An Overview of Recent Research at Wonderwerk Cave, South Africa

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Introduction

Wonderwerk Cave, located in the Northern Cape Province of South Africa between the towns of Danielskuil and Kuruman (27°50' 45"S, 23° 33' 19"E) (Figure 1a), is a massive cavern (ca. 2400 m²) running 140 metres into the eastern flank of the Kuruman Hills, with average height inside the cave 10m, and average width 17 m. The enormity of the cave and the extensive time depth spanned by the archaeological record, ca. 2 million years, present a unique challenge. Seven different areas within the cave have been excavated, each yielding a distinctive stratigraphic sequence and situated in different parts of the cave characterized by its own physical environment. As such it is more appropriate to consider the cave as an archaeological landscape rather than as a single site. The goal of this article is to provide a general overview of this landscape and the associated modes of hominin occupation as they vary over time and space.

Physical Configuration of the Cave

Wonderwerk Cave is a solution cavity that formed in stratified dolomitic limestone overlain by beds of Banded Ironstone Formation (BIF) of early Proterozoic–late Archaean Age (2–3 Ga) (Kent 1980; Knoll & Beukes 2009). The cave lies 1660m a.s.l. at the base of a small foothill overlooking the Ghaap plateau with the entrance facing north (Figure 1b). The opening of the cave mouth (currently 15 m wide and 7 m high - Figure 2a) was probably the result of a combination of uplift of the Kuruman Hills and erosion. Beryllium exposure dating of rocks at the cave mouth indicate that there has been gradual erosion of this rock so that during early periods of occupation the cave entrance would have been ca. 20-30m further to the north of the current mouth (Matmon (personal communication 2011).

To examine the relationship between the cavern and the hillside in which it sits, a 3D surface model of the cave interior generated using laser scanning (Figure 1c), was integrated into a detailed topographical survey map of the hill (Rüther et al. 2009). It shows that the back of the cave lies deep within the hillside - under 53 m of BIF. The cave runs due south into the hillside turning slightly to the west at around its midpoint (Figure 1c). The sedimentary deposits gently slope down from the cave front towards the back.

The roof of the cave is flat but slightly arched and comprised of solid rock with some dissolution cavities towards the back of the cave. Moisture reaches the cave interior through cracks in the roof, particularly 20 m in from the mouth where an impressive stalagmite has formed that rises 2.8 m above the current cave floor and is 2 m in diameter at its base. At this point in the cave, adjacent to Excavation 1, there is today a steady drip of water following heavy rains. Radiocarbon dates of a core taken in this stalagmite indicate that it spans (not continuously) the last 35,000 yrs BP (Brook et al. 2010). At the base of Excavation 1, our team has documented natural phreatic cave sediments which were formed before the cave mouth was open. These deposits are distinct from the overlying sediments in that they do not include quartz sand or archaeological remains, while the overlying sediments which contain archaeological finds, represent quartz-rich sands and silts.

The back of the cave (Excavation 6) is a solid dolomite surface but there is a side chamber that opens up towards the west (Figure 2b). This chamber has not been excavated and access is limited to a low and narrow gap between the sediment and the cave roof. There is a buried stalagmite in this chamber that remains to be sampled. It is important to emphasize that the back of the cave lies well within the mass of the hill and that this side chamber does not appear to lead to a buried cave entrance. It is also important to stress that Wonderwerk is likely part of a much larger karstic feature similar to the massive karstic features in the immediate region including Bushman’s Hole (5 km to the south) and the Eye of Kuruman (60 km to the north).
Figure 1. Wonderwerk Cave

Figure 1. a. Map showing location of Wonderwerk Cave. b. Historical Photo of Wonderwerk Cave and hill in which it sits (courtesy of the Duggan-Cronin Collection, McGregor Museum, Kimberley). c. Plan of Wonderwerk Cave generated from 3D surface model with excavation areas indicated (Courtesy H. Rüther, Zamani UCT Project). Walkway marked in brown, excavation areas indicated by number.

