

Field and Technical Report

AN EXPERIMENTAL INVESTIGATION INTO THE ORIGIN OF
INCISED LINES ON A 4000-YEAR-OLD ENGRAVING FROM
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INTRODUCTION

In 1979, excavations at Wonderwerk Cave, situated in the Northern Cape Province of South Africa, yielded several small slabs of dolomitic rock with fine-line engravings of animals and geometrics (Thackeray *et al.* 1981). One of these examples of *art mobilier*, radiocarbon-dated to *circa* 4000 BP, bears the engraved image of a zoomorph that has been likened to a zebra (Thackeray *et al.* 1981). For the sake of continuity we refer to the zoomorph as a zebra, although it could possibly depict another striped species such as a bushbuck or kudu. The 20 mm thick dolomitic slab is broken, perhaps deliberately, and retains only the hind quarters and rump of the zebra. The surface of the stone that the image occupies appears to have been smoothed in preparation for the engraving. Present on the rump are several fine incised lines, virtually impossible to see with the naked eye, that have been interpreted as symbolic wounds in the context of the principle of 'sympathetic hunting magic' (belief in securing success in a prospective hunt or control over an animal through ritually 'wounding' an image) (Fig. 1; Thackeray 2005a). These lines, although clustered together, appear random, and it is not immediately obvious if and how they relate to the zebra engraving. The purpose of this paper is partly to assess the amount of pressure required to produce such incisions, and also to assess, through experimental replication and microscopic analysis, whether these fine lines were intentionally engraved to form part of the larger image.

Microscopic examination was undertaken by Alexander Marshack (Beaumont & Vogel 1989), as well as by Thackeray (2005a) who interpreted the fine-line incisions on the rump of the zebra as deliberate representations of symbolic wounds. However, a question has arisen as to whether these incisions on the zebra were in fact deliberate, or whether they were the result of incidental abrasions. This study focuses on an experiment designed to replicate incisions in dolomitic rock of the kind found at Wonderwerk Cave. The experimental incisions are related back to the engraved zebra image in an effort to better understand the pressure required to create the various types of incised lines present in the zebra image. Using the experimental data we argue that the fine-line incisions present on the zebra's rump were intentionally created to form part of the entire image. By drawing on southern African historical records and ethnographic accounts, we also consider the possibility that these incisions may be understood within the framework of 'sympathetic hunting magic'.

BACKGROUND

A recent study to investigate the anthropic origin of purportedly incised lines on parietal stone slabs from Wonderwerk Cave, from deposits predating 10 000 BP, used neutron tomography to scan inside the rocks (Jacobson *et al.* 2012). This method is able to image the internal structure of the rock to detect whether the so-called 'incisions' are manifestations of internal fissures or whether they are surface modifications. One piece from the study undertaken by Jacobson *et al.* (2012) showed evidence of possible anthropic origin, although these lines are clearly random and do not form part of a recognisable formal image. The density and distribution of these

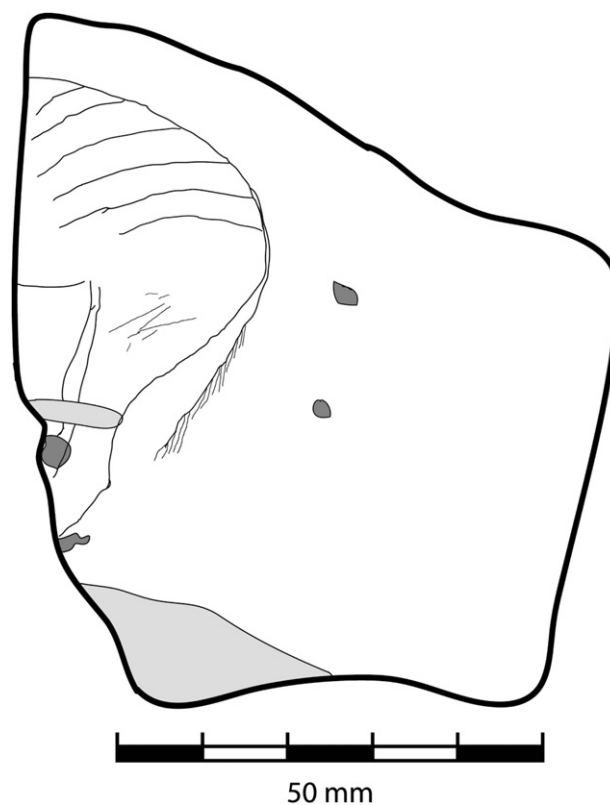


FIG. 1. A line drawing of the zebra engraving on the dolomite slab from Wonderwerk Cave c. 4000 BP showing the fine-line incisions on the rump. Dark grey areas represent patches of ochre. Light grey areas represent areas where the stone surface has been damaged.

lines are more suggestive of scoring for purposes of obtaining pigment (e.g. Hodgskiss 2010), rather than symbolic art.

