP-3203	-	-	-	-	-	-
OBP-2892*	-	-	-	20	1	-
OBP-2892-2	-	-	-	20	1	-
OBP-2893	-	-	-	-	-	-
OBP-3575	-	-	-	-	-	-
OBP-2790	-	-	-	-	-	-
OBP-3384	-	-	-	20	1	-
OBP-3653	-	-	-	20	1	-
OBP-3840	-	-	-	-	-	-
OBP-3723	-	-	-	-	-	-
OBP-3757	-	-	-	-	-	-
OBP-3646*	-	-	-	-	-	-
OBP-3646-8	-	-	-	-	-	-
OBP-3841	-	-	-	-	-	-
OBP-3633	-	-	-	-	-	-

Pieces OBP-3722 to OBP-2613 first and second submersion information

				First submersion			Second submersion		
Piece #	Layer	Square	Date of Excavation	% solution	Period	No. of pieces cleaned	% solution	Period	No. of pieces cleaned
OBP-3722	YRS déc. 8	B2D	2018	20	54 mins	1	-	-	-
OBP-3726	YRS déc. 8	B2D	2018	20	46 mins	1	-	-	-
OBP-1910	GS déc. 14	B3C	2018	20	6 mins	1	-	-	-
OBP-1979	GS déc. 14	B2B	2018	20	1 hr 22 mins	1	-	-	-
OBP-2018	GS déc. 14	B2A	2018	20	1 hr 53 mins	1	-	-	-
OBP-2014	GS déc. 14	B2A	2018	20	1 hr 12 mins	1	-	-	-
OBP-2027	GS déc. 14	B2A	2018	20	1 hr 14 mins	1	-	-	-
OBP-1999	GS déc. 14	B2C	2018	20	1 hr 9 mins	1	-	-	-
OBP-1331	GS déc. 4	B3C	2018	20	1 hr 30 mins	5	-	-	-
OBP-1771	GS déc. 12	B2A	2018	20	1 hr 33 mins	1	-	-	-
OBP-694	GS déc. 6	B2D	2018	20	59 mins	1	-	-	-
OBP-565	GS déc. 5	B2C	2018	20	17 mins	1	-	-	-
OBP-771	GS déc. 7	B2A	2018	20	1 hr 4 mins	1	-	-	-
OBP-618	GS déc. 6	B2A	2018	20	14 mins	1	-	-	-
OBP-1096	GS déc. 9	B2D	2018	20	19 mins	1	-	-	-
OBP-998	GS déc. 9	B2A	2018	20	43 mins	1	-	-	-
OBP-1576	GS déc. 12	B3B	2018	20	25 mins	1	-	-	-
OBP-1593	GS déc. 12	B3B	2018	20	15 mins	1	-	-	-
OBP-1543	GS déc. 12	B3B	2018	20	10 mins	2	-	-	-
OBP-1648	GS déc. 12	B2B	2018	20	56 mins	1	10	1 hr 53 mins	1
OBP-1744	GS déc. 12	B2A	2018	20	1 hr 27 mins	1	-	-	-
OBP-1719	GS déc. 12	B2C	2018	20	28 mins	1	-	-	-
OBP-2703	GS déc. 19	B2A	2018	20	1 hr 2 mins	2	-	-	-
OBP-2715	GS déc. 19	B2A	2018	20	1 hr 46 mins	1	-	-	-
OBP-2691	GS déc. 19	B2A	2018	20	1 hr 23 mins	6	-	-	-
OBP-3302	YRS déc. 5	B2C	2018	20	7 mins	4	-	-	-
OBP-?	YRS déc. 4	B2D	2018	20	27 mins	7	-	-	-
OBP-2839	GS déc. 20	B2B	2018	20	1 hr 4 mins	2	-	-	-
OBP-2791*	GS déc. 20	B2B	2018	20	51 mins	5	-	-	-
OBP-2791-2	GS déc. 20	B2B	2018	20	51 mins		-	-	-
OBP-2891	GS déc. 20	B2D	2018	20	49 mins	3	-	-	-
OBP-2613	GS déc. 18	B2	2018	20	12 mins	1	-	-	-

