


Rock art from Andriamamelo Cave in the Beanka Protected Area of western Madagascar

David A. Burney, Julian P. Hume, Roger Randalana, Radosoa A. Andrianaivoarivelo, Owen Griffiths, Gregory J. Middleton, Tanambelo Rasolondrainy, Ramilisonina & Chantal Radimilahy

To cite this article: David A. Burney, Julian P. Hume, Roger Randalana, Radosoa A. Andrianaivoarivelo, Owen Griffiths, Gregory J. Middleton, Tanambelo Rasolondrainy, Ramilisonina & Chantal Radimilahy (2020): Rock art from Andriamamelo Cave in the Beanka Protected Area of western Madagascar, *The Journal of Island and Coastal Archaeology*, DOI: [10.1080/15564894.2020.1749735](https://doi.org/10.1080/15564894.2020.1749735)

To link to this article: <https://doi.org/10.1080/15564894.2020.1749735>

 [View supplementary material](#) 

 Published online: 26 May 2020.

 [Submit your article to this journal](#) 

 [View related articles](#) 

 [View Crossmark data](#) 



Rock art from Andriamamelô Cave in the Beanka Protected Area of western Madagascar

David A. Burney^a, Julian P. Hume^b, Roger Randalana^c, Radosoa A. Andrianaivoarivelo^c, Owen Griffiths^{c,d}, Gregory J. Middleton^e, Tanambelo Rasolondrainy^f, Ramilisonina^g, and Chantal Radimilahy^g

^aNational Tropical Botanical Garden, Kalaheo, Hawaii, USA; ^bBird Group, Department of Life Sciences, Natural History Museum, Tring, United Kingdom; ^cBiodiversity Conservation Madagascar, Antananarivo, Madagascar; ^dAustralian Museum, Sydney, New South Wales, Australia; ^eSydney Speleological Society, Sandy Bay, Tasmania, Australia; ^fDepartment of Anthropology, Yale University, New Haven, Connecticut, USA; ^gInstitut de Civilizations, Musée d'Art et d'Archéologie, Antananarivo, Madagascar

ABSTRACT

Stylistically unique black rock drawings have been discovered in Andriamamelô Cave in western Madagascar. Several image groupings comprise naturalistic scenes with anthropomorphic, zoomorphic, and therianthropic figures. These complex images are not similar to the polychrome painted symbols previously described from the Isalo region of SW Madagascar. Eight instances were noted where images and themes suggest Ptolemaic Egyptian mythological characters and symbols, some possibly of stellar constellations. One type of M-shaped figure occurred 16 times throughout the entire design field. We have not found this figure in other rock art around the Indian Ocean, except a rare occurrence in Borneo, believed to have been created about 2000 years ago. It also matches one distinctive character found in the Amharic alphabet of Ethiopia. One set of eight curvilinear resembles Arabic characters or indigenous *Sorabe*. Extant animals were tentatively identified, and also three of the extinct megafauna may be pictured (elephant bird, tortoise, and sloth lemur). The latter appears in an inferred hunting scene, with a hunter pointing a weapon, the giant lemur upside down, and two dogs. Images suggest connections between traditional Malagasy symbology and the disparate worlds of the island's ancient influences, both from NE Africa and Borneo. Milligram-sized samples of the black pigment were collected from an image for AMS ¹⁴C dating, but they contained insufficient carbon in aggregate.

ARTICLE HISTORY

Received 7 October 2019
Accepted 24 March 2020


KEYWORDS

Cave art; rock art; Madagascar; *Sorabe*; Egypt; Borneo; extinct megafauna

Introduction

Prehistoric cave art has provided unique glimpses into the minds of people of the past in many lands around the world, including those surrounding the Indian Ocean. However, until recently parietal art was largely unknown from Madagascar (but see Radimilahy 2010). A site has been described from the semiarid SW part of the island

CONTACT David A. Burney  dburney999@gmail.com  National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo HI 96741 USA.

 Supplemental data for this article is available online at <https://doi.org/10.1080/15564894.2020.1749735>.

© 2020 Taylor & Francis Group, LLC

consisting largely of painted symbols and geometric designs, and not pictorial art (Rasolondrainy 2012). Almost universally, cave and rock art images are extremely problematic for radiometric and other direct dating techniques, but this site, Ampasimaiky Rock Shelter, provided some clues as to the age range because the investigator was able to recognize that the symbols included apparent words written vertically in an ancient African script, Libyco-Berber, part of a family of alphabets used in Africa between 500 BC and AD 800. Other parietal art has been reported informally from the Makay region of southern Madagascar (Anonymous 2018). It is similar to that described for Ampasimaiky by Rasolondrainy, including paintings of geometric designs and symbols, perhaps with magical or ceremonial applications.

Here we report a stylistically distinct example from western Madagascar, a presently unique pictorial art forming a panorama of images on the wall of a cave. These complex images appear culturally unrelated to the other cave art discoveries reported from Madagascar. Depictions, all in dry-applied black pigments (charcoal or iron minerals), include several image groupings that comprise naturalistic scenes, with anthropomorphic, zoomorphic, and human-animal hybrid (therianthrope) figures, action and perspective cues, and possible occult symbolism. There are no characters from the Latin alphabet. No cattle images, nor any Judaeo-Christian, Muslim, or Hindu symbology have been identified. Of possible significance is a repeated use of a cursive, generally M-shaped motif (\mathfrak{h}), with anthropomorphic development in a few cases. There is also one short horizontal string of characters similar to Arabic. Interview results indicate that the local people associate the images with a different ethnic group from themselves (Vazimba or Bôsy), from an unknown time, who made the images in connection with divination.

We wish to present the images, provide some initial classification as to type, and compare them to imagery left by people on cave and rock shelter walls, as well as with other ancient art and symbology, throughout the Indian Ocean region. We are not able at this stage to say with certainty when the art was made, by whom, or why. An important future goal for cave art research would be to seek more of this apparently unique style of art in caves and rock shelters of western Madagascar, and to further investigate the symbolism employed by magico-religious practitioners in this remote area today for possible connections to ancient influences from NE Africa, Borneo, and other areas.

Materials and methods

Location and geology

Andriamamelô Cave is about 1 km E of the small village of Anahidrano, Madagascar (-17.781896S/44.460088E, el. 160 m ASL). It is located in karstified limestone of the Paysage Harmonieux Protégé de Beanka, a 17,100 ha protected area that was officially recognized on April 22, 2015 by a Malagasy government decree. Managed by Biodiversity Conservation Madagascar (BCM), Beanka is located ca. 350 km NW of the capital of Antananarivo and 55 km E of Maintirano (Figure 1). This is part of an extensive karst region (*tsingy* in Malagasy) that includes the Parc National de Bemaraha to the south, a UNESCO World Heritage site, and the little-studied Antsingimavo karst area to the north. Within the Mesozoic limestone, rugged karst surface features, caves,

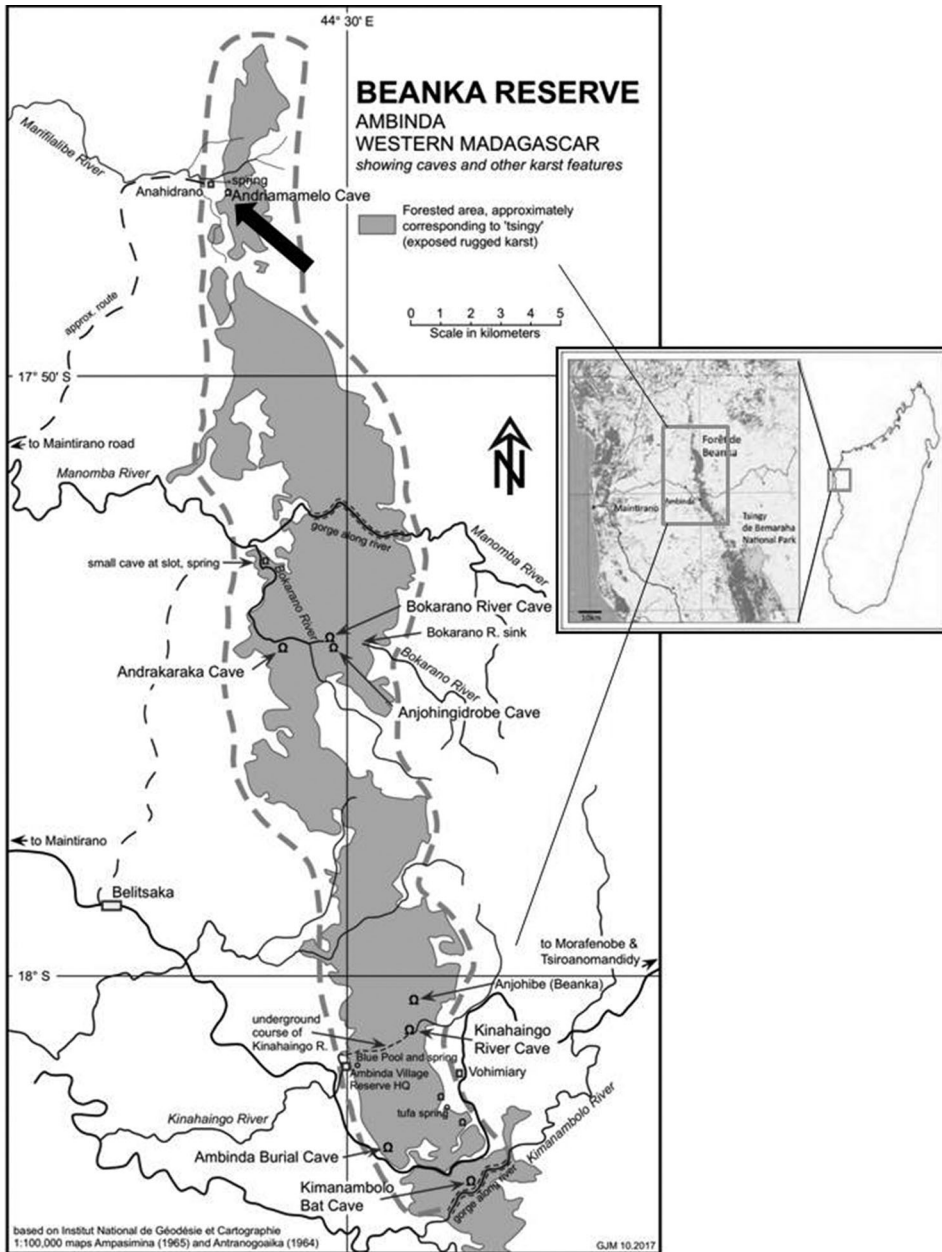


Figure 1. Large arrow denotes location of Andriamamelo Cave, near village of Anahidrano in western Madagascar. The site is in the northernmost section of the Beanka Protected Area.