Numerous studies have been recently undertaken that have sought to understand how naturally produced striations differ from those produced through anthropogenesis. Humans use various types of rocks to produce powder (Hodgskiss 2010, 2013), create images (Henshilwood *et al.* 2009) and polish tools. These activities all produce wear in the form of striations on the surface of the rock. Groove appearance can be used to determine the particular activity that created them, and whether a sharp point or thin cutting edge was used to create them. For instance, an incision made with a thin cutting edge of a stone flake will produce similar groove morphology throughout the incision, whereas the sharp point of a burin will result in greater morphological variability in cross-section owing to changes in orientation of the tool tip during incising (d'Errico & Nowell 2000). Five activities have been identified that produce striations, namely grinding, scraping, scratching, scoring and incising. Each of these activities leaves characteristic grooves or striations.

- 1) Grinding – this can occur intentionally or accidentally through incidental abrasive contact. Grinding is characterised by multiple parallel striations that may have a variety of profile shapes (Hodgskiss 2013). The inner facets of the groove are flat or slightly convex and contain many tapered micro-striations (Henshilwood *et al.* 2009). The striations caused through incidental abrasive contact display granulated inner surfaces and usually have no micro-striations (d'Errico & Nowell 2000).
- 2) Scraping – this is usually produced by moving a stone tool multiple times in a back-and-forth motion transverse to the tool's cutting edge (Alvarez *et al.* 2001). Inner groove morphology consists of parallel micro-striations of different width and depth (Henshilwood *et al.* 2009).
- 3) Scratching – is an incidental mark that is shallow and erratically placed and orientated (Hodgskiss 2013). Micro-striations are not normally present.
- 4) Scoring – this is produced by pushing a tool multiple times across the surface of a rock, usually for the purpose of producing powder. Scoring is characterised by frayed or tapered striations (Hodgskiss 2013).
- 5) Incising – an incision is a narrow linear groove created by a single event through the continuous application of force and constant contact of the tool with the worked material (Alvarez *et al.* 2001; Hodgskiss 2010). Incisions created with a stone tool are differentiated from naturally produced grooves by having straight walls and homogenous internal morphology (d'Errico & Nowell 2000). An incision made with a lithic edge will contain parallel micro-striations of different width and depth resulting from projections of the tool surface (d'Errico & Nowell 2000; Alvarez *et al.* 2001; Brumm *et al.* 2006; Henshilwood *et al.* 2009).

Henshilwood and colleagues (2009) have outlined certain criteria that can be used to gauge the intentionality of incised lines. While any of these criteria alone does not guarantee intentionality, occurring together they provide a stronger argument for intentionality of design. According to the authors, thin incised sinuous lines (insufficient for producing powder), arranged in an apparent pattern or in juxtaposition to similar incisions showing regular cross-sections and a constant pressure, are unlikely to be occasioned through natural or incidental processes (Henshilwood *et al.* 2009: 30).

Wonderwerk Cave has produced numerous seemingly engraved pieces of rock (Thackeray *et al.* 1981) some of which have been interpreted within the context of 'sympathetic

hunting magic' (Thackeray 1983, 2005a, 2013). Although far from universally accepted, it is apropos at this point to give a short discussion of the support for this concept within the current southern African rock art paradigm.

HOW DOES THE CONCEPT OF 'SYMPATHETIC HUNTING MAGIC' TALLY WITH CURRENT ROCK ART RESEARCH?

One of the fundamental tenets of current rock art research in southern Africa is that prehistoric paintings and engravings are imbued with meaning and cultural idiom (e.g. Lewis-Williams 1981, 1982, 1998, 2002; Lewis-Williams & Pearce 2004; Lewis-Williams & Challis 2011). While not all San images are associated with trance and a supernatural realm (Vinnicombe 1976; Smith & Ouzman 2004; Lewis-Williams 2006: 105), it is thought that many of the older images were perceived in terms of supernatural potency with which people could actively engage for ritual purposes (Lewis-Williams 1998, 2002). Lewis-Williams and Challis (2011: 146) argue that the art itself was believed to possess certain properties and, in certain instances, may have afforded the image-maker control over what was depicted (also see Lewis-Williams & Pearce 2004).

The interaction with art, with the aim of influencing events in the physical world, can be seen in rain-making rituals. The rhinoceros appears to be one of the animals on which the mythical rain animal is based (Ouzman 1995). In the Magaliesberg, an engraving of a rhinoceros with 'cuts' across its body is suggestive of the rain-making ritual. In this instance, the interpretation is that the engravings were actively used in the rain-making ritual whereby the supernatural cutting of the rain animal was acted out on the rhinoceros engraving (Pearce 2007). It is clear from the above that some Bushman art functioned as a link to the spirit world and as a means whereby shamans or medicine men could, to a certain extent, influence the tangible world.

The magical control of supernatural animals or beings extends also to the physical world. In recorded /Xam cosmology, the ability to control and influence the movements of game animals was attributed to certain medicine men who would use this supernatural ability to assist in the hunt (Bleek & Lloyd 1911: 285; Lewis-Williams & Challis 2011). Both Marshall-Thomas (2006: 100–101, 250) and Vinnicombe (2009: 180) describe certain ritual practices that were performed in an attempt to control the movement of prey and hasten its death. This magical control over game was also practised during the curing dance of the !Kung (England 1968). During such rituals, women made cuts in the hunters' shoulders with arrowheads and burnt the blood mixed with buchu in a horn to "make the springbok lie down to die" (Bleek 1932: 248; also see Bleek 1936; Mitchell & Plug 1998). Although scarification was not practised by all Bushman societies, the context in which it is mentioned by //Kabbo suggests it may have had a magical purpose (Bleek 1936: 144–161).