History of Research

A detailed history of research at Wonderwerk Cave and early travellers that visited or noted the site can be found in Humphreys and Thackeray (1983), Beaumont (1990; 2004) and Beaumont and Vogel (2006). A number of aspects of this history are critical to understanding the archaeology of the site. The front part of the cave served as the home of the Bosman family in the period 1909-1911 while they built a house on the farm where the cave is located (Rudner & Rudner 1968). Thus, some features of the surface topography of the cave sediments – including a dagga floor adjacent to the entrance and rubble dumped behind the stalagmite, reflect their modifications of the site – first for their home and subsequently for storing farm equipment (Malan & Wells 1943). However, their most dramatic intervention in the cave was the excavation of the organic rich cave sediment, which was sold as guano for fertilizer in the early 1940s. From ca. 35 m inwards from the cave mouth, this enterprise has left massive pits throughout the site along with discarded heaps of sediment and rocks.

The first archaeological excavations at the site by Malan (Malan & Wells 1943) demonstrated that the site included Earlier Stone Age (ESA) deposits but did not reach the base of these deposits. Malan also established the excavation grid, based on a yard square system, that has been maintained by subsequent projects. Further archaeological investigations within the cave were undertaken by the Peabody California Africa Expedition (Camp 1948) and Karl Butzer (Butzer et al. 1978; Butzer 1984a, b), but these were limited in scale.
In 1978, excavation was renewed on a large scale by Peter Beaumont together with Ann and Francis Thackeray who were engaged in their doctoral research on the Later Stone Age (LSA) strata of the site. The Thackerays limited their excavation to the LSA occupation in Excavation 1. This project yielded incised stone slabs, which at the time represented the oldest dated art mobilier from Africa (Thackeray et al. 1981), along with a rich Holocene sequence of faunal and cultural remains (Humphreys & Thackeray 1983; Thackeray 1981; Thackeray 1984, 1988; Thackeray & Lee-Thorp 1992; Thackeray & Brink 2004). Beaumont’s work continued in Excavation 1 where he further documented the extensive ESA sequence reaching ca. three metres in depth (Beaumont 1990; 2004; Beaumont & Vogel 2006). He also carried out a series of excavations deeper within the cave in areas labelled Excavations 2-7 (Figure 1c). It transpired that in each excavated area, a slightly different slice of the caves occupational history was represented. As such, excavated Stratum 1 in one excavation was not necessarily equivalent in content or time to Stratum 1 in another excavation area. However, based on preliminary examinations of the lithic assemblages, Beaumont created a series of Major Units which he used to correlate strata across the different excavations (Beaumont & Vogel 2006). This system lacks precision due to the absence of robust radiometric dates with which to tie in the different excavations and strata, as well as the absence of detailed lithic, biochronological (faunal/floral) or palaeoclimatic data with which to substantiate these correlations. Given the scale and complexity of the cave infill, we feel that the use of the Major Units is at present not supported by the available data and that each excavation should be perceived as a separate site until the stratigraphic associations can be verified.

Beaumont also cleared out the debris left behind by the ‘guano’ digging and cleaned their grab pits. This loose disturbed material was dumped directly in front of the cave creating an artificial terrace that is now a prominent feature hiding the original topography of the natural talus slope of the cave (Figure 1b). The stone rubble Beaumont recovered while cleaning the guano digger’s pits was used to create a flat walkway leading from the front to the very back of the cave (Figure 1c). Beaumont also laid out an excavation grid across almost the entirety of the cave interior following Malan’s original excavation grid. Beaumont’s grid is laid out across areas well beyond the limits of his excavations. This grid still stands and is a testament to his transformation of Wonderwerk Cave into one of the major prehistoric sites in southern Africa.

Beaumont excavated in 5 cm spits, beginning at 0 height at the top of each new stratum. No piece plotting was undertaken nor were the squares divided into sub-units. As such, Beaumont’s excavation allows us to explore spatial variability between excavation squares, but does not permit identification of the precise spatial distribution of individual artefacts, faunal or botanical items.

Current Research

In 2004, our team began research at the site with the goal of documenting the ESA and MSA archaeological remains from Beaumont’s excavations, currently curated by the McGregor Museum. This was to be accompanied by on-site sampling of sediments for dating in each of the excavation areas and their respective strata. A further goal was to contextualize the museum collections via detailed geological descriptions of the standing sections in each excavation area, including micro-morphology of the lithostratigraphic units identified, in order to understand site formation processes as well as reconstruct the palaeoclimate.