narrow canyons, and subterranean rivers are covered in dense dry deciduous forest, thick lianas, and patches of more open rocky woodlands. The nearly impenetrable nature of this landscape, combined with low human population densities in modern times, has limited anthropogenic pressure in this vast area, preserving natural habitats, endemic species, and caves containing previously untouched evidence for past life (Goodman, Gautier, and Raherilalao 2013; Burney et al. 2020).

ANDRIAMAMELO CAVE

Anahindrano, Beanka Karst (North)
Western Madagascar

SSS Map No. 2407

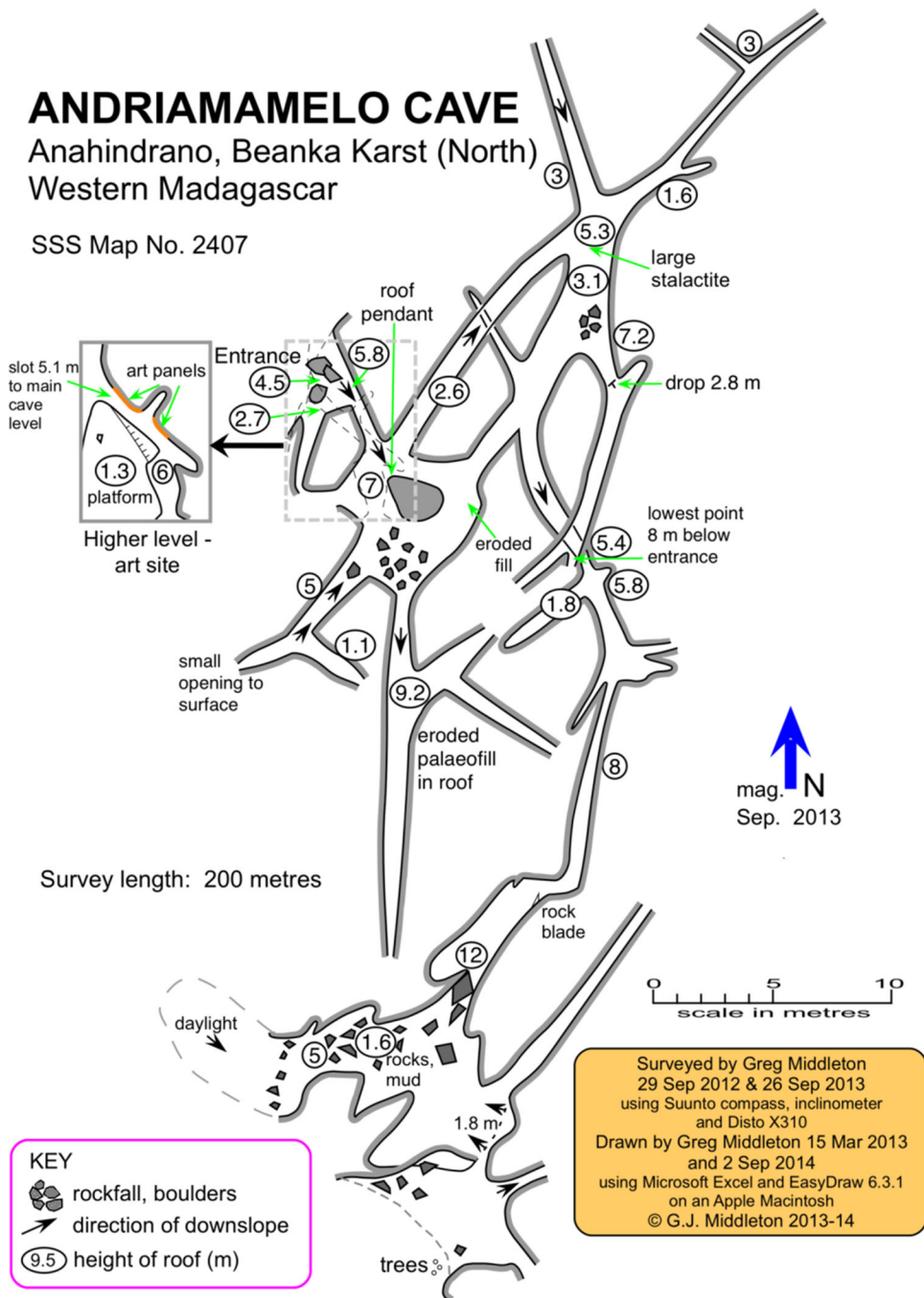


Figure 2. Map of Andriamamelo Cave. Inset shows position of cave art design field, above an entrance.

Andriamamelo Cave (see [Supplementary material, S1 for photographs](#)), in the far northern part of the Beanka Protected Area, was first surveyed by GM in 2012 (Figure 2). The next year, the cave art was found in a higher level and added to the map

Table 1. Inventory of black rock drawings from Andriamamelo Cave, Madagascar.

Location	# ¹	Description	Details and interpretation	W × H ² (cm)	
Panel 1A (l. to ctr.)	1	Crocodile	Plan view, facing l.	37 × 11	
	2	Hybrid zoomorph	Tail of fish, with beaked head, facing l., seahorse?	12 × 33	
	(r.)	3	Bird	Wings spread, facing up	5 × 4
		4	Duck	Head only, facing l.	10 × 5
		5	Zoomorph	Short-tailed quadruped, facing l., lemur?	7 × 6
		6	Indistinct zoomorphs (5)	Unidentifiable shapes with appendages	
		7	Scorpion	Facing left, two horns, four legs, and very long tail with point	23 × 8
		8	M-figure	“Head” on left, with extra line forming floor on right	16 × 10
		9	4 small marks or smudges	One sampled for dating	2-5 each
Panel 1B (l.)	10	M-figures (4)	2 contiguous, apparently connected vertically	8,8,13,10	
	11	Zoomorph	Elongate quadruped, showing two digits, chameleon?	2 × 8	
	12	Zoomorph	Long-eared quadruped, goat?	7 × 4	
(r.)	13	M-figure	Large, bulbous head	17 × 14	
	14	M-figures (2)	One bulbous head, sword in right hand, other with pointed head	18 × 18, 11 × 7	
Panel 2A	15	Indistinct zoomorphs (2)	Bat? and falcon?, latter just below “sword”	7 × 9, 2 × 8	
Panel 2B (l.)	16	M-figures (2)	Both have bulbous heads, one up, other down, latter has only 2 legs	15 × 13, 8 × 10	
	17	Zoomorph	Lemur? with bushy tail, on back, possibly a skin	11 × 16	
(ctr., top row, l.-r.)	18	Anthropomorph/ M-figure	Large, indistinct trunk and head, probably connects to arm on 2B (l.)	16 × 33	
	19	Anthropomorph/ M-figure	Headless, with thick trunk and thin legs widespread		
	20	Elongate cylinders (3)	Discontinuous vertical objects, tree trunks?		
	21	Hybrid zoomorph	Ibis, with bill pointing to hunting scene, body crescent-shaped	11 × 6	
	22	M-figure	Indistinct, on cracking surface	6 × 6	
(ctr., bottom row)	23	Zoomorph	Elephantbird, long-necked creature with head ornaments, looking right	3 × 15	
	24	Zoomorph/ therianthrope	Superimposed over above, sorcerer crouching over 2 nd elephantbird		
	25	Elongate cylinders converge	Succulent tree with branch pattern of <i>Didierea</i>	4 × 12	
	26	Therianthrope	Identified as sorcerer by local informant, <i>Anubis</i> -like, looking to right	4 × 9	
	27	Amorphous cylinders	Tree roots, sorcerer appears to be looking past big tree at the hunter		
	28	Anthropomorph	Behind the upside-down zoomorph below, aiming a weapon		
	29	Zoomorph	Sloth lemur on back, with long legs and sharp claws extended upward	18 × 13	
	30	Zoomorphs (2)	Two dogs, one looking toward lemur, other away	7 × 10, 10 × 7	
	Panel 2C	31	Charcoal smudges (6)	4 on horizontal line, 2 above right angle	1-4 each

(continued)

Table 1. Continued.

