

# The Dinosaur Tracks of Otjihaenamaparero, Otijwarongo District, Namibia

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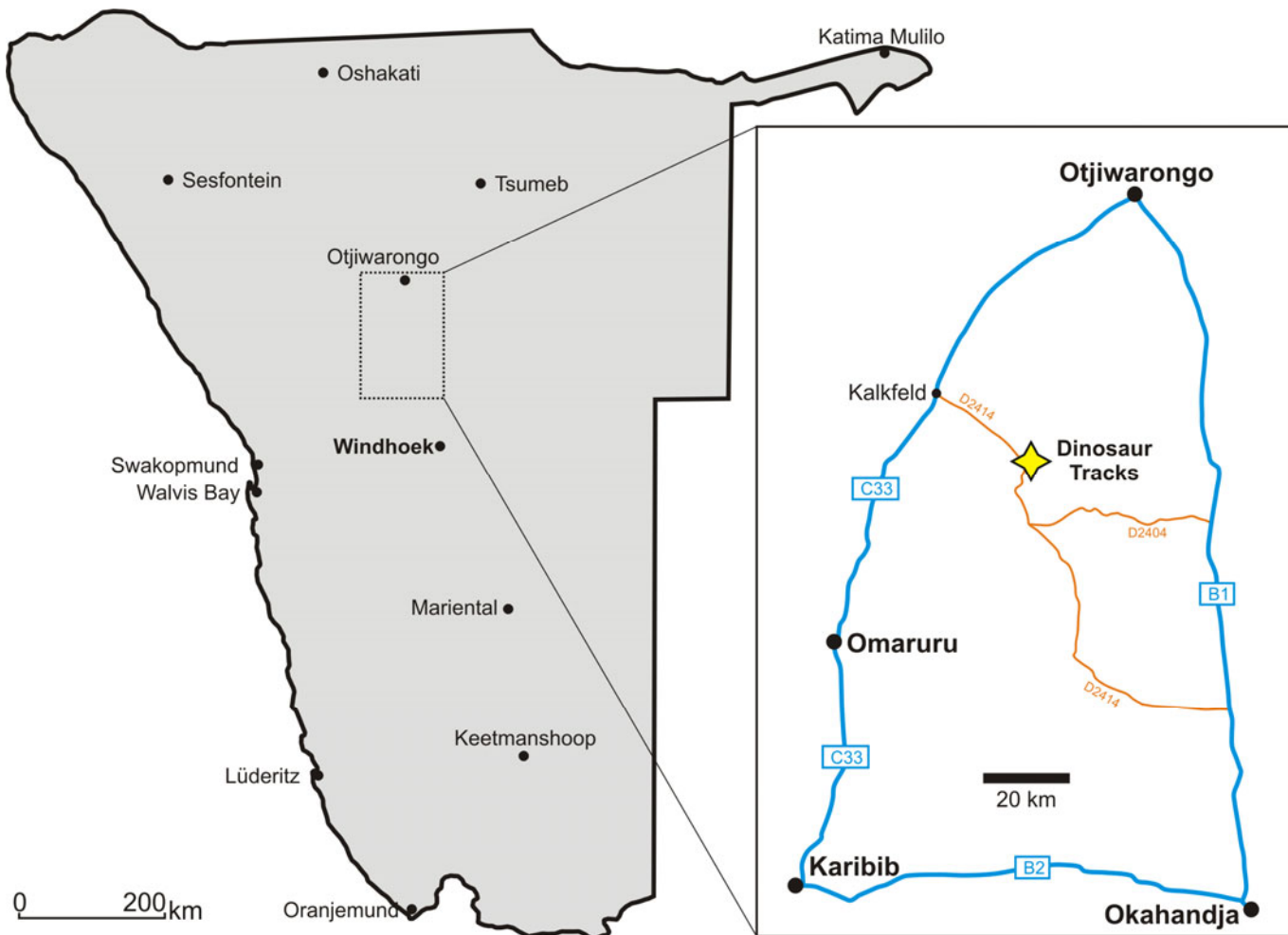


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The Karoo basin in southern Africa was a major sediment deposition area from the Carboniferous until the Jurassic. Evidence for the occurrence of dinosaurs can be found there from the Upper Triassic onwards, where they had to face an environment that increasingly changed towards an arid climate. Apart from skeletons, dinosaur tracks were discovered at several places in Namibia. Among them, the trackways of Otjihaenamaparero are renowned as the most impressive ones.

### How to get there & terms of entrance

The trackways are located on the territory of farm Otjihaenamaparero 92, located approximately 180 km north of Windhoek. One can reach the farm on pads D2414 (south of Kalkrand, via C33) or D2404 (between Okahandja and Otjiwarongo, via B1). The turnoffs are signposted. Coordinates: 21°2'24.46" S, 16°24'1.74" E. Considering bad road conditions and a lack of mobile network coverage in the solitary area, it is recommended to carry a spare tire and enough drinking water. Sufficient time should be allowed to cope with the pad conditions. The traveller will however be rewarded with great scenery along the route. It is best to visit the tracksite at times of angular sunlight, when shadows emphasize the impressions.



**Fig. 1: Location of Dinosaur Tracks National Monument in Namibia and route scheme**

The entrance fee has to be paid at the farmhouse (20 N-\$ p. p., March 2013). The two tracksites are located at 150 and 450 m walking distance from the farmhouse. Footwear that protects from small biting and stinging animals is recommended.