The Front of the Cave

Excavations 1 and 2 are located respectively ca. 20 m and 40 m in from the front of the cave. The LSA occupation (Archaeological Strata 1-4) in Excavation 1 (in areas excavated by both the Thackerays and Beaumont) covers an area of 116 sq. yards and reaches a depth of up to 2 m (Beaumont & Vogel 2006). Occupation of these levels provides evidence for the use of the site as a base camp with clear occupation horizons characterized by dense deposits of lolithics and fauna along with defined features including hearths. Radiocarbon dates place the onset of this occupation in Startum 4d to ca. 12,000 BP (Humphreys and Thackeray 1983). Rock art on the cave walls, comprising animals and geometric designs in red, yellow, orange, black and white, is spatially limited to this area of the cave and stylistically can be tentatively correlated with the later phases of the LSA occupation. We have found traces of LSA use in other parts of the cave. One particularly interesting discovery was a wooden arrow shaft lying on the surface near the middle of the cave.
Archaeological Stratum 5 in Excavation 1, ca. 20 cm. thick, underlies the LSA deposits and consists of densely packed sub-angular cobbles of dolomite. The source material for this unit remains unclear as does its extent beyond Excavation 1. Stratum 5 appears best understood as a lag deposit that resulted from a significant erosional event. The underlying Stratum 6 is characterized by typical Acheulean stone tools, although there are some clearly intrusive LSA flake tools within the Stratum 6 assemblage, so that there is a very significant unconformity representing at least 400,000 years, between the ESA and LSA deposits in Excavation 1.

The Acheulean deposits in Excavation 1 reach ca. 3 m in depth and encompass Strata 6-10 although there is a small sample of handaxes from the bottom of Stratum 5. Diachronic changes in the Acheulean lithic industries within this sequence are discussed by Chazan in this volume. We have not found either or a reduction in biface size or the presence of blade production to support the attribution of any of these strata to the Fauresmith (Underhill 2011), a transitional ESA-MSA industry, as has been claimed by Beaumont and Vogel (2006). As such the entire sequence represented in Strata 6-10 of Excavation 1 can be attributed to the Acheulean. The parent material sediments in these levels includes both windblown sands and aggregates with limited anthropogenic contribution. There is also evidence for low energy water flow as an element in site formation, along with evidence for bioturbation and complex diagenetic processes (Chazan et al. 2008).

The mode of occupation of the site during the Acheulean is in stark contrast to the dense anthropogenic deposits of the overlying LSA. Tools in the Acheulean are few and dispersed with no evidence for concentrations of items or for features such as structured hearths (for tool counts by layer see Chazan, in this volume). However, Fourier transform infrared microspectroscopy and micromorphology (mFTIR) on intact sediments, combine with the presence of potlid fractures on lithics and burnt bone to indicate the presence of fire during the formation of the Acheulean Stratum 10 (Berna et al. 2012). The multiple lines of evidence for the presence of fire over 30 metres from the current day cave entrance is best explained as the result of the introduction of fire into the cave by Acheulean hominins, However, it is unclear how we are to reconcile the burning of both faunal remains and lithic items with the low density of artefacts and the absence of visible hearth structures. This topic is a major focus for future research at the site.

In contrast to the LSA strata, the Acheulean occupation of Wonderwerk Cave is not consistent with the use of the site as a base camp. Debris from biface manufacture is very rare so that it is clear that these tools were made elsewhere before being discarded in the cave. It is possible that for the Acheulean hominins, the cave served as a protected part of the landscape, rather than as a focal point for particularly intensive activity. It is worth mentioning in this context Brain’s suggestion that early hominin use of the site might be analogous to baboon nesting in caves (Brain 1981). Although there are very significant differences in adaptations and cognitive abilities between baboons and early hominins, the evidence from Wonderwerk suggests that this proposal might be relevant.

The preservation of botanical and faunal remains in the Acheulean levels is excellent although the bone tends to be highly fragmented. Analysis of macro-botanical remains and charcoal (M. Bamford), grass phytoliths (L. Russow), and pollen (L. Scott), as well as the micro-fauna (M. Avery, Y. Fernandez-Jalva) and macro-fauna (see Brink et al., in this volume) are enabling us to create a detailed record of climate during the Acheulean occupation.

