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Possible Pleistocene hominin tracks from South Africa's west coast

Two probable tracks have been identified on the ceiling of a small overhang in the Pleistocene Langebaan Formation on South Africa's west coast. They may have been made by a hominin trackmaker. They appear to have been registered at walking speed on a level, sandy dune substrate. Three tracks, attributed to *Homo sapiens*, were previously identified near Langebaan in 1995, and were popularly labelled 'Eve's Footprints'. The new identification of possible hominin tracks near Langebaan is the second from South Africa's west coast. This discovery adds to the sparse but growing global record of possible hominin tracks preserved in aeolianites.

Significance:

- Two probable fossil tracks have been identified on the ceiling of an overhang near Langebaan.
- The tracks may have been made by a human walking on a level dune surface during the Pleistocene.
- This discovery is the second of its kind on the west coast, and complements the 1995 identification near Langebaan of Pleistocene fossil tracks attributed to humans.

Introduction

The presence of fossil vertebrate tracks in Cenozoic aeolianites on South Africa's west coast is well established, since a 1976 report of a carnivore trackway at Kraalbaai, near Langebaan.¹ In the 1990s this trackway could not be located, but further tracks were identified nearby in 1995, and attributed to a hyaena, and a purported hominin trackway, containing three tracks, was dated to ~117 ka² and described in detail³. The tracks all occurred in the Late Pleistocene Langebaan Formation of the Sandveld Group.⁴

The announcement of the discovery of hominin tracks created considerable interest, and they became popularly known as 'Eve's footprints'.⁵ A trackway replica is exhibited at Geelbek Visitor Centre in the West Coast National Park. International acceptance of their hominin nature was more muted. Lockley et al.⁶ described them as 'rather poorly preserved' and 'less well-defined'. Bennett and Morse⁷ indicated that they were not unequivocally human, had 'relatively poor anatomical form', and stated that 'not all authorities are convinced that they are in fact human tracks'. However, the hominin interpretation was not contested; for example, the tracks were mentioned in a study on the morphological affinity of hominin footprints.⁸

No further fossil tracks have been reported in the subsequent quarter-century, although there have been a number of Cape south coast hominin tracksite discoveries.^{9,10} Unfortunately, modern graffiti on aeolianite surfaces in the Langebaan area occurs in abundance, and such graffiti abutted the trackway identified by Roberts³. A possible hominin tracksite on the Cape south coast was defaced and compromised by graffiti before it could be properly assessed.¹¹ The prevalence of graffiti may in part account for the absence of further reports of fossil tracks from the west coast. This, combined with the lack of international consensus with regard to the attribution of 'Eve's footprints', means that the identification of possible further hominin tracks at sites free of graffiti is potentially of interest.

A new site was recently discovered by one of us (RH) on an aeolianite surface in the Langebaan Formation (Figure 1). Two probable tracks (referred to herein as 'tracks'), which can possibly be attributed to a Pleistocene hominin trackmaker, occur in hyporelief on the ceiling of an overhang. The purpose of this article is to describe this site and discuss its implications.

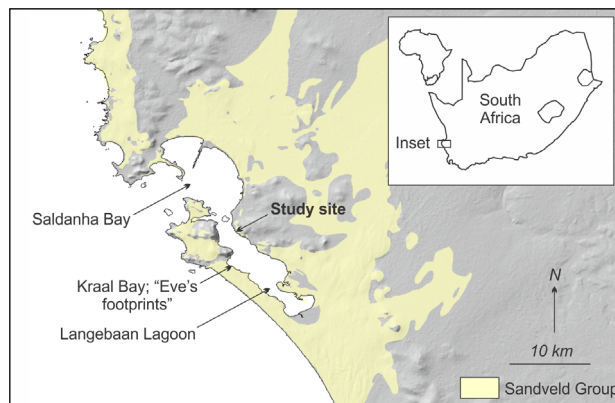


Figure 1: Locality map showing Sandveld Group sediments in the Langebaan region of South Africa's west coast, and the study site in relation to 'Eve's footprints'.

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Methods

GPS readings were taken and elevation was obtained using a hand-held Garmin 60 device. Locality data were reposit with the African Centre for Coastal Palaeoscience at Nelson Mandela University, to be made available to researchers upon request. The rock overhang dimensions were measured. Maximum track length (from the most proximal to most distal margins of the track, in the longitudinal axis of the track), track width, track depth, and pace length (from the most proximal portion of the first track to the most proximal portion of the second track) were measured. Results were recorded in centimetres. The trackway bearing was determined.

Photographs were taken, including images for photogrammetry.¹² Photogrammetry 3D models were generated with Agisoft MetaShape Professional (v. 1.0.4) using an Olympus TG-4 camera (focal length 4 mm; resolution 314 dpi; pixel size 4608 x 3456 μm). Final images were rendered using CloudCompare v2.6.3.beta.

Results

The aeolianite deposits form part of the Kraal Bay Member of the Langebaan Formation. They unconformably overlie intrusive rocks of the Palaeozoic Saldanha Batholith (Hoedjiespunt Granite) of the Cape Granite Suite, that fringe the Langebaan Lagoon. The site is situated on a level surface 18 m above sea level. The relatively coarse-grained (medium to coarse sand) aeolianite forms a massive outcrop, with homogeneous beds reaching several metres in thickness with no foresets visible. Vertically orientated solution pipes are evident (Figure 2a).