Location	# ¹	Description	Details and interpretation	W × H ² (cm)
	32	Geometric motif	Large right angle, opening to lower right	24 × 24
	33	Elongate cylinders (2)	Joined at base to form tree like <i>Didierea</i>	3 × 20
	34	Anthropomorph	Action figure looks like person throwing a spear with right hand	5 × 5
	35	Amorphous	Pedestal end of right angle appears to be a platform for action figure	
	36	M-figure	Trident-shaped, and with flat feet and small head	4 × 10
	37	Zoomorph	Tortoise? Image indistinct, only recognized in D-stretched photo	
Panel 2D	38	Amorphous	Very faint irregular shapes, possibly mineral stains	
	39	M-figure	Only clear image on this panel	5 × 6
	40	Anthropomorph	Man with tail is indistinct, but style and posture similar to hunter	7 × 11
Panel 2E	41	Amorphous image	Complicated indistinct scene, with curvilinear motifs, possibly boat?	
(corner 2E/F)	42	Geometric	Labyrinth, 20 thick curvilinears, continuing around edge into cleft	37 × 17
Panel 2F	43	Geometric (continued)	Continuation of labyrinth outside cleft	
	44	Curvilinear motifs (8)	Faint characters are in some cases similar to Arabic script or <i>Sorabe</i>	27 × 9

¹Numbers correspond to photos in [Supplementary material \(S2\)](#).

²Width × height measured on 1:1 copy for complete images only.

(Middleton 2013, 2015). DAB and JPH measured and photographed the faint images September 26, 2013, and JPH drew full-scale copies of the drawings. The art is situated on two flat pale gray limestone panels (1 and 2) that are separated by a large cleft ([Supplementary material, S1. #2–#8](#)). Drawing continues around the contiguous corners to two smaller vertical panels that partially face each other over a cleft. The opening of the cave faces westward, and direct sun reaches the area of the panels in the afternoon. It was noted by one of the park rangers on August 24, 2014, that the sun fell directly on the drawings at about 1400 hours (2:00 p.m.). The decorated area ranges along 3 m of the wall, and stands almost 1 m high. The walk-in cave entrance ([Supplementary material, S1. #1](#)) is NW of the panel about 5 m below, and the panels are most easily reached by climbing up onto a large rock platform S of the main entrance, from which vantage the faint drawings become visible from as much as ca. 15 m distance in good afternoon light, as observers have noted when visiting near the end of Austral winter ([Supplementary material, S1. #2](#)).

Field methods

Individual elements of the artwork and complex scenes with apparently associated images were digitally photographed under natural and artificial light, perpendicular to the plane of each panel. Digital enhancements were applied to heighten the contrast of key images where noted in the text, including the “D-Stretch” technique widely used in recent cave art studies (e.g., Hoerman 2016) to reassign ambient colors to a broader

spectrum. JPH made field drawings of each image at 1:1 scale. These were digitized and converted to high contrast monochrome.

Archaeological surface survey was conducted in the vicinity of the cave art chamber, including the area inside the main walk-in entrance below, which receives any materials that would fall from the ledge where an artist or viewer would have to stand to reach the drawings. Animal bones and small pieces of charcoal were recovered from the floor for identification and ^{14}C dating. Very small samples of the black pigment were collected by scraping with a stainless steel blade from part of a geometric motif (Table 1. #9). AMS ^{14}C dating methods used are described by Beta Analytic (2019).

One local informant (unnamed to protect his privacy) said by others in the adjacent village to be the most knowledgeable concerning the art, was interviewed in detail. We talked to him on September 26, 2013, at the art panels, for approximately 30 minutes. DAB directed questions in English to RA, who conveyed questions in Malagasy to the informant, and then back-translated to DAB in English. Answers were recorded via written notes.

The art presentation was described using terminology from the International Federation of Rock Art Organizations (2015), including *design field* for the entire stone surface bearing rock art at a site; *panel* for an unbroken, uniform stone plane bearing rock art; *images*, for contiguous, multi-component pieces of rock art; and *figures/motifs*, for singular components of images. These may be recognizable zoomorphic, anthropomorphic, or hybrid (therianthrope) forms, or nonrepresentational, such as *linears*, *patterns*, or *geometrics*. All six of these classes of figures/motifs are represented in the drawings at Andriamamelo.

Results

Cave setting and design field layout

The cave is a series of interconnected narrow cleft passages (solution-widened joints – see Supplementary material, S1. #1, #9, #10) extending ca. 50 m N-S and 20 m E-W (Figure 2). The lowest point in the cave is 8 m below the entrance. The two largest art panels are on a pair of generally SW facing vertical slabs of limestone, and art continues around the corner of both blocks along the vertical cleft that separates them. The entire design field is situated above the main chamber just inside the walk-in entrance with the panels' bottom edge ca. 5 m above the floor (Supplementary material, S1. #5). A natural stone platform forms a higher floor for simultaneous eye-level viewing of the entire design field from the SW. The viewer is standing under a flat cave roof 1.3 m high, stained black with iron oxides and soot, and the artwork is to the NE across a 1 m chasm bounded by hanging ledges that drop 4 m to the floor inside the entrance below. Because the wall of the room floored by the platform is discontinuous to the S and W, the panels are well-lit all day, but particularly in the late afternoon (Supplementary material, S1. #2, #4).

Specific contents by panel/subpanel

To characterize the complex faceted nature (Figure 3) of the two main panels, and to more specifically locate individual images, panel 1, NW of the vertical cleft, was divided

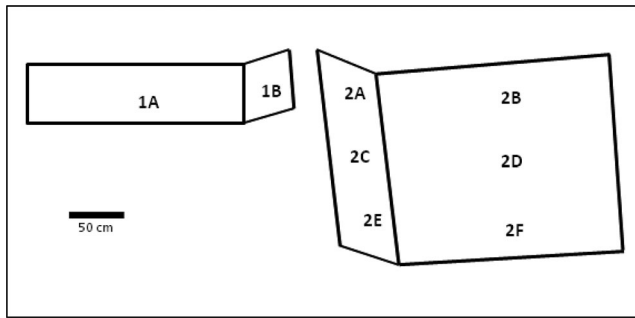


Figure 3. Schematic of design field in perspective view as it appears when observer is centered directly in front of panels. Numbers correspond to sub-panel designations.

into a large sub-panel 1A, and a smaller 1B that is situated on a smaller face that is around the corner from 1A, facing the vertical cleft (Figure 3). Panel 2 is SE across the crevice, and is both larger and more profusely decorated, and also topographically varied. The small facet roughly facing sub-panel 1B consists of three small, weakly separated sections, 2A, 2C, and 2E. Directly across from them around the corner of panel 2 are three long horizontal strips of rock, 2B, 2D, and 2F, each heavily decorated with complex images and individual motifs, and separated by wall cracks and strips of rock with rougher texture.

Table 1 provides an inventory of the art, including 16 zoomorphs, 6 anthropomorphs, 2 therianthropes, 2 geometrics, 16 examples of an unidentified M-shaped motif, and many amorphous, curvilinear, patterned, and indistinct forms, for a total of 72 or more individual objects (see Supplementary material, S2 for photographs, each followed by artist's reconstruction). Nearly all images are oriented in upright position, many arranged in level horizontal arrays as in lines of text or hieroglyphics.

Panel 1A

This roughly rectangular face of grayish-white, relatively smooth limestone contains predominantly zoomorphs, including a distinct plan view of a crocodile (Supplementary material, S2. #1), a bird in flight (Supplementary material, S2. #3), the head of a duck (Supplementary material, S2. #4), and a long-tailed, horned creature that is probably a scorpion (Supplementary material, S2. #7). A short-tailed baboon-like quadruped (Supplementary material, S2. #5) is problematic in that living and extinct quadrupedal lemurs had long tails. One large enigmatic hybrid zoomorph has a fish-like tail and a bird-like beak (Supplementary material, S2. #2). Its vertical orientation is suggestive of a seahorse (*Hippocampus* sp.). Animals in profile are all looking left (right and left designations are from the perspective of the viewer except where noted otherwise). The panel also contains one of the ubiquitous objects we have termed "M-figures" (Supplementary material, S2. #8) but this is the least typical of the 16 identified in the design field, as it is the only one on its side and with an apparent "floor" on the right side. There are five unidentifiable shapes, with appendages (Supplementary material, S2. #6), and four large black dots or smudges (Supplementary material, S2. #9). One of these dots (light patch in Supplementary material, S2. #9) was sampled for radiocarbon dating. The decorated portion of the panel is 108 cm wide and 45 cm tall.

Panel 1B

This sub-panel forms an approximate right angle with 1A, facing SE and forming the left side of the cleft between the panels. It is pinkish-white in background color and 69 cm wide × 41 cm high. This area on the left side of the cleft is predominantly covered with five M-figures ([Supplementary material, S2. #10](#)). They resemble an upright cursive M-shape but with an elongate central line that extends generally well above the curves (**h**). One of these has a large, bulbous “head” ([Supplementary material, S2. #13](#)) and two others are contiguous vertically, suggesting a linearized anthropomorph. A small long-bodied tailless zoomorph ([Supplementary material, S2. #11](#)) shows two opposed digits on a front limb, suggestive of a chameleon. Another zoomorph ([Supplementary material, S2. #12](#)) is a quadruped with large ears, perhaps a goat.

Panel 2A

Across the cleft from the top of 1B, facing NW, is a small rough-textured panel (decorated portion 33 cm wide × 40 cm high). The rock has a dark gray patina, with light gray in the cracks. This is the most difficult panel to reach for artist or viewer. Close access for drawing probably required, because of its distance from the horizontal ledge, that the artist brace his or her back against panel 1B, or stand on scaffolding to reach it. Two distinct M-figures are featured ([Supplementary material, S2. #14](#)), one with a bulbous head and a crossed line on an extra long right arm, resembling a sword. The other has a pointed head. Two zoomorphs are present ([Supplementary material, S2. #15, #15B](#)), one resembling a bat and the other a falcon or other long-tailed raptor perched on a branch. The latter is directly below the point of the “sword” of the M-figure.