The first bifaces appear in Excavation 1 in Stratum 11. The lithic assemblage from this layer is extremely small and it is not clear that this is a distinct unit in its own right (see discussion in the article by Chazan, in this volume). The underlying basal Stratum 12 contains an assemblage of small flake and core tools that has been attributed to the Oldowan based on parallels to Sterkfontein and Swartkrans (Chazan et al. 2008; 2012). Here, as in the overlying Acheulean strata, the density of artefacts is very low and anthropogenic features are absent. Sediments are sands deposited by low energy sheet flow. The Stratum 12 lithic artefacts have sharp and fresh edges and none are abraded as would be expected if they had been swept into the cave from outside. Indeed, there is no reason to question that the artefacts are not in primary depositional context inside the cave. As such, Wondewerk Stratum 12 represents the earliest, well-documented instance of intentional cave use by early hominins. Faunal remains from Strata 12-11 are discussed in the article by Brink et al. (in this volume). To date, there are no clear anthropogenic modifications on the bones (cut marks, percussion fractures), such that it has not been possible to directly link the lithics and faunal remains. This taphonomic research is still in progress.

Preliminary age determinations for Strata 12-9 in Excavation 1 were published in Chazan et al. (2008) based on palaeomagnetic and cosmogenic burial age dating and further ages in Matmon et al. (2012). The revised palaeomagnetic sequence obtained is Normal-Reverse-Normal which, when combined with the cosmogenic burial age determinations and the characteristics of the archaeological and faunal assemblages,
place the basal Stratum 12 in the Olduvai Normal subchron (2.0-1.78 ma) and the beginning of the following Reverse period (middle Reverse period of the Matuyama chron). The first appearance of handaxes is correlated with the Post-Olduvai Reversed period in the interval between 1.78 and 1.1 ma. The Acheulean Stratum 10 falls within the Jaramillo Normal subchron (1.07-0.99 ma.), but there is some uncertainty concerning the age of the overlying Stratum 9. A single cosmogenic burial age places the base of Stratum 9 in the Jaramillo but for the upper part of this stratum we only have palaeomagnetic signals that are Normal without a cosmogenic burial age. Because there is a clear erosional contact within Stratum 9, we suspect that there is a hiatus within this level that could correspond to the Reverse period between the Jaramillo Normal subchron and the Brunhes Normal chron (0.99-0.776 ma). If this hypothesis proves to be correct, there is a gap of ca. 200,000 years between the lower Stratum 9 and the Upper Stratum 9 deposits. All deposits above the middle of Stratum 9 then date to the Brunhes Normal chron (<0.776 ma).

Excavation 2 is located to the south-west of Excavation 1 (Figure 1c) although there is no continuous profile connecting the two excavation areas. Most of the excavated area is on a small shelf between a deep pit left by the guano diggers and the western cave wall. The guano diggers pit has been straightened leaving the profiles visible to visitors to the cave today. Beaumont identified two main Strata in Excavation 2. Stratum 2, the most significant occupation, has yielded a lithic industry that is dominated by prepared core technology including large Levallois cores, which has been attributed to the MSA by Beaumont and Vogel (2006), an observation that is supported by our analysis. Dating these strata using Optically Stimulated Luminescence, is in process, but published U/Th ages place Stratum 2 between 95-220 ka (Beaumont & Vogel 2006). As such, Stratum 2 in Excavation 2 fills part of the stratigraphic hiatus in Excavation 1 between the top of the ESA (Stratum 6) and the base of the LSA (Stratum 5).

The Middle of the Cave

Beaumont’s Excavations 3-5 and 7 are situated in the central part of the cave, however none of these units produced significant archaeological assemblages. To date, our research in these areas has been limited to documenting the standing profiles. There appears to be a difference between the west and east sides of the cave at this point. On the west side there is a dense mat of organic materials with coprolites, bone, grass and wood clearly visible within it. The mat reaches a thickness of ca. 30 cm. and appears to be of Holocene age (Brook et al. 2010). Organic material is absent from the east side of the site but there are very extensive ash deposits, particularly evident in the long trench of Excavation 4 and 5. U-Th ages for Excavation 5 ranging from 73-187 ka have been published, but the context of the samples is unclear (Beaumont & Vogel 2006). The central part of the cave remains at this stage very poorly understood and will be the focus of future research. There is very little evidence for hominin activity in this part of the cave and no compelling data to indicate hominin involvement in the accumulation of organic deposits.

The Back of the Cave

Beaumont excavated a three-step section that covers much of the back of the cave in addition to a corridor leading off to the western side chamber (Figure 2b). Our preliminary analysis of the lithic assemblage from the stepped section indicates that the archaeological deposits can be attributed to the Fauresmith industry – with the presence of blades, prepared core technology, and irregular bifaces. The lithic analysis is still ongoing so it is not yet possible to divide the sequence into phases. The depositional processes in this part of the cave are extremely complex. The archaeologically sterile sediments at the base of the section are homogenous red sands. However, the overlying archeological deposits are marked by complex diagenesis and highly localized processes including ponding (indicating the presence of standing water) and dense concentrations of microfauna (either deposited there by sheet water or else indicative of raptor activity). The sediments slump towards the west in the direction of the side chamber and there is clear evidence for low energy water activity.

