

## Last Interglacial (c. 117 kyr) human footprints from South Africa

Dave Roberts and Lee R. Berger\*

*A rare fossilised trackway of human footprints, dated to c. 117 kyr, has been discovered along the shore of Langebaan Lagoon, South Africa. The footprints present direct evidence of human morphology and behaviour at a potentially critical period in human evolution and in the region that presently offers the best fossil record for the origin of anatomically modern human morphology at approximately 120 kyr ago.*

Knowledge of African human morphology and behaviour during the period 150 000–100 000 years ago is important in understanding the origins of modern humans.<sup>1–10</sup> African fossil human and archaeological remains from this period are scarce, especially from open-air sites. Dated trace fossils recording human presence, morphology and activities are thus extremely valuable. We report here human and animal footprints, dated to c. 117 000 years ago (117 kyr), preserved in calcified aeolianites (Figs 1 and 2), at Langebaan Lagoon, 110 km north of Cape Town, South Africa. The footprints are close to several important Middle Pleistocene hominid-bearing and archaeological sites, and are of a similar age to the Klasies River Mouth and Border Cave human fossil sites.<sup>11–15</sup>

Active, partially vegetated Holocene dunes seaward of the calcified dunes constitute excellent modern analogues of earlier formations. The modern dunes are formed by dry, south-southwesterly (summer) winds in this Mediterranean climate, set oblique to the shoreline. The geometry of the aeolianites, allied with internal structure (dominated by north-northwesterly dipping foresets) and localised root disturbance are indicative of a genesis closely analogous to that of the Holocene dunes.

The hominid footprints reported here were evidently made in rain-moistened sand<sup>16</sup> (dry sand lacks cohesion). Vertebrate footprints in soft sediment form a depression of compressed, deformed and truncated laminae, surrounded by an up-arched rim.<sup>17–19</sup> The sloping dune surface caused asymmetrical rim development, such that the ridges formed on the down-slope side of each print (Fig. 2). In the right (up-dip) print, pressure was distributed evenly along the inner margin of the foot during weight transfer, forming a depression of fairly uniform depth. The left (down-dip) print indicates that most pressure was exerted by the ball of the foot, coinciding with maximum depression depth (3.2 cm). This pattern of weight

distribution and resulting footprint morphology can be readily duplicated by walking diagonally down modern, wetted dune slipfaces.

All the footprints were made only a few metres from the Pleistocene lagoon shore, when mean sea level was approximately at +1.3 m, that is, the height above present mean sea level of the conformable contact of the aeolianite with the underlying lagoonal calcarenites (the coastline in this area has been tectonically stable since the Middle Pleistocene).<sup>20</sup> The prints were

rapidly buried by subsequent aeolian sedimentation.<sup>16</sup> Precipitation, alternating with strong southerly winds, characterises spring and autumn today. The calcified lagoonal sediments were dated at 118 ( $\pm 18$ ) kyr by infrared stimulated luminescence (IRSL). Thermoluminescence (TL), IRSL and U/Th dating yielded dates of 228 ( $\pm 25$ ) kyr, 107 ( $\pm 7$ ) kyr and 103 ( $\pm 7$ ) kyr, respectively, on footprint-bearing aeolianite. The TL date is regarded as unreliable because of the lower dose rate involved in the measurement. A U/Th date on carbonate in the aeolianite yielded an age of 102.6 ( $\pm 7$ ) kyr. A U/Th date of 75 ( $\pm 9$ ) kyr on calcrete 8 m above the hominid footprints (Woodburn *et al.*, in prep.) reflects the average age of dune calcification. The true age of the footprints is estimated from sea-level oxygen isotope curves<sup>21–23</sup> at ~117 kyr, i.e. late oxygen isotope sub-stage 5e; sea level must have been falling to have prevented the prints' subsequent erosion.

Using foot length to estimate stature is



Fig. 1. Footprints viewed from the west, looking across Langebaan Lagoon. The footprints occur in medium- to coarse-grained quartz/bioclastic aeolianite, on the tangential toe set of cross-strata dipping north at about 10°. These Pleistocene dune systems are parallel to the shoreline, having accreted mainly vertically. They form a ridge 8 km in length, ranging up to 50 m in height and situated 0.8–1.5 km from the modern strandline. The prints are 40 cm above the conformable contact of the aeolianite with underlying calcified and bioturbated lagoonal muddy sands. Present mean sea level is 1.3 m below this contact. Two complete footprints and the recently eroded remnants of a third, form a right-left-right track descending diagonally down the palaeo-dune slip face. The zones of sand disturbance are ~25 cm long but actual foot lengths are estimated to be 22 cm, and breadth at the distal ends of the metatarsals is 8.5 cm. Heel to heel stride length is 51 cm and well-developed arches are evident. Vague toe marks are discernible distally in the right rear print (not visible in this photograph); the hallux is the longest toe. The long axes of the right and left prints form angles of ~20° and ~40°, respectively, to the direction of motion. Pronounced ridges of sand occur on the downslope margins of both complete prints, and form the remnants of the third (front) print. Hyena and small antelope footprints are similarly preserved on different foresets. The trace-bearing foresets were exhumed and exposed by wave erosion during the Flandrian transgression. Preservation was greatly enhanced by the high initial CaCO<sub>3</sub> content (approximately 30%) of the dunes. The hominid trackway can be extrapolated updip into an adjacent cliff, raising the possibility of back-tracking by excavation. (Photo courtesy of Kenneth Garrett and *National Geographic*.)

