RESEARCH PROPOSAL FOR EXCAVATIONS AT BORDER CAVE

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in collaboration with

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Scientific background and heritage significance

Site location

Border Cave is situated in KwaZulu-Natal (27°1'19"S, 31°59'24"E) 82 km from the Indian Ocean (Figure 1). Located in the Lebombo mountain range below the rim of an escarpment at an elevation of *c*. 600 m above sea level, the cave faces West, overlooking eSwatini (formerly Swaziland). The shelter is semi-circular in shape and approximately 50 m wide by 35 m long. The cave formed in the Lower Jurassic felsic extrusive rocks of the Jozini Formation, Lebombo Group, approximately 182.1±2.9 mya (Riley et al., 2004). Two volcaniclastic facies of the Jozini Formation are exposed in the cave: a clast- and a matrix-supported flow breccia. The cave formed through the weathering of these rocks (Cooke et al., 1945; Backwell et al., 2018).

Previous excavations

The first excavation campaign took place in 1934 when Dart dug a narrow East-West trench to bedrock at the entrance to the shelter (Figure 1, EXC. 1). The 168 cm-thick sequence and the material it yielded were never published. From what was published later (Cooke et al., 1945), it seems that some Iron Age (IA) artefacts were recovered at the top of the sequence, while MSA ones were retrieved in the layers below it. In 1940 W.E. Horton dug an enormous pit in the centre of the cave deposit, ostensibly to extract bat guano. He removed most of the upper layers down to what is now called Member 4 WA. He uncovered archaeological and human remains, namely BC1, an adult partial cranial vault and the shafts of two femora and

tibiae, likely belonging to the same individual, and BC2 a partial adult mandible (Cooke et al., 1945; Beaumont, 1978). These discoveries prompted a second excavation episode, conducted by Cooke, Malan and Wells (1945), which linked Dart's trench and Horton's pit (Figure 1, EXC. 2). They discovered an infant burial (BC3) with a *Conus* shell originally covered in ochre (d'Errico and Backwell, 2016), and recovered additional human remains from Horton's dump, which they attributed to the MSA. The third excavation episode, carried out by Beaumont between 1970 and 1975, took place in three different areas (EXC. 3A Front, EXC. 3A Rear and EXC. 3B, Figure 1), and revealed a 4 m-deep sedimentary sequence comprising alternating units of brown sand (BS) and white ash (WA) (Beaumont, 1973; Butzer et al., 1978). The sequence includes, from the bottom to the top, MSA lithic assemblages originally attributed to the Pietersburg Industry, but later assigned to MSA I, MSA II/Howiesons Poort (HP) and MSA III/post-HP, and an unusually early Later Stone Age assemblage termed ELSA. The ELSA layers are overlain by a thick, virtually sterile deposit, itself capped by Iron Age deposits. BC4, an Iron Age skeleton missing the skull, was found in layer 1 BS.UP outside the grid area, and near the surface in the southern part of the cave and has been directly dated to 340±45 BP and 480±45 BP (Beaumont et al., 1978; Beaumont, 1980; Vogel et al., 1986). BC5 is a nearly complete adult mandible, found by Powell and Beaumont in 1974 while collecting sediment samples. It comes from the South section of excavation 3A, just above the base of undisturbed 3 WA. It was found close to a sub-circular shallow depression apparently dug into lower level 4 BS. BC5 has yielded an electron spin resonance (ESR) age of 74±4 ka (Grün et al., 2003). BC6 (humerus), BC7 (proximal ulna), BC8a and BC8b (two metatarsals) were recovered from disturbed deposits (Grün and Beaumont, 2001). All of the human remains recovered from Border Cave are considered to be anatomically modern (Rightmire, 1989; Grün and Beaumont, 2001; Grün et al., 2003). The fourth excavation episode (EXC. 4A and EXC. 4B, Figure 1), conducted in 1987 by Beaumont, Todd and Miller significantly expanded excavation 3A (Beaumont et al., 1992). Excavation 4A focused on expanding the upper layers of Beaumont's sequence, while excavation 4B focused on connecting excavation 3A to excavation 2. During these excavations the deposits were extensively dated (Grün and Beaumont, 2001; Grün et al., 2003; Millard, 2006; Bird et al., 2003). Middle Stone Age and ELSA lithic assemblages from these excavations have been documented by Villa et al. (2012), and d'Errico et al. (2012) have described contemporaneous organic artefacts.