Pieces OBP-3722 to OBP-2613 third submersion and spot cleaning information, notes

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-3722	-	-	-	-	-	-
OBP-3726	-	-	-	-	-	-
OBP-1910	-	-	-	-	-	-
OBP-1979	-	-	-	20	1	-
OBP-2018	-	-	-	-	-	-
OBP-2014	-	-	-	20	1	-
OBP-2027	-	-	-	20	1	-
OBP-1999	-	-	-	-	-	-
OBP-1331	-	-	-	-	-	-
OBP-1771	-	-	-	-	-	-
OBP-694	-	-	-	-	-	-
OBP-565	-	-	-	-	-	-
OBP-771	-	-	-	-	-	-
OBP-618	-	-	-	-	-	-
OBP-1096	-	-	-	-	-	-
OBP-998	-	-	-	-	-	-
OBP-1576	-	-	-	-	-	-
OBP-1593	-	-	-	-	-	-
OBP-1543	-	-	-	-	-	-
OBP-1648	-	-	-	-	-	-
OBP-1744	-	-	-	-	-	-
OBP-1719	-	-	-	-	-	-
OBP-2703	-	-	-	-	-	-
OBP-2715	-	-	-	20	1	-
OBP-2691	-	-	-	-	-	-
OBP-3302	-	-	-	-	-	-
OBP-?	-	-	-	-	-	-
OBP-2839	-	-	-	-	-	-
OBP-2791*	-	-	-	-	-	-
OBP-2791-2	-	-	-	20	1	-
OBP-2891	-	-	-	20	1	-
OBP-2613	-	-	-	-	-	Cleaning revealed piece to be bone, will be labelled accordingly and removed from ochre assemblage

Pieces OBP-2633 to OBP-4646 first and second submersion information

				First submersion			Second submersion		
Piece #	Layer	Square	Date of Excavation	% solution	Period	No. of pieces cleaned	% solution	Period	No. of pieces cleaned
OBP-2633	GS déc. 18	B2B	2018	20	1 hr 9 mins	1	-	-	-
OBP-2606*	GS déc. 18	B2B	2018	20	47 mins	5	-	-	-
OBP-2606-4	GS déc. 18	B2B	2018	20	47 mins		20	1 hr 42 mins	1
OBP-2605	GS déc. 18	B2A	2018	20	33 mins	5	-	-	-
OBP-1898	GS déc. 14	B2A	2018	20	25 mins	5	-	-	-
OBP-1896	GS déc. 14	B3C	2018	20	41 mins	7	-	-	-
OBP-2663	GS déc. 18	B2A	2018	20	57 mins	1	10	2 mins	1
OBP-2628	GS déc. 18	B2B	2018	20	1 hr 13 mins	1	-	-	-
OBP-1333	GS déc. 10	B2D	2018	20	45 mins	2	-	-	-
OBP-1314	GS déc. 10	B2D	2018	20	22 mins	1	-	-	-
OBP-2148	GS déc. 15	B2B	2018	20	1 hr 11 mins	1	-	-	-
OBP-1120	GS déc. 10	B2B	2018	20	40 mins	5	20	1 hr 22 mins	1
OBP-2158	GS déc. 15	B2B	2018	20	1 hr 7 mins	1	-	-	-
OBP-2042*	GS déc. 15	B2B	2018	20	38 mins	3	-	-	-
OBP-2042-1	GS déc. 15	B2B	2018	20	38 mins		-	-	-
OBP-2247	GS déc. 16	B2D	2018	20	1 hr 19 mins	3	20	2 hrs 16 mins	1
OBP-2243	GS déc. 16	B3C	2018	20	18 mins	6	-	-	-
OBP-4160	GS déc. 23	B3C	2018	20	58 mins	5	-	-	-
OBP-992	GS déc. 9	B2A	2018	20	36 mins	1	-	-	-
OBP-4149*	GS déc. 22	B2A	2018	20	30 mins	6	-	-	-
OBP-4149-3	GS déc. 22	B2A	2018	20	30 mins		-	-	-
OBP-751	GS déc. 7	B2A	2018	20	44 mins	1	-	-	-
OBP-5208	GS déc. 34	B2	2019	20	5 mins	1	-	-	-
OBP-4842	GS déc. 32	B2	2019	20	23 mins	1	-	-	-
OBP-1221	GS déc. 10	B2A	2018	20	43 mins	1	-	-	-
OBP-4984	GS déc. 34	B2	2019	20	1 hr 48 mins	1	-	-	-
OBP-424	GS déc. 4	B2B	2018	20	33 mins	2	-	-	-
OBP-2426	GS déc. 17	B3C	2018	10	45 mins	1	-	-	-
OBP-205	GS déc. 2	B2D	2018	10	14 mins	2	-	-	-
OBP-4708*	DRG déc. 2	B3C	2018	10	1 hr 31 mins	3	-	-	-
OBP-4708-1	DRG déc. 2	B3C	2018	10	1 hr 31 mins		-	-	-
OBP-4646*	GS déc. 30	B2A	2018	10	26 mins	3	-	-	-