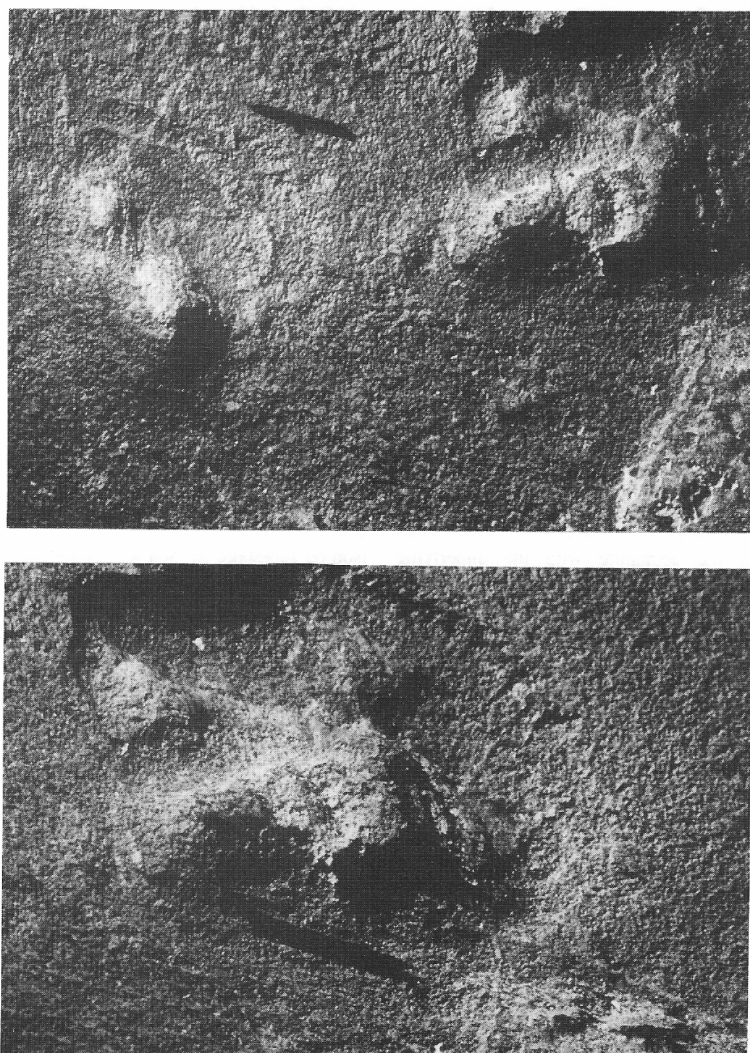


Fig. 2. Another view of the footprints. (Top) The right and left prints; (bottom) the left (front) print, showing especially the ridge of sand squeezed out on the downslope side of the foot. The pen (dark stripe running obliquely down from left to right) is 12 cm long.

imprecise, but if relationships of pooled modern human foot length to stature are applicable, the stature of the early walker by the lagoon would have been ~137–168 cm (refs 24–26). This range encompasses the mean height reported for adult San women (148 cm) and for adult San men (166 cm) in the central Kalahari prior to 1915.<sup>27</sup> The footprints are appreciably larger, at 22 cm, than incorrectly dated human footprints recorded at East London, South Africa (19 cm in length).<sup>16,28</sup>

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Dave L. Roberts is with the Council for Geoscience, P.O. Box 572, Bellville, 7535 South Africa (e-mail: geoscience@iafrica.com) and Lee R. Berger is in the Palaeo-Anthropology Research Group, Department of Anatomical Sciences, University of the Witwatersrand, 7 York Rd, Parktown, Johannesburg, 2193 South Africa.

Footnote: A further, illustrated account of the Langebaan footprints is to be found in the September 1997 issue of *National Geographic*, whose photographer, Kenneth Garrett, provided Fig. 1 of the above article as well as this month's cover picture. The February 1997 issue of the magazine includes another of its incomparable series of articles on the African evidence for early man. These feature some of the authors and material reported on in the April issue of this *Journal*, which commemorated the 50th anniversary of the discovery of 'Mrs Ples'.

**The Transvaal Museum Shop has replicas of 'Mrs Ples', subject to availability.**

Contact Dr Francis Thackeray or Diana Bolsmann, Transvaal Museum, P.O. Box 413, Pretoria, 0001.  
Tel: (012) 322-7632  
Fax: (012) 322-7939  
E-mail: mrsples@global.co.za