Panel 2B

Around the corner from 2A is a long smooth strip of pale gray limestone with a pinkish-orange mineral stain through the middle portion. This most profusely decorated portion of the entire design field is 110 cm wide and 43 cm tall, and faces SW. On the left side are two M-figures, each with bulbous heads ([Supplementary material, S2. #16](#)). One is held erect and the figure has two branches or digits on the right leg. The other figure’s head is tilted downward and lacks the middle “leg” typical of the other objects in this class. Near them is a zoomorph ([Supplementary material, S2. #17](#)) that appears to be a bushy-tailed quadruped, perhaps a lemur on its back or a lemur skin. Continuing to the top center of the panel, there are two unusual anthropomorphic M-figures ([Supplementary material, S2. #18, #19](#)). One is the largest of these in the entire design field, standing 33 cm tall, the other is headless and appears to have a thick trunk and widespread legs, although these images are indistinct. The former extends through or behind other images, giving the impression of a large entity standing behind or amidst the others. These are separated from the rest of the images on the panel by three elongate cylinders ([Supplementary material, S2. #20](#)), discontinuous vertical objects like tree trunks, one with a three-branched “root zone” at the bottom.

Along the bottom of this panel is a complex image made up of figures drawn with fine detail ([Figure 4](#)). On the left of this sequence is a partly obscured pair of

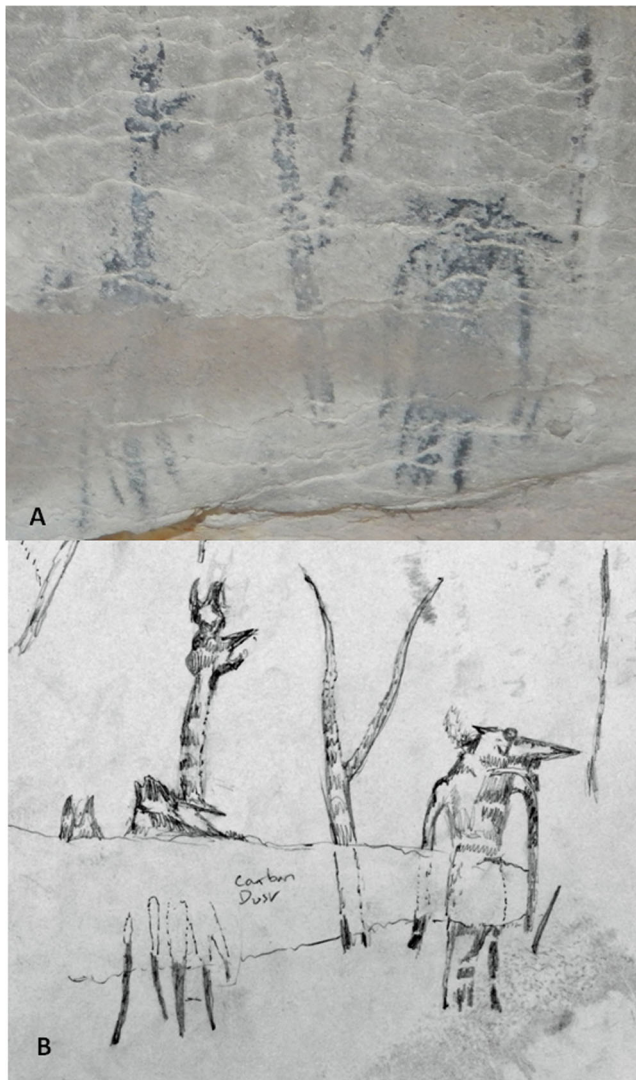


Figure 4. Photograph (A) and artist's sketch (B) of the center, bottom row, of Panel 2B. Left side shows a zoomorph that includes a possible long-necked bird with plumes on its head, with partially obscured second plumed head and a "sorcerer's" head, next to a succulent tree, and a standing "sorcerer" on the right.

superimposed zoomorphs with heads that appear to have large feathers (or horns—an alternative explanation of this image could be that the strange heads are ceremonial bucrania). One is very long-necked ([Supplementary material, S2. #23](#)), perhaps like an elephant bird (*Aepyornis*, *Vorombe*, or *Mullerornis*). The other appears to be crouching ([Supplementary material, S2. #24](#)), with a head similar to the former; emerging from the (viewer's) right side of this confusing image is another head, similar to that of the "sorcerer" described below, and looking to the right of the panel, toward a standing image of this therianthrop figure. Next to this confusing scene is a tree-like object ([Supplementary material, S2. #25](#)) with a branching aspect suggestive of the succulent

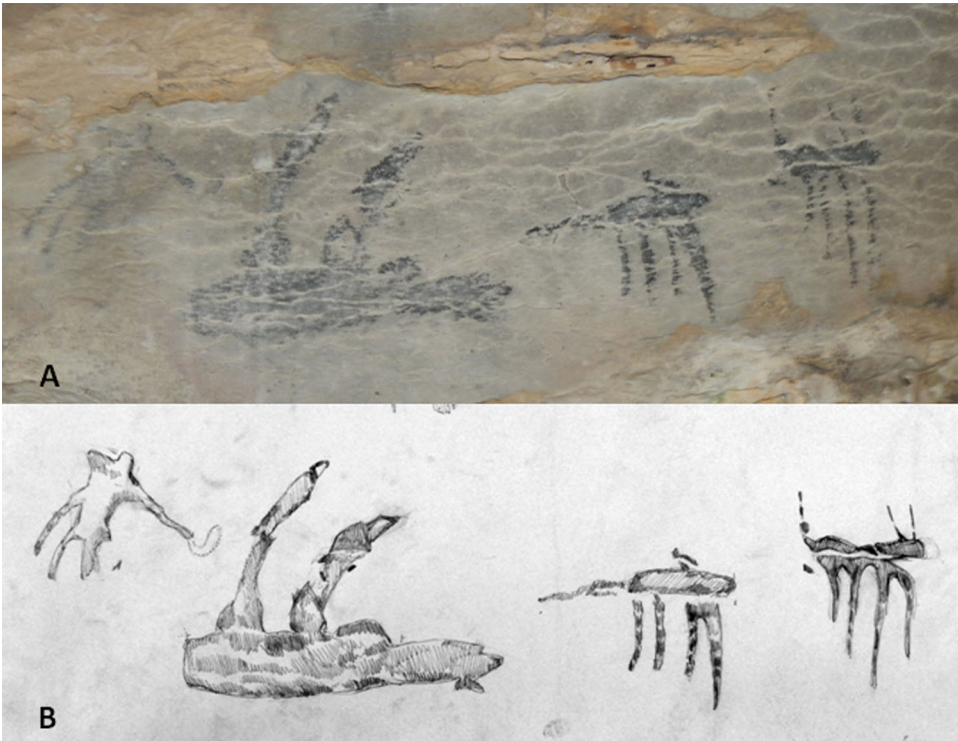


Figure 5. Photograph (A) and artist's sketch (B) of the inferred "hunting scene." Hunter (background, left) extends weapon toward inverted large animal in foreground. Two dog-like zoomorphs are on the right.

Didierea typical of arid landscapes of SW Madagascar. Next to the tree is a clear, detailed therianthrope form (Supplementary material, S2. #26), body facing the viewer, but looking over its left shoulder to the right of the panel, with bulging eyes. This image has a human-like body and a head with a sharp-pointed muzzle (reminiscent of the European "plague masks" of the seventeenth century, but without the down-curve of the beak). It shows strong similarity to Egyptian *Anubis* figures (e.g., Metropolitan Museum of Art 2020, coll. #23.2.84), but notably with smaller ears than usually depicted in the jackal-headed Egyptian god of death. Like many *Anubis* depictions, it appears to be holding a rectangular object in the right hand (perhaps an *ankh* or a ratite feather) and a staff in the left. It has an apparent tail and pointed feet, one appearing forked and the other hoof-like. This figure was identified by a local informant (see below) as "le sorcier" (the sorcerer). The figure appears to be looking through the tree roots described above, toward a hunting scene.

The next four pictures to the right on this level are drawn in active poses and in apparent perspective (Figure 5), yielding a complex image we interpret as a hunting scene (Burney 2016). Standing on the left behind the other figures is an anthropomorph (Supplementary material, S2. #28) that appears to be brandishing a weapon, perhaps drawing a bow. There are two distinct legs, and a third appendage pointing backward in the manner of a tail or a sheathed sword. The posture and detail evoke classical images of the conspicuous constellation Orion (see Cartwright 2017). The weapon

seems to aim toward a larger and more distinct image in the foreground (Supplementary material, S2. #29), a zoomorph lying on its back with legs in the air. We have only a few clues to the identity of this large conspicuous zoomorph. This animal's profile is consistent with that of the extinct sloth lemurs. These large primates are known as abundant subfossils from Anjohingidrobe Cave also in Beanka (Burney et al. 2020), such as *Babakotia radofilai*. Sloth lemur fossils have also been described at Anjohibe Cave in the western region (Burney et al. 1997). They are generally reconstructed with long forelimbs, a short snout, and small rounded ears (Goodman and Jungers 2014). Beyond are two zoomorphs (Supplementary material, S2. #30) we interpret as dogs, one looking toward the “sloth lemur” and the other, with erect ears, in the opposite direction.