Pieces OBP-2633 to OBP-4646 third submersion and spot cleaning information, notes

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-2633	-	-	-	-	-	-
OBP-2606*	-	-	-	20	1	Quartz piece to be removed from ochre assemblage
OBP-2606-4	-	-	-	-	-	-
OBP-2605	-	-	-	-	-	Quartz piece to be removed from ochre assemblage
OBP-1898	-	-	-	-	-	-
OBP-1896	-	-	-	-	-	-
OBP-2663	-	-	-	-	-	-
OBP-2628	-	-	-	-	-	-
OBP-1333	-	-	-	-	-	-
OBP-1314	-	-	-	-	-	-
OBP-2148	-	-	-	20	1	-
OBP-1120	-	-	-	20	1	-
OBP-2158	-	-	-	20	1	-
OBP-2042*	-	-	-	-	-	-
OBP-2042-1	-	-	-	20	1	-
OBP-2247	-	-	-	-	-	-
OBP-2243	-	-	-	-	-	-
OBP-4160	-	-	-	-	-	-
OBP-992	-	-	-	-	-	Identified as bone, to be removed from ochre assemblage
OBP-4149*	-	-	-	-	-	One quartz piece, to be removed from ochre assemblage
OBP-4149-3	-	-	-	20	1	-
OBP-751	-	-	-	-	-	-
OBP-5208	-	-	-	-	-	-
OBP-4842	-	-	-	-	-	-
OBP-1221	-	-	-	20	1	-
OBP-4984	-	-	-	20	1	-
OBP-424	-	-	-	-	-	-
OBP-2426	-	-	-	20	1	-
OBP-205	-	-	-	-	-	-
OBP-4708*	-	-	-	-	-	-
OBP-4708-1	-	-	-	20	1	-
OBP-4646*	-	-	-	-	-	-