Indeed, such scarification was believed by the /Xam and !Kung to be necessary for success in the hunt (Bleek 1936; Lewis-Williams 1981; Thackeray 2005b). Tattooing or scarification was performed on both men and women, although the reasons for tattooing do differ as do the location and design of the tattoos (Bleek 1928; Fourie 1928; Lee 1979; Silberbauer 1981; Marshall-Thomas 2006). However, as Bleek (1928) notes, among the Nharo there is no clear distinction between 'looking nice' in the sense of decoration and 'seeing well' in the sense of improved hunting prowess. These scars, and with them the perception of hunting prowess, are highly regarded among the Ju/'hoansi as a rite of passage (Lee 1979; also see Lewis-Williams

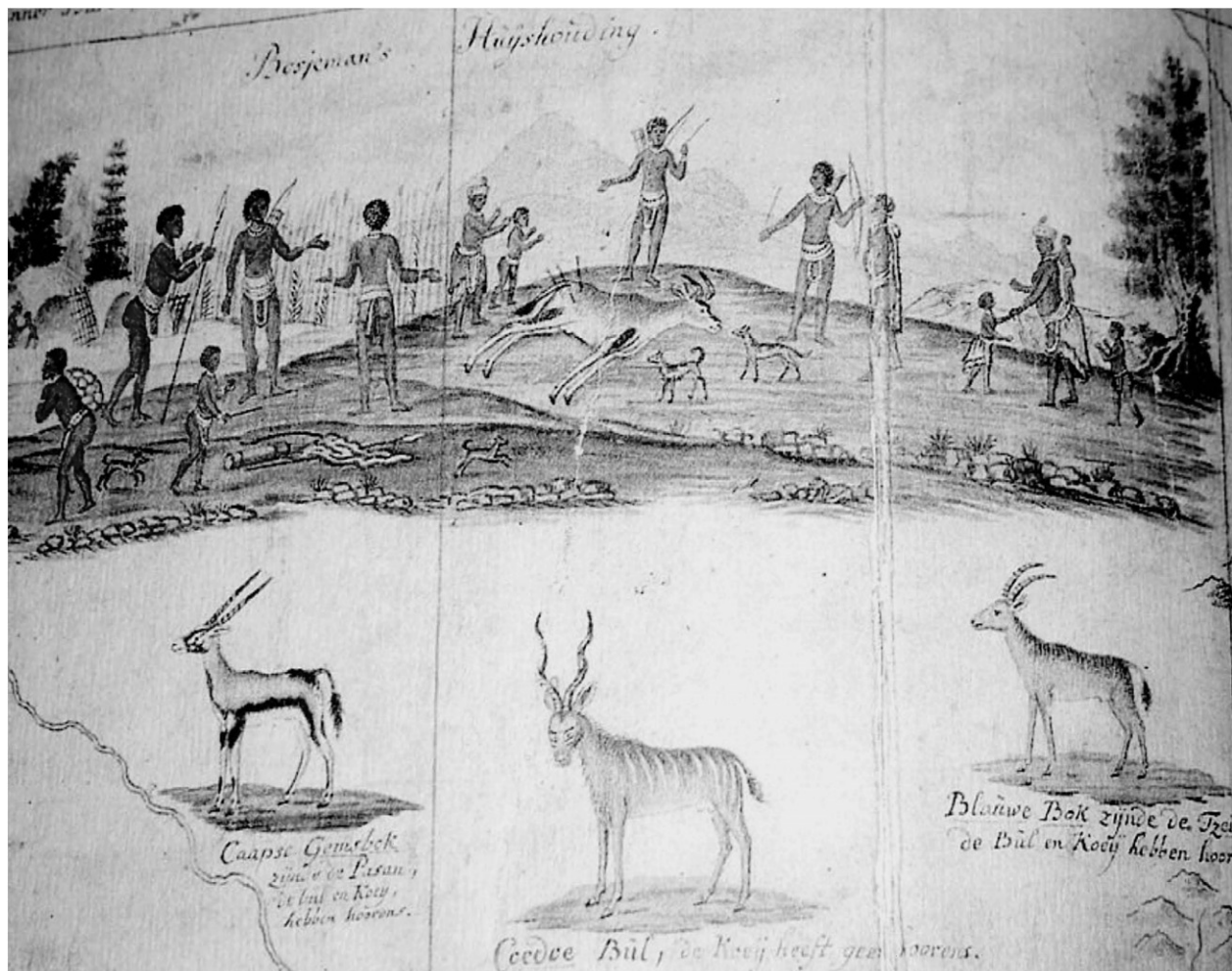


FIG. 2. Painting by R.J. Gordon in the 18th century in the Northern Cape, showing three arrows concentrated in the area of the rump of a hartebeest, successfully hunted by San. Courtesy of the Rijksmuseum in Amsterdam.