Above the hunting scene are two additional images on this panel. One is a hybrid zoomorph (Supplementary material, S2. #21). The front portion, looking to the viewer's right, is a bird head with a long beak pointing toward the hunter. The body and tail of the bird form a distinct crescent. Although the beak is straighter than that typical of an ibis, the combination of a long-beaked bird and a crescent moon is evocative of a classical Egyptian figure, the head of the god *Thoth* (Mark 2016). To the right of this depiction, on a cracking surface, is an indistinct M-figure (Supplementary material, S2. #22) and some even less distinct objects that may be merely mineral stains or charcoal smudges.

Panel 2C

In the middle of the cleft, below 2A, is a pale pinkish-orange surface with faint images covering an area 30 cm wide and 37 cm high. There are four large oval dots in a horizontal pattern, (Supplementary material, S2. #31) followed by a large geometric motif (Supplementary material, S2. #32) that forms a perfect right angle, opening to the lower right quadrant, and with limbs each precisely 24 cm in length. Two amorphous smudges are above this geometric. Inside the angle are two elongate cylinders joined at the base (Supplementary material, S2. #33), suggestive of a *Didierea*. On the end of the horizontal limb of the angle (Supplementary material, S2. #34, #35) is a pedestal-like oval, on which is standing a small anthropomorph that appears to be throwing a spear with the right hand. Inside the angle is an M-figure with flat “feet” and a small head on a long neck (Supplementary material, S2. #36). Nearby are two possible zoomorphs, which are very indistinct. One of these (Supplementary material, S2. #37) is much clearer in the D-stretched imagery (Figure 6) and may be a tortoise.

Panel 2D

Directly below the “sorcerer” and the “hunting scene” is a pinkish-orange panel 105 cm wide and 38 cm high that is rough and mineral-stained, with a small speleothem draped along the center. The only clear image on this panel is an M-figure (Supplementary material, S2. #39). There is also an indistinct anthropomorph (Supplementary material, S2. #40), perhaps a man with a tail or sword, with style and posture similar to the “hunter” described for the panel above.



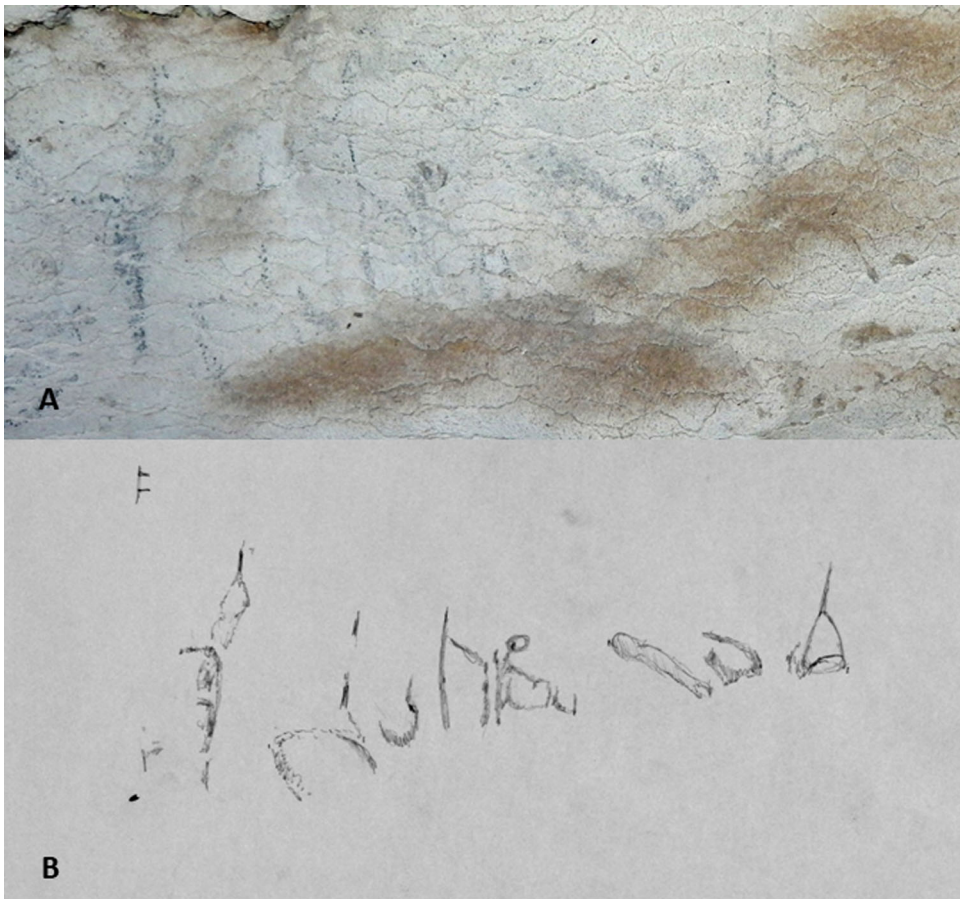
Figure 6. Photograph of Panel 2 with D-Stretch digital image enhancement. “Labyrinth” is in lower left corner. Directly above it is a faint zoomorph that we interpret as a tortoise.

Panel 2E

At the bottom of the cleft on the right side is a small flat surface 30 cm wide and 20 cm high, containing a very faint and complicated amorphous image with curvilinear motifs (Supplementary material, S2. #41) suggestive of boats depicted in cave art elsewhere in the Indian Ocean region (e.g., East Timor; O’Connor 2003). On the corner of this panel, drawn partially here and continued around the corner in 2F, is a complex labyrinth-like geometric motif.

Panel 2F

This large geometric image, 37 cm × 17 cm, is composed of 20 thick curvilinears that converge tree-like at the bottom (Supplementary material, S2. #42, #43). These roughly parallel lines appear to form a labyrinth or more properly, a maze structure (since some lines are branching). A few lines open to the outside and many others are closed at the end by curving into the next. The cream-colored background, 50 cm long and 20 cm high, is partly obscured by brown dust in the center. This labyrinth-shaped image could also be a highly stylized kily tree (*Tamarindus indica*), which the informant indicated was used locally for sacrificial rites. Further to the right, arranged in a line on this panel (Figure 7), is a string of apparent characters (Supplementary material, S2. #44), altogether 27 cm long and 9 cm high. No clearly recognizable letters were identified, although they are suggestive of Arabic script. An attempt was made by DB to transliterate this sequence, using a phonetic key to *Sorabe*, ancient writing that renders Malagasy in Arabic script (Adelaar and Himmelmann 2004). Although none of the letters are a perfect match, the middle six characters resembled (right to left, as customary) D-A-NT-IA-R-K, “da ntiark.” The first and last characters were not at all recognizable matches for any letters in *Sorabe* (or the comparable Javanese *Pegon*). In any case, these eight curvilinears are not similar to anything else found on the wall, and are almost certainly writing of some kind.



د - ط ي ا ر ك

Inferred Sorabe letters, r-l as in Andriamamelo

ك ر ي ا ط - د Sorabe, l-r

D A N T I A R K Latin transliteration, l-r

C

Figure 7. Photo (A) and artist's sketch (B) of eight curvilinears, probably script, from right of Panel 2F. Middle six show some similarity to *Sorabe* characters, archaic Malagasy in Arabic (or Javanese Pegon) script. (C) Attempt to transliterate the middle six characters to Latin equivalents (see Adelaar and Himmelmann 2004).

Interview results

Residents of the adjacent village of Anahidrano introduced us to an elderly man who agreed to give an interview. Although he provided his name, we have not opted to reveal it, in order to protect his privacy. The cave's name was apparently the name of a deceased elder of the village, and means "honorable giver of life." (See [Supplementary material, S3](#) for notes on questions and answers). He is a Malagasy man who said he was "about 60" when we interviewed him on the morning of September 26, 2013. He said he was from the Antanosy ethnic group and might have some European ancestors as well. He was originally from Ft. Dauphin, and came to this village alone 30 years before. He married a local woman, had a family, and tended many cows here. He was somewhat reticent and declined to have his picture taken. We infer that he was nervous about publicity because three years before, he explained, he had lost many cows to *dahalo* (organized bandits) and received injuries in the fight. In addition, elder Malagasy sometimes are reluctant to be photographed because they believe that after death, their photograph should not be viewed.

According to the informant, sometime in the past there was a villager named Andriamamelo who was a practitioner of *sikidy*, a type of divination with seeds that he said involved animal sacrifices nearby at a large *kily* tree (*Tamarindus indica*). Before 1996 he says there were many *dahalo* in this area. He said that a group of people called the *Vazimba* by most Malagasy, but who called themselves *Bôsy*, lived in the tsingy. He believed that the cave art was produced by their diviners, and identified in French the depiction of the *Anubis*-like therianthrope figure ([Supplementary material, S2, #26](#)) in Panel 2B as "le sorcier".

Archaeological survey

The ca. 200 m of mapped cave passages were briefly inspected for other cave art and surface archaeological evidence. No other art or wall markings of any kind (not even modern graffiti) were detected. The floor of the cave is mantled with reddish brown silt and coarse to fine organic matter and cave breakdown deposits. There were no major concentrations of pottery sherds, but scatters were noted that were composed of types that are also found in the sediments of Anjohingidrobe, a cave 15 km south of Andriamamelo in the central part of the Beanka Protected Area (Burney et al. 2020).