Pieces OBP-4646-2 to OBP-3342 first and second submersion information

				First submersion			Second submersion		
Piece #	Layer	Square	Date of Excavation	% solution	Period	No. of pieces cleaned	% solution	Period	No. of pieces cleaned
OBP-4646-2	GS déc. 30	B2A	2018	10	26 mins		-	-	-
OBP-2242	GS déc. 16	B3B	2018	10	9 mins	1	10	24 mins	1
OBP-1334*	GS déc. 11	B2C	2018	10	1 hr 4 mins	4	-	-	-
OBP-1334-2	GS déc. 11	B2C	2018	10	1 hr 4 mins		-	-	-
OBP-4235	GS déc. 24	B2	2019	10	1 hr 41 mins	1	-	-	-
OBP-3996*	GS déc. 19	B3A	2018	10	54 mins	2	-	-	-
OBP-3996-1	GS déc. 19	B3A	2018	10	54 mins		10	32 mins	1
OBP-2692*	GS déc. 19	B2B	2018	20	37 mins	7	-	-	-
OBP-2692-1	GS déc. 19	B2B	2018	20	37 mins		20	42 mins	1
OBP-2692-2	GS déc. 19	B2B	2018	20	37 mins		20	46 mins	1
OBP-2692-4	GS déc. 19	B2B	2018	20	37 mins		20	1 hr 33 mins	1
OBP-2238	GS déc. 15	B2A	2018	10	26 mins	1	-	-	-
OBP-2455	GS déc. 17	B3B	2018	10	10 mins	1	10	15 secs	1
OBP-4220*	GS déc. 24	B3D	2018	10	1 hr	4	-	-	-
OBP-4220-2	GS déc. 24	B3D	2018	10	1 hr		20	1 hr 55 mins	1
OBP-4220-4	GS déc. 24	B3D	2018	10	1 hr		20	55 mins	1
OBP-1334	GS déc. 4	B3D	2018	10	1 hr 18 mins	3	-	-	-
OBP-1781	GS déc. 13	B2A	2018	10	1 hr 16 mins	4	-	-	-
OBP-1783	GS déc. 13	B2C	2018	10	45 mins	1	10	1 hr 18 mins	5
OBP-203	GS déc. 2	B2B	2018	10	43 mins	2	-	-	-
OBP-1498	GS déc. 11	B2D	2018	10	1 hr 12 mins	1	-	-	-
OBP-748	GS déc. 7	B2D	2018	10	25 secs	1	-	-	-
OBP-3300	YRS déc. 4	B2D	2018	10	20 mins	1	-	-	-
OBP-4049	GS déc. 21	B3B	2019	10	45 mins	1	-	-	-
OBP-2460	GS déc.17	B3B	2018	10	51 mins	1	-	-	-
OBP-2986	YRS déc. 2	B2D	2018	10	27 mins	4	-	-	-
OBP-1330	GS déc. 4	B3B	2018	10	24 mins	1	-	-	-
OBP-4667	GS déc. 31	B2A	2018	20 + 10	45 mins	2	20	1 hr 41 mins	1
OBP-919	GS déc. 8	B2C	2018	10	34 mins	1	-	-	-
OBP-2953	YRS déc. 1	B2D	2018	10	52 mins	1	-	-	-
OBP-2660	GS déc. 18	B2D	2018	10	31 mins	1	-	-	-
OBP-3342	YRS déc. 5	B2D	2018	10	1 hr 1 min	1	-	-	-

Pieces OBP-4646-2 to OBP-3342 third submersion and spot cleaning information, notes

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-4646-2	-	-	-	20	1	-
OBP-2242	-	-	-	-	-	-
OBP-1334*	-	-	-	-	-	-
OBP-1334-2	-	-	-	20	1	-
OBP-4235	-	-	-	20	1	-
OBP-3996*	-	-	-	-	-	-
OBP-3996-1	-	-	-	-	-	-
OBP-2692*	-	-	-	20	2	-
OBP-2692-1	-	-	-	-	-	-
OBP-2692-2	-	-	-	-	-	-
OBP-2692-4	10	1 hr 22 mins	2	-	-	-
OBP-2238	-	-	-	-	-	-
OBP-2455	-	-	-	-	-	-
OBP-4220*	-	-	-	-	-	-
OBP-4220-2	-	-	-	-	-	-
OBP-4220-4	-	-	-	-	-	-
OBP-1334	-	-	-	-	-	-
OBP-1781	-	-	-	-	-	One quartz piece, to be removed from ochre assemblage
OBP-1783	-	-	-	-	-	-
OBP-203	-	-	-	-	-	-
OBP-1498	-	-	-	-	-	-
OBP-748	-	-	-	-	-	No reaction occurred
OBP-3300	-	-	-	-	-	-
OBP-4049	-	-	-	20	1	-
OBP-2460	-	-	-	-	-	-
OBP-2986	-	-	-	-	-	-
OBP-1330	-	-	-	-	-	-
OBP-4667	20	1 hr 48 mins	1	20	1	One piece tested in 10% solution, another in 20% solution
OBP-919	-	-	-	-	-	-
OBP-2953	-	-	-	-	-	-
OBP-2660	-	-	-	20	1	-
OBP-3342	-	-	-	-	-	-