1981). Indeed, some tattoos, usually located on the arms and chest, may have been specifically applied to improve a hunter's prowess (Mitchell & Plug 1998).

The informant Dia!kwain reported that /Xam shamans would sometimes dress up in the guise of a gemsbok during one of their ritual dances (Stow & Bleek 1930, cited in Lewis-Williams & Challis 2011: 67), possibly in an attempt to harness the antelope potency and guide the herd. At one such event, Lichtenstein (1812) records seeing a person taking on the form of an herbivorous animal and being symbolically wounded (Thackeray 2005a). Indeed, there was an empathetic bond between hunter and prey whereby, to ensure success in the hunt, the hunter must behave as he wished his prey to behave; the hunter must, metaphorically, become the antelope (Vinnicombe 1976; Lewis-Williams 1981, 2002). According to San informants, there was a belief that they metaphorically died while in trance, which they likened to the death of an animal (Lewis-Williams 1981: 91, 1983: 45).

The idea of mimetic empathy between a hunter and his prey is a concept shared by a large number of hunter-gatherer populations all over the world. In writing about the Yukaghir from northeastern Siberia, Willerslev (2004: 647; also see Willerslev 2007) has suggested that "what we are dealing with is not just some outward mimicry, simulation, or aping, but something deeper and more intense, which is the ability to put oneself imaginatively in the place of another". Examples of this behaviour among San have been observed by Moffat (1842) and Stow (1905: 82).

Clearly the conceptual framework for trance, rain making and bodily mutilation with the intention of influencing hunting prowess, within which the concept of 'sympathetic hunting magic' can be understood, was firmly established in the cosmology of the San by at least the late 18th century. How far back in time this framework extends is less certain. Lewis-Williams (1984) has argued that certain engravings from Pleistocene levels at Wonderwerk Cave indicate long-term continuity in San ideology. Thackeray (2005a) has suggested that the 4000-year-old zebra engraving relates to the practice of 'sympathetic hunting magic' in the form of incisions on the rump of the depicted animal. The placement of these incisions corresponds to San rituals of the kind reported by Lebzelter (1934) in Namibia, where hunters deliberately shot an arrow at an image of an animal in the belief that in a future hunt a real animal would be wounded on the corresponding part of the body. A tentative comparison can be made to an 18th-century painting by R.J. Gordon (Raper & Boucher 1988) of a successful San hunt in the Northern Cape, in which a hartebeest has been wounded by three arrows, all of which are concentrated in the region of the rump of the animal (Fig. 2), corresponding closely to the area where fine-line incisions are concentrated in the engraved zebra discovered at Wonderwerk Cave.

METHODS

To assess whether the fine-line incisions on the Wonderwerk zebra engraving were intended to form part of the original image or whether they accrued accidentally, we undertook a