Chrono-cultural sequence

The Border Cave sequence has been dated by ESR (Grün and Beaumont, 2001; Grün et al., 2003; Millard, 2006), amino acid racemisation (Miller and Beaumont, 1989; Miller et al., 1999), and radiocarbon methods (Vogel and Beaumont 1972; Beaumont et al. 1978; Beaumont, 1980; Vogel et al., 1986; Beaumont et al., 1992; Bird et al., 2003; d'Errico et al., 2012a; Villa et al. 2012; Backwell et al., 2018), see Table 1.

Deposits from 6 BS.UP to 2 BS.UP are attributed to MSA occupation of the site.

ESR results indicate that the MSA I members (5 WA, 5 BS, 4 WA, 4 BS), including minimum and maximum standard deviations, span 238 ka to 71 ka, the MSA II/HP layers (1 RGBS, 3 WA, 3 BS) range between 82 ka and 54 ka, and the MSA III (post-HP) layers (2 WA, 2 BS.LR C, B and A, 2 BS.UP) fall between 63 ka and 42 ka (Table 1). Although the radiocarbon ages for the lower post-HP layers 2 WA, 2 BS.LR C and 2 BS.LR B (60–49 ka C14 BP) fall outside the range of the IntCal09 calibration curve, they appear in broad agreement with the range proposed by ESR for these layers. Layer 2 WA is dated to 60 ka BP. Bayesian modelling of calibrated radiocarbon ages indicate that layer 2 BS.LR A is older than 49 ka BP, and layer 2 BS.UP accumulated between 49 ka and 45 ka BP (d'Errico et al., 2012a).

Deposits from 1 WA and 1 BS.LR are attributed to the ELSA (Beaumont, 1978; Villa et al., 2012). Recent studies, conducted before the new excavation campaign, have implied the onset of the ELSA at the site around 44 ka (d'Errico et al., 2012a; Villa et al., 2012; Backwell et al., 2018). Member 1 BS.LR C is dated 42.6 ka, 1 BS.LR B is dated 42.3 ka, and 1 BS.LR A dates to between 41.5 ka and 24 ka (Table 1). Bayesian modelling of calibrated radiocarbon ages suggest that 1 WA accumulated between 44 ka and 43 ka BP, 1 BS.LR C and B between 43 ka and 42 ka BP, and 1 BS.LR A between 41 ka and 22 ka BP (d'Errico et al., 2012a).

2015-2019 excavations

When we started excavations in 2015 our principal aims were to reassess the stratigraphic context of the sedimentary and cultural sequence, gain insights into site formation processes, conduct paleoenvironmental and palaeobotanical analyses, identify cultural trends within a secure chronological framework, document the emergence of cultural innovations, and characterize the nature and variability of burial practices in the Middle Stone Age, given that a complete infant skeleton (BC3) was recovered from a shallow pit that also contained a *Conus* shell, while the mandible of an adult (BC5) was the only element found in a shallow

pit from the same layer, dated to 74 ka. To reassess the stratigraphic context of the sedimentary and cultural sequence we decided to excavate part of the northern face of Beaumont's excavation 3A because it provided a good lateral profile of the upper members and was stepped down from the back to the front of the cave, and this enabled us to sample the sequence without having to excavate each square from surface level. We also decided to excavate part of the eastern edge of excavation 4B, which preserved the lower members to bedrock (Figure 1). Once the profiles had been restored, we were able to identify the alternating brown sand and white ash units that Beaumont (1973) and Butzer et al. (1978) attributed to members. Since then, we have sampled all of the members.

The acquisition of new dates for the sedimentary sequence at Border Cave (Tribolo et al., under review) has established a sound chronology for the site. The new ages derive from feldspar grains in MSA sediments, and the results are in accordance with those obtained by Grün twenty years ago on bovid teeth using the electron spin resonance method (Grün et al., 1990; Grün and Beaumont, 2001; Grün et al., 2003).

A reappraisal of the sedimentary sequence at Border Cave by Stratford and colleagues (2022) using an allostratigraphic approach – the subdivision of the stratigraphy based on bounding discontinuities within a time-stratigraphic framework – significantly contributes to our understanding of the site formation processes. Previous research conducted by Beaumont (1973, 1978) and Butzer and colleagues (1978) identified an alternating brown sand (BS) and white ash (WA) member system for the deposits. The allostratigraphy and facies approach broadly follows the BS-WA members but identifies finer intra-member layering and thus provides greater resolution than division into generic members. The sub-units within the members indicate that members should not be considered as homogeneous. Faunal data from the upper, middle, and lower parts of Member 2 BS corroborate this finding, with marked variation in faunal preservation between the three units. The geoarchaeological study demonstrates that the sediments have been subjected to greater post-depositional disturbance than was previously recognised. Apart from identifying burrows, pits, mudflow and water channels, there is evidence of turbation, and while post-depositional alteration of sediments often had an environmental origin, anthropogenic activities also played a part. The edges of combustion features are sometimes reworked, and this may be due to raking of hearths for site maintenance and the spreading of ash to create clean surfaces for plant bedding.