Directly below the northernmost art panel, the floor of the narrow passage was littered with cow bones and recent-looking campfire ash. We lifted a large rock and sampled the sediments exposed in profile here. From 10 to 20 cm below the floor surface, we noted a dark brown silt with snail shells, cow and bat bones, and thick pottery sherds with no diagnostic markings. Charcoal was present, and two small pieces were collected that appeared to be burned twigs with facets such as might be expected as a by-product of charcoal sketching. One of these (AMO-2:10-20, Beta-408223) was submitted for radiocarbon dating, as described in the next section. Below this level, at 20–30 cm, the brown silt continues but with less charcoal. At ca. 35 cm the sediment becomes reddish-orange silty clay with a few visible particles of charcoal.

Dating evidence

Very small samples of the black material used to make the drawings were scraped from one of the oval black dots or smudges near the lower right corner of Panel 1A (Supplementary material, S2. #9). It was expected that the black component of these tiny samples (AMO-CA #1–4) would be charcoal, and datable by AMS if 1 mg of pure carbon could be extracted. However, these samples proved to be problematic: some of the black material, under microscopic examination, proved not to be charcoal. Dark brown linear particles appeared to be plant fiber. This would not be a surprise if indeed a charred stick were used, as we suppose. However, some small dark reddish brown to black particles appeared to be of mineral origin, perhaps iron or manganese oxides or sulfides.

For comparative purposes, we also examined microscopically a sample of the black stain that covers much of the cave ceiling above the art panels. It was not entirely charcoal (soot) either, as there were very dark reddish brown mineral grains here also that appear to be iron or manganese oxides or sulfides.

Three of the four micro-samples from the cave art (AMO-CA#1, 2, and 4) were processed for generation of a graphite target for AMS ^{14}C measurement. Because of the low carbon yield, they were combined to yield a total of only 250 μg (0.25 mg) of C. This was deemed insufficient for dating, only about one-quarter of the usual amount required. The fourth sub-sample has been retained for possible future use in a second dating attempt. The poor yield of the other three casts doubt on the feasibility of dating with even the most refined present methodologies, however.

Although the connection between the charcoal sample from the floor below the art and the art itself is highly uncertain, it was deemed useful to obtain a date for general context of the cave itself. After pretreatment of a piece of one of the charred twigs with acid/alkali/acid protocol, AMO-2:10-20 was dated by accelerator mass spectrometer. It proved to be relatively recent, with a conventional radiocarbon age of 110 ± 30 yr BP, calibrating at 95% probability to AD 1695–1725 and 1805–1950+). This suggests that this charcoal in a hearth ca. 5 m below the design field in the lower chamber (which may have nothing to do with the art, but cannot be entirely ruled out) could date from the early eighteenth century or virtually any time since.

Discussion

Inferences regarding age of the art

From a stylistic perspective, it is not certain that all of these drawings were created by a single person or at a single time. Panel 2B in particular is notable for the level of detail, the use of perspective, and the depiction of action scenes. Panel 1A represents the opposite extreme, where drawings are generally of a more coarse nature and without strong apparent interactions between individual figures or motifs.

It could be said that the most unusual characteristic of this cave art find is *what is entirely lacking*. There are no depictions of cattle (except one possible instance of cattle skulls used as ceremonial bucrania), in sharp contrast to the many cattle symbols previously described from SW Madagascar (Rasolondrainy 2012) and to the frequent

presence of cattle in recent Malagasy folk art and the presumed long importance of cattle to nearly all present-day Malagasy ethnic groups. There are no crosses or other recognizable religious symbols of Judaeo-Christian origin, nor are there any letters in word-like strings from any recognizable alphabet except perhaps one indistinct string of eight characters similar to Arabic, possibly the little-known indigenous *Sorabe* (Adelaar and Himmelmann 2004). Ever since the early nineteenth century, English and French influence on Madagascar has been widespread, including the Latin alphabet and Christian symbolism. Since pictorial art, and particularly “pagan” symbols, are explicitly forbidden by the Koran, a directly Islamic origin for the drawings seems unlikely. The “M-figures” could arguably be a Hindu symbol, although the trident shape in Hindu symbolism normally points upward (as on the apex of temples or in the hands of Shiva), not downward as observed in 15 of 16 cases in this design field (in the other case, it was sideways).

In terms of conceivable religious symbolism, instead, we note eight cases in the drawings where complex images showing human and animal interaction and possibly magico-religious ceremonies and symbols are portrayed. These images seem to invoke late Egyptian and/or Graeco-Roman themes, perhaps blended (David 2003) as in Ptolemaic Egypt: (1) The falcon (Supplementary material, S2. #15), *Horus* (see Metropolitan Museum of Art 2020, coll. #26.7.995), perches just below the “sword” of one of the M-figures (Supplementary material, S2. #14) on Panel 2A; (2) the head of *Thoth* appears along the top of Panel 2B (Supplementary material, S2. #21) in the late Egyptian form of an ibis head with body and tail formed by a crescent moon (Mark 2016); (3) the left lower center of this panel depicts “elephantbird” images both showing a head with large plumes (Supplementary material, S2. #23), evoking *Ma’at*, the Egyptian bird goddess who supplies an *ostrich feather* (similar to the elephantbird) to *Anubis* for weighing the hearts of the deceased (Metropolitan Museum of Art 2020, coll. #30.3.31 and # 33.8.21); (4) the two heads of a “sorcerer,” one on a crouched figure (Supplementary material, S2. #24) interacting with “*Ma’at*” and the other walking toward the hunting scene (Supplementary material, S2. #26), look like a small-eared *Anubis* (e.g., Metropolitan Museum of Art 2020 coll. #23.2.84); (5) the pose of the hunter (Supplementary material, S2. #28) is decidedly like Classical depictions of the constellation Orion, or *Sah* in ancient Egypt, syncretized with *Osiris*, (Cartwright 2017) complete with two hunting dogs (Supplementary material, S2. #30) as in mythology, represented in the sky by the constellations Canis Major and Canis Minor (Allen 1963) adjacent to Orion; (6) in Panel 2C the large right angle (Supplementary material, S2. #32) with limbs of equal length was itself a mystical symbol in Classical times, as the distance between the ends of the limbs of an isosceles right triangle (the hypotenuse) was *Pythagoras’ Constant*, equal to the irrational number $\sqrt{2}$ times the length of a side and therefore a very special number to some philosophers of the time (Schimmel 1993; Katz 1998). This “square” symbol persists in modern Freemasonry (Duncan 1866); (7) the *labyrinth*-like geometric (Supplementary material, S2. #42, #43) depicted with 3D effect on the corner of Panels 2E and 2F has many potential connections, as labyrinths in ancient times ranged from a huge one in Egypt near the pyramids to the mythological Labyrinth of the Minotaur on Crete, as well as other labyrinths and labyrinth symbols in Greece, India, and North America (Saward 2003), all presumably of religious significance; and (8) another symbol

that occurs in many cultures is the conspicuous scorpion (Supplementary material, S2. #7) on panel 1A. As in the distinctive constellations of the night sky and the mythology of Mediterranean traditions, the scorpion was the mortal enemy of Orion, and occurred on the opposite side of the sky—an often-repeated story that appears as far back as *The Iliad* of Homer. Similarly, it appears on the opposite side of the design field at Andriamamelo.

Thus the pictorial evidence seems to point to Egypt, perhaps especially the Ptolemaic period (last three centuries BCE). At this time, Classical Graeco-Roman mythology and the older Egyptian deities were undergoing syncretization. This mélange of gods and traditions (including the Pythagorean cult) were probably known to the ivory-trading maritime people of the Red Sea region due north of Madagascar (Burstein 1996). They may also have been known to the coastal African peoples of Azania, since Roman artifacts have been found as far south as the Rufiji Delta in Tanzania (Chami 1999). By the first century AD, the Classical author of *The Periplus of the Erythrean Sea* (Schoff 1912) was clearly familiar with the area as far south as *Rapta*, on the Tanzanian coast south of Zanzibar.

These observations invite speculation that the creators of at least some of the most detailed art at Andriamamelo, although apparently not employing the Latin alphabet, may have been well aware of a cluster of key Egyptian and Classical deities and stories, perhaps including knowledge of constellations. If these many correspondences are more than coincidental, one can envision two possibilities, both surprising. One is that at least some of the more detailed artwork here dates to approximately the beginning of the Christian Era or a few centuries before; or equally remarkable, that a magico-religious tradition in Madagascar retained imagery, perhaps in the form of zodiacal symbols and mystical tales, for many centuries, perhaps until the eighteenth century or after. Either interpretation is potentially controversial, but not inconceivable, especially since many of these figures are represented as constellations visible from the latitude of Madagascar, or recur as themes in mysticism, such as passage to an afterlife, supernatural help in hunting, and the special mathematical properties of the right triangle. These themes might have remained relevant to Malagasy life through the generations and could have been preserved in oral traditions and perhaps occult writings in *Sorabe* (Adelaar and Himmelmänn 2004).