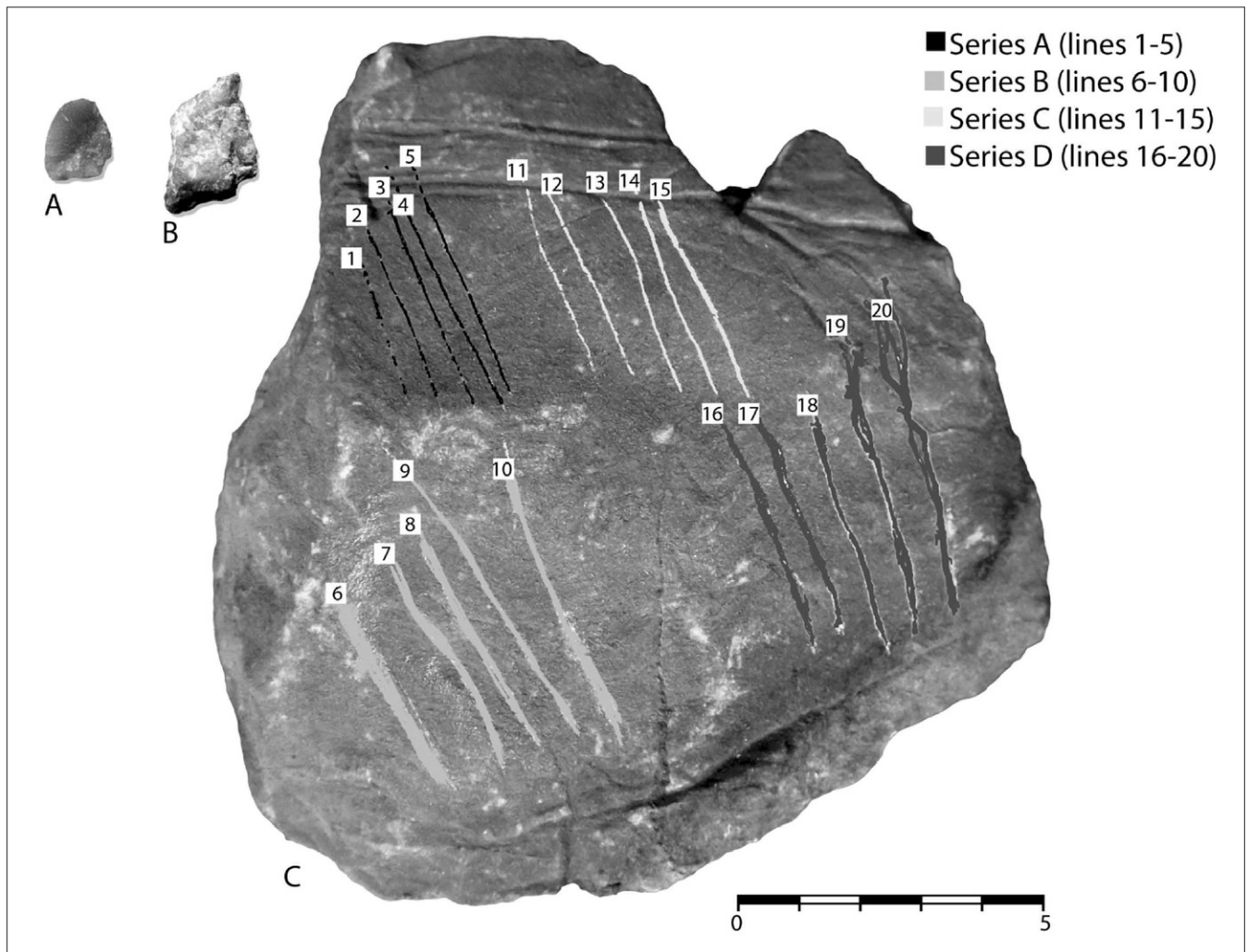


FIG. 3. Two experimental chert flakes (A and B) and a dolomite slab (C) with four series of experimental engraved lines. (A) A thin-edged chert flake; (B) a pointed chert piece; (C) the dolomite slab.

microscopic examination of the various incised lines and attempted to gauge the pressure required to incise each type of line on the Wonderwerk zebra. We classified the lines on the engraved image into five categories associated with the following: (1) the body and legs; (2) the stripes of the zebra; (3) the tail; (4) the tail hairs; and (5) the fine-line incisions on the rump. To determine the pressure required to incise each line an experiment was conducted on a similar slab of dolomite using chert flakes, both derived from a non-archaeological context. Our intention was to see whether a similar amount of pressure was needed to produce the fine-line incisions as was exerted to produce the rest of the engraved image, the underlying assumption being that similarly incised lines are more likely to be related than not. We selected two types of chert flakes: those with thin cutting edges and those that retained a sharp point, similar to a burin. These flakes were used experimentally to incise various lines into the dolomite (Fig. 3).

A single individual carried out the experimental engravings while another person recorded the experiment on film. Four series of five lines each were incised into the dolomite. Each of the five lines in the experiment was incised qualitatively in the sense that we did not set out specific pressure parameters prior to the experiment. Rather, the incisions ranged from a light drag over the surface of the dolomite (Line 1) to a very purposeful incision where the engraver had to push down forcefully onto the dolomite surface (Line 5). From Line 3 onwards, the engraver considered that enough

pressure was being applied to rule out possible accidental scratch marks caused by, for instance, abrasion. Series A was made with single strokes using a chert flake that had a thin cutting edge of 0.24 mm. Series B was made using the same piece but each line consisted of ten strokes. Series C and D were made using the point of the burin-like piece, where the width of the point measured 0.51 mm, with single strokes and ten strokes respectively. Each line in the four series was numbered consecutively, with Lines 1 to 5 representing Series A. For the purposes of this paper, we focus primarily on the first series of incised lines of single strokes (Series A), which, as we discuss below, are technologically similar to the single strokes of the engraved zebra from Wonderwerk, that is, they were made with a single stroke using a sharp edge rather than a pointed burin.

A digital scale, accurate to two decimals, was used to measure the weight in grams that was applied to the dolomite during each experimental stroke. The experiment was recorded using a Canon Powershot A550 digital camera that had a slow-motion play-back function. The fluctuating numbers, shown in grams on the scale as the incisions were made, were converted to kilopascals using the formula: $1\text{Pa} = \frac{\text{kg}}{\text{m.s}^2}$ (where m is metres and s is duration in seconds). The engraved lines on the dolomite slab were analysed and recorded at $\times 50$ magnification using an Olympus BX51M light microscope. Additional oblique lighting was used to enhance the contrast

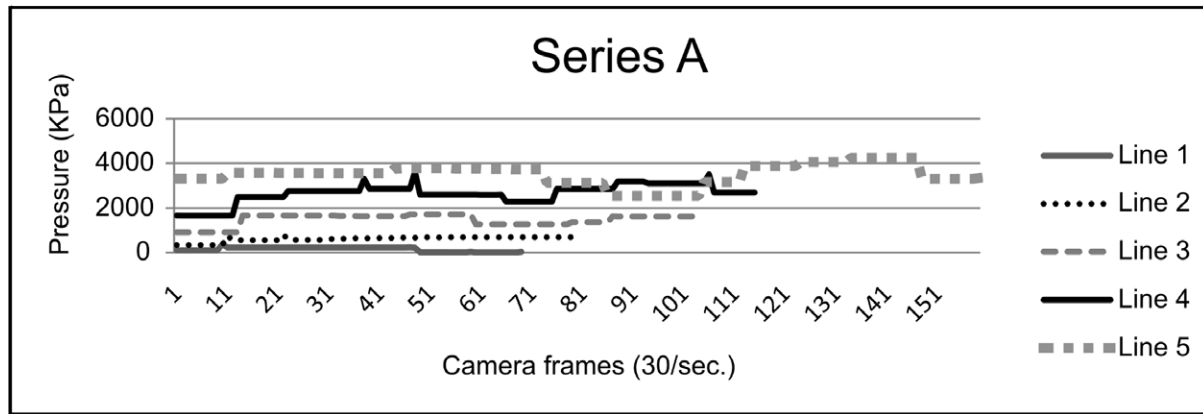


FIG. 4. Graph showing the pressure of each of the five incised lines in Series A.