The remains of a child have been identified during our new excavations, from 1 BS.LR C dated 42.6 ka. Based on preliminary diagnoses and comparative morphological evaluations, the new skeletal element is a vertebral centrum representing a 3–4-year-old child. The

vertebral centrum (BC264) was discovered during the 2015 excavation in square N109 E119.

The Border Cave deposits are unparalleled in terms of MSA plant preservation. Desiccated grass bedding is found throughout the sequence, except in Member 4 WA (Wadley et al., 2020a; Sievers et al., 2020). Grass bedding throughout the sequence overlies a layer of ash, suggesting that ash was intentionally used to deter crawling insects (Wadley et al., 2020a). Comprehending that ash deters crawling insects and using it as a tool that provides delayed gratification following planning and strategizing, decision-making, and organisation that entails a sequence of events (Coolidge 2019, Wadley 2021), implies complex cognition in Border Cave inhabitants 200 thousand years ago. The discovery of 55 cooked *Hypoxis angustifolia* rhizomes in layers aged 170 ka at Border Cave (Wadley et al., 2020b) provides the earliest known evidence for the consumption of underground storage organs. Wood and charcoal occur throughout the Border Cave sequence, except in the oldest Members 5 WA and 6 BS. Fragmented bone is preserved throughout the sequence, representing small and very large animals. Ochre occurs throughout the sequence, but in very low numbers. The scarcity of ochre at the site is difficult to explain in terms of a lack of availability because iron-rich rocks are present within and close to the Border Cave shelter. This suggests that the dearth of ochre is best explained in terms of cultural behaviour. Preliminary analysis of the ochre recovered by us shows that it was apparently not used as a soft hammer for knapping, and neither was it incorporated in compound adhesives used for hafting. Possible ochre grains in ancient bedding dated to 200 ka years ago (Wadley et al., 2020a) suggest that it may have rubbed off from animal hides or human skin, in which case it was used in the tanning of hides (Audouin and Plisson, 1982) and possibly as a sunscreen (Rifkin, 2011), though a symbolic function for body paint cannot be ruled out.

In Backwell et al. (2018) we report that the lithic sample retrieved was small and thus it was not possible to determine to what extent the industries named in previous publications corresponded with the newly excavated material. We did find, however, that the highest number of blades and blade fragments were found in Members 4 WA (MSA I), 5 BS (MSA I) and 2 BS.LR (post-HP), and not in 3 BS, 3 WA or 1 RGBS which are the purported HP members, where one would expect to encounter a bladelet and blade-rich technology. In Square N108 E115 in Member 3 BS, which is purportedly HP, there were several *Levallois* cores, but because of the small sample size it was not possible to determine whether *Levallois* technology is chronologically restricted. Preliminary study showed that there are technological differences within the same member, for example the Lower and Upper layers in Member 2 BS (post-HP) have different lithic profiles. The differences might correspond to

functional variability within the same cultural tradition, but it could also mean that the original grouping of layers into larger members was incorrect. This finding highlighted the need to study the lithic material according to layers identified during excavations rather than by member.

Scope of work envisaged for proposed excavations

One of our short-term aims is to excavate deposits on the South profile of excavation 4A (Figure 1) in Members 3 BS, 3 WA and 1 RGBS to better understand the lithic technology and people represented at the site for the period currently attributed to the Howiesons Poort. The deposits that span the period 82,000–54,000 years ago that we have excavated (Members 3 BS, 3 WA, 1 RGBS in excavation squares E117 N108 and N109 on the North profile), have yielded only two possible Howiesons Poort lithics, and this deserves further investigation.

We plan to expand excavations in the Early Later Stone Age deposits in excavation 4A on the South profile (Figure 1) in order to verify the results and hypothesis stemming from two papers that we published showing that elements of a material culture similar to that found at Later Stone Age sites emerged in the region 44,000 years ago (d'Errico et al., 2012a; Villa et al., 2012). They take the form of ostrich eggshell beads, bone arrowheads, a poison applicator, a lump of beeswax, a digging stick, microliths that were hafted with *Podocarpus* tree resin and a bored stone, probably used as a weight on a digging stick, to mention a few. Our strategy is to expand excavations by a metre, with the aim of finding a wider range of cultural innovations for this time period.

Another reason for expanding excavations in this area is that the transition from the Middle Stone Age to Later Stone Age occurs 15,000 years earlier at Border Cave than at any other South African site. We want to excavate more deposits recording this time to know if the innovative items recorded at 44 ka disappeared and re-emerged later in time, or if there was continuity in the culture.

