



## Blombos Cave: Middle Stone Age ochre differentiation through FTIR, ICP OES, ED XRF and XRD



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### ABSTRACT

In Africa, ochre is ubiquitous in archaeological sites after 100 ka and likely served a symbolic role in the lives of prehistoric people. Archaeological excavation of the c. 100–72 ka Middle Stone Age (MSA) levels at Blombos Cave (BBC) located in the southern Cape, South Africa, have yielded significant amounts of ochre as artefacts or residues. Although recent archaeological evidence from BBC and elsewhere has provided remarkable insights into the ways that ochre was used, for example its use as a pigmented 'paint', the significance of ochre can be further understood by studying its procurement pattern. To this end, the geochemical characterisation of recovered ochre can tell us about the temporal and spatial variation present at a site. The analysis of BBC ochre was accomplished using FTIR, ED XRF, ICP OES and XRD with the aim of determining the mineral and elemental composition variability of ochre across layers and thereby gauging whether there were preferred or different ochre procurement patterns or sources over time. For example, it was found that ochre residues from the c. 100 ka CP layer had kaolinite and quartz as the principal minerals, while ochre residues from the c. 97 ka CJ layer consisted mainly of calcite and quartz. Thus, mineral composition can indicate procurement of different sources of ochre during the various stages of the cave occupation. Elemental analysis of ochre residues from the c. 77–72 ka Still Bay, CJ and CP layers also revealed differences in minor and trace elements. These findings seem to indicate some differences in the ochre from these levels and can also be taken as an indication of different ochre sourcing.

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### 1. Introduction

Ochre, a mineral rich in iron oxide, is present after c. 100 ka at most MSA sites in southern Africa (Watts, 2010), and at the Pinnacle Point site near Mossel Bay ochre was being used at 165 ka (Watts, 2010). At Blombos Cave (BBC), ochre was processed together with fat, charcoal and a liquid to produce a pigmented compound (essentially paint) at 100 ka (Henshilwood et al., 2011). At most MSA sites, evidence of scraping or grinding of ochre, probably to produce powder, is frequent, and some pieces have crayon shapes as a result of being scraped on an abrasive surface (Henshilwood et al., 2009). At BBC, seventeen pieces of ochre deliberately engraved with

abstract patterns were recovered from levels dating to 100–72 ka (Henshilwood et al., 2009). The occurrence of ochre at MSA sites is often interpreted as early evidence for the symbolic use of colorants (d'Errico et al., 2012). Ochre was used also in practical ways including incorporating it in the adhesive used during hafting (Wadley et al., 2009), for skin protection (Klein, 1999), and as a medicine (Velo, 1984).

As applied in archaeology, the term ochre refers to a wide range of materials that exhibit colours ranging from blood red to yellow depending on the presence and proportions of iron oxide chromophore and/iron hydroxides, matrix composition and particle size distribution (Mortimore et al., 2004). The iron oxides occur mainly as goethite/limonite ( $\alpha$ -FeOOH), hematite ( $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>), and magnetite (Fe<sub>3</sub>O<sub>4</sub>), including maghemite ( $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>) and lepidocrocite ( $\gamma$ -FeOOH). These iron oxides are found in various matrices which include white minerals such as chalk (CaCO<sub>3</sub>), kaolinite (Al<sub>2</sub>Si<sub>2</sub>O<sub>5</sub>(OH)<sub>4</sub>), quartz (SiO<sub>2</sub>), gypsum (CaSO<sub>4</sub> 2H<sub>2</sub>O), and talc

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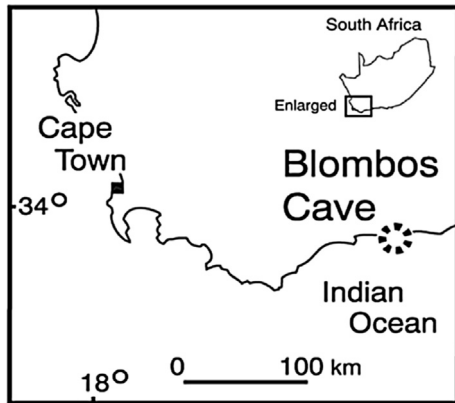


Fig. 1. Location of Blombos Cave.

( $Mg_3Si_4O_{10}(OH)_2$ ) (Montagner et al., 2013). Yellow ochre consists mainly of goethite/hydrated iron oxides, and red ochres have hematite as the main chromophore (Bikiaris et al., 2000; Elias et al., 2006).

BBC is located on the southern Cape coast of South Africa, approximately 300 km east of Cape Town (Fig. 1). It is situated in a steep wave-cut cliff, 100 m from the Indian Ocean and 34.5 m above modern sea level. The inside of the cave consist of about 55 m<sup>2</sup> of visible deposits with a depth of 3 m and 4–5 m at the back and front, respectively (Henshilwood, 2005). Excavations between 1992 and 2011 uncovered a stratified sequence of LSA and MSA deposits (Henshilwood, 2012). The chronology of the MSA levels at BBC

suggests that human occupation was determined largely by Pleistocene sea level fluctuations, with the occupation phases, at least in part, corresponding to high sea-level stands (Henshilwood, 2008).