and increase the visibility of the incisions as well as to allow an appreciation of the depth of these lines. The dimensions of each line were calculated using the digital measuring function of the microscope. Microscopic comparison was made between the experimental slab and the Wonderwerk piece.

RESULTS

The results of the pressure test for Series A are presented in Figure 4 and Table 1. The figure shows the fluctuating pressure in kilopascals exerted for each incision as well as the duration of each incision measured by camera frames per second. Although there is some overlap in pressure between Lines 4 and 5, each incision was significantly more forceful than the preceding one.

As can be seen in Table 2 (also Fig. 5), the mean width of the lines increases proportionally with the pressure applied. Line width data from the engraved dolomite slab from Wonderwerk were obtained using the same method (Fig. 6; Table 2). The engraved body and stripes of the zebra correspond well with Line 4 in the experiment (associated with a mean pressure of 2380.7 kPa). The zebra's engraved tail correlates with Line 3 (associated with a lower pressure of 1469.7 kPa). The widths of the fine tail hairs and fine-line incisions fall between those of Lines 1 and 2 (associated with mean pressures of 147.7 and 600.2 kPa, respectively). We noted fewer fine-line incisions on the rump of the zebra than originally recorded by Marshack (Fig. 1; cf. Beaumont & Vogel 1989). These incisions are wider than the tail hairs, albeit fainter in appearance.

While there may not be a direct correlation between pressure and intentionality, we can say that a similar pressure was required to produce the fine-line incisions and the tail hairs. Although the possibility exists that other factors could produce a similar pressure, there are two reasons why we do not believe this to be the case. First, the position and orientation of the fine-line incisions are not what would be expected from incidental abrasion. They are confined to a very small and specific area on the pictograph, that is, the rump of the zebra. Had these resulted from incidental abrasive contact, we would expect them to appear over a larger area. The orientation of the lines, in an almost criss-cross pattern, is not what is expected from incidental contact with another surface. Rather, the differ-

TABLE 1. Showing the pressure (kPa) results for each of the five lines in experimental Series A.

	Line 1	Line 2	Line 3	Line 4	Line 5
Mean	148.73	600.23	1469.74	2580.74	3324.40
S.D.	102.79	116.15	265.92	428.1	473.41
n	71	84	107	119	170

ent angles and the fact that none of the lines overlap with each other is suggestive of intentionality of the design (Fig. 7). Secondly, the tail hairs are clearly part of the zebra engraving. There is no ambiguity here. The regularity in profile and outline of these lines and the fine-line incisions indicates that a constant pressure was applied during their formation process – most likely by the same tool (see Brumm *et al.* 2006). The striations caused through abrasive grinding have a parallel orientation and irregular profiles (see Hodgskiss 2013). The juxtaposition of so many similar incisions and the absence of definitive abrasive striations is a strong indication of intentionality of design (Henshilwood *et al.* 2009: 30). Every incised line on the Wonderwerk dolomite slab, with the exception of the back of the zebra image, appears to have been made with a single stroke using a thin cutting edge (*sensu* d'Errico & Howell 2000:136). The line that forms the back of the zebra comprises two overlapping incisions. Furthermore, both the fine-line incisions and the other zebra incisions display a similar degree of weathering, suggesting that they were created at about the same time. Had the fine-line incisions been intended as test incisions, to test the sharpness or suitability of the engraving tool, we should expect to see them off to the side of the image rather than in it.

CONCLUSION

If the fine-line incisions on the rump were intentional, the obvious questions that arise are: first, are the incisions meaningfully associated with the larger zebra image, and secondly, what were they meant to represent? In light of the microscopic analysis results described above, we believe that the fine-line incisions were intended to constitute part of the larger image.

TABLE 2. Comparative mean width values for the experimental series and the engraved zebra from Wonderwerk Cave. Measurements are in μm .