We plan to excavate two large ancient pits, one flat and the other round, which are exposed on the North face of excavation 3A rear, in squares N108 E114-115 in Member 5 BS (Figure 1). Member 5 BS is dated by ESR to between 161,000 and 144,000 years ago. We are going to evaluate different hypotheses based on their size and shape; including that the bowl-shaped one may preserve traces of use as a roasting pit, and that the rectangular one contains human remains.

We plan to expand excavations along the North section of excavation 3A rear in N109 E118 (Figure 1) as only one quarter of the square has been excavated. Excavations in this square will serve to remove a column of unexcavated deposit, which will provide a continuous lateral profile of the sequence from the youngest to the oldest members.

In accordance with our interest in archaeological evidence of complex cognition before and after 100 thousand years ago, we will continue with existing excavations on the North wall of excavation 3A rear in square N108 E117, which spans Members 4 WA (~120 ka) to 3 BS (~60 ka) with the aim of identifying evidence of innovation and modern behaviour.

We also want to continue excavating the stratigraphic sequence on the North wall of excavation 3A rear to retrieve more lithic artefacts because our sample size is small. Analysis of our current lithic sample suggests the need for a revision of the cultural attributions made by Beaumont, and this requires a larger sample size. An increased sample size will also enable us to look for regional features and affinities with other Middle Stone Age sites in sub-Saharan Africa.

With an increased sample of all types of artefacts, future work will investigate the artefact density throughout the sequence, based on plotted artefacts and non-plotted bucket finds.
An increased sample size will also enable us to produce a high-resolution multi-proxy record of environmental change (based on charcoal, wood, pollen, phytoliths and fauna) and contemporaneous human behaviour that extends from MIS 7 (243 ka) to MIS 2 (29 ka). This will contribute to our understanding of the impact of climate change on subsistence strategies in this region and provide a framework for our understanding of the emergence of behavioural modernity.

Research and technical team members

- Lucinda Backwell, University of the Witwatersrand, Principal Investigator, project coordinator, archaeologist, excavator, specialises in bone tool technology and organic material culture.
- Lyn Wadley, University of the Witwatersrand, Co-Investigator, archaeologist, excavator, specialises in organic remains, lithic technology, and behavioural modernity.

- Francesco d'Errico, University of Bordeaux, Co-Investigator, archaeologist, excavator, specialises in bone tool technology, lithic technology, ochre, and behavioural modernity.
- Paloma de la Peña, University of the Witwatersrand, excavator, specialises in lithic technology.
- Dominic Stratford, University of the Witwatersrand, excavator, specialises in geoarchaeology and Geographic Information System mapping.
- Emese Bordy, University of Cape Town, specialises in geology.
- Marion Bamford, University of the Witwatersrand, specialises in palaeobotany.
- Chantal Tribolo, University of Bordeaux Montaigne, specialises in thermoluminescence dating.
- Norbert Mercier, University of Bordeaux Montaigne, specialises in thermoluminescence dating.
- William Banks, University of Bordeaux, excavator, specialises in Bayesian modelling of dates.
- Kristian Carlson, Keck School of Medicine, University of Southern California, specialises in palaeoanthropology.
- Tea Jashashvili, Keck School of Medicine, University of Southern California, specialises in palaeoanthropology.
- Amélie Beaudet, University of Cambridge, specialises in palaeoanthropology.
- Christine Sievers, University of the Witwatersrand, specialises in seed identification.
- Irene Esteban, University of Barcelona and University of the Witwatersrand, specialises in phytolith analysis.
- Marine Wojcieszak, Royal Institute for Cultural Heritage, Belgium, specialises in chemistry and the analysis of residues and sediments.
- Jamie Clark, George Mason University, University of the Witwatersrand and Universität Tübingen, specialises in faunal analysis and taphonomy.
- Frank Neumann, University of the Witwatersrand, specialises in palynology.
- Guilhem Mauran, University of the Witwatersrand, excavator specialises in chemistry and the analysis of residues.
- Sandra Lennox, University of the Witwatersrand, specialises in anthracology.
- Daniela Rosso, University of Nice, specialises in ochre analysis.
- Olga Vilane, Amafa Heritage AkwaZulu Natali, specialises in the identification of stone tools, bone, wood, charcoal, and seeds.

- Ashley Kruger, Stockholm University, specialises in ancient DNA analysis, residues.
- Riaan Rifkin, University of Pretoria, specialises in ancient DNA analysis, pathogens.

Excavation schedule

18 October – 8 November 2022

Authorised representatives

Lyn Wadley, Francesco d'Errico, Dominic Stratford

Potential threats to the site

None