A board provides information about the tracks. The site is a protected National Monument. Any interference, change or destruction of the tracks or their surroundings are forbidden and are subject to fines and prison sentence.



## Geology and palaeogeography

The trackways are located near the north-west base of Mount Etjo in sandstones of the basal Etjo Formation (Lower Jurassic, approx. 200-190 ma) (SCHNEIDER, 2008: 93ff.).



**Fig. 2: South-east side of Mount Etjo, plateau built up by Etjo Sandstone**

During the Upper Triassic (Karnian), a half-graben formed in northern Namibia: the Waterberg Basin (also: Omingonde Basin), which, under semiarid conditions, consumed the erosional debris deriving from the surrounding proterozoic peneplains. At first, the Mount Etjo area was covered by an extensive lake (Lower Omingonde Formation), followed by braided river systems while aridity increased (Middle Omingonde Formation), finally replaced by a landscape with eolic dust plains and salt pans (Upper Omingonde Formation). The drought finally led to the formation of a sand desert dominated by dunes around the Triassic-Jurassic boundary (Etjo Formation). The fauna gathered at episodic rivers, lakes and ponds between the dunes, where they left their tracks in the wet shoreline sand. Wind-blown sand soon covered the tracks, hence contributing to their conservation. Landscape and climate were similar to the present-day Kalahari (CATUNEANU et al., 2005: 245).

The tectonic processes that accompanied the formation of the South Atlantic Ocean led to the formation of a prominent tectonic structure in northern Namibia, the Waterberg Fault, from the Lower Jurassic onwards (approx. 180 ma). Along the fault line, proterozoic basement and overlying mesozoic sediments were thrust over the Waterberg Basin in a steep angle in a south-easterly direction. The sediments located south-east of the fault were subsequently protected from erosion by the overlying thrust sheet (a large body of rock that suffered extensive horizontal movement along a fault plane). Today, they form the inselbergs of Mount Etjo and Waterberg, while the thrust sheet itself fell victim to erosion for the most part.

Karoo Sequence (Upper Carboniferous - Jurassic)	Lias - Dogger	<b>Etjo Formation</b> Desert
	Karnian - Lias	Upper Omingonde Formation Semi-desert
		Middle Omingonde Formation River system
		Lower Omingonde Formation Inland lake

**Fig. 3: Stratigraphic scheme of the Waterberg Basin, after CATUNEANU et al., 2005 and SCHNEIDER, 2008**



**Fig. 4: Present-day examples for the assumed palaeoenvironment: Steppe vegetation in the Kalahari (above) and interdune salt-clay pans of an ephemeral river in the Namib desert (below)**

## The outcrop

Due to the tectonic processes, the track-bearing bedding planes are strongly jointed today and have a north-west dip. They are situated several hundred meters lower than the coeval strata of Mount Etjo south of the Waterberg Fault which were flexed upwards by the thrust movement and now form the top of the table mountain.

The tracks of Tracksite 2 were marked with white paint by personal initiative of the land owner to improve their visibility. This is against the principles of the care and conservation of historic monuments – also in Namibia. Furthermore, some tracks were affected by attempts to remove them.

## Tracksite 1

The trackway left by a small dinosaur can be seen at so-called Tracksite 1 on the way to the main site. It consists of tridactyl imprints of hind feet with a diameter of 6-7 cm, which led to the interpretation of the trace as left by a bipedal dinosaur of the order Theropoda, suborder Ceratosauria (SCHNEIDER, 2008: 108 f.). The assigned genus is *Syntarsus* (GEOLOGICAL SOCIETY OF NAMIBIA, undated), which is related to the carnivorous dinosaur *Coelophysis* (CARRANO & SAMPSON, 2008). Apart from the 12 m long trackway, some further tracks and short trackways can be found nearby.



Fig. 5: Tracksite 1



**Fig. 6: Tridactyl-bipedal track from Tracksite 1, direction of movement from fore- to background (scale: 6 cm)**



**Fig. 7: A single imprint of the track shown in fig. 6**

### **Tracksite 2**

Here, the exposed bedding plane shows two crossing trackways of a larger dinosaur species with 30 imprints altogether, and numerous single imprints in different states of preservation. The longer of the two tracks can be followed for over 28 m. The size of the individual imprints is 45x35 cm with a step length of 70-90 cm (SCHNEIDER, 2008: 107). The originator of the tracks could so far only generally be assigned to the Ceratosauria (Theropoda) group (GEOLOGICAL SOCIETY OF NAMIBIA, undated). Additionally, the vast plane also contains single imprints and short trackways left by smaller dinosaurs.



**Fig. 8: Tracksite 2 – Overview**



**Fig. 9: Ceratosaurid track at Tracksite 2 (scale: 6 cm)**





**Fig. 10: One of the two crossing trackways**



**Fig. 11: Trackway no. 2**



**Fig. 12: Some more tracks (scale: 6 cm). The lower specimen is well-known from publications and shows marks from an attempt to mark or remove it (upper right and bottom)**

## About the difficulties of track classification

Skeletons of theropod dinosaurs were found at several occurrences of Etjo Sandstone in Namibia, among others at the eponymous Mount Etjo and at Waterberg, but not in the vicinity of the Otjihaenamaparero tracks. An assignment of the tracks to certain theropod genera or even species is therefore associated with a relatively high degree of uncertainty.

## Acknowledgment

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## Literature

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