	Back and legs	Stripes	Tail	Tail hairs	Fine lines	Line 1	Line 2	Line 3	Line 4	Line 5
Mean	122.8	125.1	90.2	43	54.4	38.7	74.6	98.6	128.5	156.5
S.D.	21.7	12.3	8.4	9.2	9.5	6	12.4	6.6	2.1	17.3
n	16	6	4	6	12	5	5	5	5	5

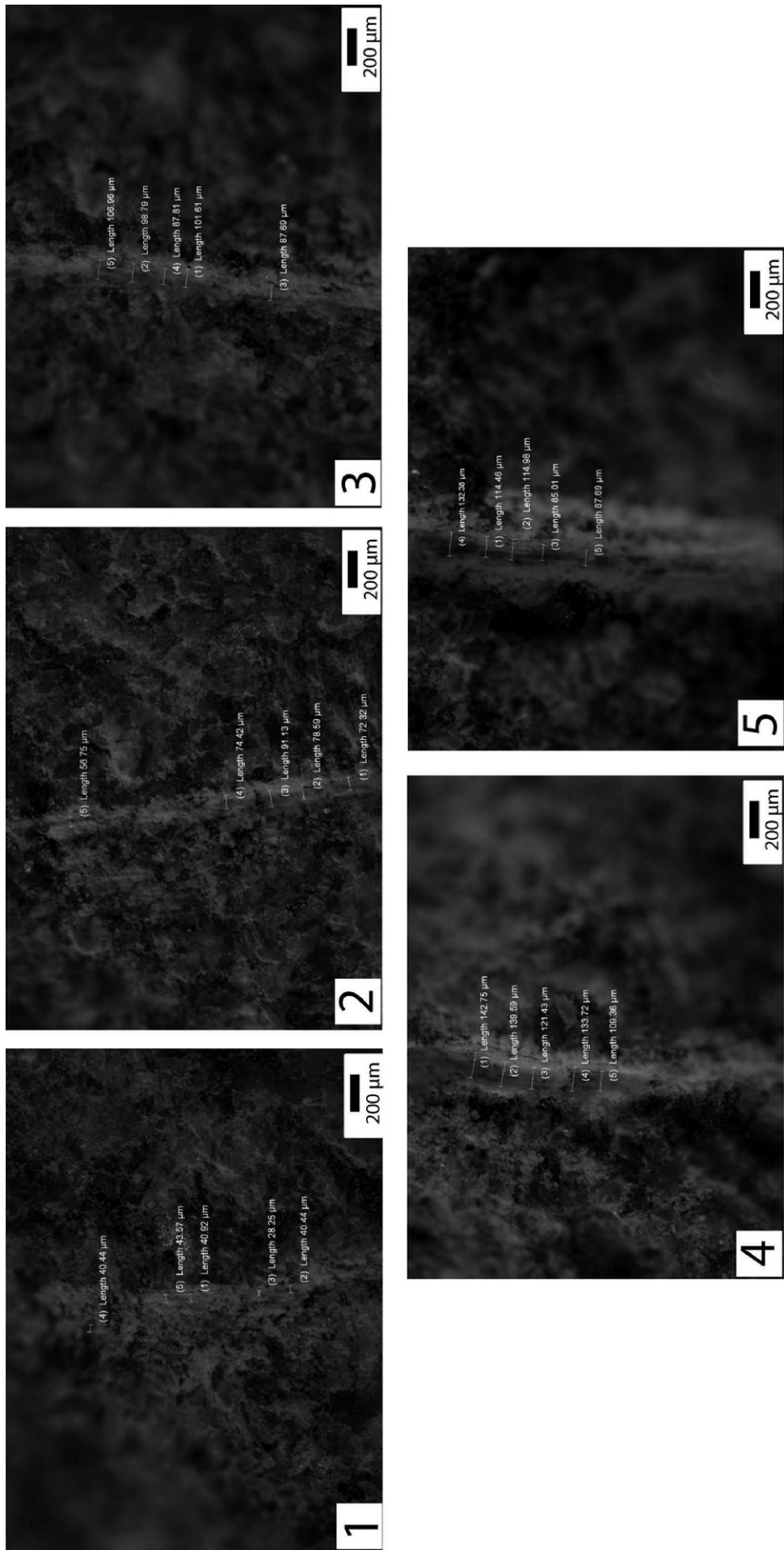


FIG. 5. Micrographs of the experimentally incised lines at ×50 magnification.