Pieces OBP-1895 to OBP-2659 first and second submersion information

				First submersion			Second submersion		
Piece #	Layer	Square	Date of Excavation	% solution	Period	No. of pieces cleaned	% solution	Period	No. of pieces cleaned
OBP-1895	GS déc. 14	B3B	2018	10	23 mins	5	-	-	-
OBP-3526	YRS déc. 7	B2D	2018	10	46 mins	1	-	-	-
OBP-3347	YRS déc. 5	B2D	2018	10	1 hr 3 mins	1	-	-	-
OBP-2626	GS déc. 18	B2B	2018	20	1 hr 34 mins	1	-	-	-
OBP-2085	GS déc. 15	B3B	2018	20	1 hr 42 mins	1	-	-	-
OBP-2039	GS déc. 15	B3D	2018	20	52 mins	5	-	-	-
OBP-2689	GS déc. 18	B2A	2018	20	1 hr 16 mins	1	10	1 hr 53 mins	1
OBP-1680	GS déc. 12	B2D	2018	20	1 hr 6 mins	1	-	-	-
OBP-2457	GS déc. 17	B3B	2018	20	26 mins	1	-	-	-
OBP-2755	GS déc. 19	B2B	2018	20	1 hr 8 mins	1	-	-	-
OBP-2412	GS déc. 17	B2C	2018	20	4 mins	1	-	-	-
OBP-1901	GS déc. 14	B2D	2018	20	1 hr 32 mins	2	-	-	-
OBP-2245*	GS déc. 16	B2A	2018	20	31 mins	10	-	-	-
OBP-2245-1	GS déc. 16	B2A	2018	20	31 mins		-	-	-
OBP-2245-4	GS déc. 16	B2A	2018	20	31 mins		-	-	-
OBP-2245-6	GS déc. 16	B2A	2018	20	31 mins		-	-	-
OBP-2032	GS déc. 15	B3A	2018	20	14 mins	3	-	-	-
OBP-1238	GS déc. 10	B2B	2018	20	1 hr 50 mins	1	-	-	-
OBP-2525	GS déc. 17	B2B	2018	20	1 hr 41 mins	1	-	-	-
OBP-2505	GS déc. 17	B3D	2018	20	2 mins	1	-	-	-
OBP-2435	GS déc. 17	B3C	2018	20	48 mins	1	-	-	-
OBP-X-1	Test trench	Cleaning	2018	20	3 mins	1	-	-	-
OBP-1121	GS déc. 10	B2D	2018	20	27 mins	1	-	-	-
OBP-321-1	GS déc. 3	B2D	2018	20	28 mins	1	-	-	-
OBP-206	GS déc. 2	B2C	2018	20	11 mins	1	-	-	-
OBP-2673	GS déc. 18	B2A	2018	20	2 hrs 9 mins	1	-	-	-
OBP-1384	GS déc. 4	B2B	2018	20	47 mins	1	-	-	-
OBP-3150	YRS déc. 3	B2C	2018	20	18 mins	1	-	-	-
OBP-1080	GS déc. 9	B2D	2018	20	14 mins	1	-	-	-
OBP-1782	GS déc. 13	B2B	2018	20	1 hr 10 mins	3	-	-	-
OBP-1784	GS déc. 13	B2D	2018	20	7 mins	3	-	-	-
OBP-2659	GS déc. 18	B2D	2018	20	1 hr 11 mins	1	-	-	-

Pieces OBP-1895 to OBP-2659 third submersion and spot cleaning information, notes