The MSA levels are divided into four phases: M1, upper M2, lower M2 and M3 (Fig. 2), and these have been dated using a number of methods including thermoluminescence (TL), optically stimulated luminescence (OSL) and electron spin resonance (ESR) (Henshilwood, 2012). A hiatus level composed of undisturbed aeolian sand overlying the M1 phase is dated by OSL to 69 ka and 70 ka (Jacobs et al., 2006). OSL ages ranging from 75 ka to 73 ka (Jacobs et al., 2013) were obtained for the upper part of the M1 phase (layers CA – CDB) that equates with the Still Bay techno-tradition which is characterised by bifacial foliate points. The M1 phase is well known for yielding bone tools, engraved ochres and perforated *Nassarius kraussianus* shell beads (Henshilwood, 2012). The upper M2 phase, also containing Still Bay artifacts, is dated to between 77 ka and 73 ka by OSL (Jacobs et al., 2013).

The lower layers in the M2 phase (layer CG, CGAA, CGAB, CGAC) are dated to between 82 ka and 85 ka (Jacobs et al., 2013). The upper levels of the M3 phase (layers CH – CJ) are dated to ca. 94–97 ka, coinciding with the high sea-level stand during Marine Isotope Stage (MIS) 5c, and contain fragments of engraved ochre, a wide range of faunal remains, some fish remains and high frequencies of shellfish (Henshilwood et al., 2009). Toolkits for ochre processing were found in the lower c. 100 ka layers CP and CPA (Henshilwood et al., 2011), providing further evidence for the antiquity of symbolic behaviour during the MSA. A preliminary age of >130 ka is attributed to the lower M3 phase (the lowest excavated level at the site).

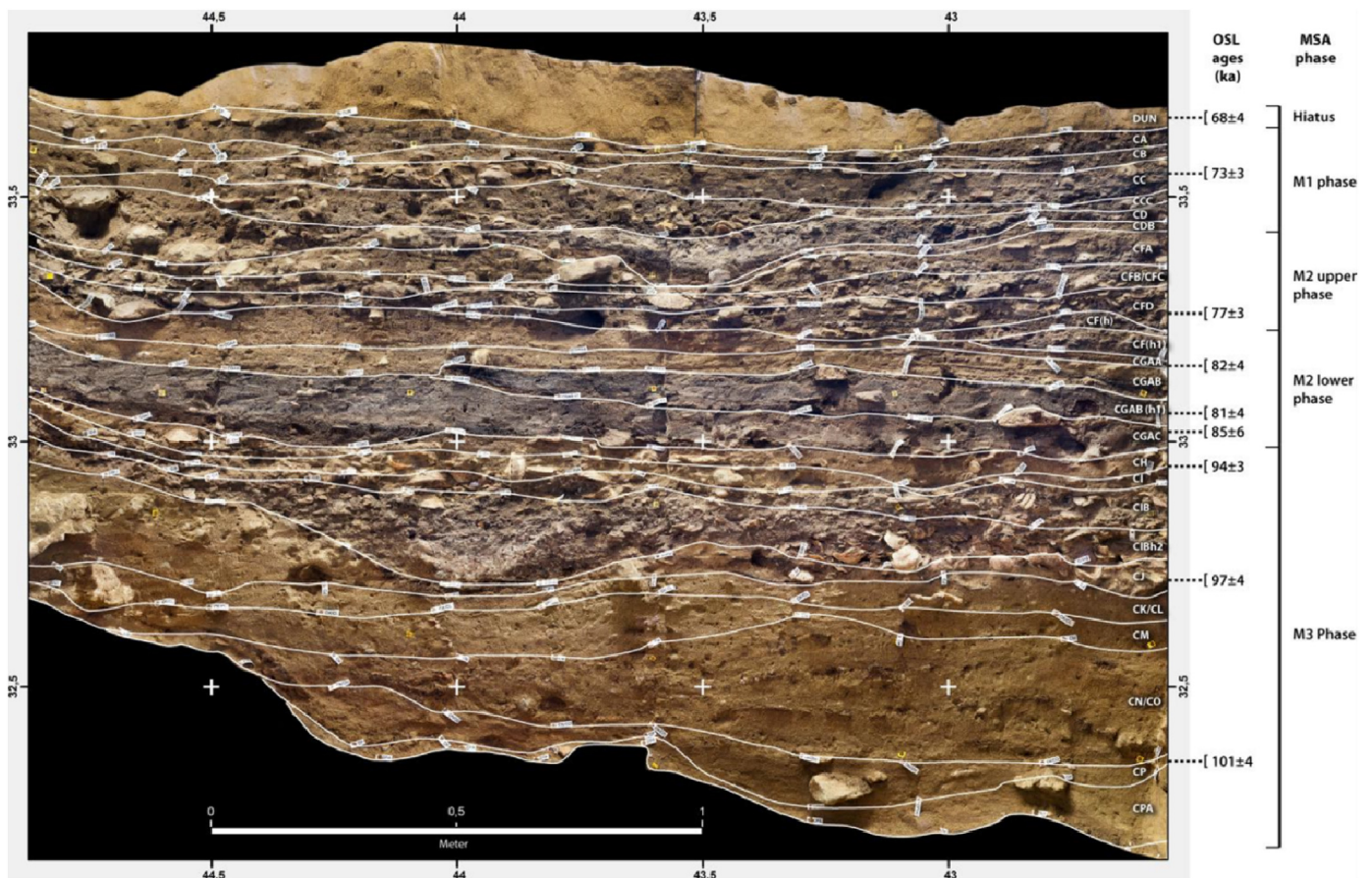


Fig. 2. Stratigraphy of Blombos Cave showing layers from which ochre material was recovered. Courtesy of Magnus Haaland.

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