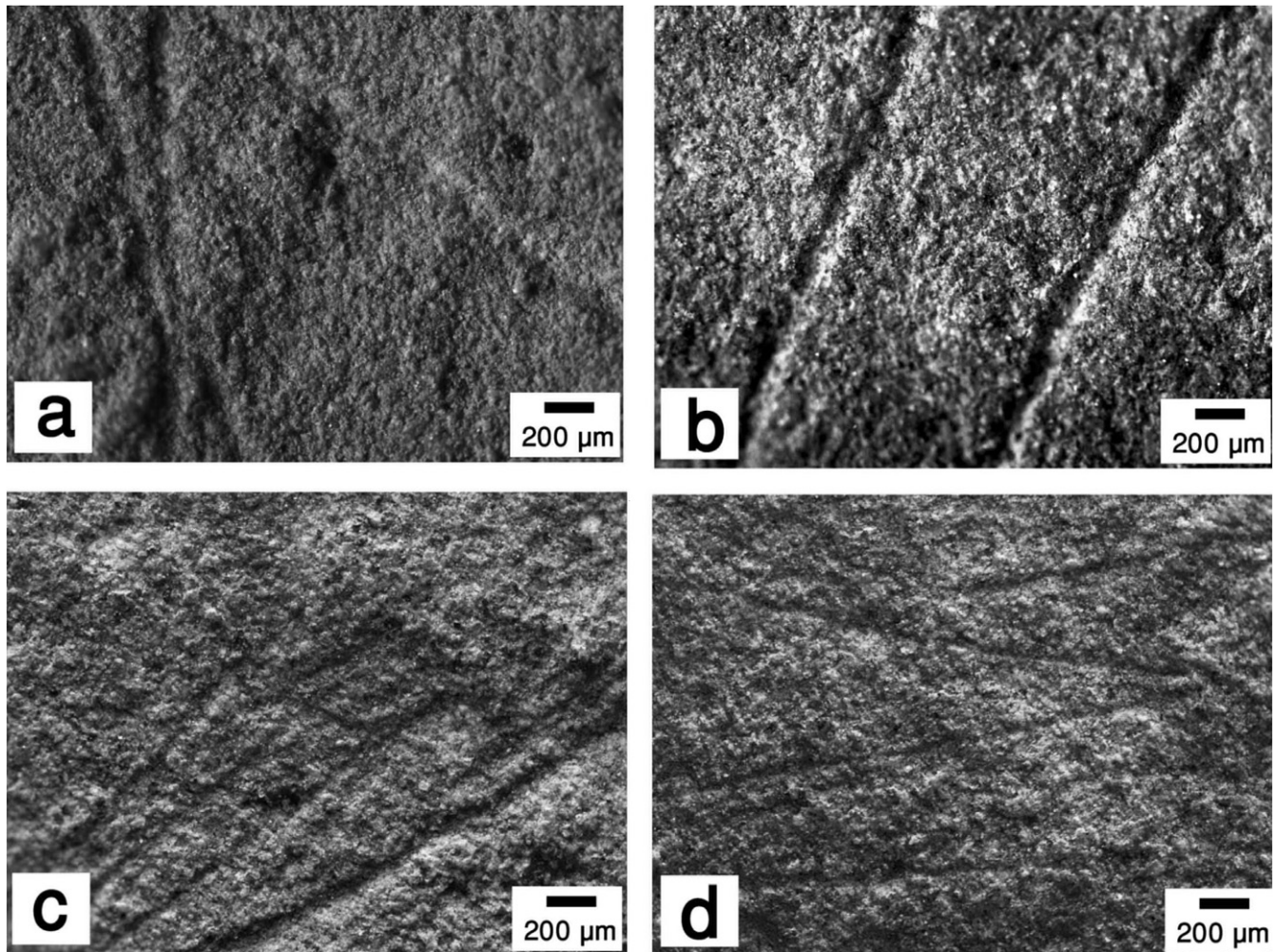


FIG. 6. Four sets of incised lines from the engraved stone slab from Wonderwerk Cave. (a) The double lines making up the back of the zebra and one of the stripes; (b) the leg of the zebra; (c) the tail and tail hairs; (d) the fine-line incisions on the rump of the zebra. Micrographs are taken at $\times 50$ magnification.

The incisions appear to be made with a similar tool and show a uniform degree of weathering, suggesting they were done at the same time. A critical distinction to establish is whether the engraving occurred prior to the hunt, in which case it is likely to be sympathetic magic, or after the hunt, in which case it is simply a depiction of an event. Unfortunately, there is no 'scientific' way to know this. Current rock art research holds that San art was not a record of daily events, but should rather

be interpreted within the context of San cultural idiom (Lewis-Williams & Challis 2011). Thackeray (2005a,b, 2013) has previously argued that the principle of sympathetic hunting magic may be part of this cultural idiom.

We conclude that the fine-line incisions on the rump of the Wonderwerk zebra were engraved deliberately as part of the larger image. As suggested by Thackeray (2005a), based in part on ethnographic data from southern Africa, the fine-line incisions may represent 'symbolic wounds' inflicted in the belief that this would contribute to success in a prospective hunt. The principle of 'sympathetic hunting magic' and shamanism are not necessarily mutually exclusive concepts (Thackeray 2013). Sympathetic hunting magic should not be excluded as one of the factors associated with at least some examples of southern African rock art.

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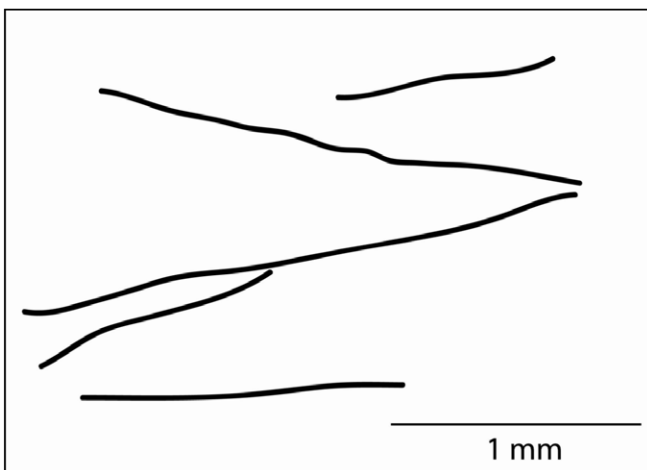


FIG. 7. A tracing of a portion of the fine-line incisions on the rump of the Wonderwerk zebra.

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