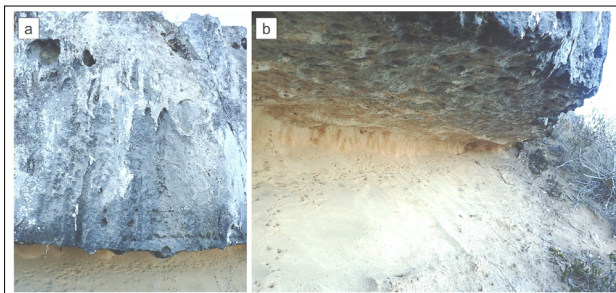


Figure 2: (a) The massive aeolianite outcrop above the overhang, facing east, showing homogeneous beds and solution pipes. (b) View of the overhang facing southeast, showing track-bearing ceiling and rear wall composed of a palaeosol.

The overhang is 6.6 m long and 1.5 m deep. It has a lens shape, pinching out at the lateral edges. Maximum ceiling-to-floor height of the lagoon-facing overhang is 1.2 m. It has a sandy floor, a friable aeolianite ceiling, and a rear wall composed of a palaeosol into which the overhang has incised (Figure 2b). There is no evidence of graffiti.

Many protrusions are present on this overhang surface, representing the infill of depressions in the (now absent) original dune surface. They are interpreted here as natural casts of probable vertebrate tracks, although in most cases their amorphous nature, poor preservation and lack of morphological detail preclude identification to trackmaker group, and imply that a non-biogenic origin for these features cannot be completely excluded. The two largest of these features, interpreted here as probable tracks, exhibit some definable morphological characteristics, and approximately similar orientations, suggesting a trackway segment (Figure 3a), with a bearing of 355° (heading towards the rear wall). The southern feature is referred to as Track 1, and the northern feature as Track 2, consistent with the inferred direction of travel. Track 2 exhibits better morphological detail.

Track margins are not crisply defined, and the possibility that measured track lengths may include infill of heel-drag impressions cannot be excluded, reminiscent of the phenomenon noted at a hominin tracksite by Helm et al. (Fig. 5)¹⁰ on the Cape south coast. Track 1 (Figure 3b) is

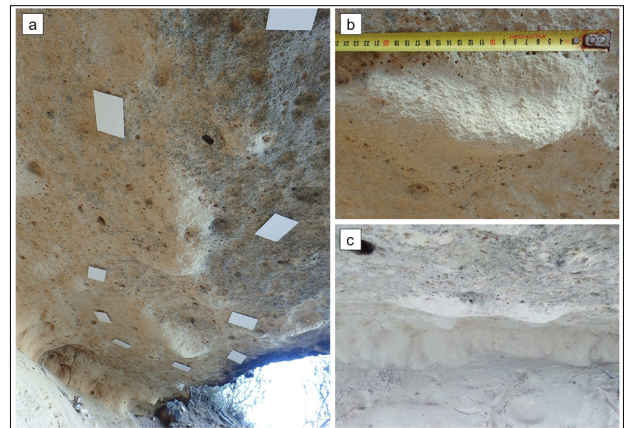


Figure 3: (a) Tracks on overhang ceiling, viewed facing south. (b) Track 1 in profile. (c) Track 2 in profile.

28 cm in maximum length, and 14 cm in maximum width. Maximum depth of the anterior portion is 3 cm, and the posterior portion is 4 cm. Track 2 (Figure 3c) is 29 cm in maximum length, and 13 cm in maximum width. Maximum depth of the anterior portion is 3.5 cm, and the posterior portion is 4 cm.

Pace length is 49 cm. Both features exhibit an outward convexity, more evident in Track 2, with the medial margin in particular being curved (Figure 4a). When only two tracks are present, the approximate trackway direction can be inferred by bisecting the two footprint long axes, assuming equal rotation from the midline. In this case, each track is aligned $\sim 18^\circ$ to the outside of the bisector (Figure 4b). No definite evidence of digit traces or displacement rims is evident, although a faint hallux trace may be present at the anterior end of Track 2 (Figure 4b).

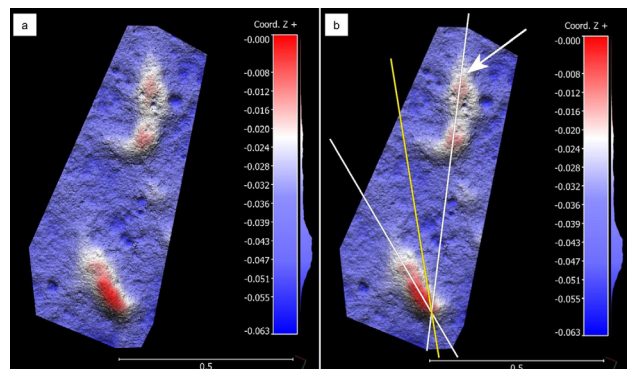


Figure 4: (a) Photogrammetry colour mesh of possible hominin tracks, using 64 images. Photos were taken an average 27.1 cm from the surface. The reprojection error is 0.731 pix. Vertical and horizontal scales are in metres. (b) Identical image to (a), with the addition of white lines to indicate footprint long axes, and the yellow line as a bisector; the arrow indicates faint possible hallux trace at the anterior end of Track 2.