Chronological control for the archaeological deposits in Excavation 6 is very limited. The palaeomagnetic signal for this part of the sequence are Reversed at the base (i.e. sterile red sands), followed by a consistent Normal that covers the entire archaeological deposition, in conformity with estimates for the age of the Fauresmith as younger than 780,000 ka. (Porat et al. 2010). The cosmogenic burial ages of the sediments reflect the age of the initial shielding of the sediments upon entry into the cave mouth, and as a result are far earlier than the actual age of the associated archaeological finds. These ages are all greater than 1.5 ma. and are clearly incompatible with the age of deposition based on the nature of the archaeological remains (Matmon et al. 2012). Beaumont and Vogel (2006) have published one U/Th age on a stalagmite from this locality giving a minimum age of 187±8 ka (note that this is published as a
minimum age). The exact provenience of this stalagmite in relation to the archaeological material remains unclear but this age does conform to the available data, that the Excavation 6 occupation is older than the MSA.

Figure 2. a. The Cave Entrance Looking out. b. View of Excavation 6

Figure 2. Partial panoramic photographs showing: a. the cave entrance looking out. b. View of Excavation 6 at the back of the cave and the recess going off to the west (Courtesy H. Rüther, Zamani UCT Project).
The back of the cave, 140 m from the entrance and without direct light, is a highly unusual setting for an early hominin cave occupation. Chazan and Horwitz (2010) suggest that this area was occupied because of its unique sensory properties of light and sound, and should not be viewed as a regular activity zone. The presence of manuports introduced from outside the cave, in the form of quartz crystals and large numbers of ironstone slabs – some with flakes removed but others unmodified, adds to the unusual nature of this context. Furthermore, on the surface of some of the ironstone slabs, Beaumont and Vogel (2006), Bednarik and Beaumont (2010) and Chazan and Horwitz (2009) have noted the presence of lines, possibly representing intentional incisions made by hominins (Figure 3a). A sample of incised slabs analyzed using x-ray and neutron tomography has proved that in most instances the surface lines are actually the expression of natural fissures in the rock (Jacobson et al. 2013). There is however one case where incised lines on the slab surface do not have any associated internal cracks. Other geological mechanisms such as glacial abrasion could account for these surface lines such that further research is needed to determine whether the markings are in fact anthropogenic in origin. However, the recent discovery of a rounded cobble of specularite with two deeply incised sub-parallel lines in the material excavated by Beaumont from Square AA 146, Stratum 3, Spit 125-130 cm., underscores the remarkable nature of this archaeological context and provides the first unequivocal evidence for intentional marking of rocks in Excavation 6 at Wonderwerk Cave (Figure 3b). Based on our current understanding of the chronology of Excavation 6, this artefact predates the Blombos incised ochre (Henshilwood et al. 2001) by at least 100,000 years. Chazan and Horwitz (2010) have proposed that the unusual repertoire of objects – lithic artefacts, manuports and modified items – that occur in the back of the cave, may represent activities that serve as precursors to the emergence of modern symbolic behaviour.
The Contemporary Landscape

Wonderwerk Cave encompasses a unique record of human activity covering a time of close to two million years. The spectacular preservation of botanical and faunal remains also constitutes a unique record of the ecology of the interior of southern Africa over the entire Pleistocene and Holocene. The significance of the site is recognized by its inclusion on the South African list of sites slated for World Heritage status. The invaluable research potential of Wonderwerk Cave stands in a precarious balance with its role as a key tourist attraction for the region. The McGregor Museum has been leading efforts to reconcile the demands of research and conservation at the site with the development of safe visitor access. This is a tremendous challenge but progress has recently been made with the construction of a buttressing wall to support the visitor path in the front of the cave and protect the western section of Excavation 1 from collapse. It is also important to recognize the educational importance of Wonderwerk Cave, which is included in the local school curriculum and is visited by school pupils on a regular basis. One of the most exciting challenges is finding ways to connect the archaeological research at Wonderwerk Cave and the public experience of this spectacular site.

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References