An enigmatic motif

The mystery of these unique drawings is further compounded by the ubiquity of the M-figures, the only frequently repeated letter-like symbol noted. Because of its abundance and consistency throughout the panels (especially adjacent to the cleft between the panels), a search was made for this motif in a wide range of alphabets and pictographs from the Indian Ocean region and beyond. Rock art images were inspected from throughout Africa (Willcox 1984), as well as Socotra (Van Rensburg and De Geest 2015) and the Indonesian Islands (Fage 1989; Hoerman 2016; O'Connor 2003; O'Connor and Oliveira 2007). Similarly, alphabets from the written languages of these lands and others were also scanned for a “downward pitchfork” symbol. Two correspondences only were noted (Figure 8). In Ethiopian Amharic, the letter “häwt,” (ሐ) is

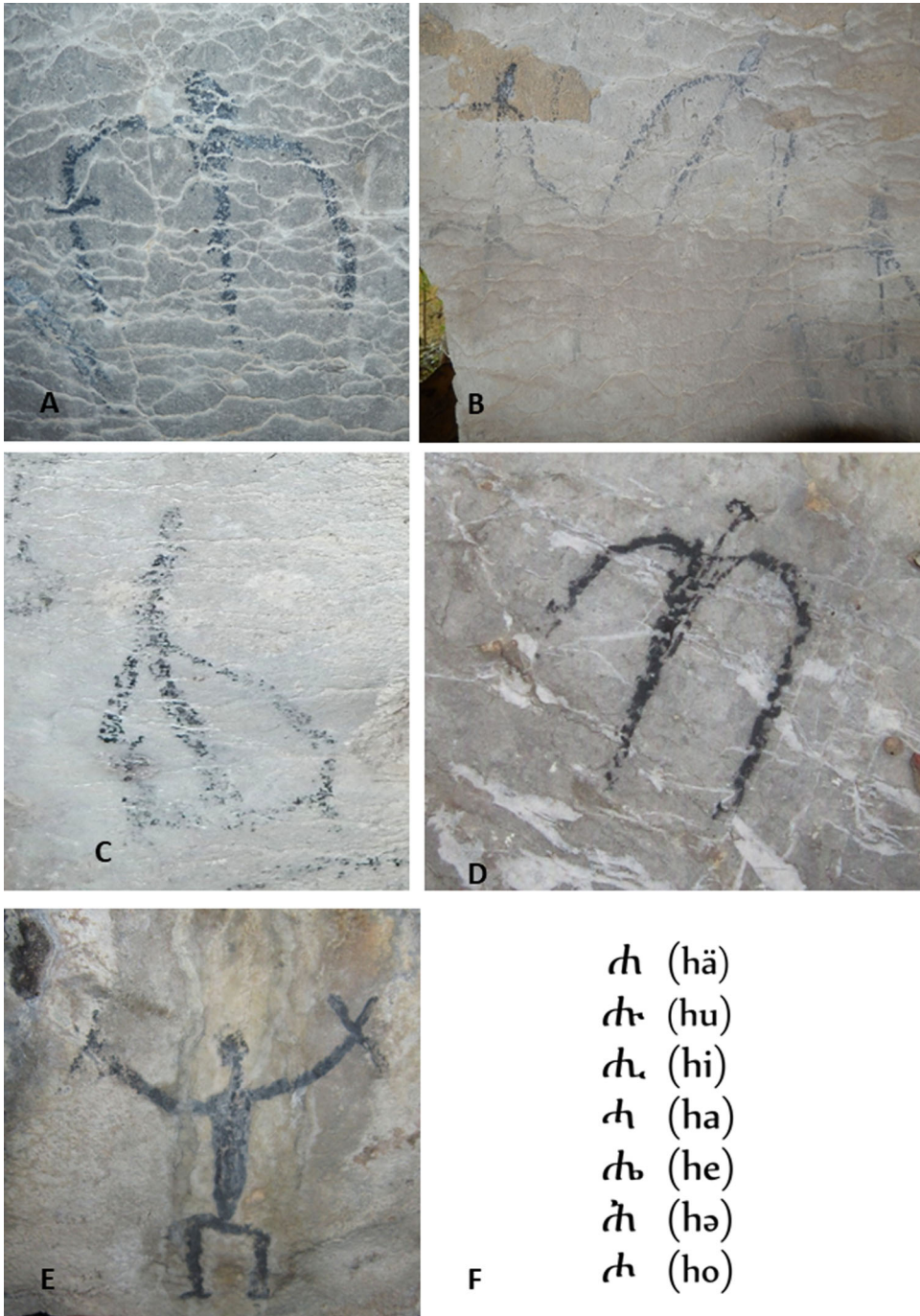


Figure 8. (A–C) Examples of the “M-figures” that occur 16 times throughout the design field; (D) photographs of a similar figure, and an anthropomorph (E) with “sword,” from Bornean rock art site (from Hoerman 2016; used with permission); (F) the Amharic letter *hāwt* with vowel modifications. Basic pronunciation of the symbols in the cave would be *hā* in most cases.

essentially identical. It is pronounced as an “h” with small modifications such as longer or shorter limb, or contingent slashes on the limb or “head,” to produce seven following vowel sounds (e.g., hä, hu, hi, etc.). The form at Andriamamelo is generally unmodified, thus *hä*.

The other, perhaps equally surprising correspondence, pertains to a symbol noted on some black rock drawings from Borneo (Hoerman 2016), undated, but thought to be ca. 2000 yr B.P. This motif is, like the Amharic letter, essentially identical to the M-figures. However, the M-figure is not prevalent in known cave art from Borneo to the extent that it is at Andriamamelo, and its meaning there is unknown. Cross-marks on long arms of stylized human figures, thought to represent “swords,” are common in the black rock drawings on Borneo, however (Hoerman 2016), and one M-figure at Andriamamelo (Figure 8A) has a conspicuously crossed limb.

A similar but not identical symbol, essentially more squarish in outline and lacking a longer line or “head” extending above the central axis of the symbol, has been described from the cave art of the Isalo region of southern Madagascar (Rasolondrainy 2012). This symbol is similar to one identified from Lybico-Berber, a Libyan script thought to have been in use about two millennia ago.

Variants of the Andriamamelo M-figure, generally similar but not identical as in the Bornean case, occur in rock art of the Horn of Africa and Lake Victoria region (Willcox 1984). For instance at the Ba’atti Sollum rock shelter in Eritrea schematized human figures are similarly abstracted, but in most cases show both arms and legs, although a few have a longer mid-line than the Andriamamelo figures but no legs depicted (Graziosi 1964).

Another possibility is that the symbol is merely pornographic, invoking a buttocks or vulva with a protruding shaft. Comparison to a comprehensive catalog of vulvae and buttocks drawings from cave and rock art worldwide (see Guthrie 2005, 329–66) showed that these commonly occurring depictions in parietal art worldwide almost never resemble the M-figure, and none were a good match.

The last possibility we can offer is that the symbol is indigenous to a particular Malagasy diviner or cult. It may be a kind of signature or invocation. Ramilisonina (personal observation) has noted that one divination method practiced among Malagasy shamans is the exercise of drawing without benefit of sight, blindly producing images that are intended to channel spirits. Perhaps, in this sense, our M-figures are symbols for ghosts or the life force. Some of the depictions, such as the large figure that stretches across 33 cm of Panel 2B, certainly seem anthropomorphic, but also perhaps alien or threatening. The human spirit or life force itself, sometimes represented in translation as “to breathe” in some Austronesian languages (e.g., Hawaiian; Pukui, Elbert, and Mookini 1975) is *hā* (phonetically, *hä*). Is it possible that this symbol connects Madagascar’s occult lore directly to Borneo, and to the Austronesian word *hä* as conveniently symbolized here by an African Amharic inscription that pronounces this syllable? We do not have at this time any way of resolving this tenuous, but compelling coincidence, but it is consistent with the prevalent notion that the unique culture of Madagascar arose from a blending of African and Southeast Asian traditions one to two millennia ago (Dewar and Wright 1993). Perhaps the M-figures are symbolic of spirits, or merely a highly schematized human form. It should be noted, however, that mixed

with these symbols on the Andriamamelo panels are much more naturalistic images of humans, animals, and therianthropes.

Conclusions

It should be evident that, whatever this art represents, it potentially sheds new light on Malagasy prehistory. It seems to show connections between traditional Malagasy symbology and the disparate worlds of the island's ancient influences, both from NE Africa and Borneo. Two extremely important areas to follow up in further investigations are: (1) the symbology of the *sikidy* and *ombiasy* traditions of Malagasy pre-Christian beliefs as perhaps still practiced by remote “Vazimba” cultural elements (and indeed many, if not all, Malagasy ethnic groups) in remote parts of Madagascar—a clear challenge for cultural anthropologists; and (2) the pursuit of cave explorations in the region aimed at finding more of this remarkable cave art legacy. It would be surprising indeed if this were the *only example* of this art style. Black rock drawings or any art depicting mythological figures, and lacking evidence for cattle-oriented culture and more recent European influences (Latin alphabet, cars, airplanes, flags, etc.), should be sought throughout Madagascar. Cave art like this can be easily overlooked. In caves with active speleothem growth, calcite might have obscured the drawings. On the other hand, calcite overgrowth can sometimes be dated radiometrically (U-series) in cases where carbon is insufficient for ^{14}C (see Rowe 2012). No such overgrowth of imagery was observed at Andriamamelo, but it is worth a search there and elsewhere for drawings covered in potentially datable calcite minerals.

It may be that the age of this indigenous artwork at Andriamamelo, as well as the motivation and the identity of the artists, will remain uncertain. This remarkable art is in one of Madagascar's most inaccessible areas. This has until now perhaps protected this fragile resource. Some sort of protection, beyond the very occasional visits of Beanka forest rangers, is needed for the site. Official designation of this unique cultural resource could help, as well as a focused study of the area aimed at learning more about this resource and developing a resource plan. If this art is perhaps 2000 years old, that is of course interesting, especially in light of recent estimates for the timing of initial human settlement of the island (see Douglass et al. 2019; Mitchell 2019). These range from slightly over one millennium (Anderson et al. 2018) to over 10 millennia (Hansford et al. 2018). On the other hand, if a little known, non-literate ethnic group has retained ancient stories, beliefs and rituals that came to Madagascar two millennia ago and survived for centuries with many details intact, that is equally or more remarkable. One could argue that the symbols have “evolved” as perhaps indigenous elements have been substituted, such as the head of a small-eared, long-nosed indigenous *fosa* (*Cryptoprocta*) for *Anubis*, *Màat* with feathers of a different ratite, and Orion adjacent not to a bear, lion, hare, or bull as in stories elsewhere, but perhaps a now-extinct large sloth lemur of Madagascar.