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-1895	-	-	-	-	-	-
OBP-3526	-	-	-	-	-	-
OBP-3347	-	-	-	-	-	-
OBP-2626	-	-	-	-	-	-
OBP-2085	-	-	-	-	-	-
OBP-2039	-	-	-	-	-	-
OBP-2689	-	-	-	-	-	-
OBP-1680	-	-	-	20	1	-
OBP-2457	-	-	-	-	-	-
OBP-2755	-	-	-	20	1	-
OBP-2412	-	-	-	-	-	-
OBP-1901	-	-	-	20	1	-
OBP-2245*	-	-	-	-	-	-
OBP-2245-1	-	-	-	20	1	-
OBP-2245-4	-	-	-	20	1	-
OBP-2245-6	-	-	-	20	1	-
OBP-2032	-	-	-	-	-	-
OBP-1238	-	-	-	20	1	-
OBP-2525	-	-	-	-	-	-
OBP-2505	-	-	-	-	-	-
OBP-2435	-	-	-	-	-	-
OBP-X-1	-	-	-	-	-	-
OBP-1121	-	-	-	-	-	-
OBP-321-1	-	-	-	-	-	-
OBP-206	-	-	-	-	-	-
OBP-2673	-	-	-	-	-	-
OBP-1384	-	-	-	-	-	-
OBP-3150	-	-	-	-	-	-
OBP-1080	-	-	-	-	-	-
OBP-1782	-	-	-	20	1	-
OBP-1784	-	-	-	-	-	-
OBP-2659	-	-	-	-	-	-

Pieces OBP-3936 to OBP-1947 first and second submersion information

				First submersion			Second submersion		
Piece #	Layer	Square	Date of Excavation	% solution	Period	No. of pieces cleaned	% solution	Period	No. of pieces cleaned
OBP-3936	YRS déc. 10	B2D	2018	20	17 mins	1	-	-	-
OBP-2966	YRS déc. 1	B2D	2018	20	1 hr 8 mins	2	-	-	-
OBP-1780	GS déc. 13	B3D	2018	20	15 mins	2	-	-	-
OBP-3959	YRS déc. 10	B2C	2018	20	44 mins	1	-	-	-
OBP-605	GS déc. 5	B2D	2018	10	1 hr 16 mins	1	-	-	-
OBP-789	GS déc. 7	B2B	2018	10	1 hr 17 mins	1	-	-	-
OBP-1122	GS déc. 3	B3B	2018	10	18 mins	2	-	-	-
OBP-207	GS déc. 2	B2D	2018	20	10 mins	5	-	-	-
OBP-321	GS déc. 3	B2D	2018	20	39 mins	6	-	-	-
OBP-1899	Gs déc. 14	B2B	2018	20	56 mins	4	-	-	-
OBP-1428b	GS déc. 11	B2A	2018	20	57 mins	1	-	-	-
OBP-2007	GS déc. 14	B2A	2018	20	1 hr 33 mins	1	-	-	-
OBP-320?	GS déc. 3?	B2C?	2018	20	12 mins	6	-	-	-
OBP-1720	GS déc. 12	B2C	2018	10	19 mins	1	-	-	-
OBP-3243-2	YRS déc. 4	B2C	2018	10	29 mins	1	-	-	-
OBP-3243-4	YRS déc. 4	B2C	2018	10	30 mins	1	-	-	-
OBP-848	GS déc. 8	B2D	2018	10	1 hr 52 mins	1	-	-	-
OBP-1778	GS déc. 13	B3B	2018	10	16 mins	1	-	-	-
OBP-1549	GS déc. 12	B2D	2018	10	2 hrs 16 mins	2	-	-	-
OBP-747	GS déc. 7	B2B	2018	10	1 hr 18 mins	1	-	-	-
OBP-1545	GS déc. 12	B3D	2018	10	3 mins	1	-	-	-
OBP-2038	GS déc. 15	B3C	2018	10	4 mins	2	-	-	-
OBP-2033	GS déc. 15	B3B	2018	10	14 mins	2	-	-	-
OBP-2241	GS déc. 16	B3A	2018	10	57 mins	5	-	-	-
OBP-1012	GS déc. 9	B2B	2018	10	13 mins	1	-	-	-
OBP-200*	GS déc. 2	B3A	2018	10	36 mins	2	-	-	-
OBP-200-1	GS déc. 2	B3A	2018	10	45 mins	1	-	-	-
OBP-3881-9	YRS déc. 10	B2D	2018	10	16 mins	1	-	-	-
OBP-3924	YRS déc. 10	B2D	2018	10	20 mins	1	-	-	-
OBP-1328	GS déc. 11	B2A	2018	10	8 mins	2	-	-	-
OBP-1463	GS déc. 11	B2C	2018	10	21 mins	1	-	-	-
OBP-1947	GS déc. 14	B3B	2018	10	1 hr 10 mins	1	-	-	-