Discussion

The identification of fossil hominin tracks has been addressed^{7,13}, and the hominin track record has been reviewed in detail: tracks registered in aeolianites are a global rarity, and the southern African tracksites therefore represent an exception.^{6,7} An approach to the identification of southern African hominin tracks has been developed and refined.^{9,14} Applying these principles to the features described here facilitates their evaluation, while recognising that they apply more to well-preserved tracks in suitable substrates than to the tracks described here.

Dimensions and pace length are broadly consistent with a hominin trackmaker^{7,15}, especially considering the possible length overestimate due to heel-drag impressions as noted above. The true tracks may therefore not have been as gracile (elongate) as they appear. Moreover, the friable nature of the ceiling and tracks, indicating that they are vulnerable even to light touch, suggests that more detail might have been evident if they had been discovered earlier. In addition, a longer trackway, or more definite evidence of digit impressions, would allow for more confident trackmaker identification. Nonetheless, a possible right-left footfall pattern can be inferred from the outward convexity of each track (providing possible evidence of a medial longitudinal arch). This pattern of outward convexity would be unlikely to be registered by any contemporary trackmakers, including overstepping equids.¹⁴ In such a scenario, Track 1 would be a right track and Track 2 a left track. The different orientation of the two tracks is consistent with an eversion gait pattern or a direction change. The recorded pace length is broadly consistent with a walking gait.^{7,15} A profile view of Track 2 (Figure 3c) is similar to that of hominin tracks at Brenton-on-Sea, although at the latter site the rocks are well cemented and the tracks exhibit better preservation.¹⁰ The finding of moderately deep tracks without much morphological detail suggests they were made in a non-cohesive substrate such as dry sand.¹⁵ On the basis of track outlines, dimensions, pace length, profile view, possible hallux trace, and the suggestion that the trackmaker may have had a medial longitudinal arch, we contend that these are likely hominin tracks, while acknowledging that more rigorous identification criteria cannot be met and that this contention cannot be asserted with certainty. Nonetheless, similarity to natural cast hominin tracks on the Cape south coast is apparent.⁹

The Langebaan tracks identified by Roberts in 1995 ('Eve's footprints') were recovered and are housed in the Iziko South Africa Museum, Cape Town.³ Roberts described three natural mould tracks, in a right-left-right sequence, with displacement rims, and attributed them to *Homo sapiens*.³ The trackway was interpreted as descending diagonally down a dune, and involving a direction change. A track length of 22.8 cm and pace length of 50.0 cm were recorded.³ Evidence of a medial longitudinal arch was reported in one track, along with poorly preserved digit impressions. Roberts³ used a formula¹⁶ to estimate trackmaker stature, giving a height estimate of 152 cm. Roberts reportedly excavated the adjacent area, exposing additional tracks. However, these were in a softer substrate, and were described as 'ephemeral'. They were left in situ and covered (Avery G, personal communication, September 2018).

The aeolianite horizon at the newly identified site, 18 m above sea level, is higher than the horizon of 'Eve's footprints'. Nonetheless, the identification of further inferred hominin tracks, free of graffiti and within kilometres of those previously reported, suggests support for Roberts³ conclusion of a hominin trackmaker. The quality of preservation and lack of morphological detail are consistent with many other Pleistocene tracksites on the Cape coast, where tracks were registered on unconsolidated dune substrates.⁹ Dedicated exploration of aeolianite surfaces (preferably free of graffiti) in the area, in search of tracks of unequivocal hominin origin, would be valuable.

While the track-bearing surface has not been dated, we can speculate that if the tracks were registered during a higher-than-present sea level, the lagoon would likely have appeared different to its present-day configuration. Parts of the coastal ridge may not yet have accreted; extensive dunefields may have existed, and the western and eastern shores of the lagoon may conceivably have been linked in places by these dunes, if the extent of the lagoon was more limited.

Conclusions

The identification of two new possible hominin tracks near Langebaan adds to the sparse record of putative hominin tracks from South Africa's west coast. Although not unequivocally attributed to a hominin trackmaker, they lend credence to the purported hominin origin of the tracks identified nearby in 1995, known as 'Eve's footprints'. The newly identified tracks were probably made in a soft, sandy dune substrate by an individual moving at a walking speed.

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Competing interests

We have no competing interests to declare.

Authors' contributions

C.W.H.: Conceptualisation, data analysis, project leadership, photogrammetry. H.C.C.: Data collection and analysis, site analysis, field stratigraphy, review of drafts and revisions. J.C.D.V.: Conceptualisation, track analysis, review of drafts and revisions. R.H.: Area exploration and site discovery, conceptualisation, review of drafts and revisions. M.G.L.: Conceptualisation, data analysis, review of drafts and revisions.

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