We have done our best to confine these speculative notions to mere proposals for consideration in the Discussion section. We realize that even the basic art descriptions provided here can be ambiguous and subject to diverse interpretations. For this reason we invite readers to view all the art, in [Supplementary Material \(S2\)](#), and share their

impressions with us, in the spirit of better understanding these enigmatic messages from Madagascar's past.

Acknowledgements

The scientific study authorization was provided by the Bureau du Cadastre Minier de Madagascar. Many thanks to faculty of the Université d'Antananarivo and staffs of Association Vahatra and Institut de Civilizations for assistance with permits and logistics. We extend special thanks to the staff of BCM, including Aldus Andriamamonjy and Didier Harison Joseph Nandianina for transporting us safely to and from remote places. To the people of the village of Anahidrano, we extend thanks for hospitality and assistance with field work. Local field assistants who accompanied us throughout our mission in the area included René Rafidison, André Tsimiefitsy, Justin Maro, and Georges Ratsimbazafy. *Misaotra betsaka* to our anonymous local informant for granting us an interview. Laurie Rohde Godfrey, Lida Pigott Burney and Gail Willis Cannon provided helpful comments on the manuscript. We are also grateful to Dr. Rachel Hoerman of the University of Hawaii—Manoa for pointing out to us the similarities with Bornean rock art, and for giving us permission to use her photographs of Bornean examples.

Disclosure statement

The authors have no potential conflict of interest.

Funding

Research at Beanka was supported by the National Geographic Society via Waitt Foundation grants W263-13 and W388-15 to DAB, and by the site managing organization, Biodiversity Conservation Madagascar (BCM).

References

- Adelaar, K. A., and N. Himmelmann. 2004. *The Austronesian languages of Asia and Madagascar*. London: Routledge.
- Allen, R. H. 1963. *Star names*. New York: Dover Publications.
- Anderson, A., G. Clark, S. Haberle, T. Higham, M. Nowak-Kemp, A. Prendergast, C. Radimilahy, L. M. Rakotozafy, Ramilisonina, J.-L. Schwenninger, et al. 2018. New evidence of megafaunal bone damage indicates late colonization of Madagascar. *PLoSOne* 13 (10):e0204368. doi:10.1371/journal.pone.0204368
- Anonymous. 2018. Les premiers peintures rupestres de Madagascar (exhibition). Accessed October 2, 2019. <https://www.naturevolution.org/que-faisons-nous/sensibilisation/grand-public/expositions/exposition-photographique-les-peintures-rupestres-du-makay/>.
- Beta Analytic. 2019. Charcoal dating. Accessed October 5, 2019. <https://www.radiocarbon.com/beta-AMS-lab.htm>.
- Burney, D. A. 2016. National Geographic Explorers' Journal. Accessed October 2, 2019. <http://voices.nationalgeographic.com/2015/07/31/cave-art-may-show-what-happened-to-giant-lemurs/>.
- Burney, D. A., H. Andriamialison, R. A. Andrianaivoarivelo, S. Bourne, B. E. Crowley, E. J. de Boer, L. R. Godfrey, S. M. Goodman, C. Griffiths, O. Griffiths, et al. 2020. Subfossil lemur discoveries from the Beanka Protected Area in western Madagascar. *Quaternary Research* 93 (1): 187–203. doi:10.1017/qua.2019.54
- Burney, D. A., H. F. James, F. V. Grady, J.-G. Rafamantanantsoa, Ramilisonina, H. T. Wright, and J. B. Cowart. 1997. Environmental change, extinction, and human activity: Evidence from

- caves in NW Madagascar. *Journal of Biogeography* 24:755–67. doi:10.1046/j.1365-2699.1997.00146.x
- Burstein, S. M. 1996. Ivory and Ptolemaic exploration of the Red Sea: The missing factor. *Topoi* 6 (2):799–807. doi:10.3406/topoi.1996.1696
- Cartwright, M. 2017. Orion. In *Ancient History Encyclopedia*. <https://www.ancient.eu/Orion/>.
- Chami, F. 1999. Roman beads from the Rufiji Delta, Tanzania: First incontrovertible archaeological link with the *Periplus*. *Current Anthropology* 40 (2):237–42. doi:10.1086/200009
- David, R. 2003. *Religion and magic in ancient Egypt*. New York: Penguin.
- Dewar, R. E., and H. T. Wright. 1993. The culture history of Madagascar. *Journal of World Prehistory* 7 (4):417–66. doi:10.1007/BF00997802
- Douglass, K., S. Hixon, H. T. Wright, L. R. Godfrey, B. E. Crowley, B. Manjakahery, T. Rasolondrainy, Z. Crossland, and C. Radimilahy. 2019. A critical review of radiocarbon dates clarifies the human settlement of Madagascar. *Quaternary Science Reviews* 221:105878. doi:10.1016/j.quascirev.2019.105878
- Duncan, M. C. 1866. *Duncan's Masonic ritual and monitor*. 2009 Kindle ed. Santa Cruz, CA: Evinity Press.
- Fage, L.-H. 1989. Les dessins parietaux de Gua Kao. *Spelunca* 34:31–5.
- Goodman, S. M., L. Gautier, and M. J. Raheirilalao, eds. 2013. The Beanka Forest, Melaky Region, western Madagascar. *Malagasy Nature* 7:1–146.
- Goodman, S. M., and W. L. Jungers. 2014. *Extinct Madagascar: Picturing the island's past*. Chicago: University of Chicago Press.
- Graziosi, P. 1964. New discoveries of rock paintings in Ethiopia. *Antiquity* 38 (151):187–90. doi:10.1017/S0003598X00030957
- Guthrie, R. D. 2005. *The nature of Paleolithic art*. Chicago: University of Chicago Press.
- Hansford, J., P. C. Wright, A. Rasoamiamanana, V. R. Pérez, L. R. Godfrey, D. Errickson, T. Thompson, and S. T. Turvey. 2018. Early Holocene human presence in Madagascar evidenced by exploitation of avian megafauna. *Science Advances* 4 (9):eaat6925. doi:10.1126/sciadv.aat6925
- Hoerman, R. 2016. Utilizing rock art to trace human migration: Case studies from Sarawak, Malaysian Borneo. PhD diss., University of Hawaii-Manoa.
- International Federation of Rock Art Organizations. 2015. Rock Art Glossary. Accessed March 22, 2019. <http://www.ifrao.com/rock-art-glossary/>.
- Katz, V. J. 1998. *A history of mathematics—An introduction*. Boston: Addison-Wesley.
- Mark, J. J. 2016. Thoth. *Ancient history encyclopedia*. <https://www.ancient.eu/Thoth/>.
- Metropolitan Museum of Art. 2020. Online catalogue of ancient art. <http://www.metmuseum.org/art/collection> (specimen numbers given in text).
- Middleton, G. 2013. Caves of the Beanka karst, Melaky region, western Madagascar. In *The Beanka Forest, Melaky Region, western Madagascar*, ed. S. M. Goodman, L. Gautier, and M. J. Raheirilalao. *Malagasy Nature* 7:27–47.
- Middleton, G. 2015. Madagascar 2013—Back to northern Beanka. *Journal of the Sydney Speleological Society* 59 (2):41–53.
- Mitchell, P. 2019. Settling Madagascar: When did people first colonize the world's largest island? *The Journal of Island and Coastal Archaeology*, 1–20. doi:10.1080/15564894.2019.1582567
- O'Connor, S. 2003. Nine new painted rock art sites from East Timor in the context of the western Pacific region. *Asian Perspectives* 42 (1):96–128.
- O'Connor, S., and N. V. Oliveira. 2007. Inter- and intraregional variation in the Austronesian painting tradition: A view from East Timor. *Asian Perspectives* 46 (2):389–403. doi:10.1353/asi.2007.0014
- Pukui, M. K., S. H. Elbert, and E. T. Mookini. 1975. *The pocket Hawaiian dictionary*. Honolulu: University of Hawaii Press.
- Radimilahy, C. 2010. Un arte rupestre malgache ancien? In *A Madagascar—Photographies de Jacques Faublée, 1938-1941*, ed. M. Garlinski and E. Hopkins, 28–9. Geneva: Musée d'Ethnographie d'Geneve.

- Rasolondrainy, T. V. R. 2012. Discovery of rock paintings and Libyco-Berber inscription from the Upper Onilahy, Isalo Region, southwestern Madagascar. *Studies in the African Past* 10: 173–95.
- Rowe, M. W. 2012. Bibliography of rock art dating. *Rock Art Research* 29 (1):118–31.
- Saward, J. 2003. *Labyrinths and mazes—A complete guide to magical paths of the world*. New York: Lark Books.
- Schimmel, A. 1993. *The mystery of numbers*. Oxford: Oxford University Press.
- Van Rensburg, J. J., and P. De Geest. 2015. Rock art from Dahaisi cave, Socotra, Yemen: A preliminary report. *Proceedings of the Seminar for Arabian Studies* 45:417–30.
- Schoff, W. H. 1912. *The Periplus of the Erythraean Sea: Travel and trade in the Indian Ocean by a merchant of the First Century*. New York: Longmans, Green and Co.
- Willcox, A. R. 1984. *The rock art of Africa*. London: Routledge.