Pieces OBP-3936 to OBP-1947 third submersion and spot cleaning information

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-3936	-	-	-	-	-	-
OBP-2966	-	-	-	-	-	-
OBP-1780	-	-	-	-	-	-
OBP-3959	-	-	-	-	-	-
OBP-605	-	-	-	20	1	-
OBP-789	-	-	-	-	-	-
OBP-1122	-	-	-	-	-	-
OBP-207	-	-	-	-	-	-
OBP-321	-	-	-	-	-	-
OBP-1899	-	-	-	-	-	-
OBP-1428b	-	-	-	-	-	-
OBP-2007	-	-	-	-	-	-
OBP-320?	-	-	-	-	-	-
OBP-1720	-	-	-	-	-	-
OBP-3243-2	-	-	-	-	-	-
OBP-3243-4	-	-	-	-	-	-
OBP-848	-	-	-	-	-	-
OBP-1778	-	-	-	-	-	-
OBP-1549	-	-	-	-	-	-
OBP-747	-	-	-	-	-	-
OBP-1545	-	-	-	-	-	-
OBP-2038	-	-	-	-	-	-
OBP-2033	-	-	-	-	-	-
OBP-2241	-	-	-	-	-	-
OBP-1012	-	-	-	-	-	-
OBP-200*	-	-	-	-	-	-
OBP-200-1	-	-	-	-	-	-
OBP-3881-9	-	-	-	-	-	-
OBP-3924	-	-	-	-	-	-
OBP-1328	-	-	-	-	-	-
OBP-1463	-	-	-	-	-	-
OBP-1947	-	-	-	-	-	-

Pieces OBP-3120 to OBP-4219 first and second submersion information, third submersion and spot cleaning information, notes

				First submersion			Second submersion		
Piece #	Layer	Square	Date of Excavation	% solution	Period	No. of pieces cleaned	% solution	Period	No. of pieces cleaned
OBP-3120	YRS déc. 3	B2D	2018	10	23 mins	6	-	-	-
OBP-831	GS déc. 7	B2D	2018	10	1 hr 1 min	1	-	-	-
OBP-1218	GS déc. 10	B2A	2018	10	37 mins	1	-	-	-
OBP-582	GS déc. 5	B2D	2018	10	53 mins	1	-	-	-
OBP-3998-2	GS déc. 19	B3C	2019	20	15 mins	1	-	-	-
OBP-4270	GS déc. 25	B3D	2018	20	10 mins	2	-	-	-
OBP-8	YRS déc. 9	B2D	2018	20	15 mins	1	-	-	-
OBP-9	YRS déc. 9	B2D	2018	20	11 mins	1	-	-	-
OBP-4345	GS déc. 26	B2A	2018	20	1 hr 17 mins	3	-	-	-
OBP-4479	GS déc. 29	B3D	2018	20	17 mins	3	-	-	-
OBP-4156	GS déc. 23	B3?	2018	20	21 mins	4	-	-	-
OBP-4391	GS déc. 27	B2A	2019	20	47 mins	4	-	-	-
OBP-4265	GS déc. 25	B2A	2019	20	1 hr 3 mins	1	-	-	-
OBP-4219	GS déc. 24	B3C	2018	20	1 hr 2 mins	2	-	-	-

	Third submersion			Spot cleaning		
Piece #	% solution	Period	No. of pieces cleaned	% solution	No. of pieces cleaned	Notes
OBP-3120	-	-	-	-	-	-
OBP-831	-	-	-	20	1	-
OBP-1218	-	-	-	-	-	-
OBP-582	-	-	-	-	-	-
OBP-3998-2	-	-	-	-	-	-
OBP-4270	-	-	-	-	-	-
OBP-8	-	-	-	-	-	-
OBP-9	-	-	-	-	-	-
OBP-4345	-	-	-	-	-	-
OBP-4479	-	-	-	-	-	-
OBP-4156	-	-	-	-	-	-
OBP-4391	-	-	-	-	-	-
OBP-4265	-	-	-	-	-	-
OBP-4219	-	-	-	-	-	-