GEOLOGICAL SOCIETY OF ZIMBABWE

Field Excursion Guidebook

THE NTUMBE RIVER DINOSAUR FOOTPRINT SITES

(Lower Zambezi Valley, Chewore South)

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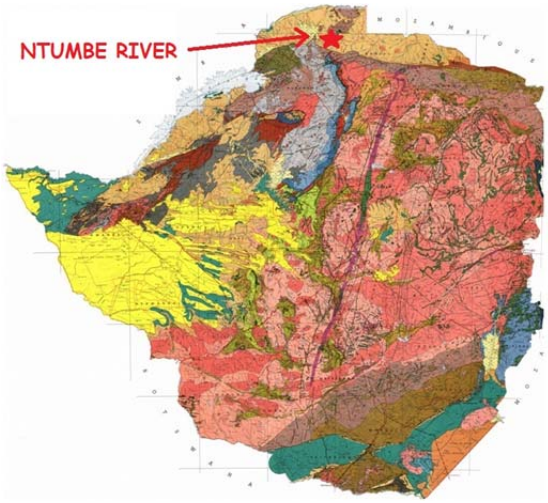
LOCATION

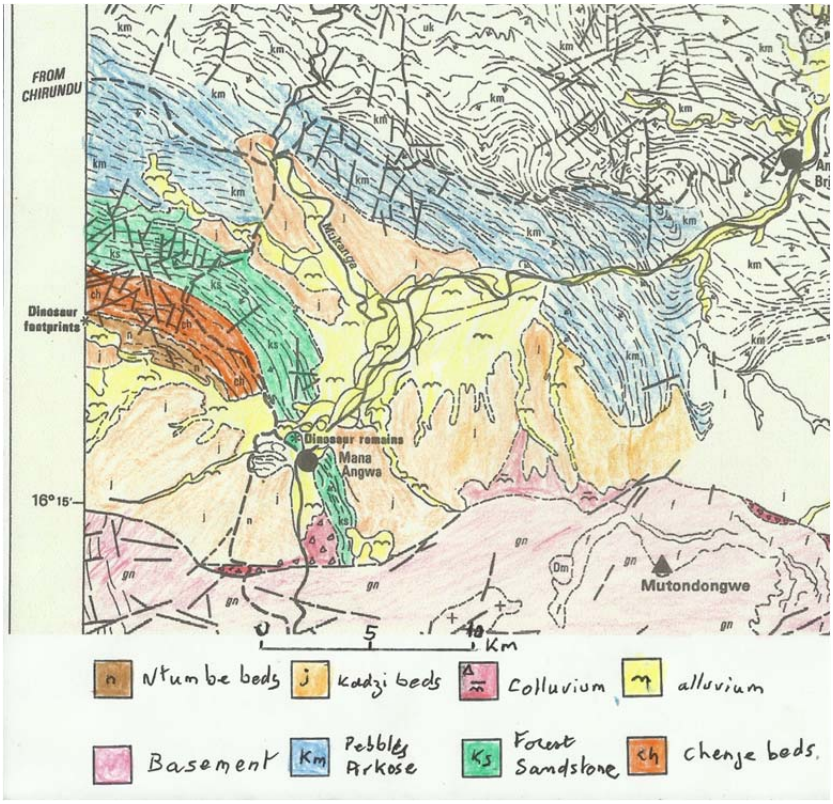
The Chewore South Safari area is located in the Lower Zambezi Valley.The Ntumbe River dinosaur footprints sites are found in the Southern part of the Chewore Safari Area, 11km SW of the Mkanga Bridge National Parks Station. Seven km South of the station and on the Mkanga Bridge – Karoi dust road, is a sign “Dinosaur Spoors” to the right of which a hunting track would lead to the first dinosaur trackway on the the Ntumbe river. All other sites fall on toposheet 1629 B2, immediately West of the 30^{0}00E Line



GEOLOGY

The Ntumbe River locality lies near the western boundary of the Karoo and post Karoo rifted Lower Zambezi Basin. Dinosaur footprints are found within strata of the post-Karoo Dande Sandstone Formation, Early Jurassic to mid-Cretaceous in age (Oesterlen and Millsteed, 1994). Broderick (1984) and later Lingham-Soliar and Broderick (2000) suggested a position immediately above the upper boundary of the Upper Karoo Forest Sandstone Formation "near" the Triassic-Jurassic boundary. The geological map of the area (Oesterlen, 1998) shows that all sites occur about 500 m (in rock thickness) above that boundary, following a succession of conglomerate and red to maroon, medium-grained, cross-bedded sandstones, informally called “Chenje Beds” (Broderick, 1990). The prints themselves belong to the " Ntumbe beds", which are unconformably followed by the "Kadzi beds".

We consider that the age of the Ntumbe beds is more likely to be Middle to Late Jurassic (Ait-Kaci Ahmed et *al.,* 2004).

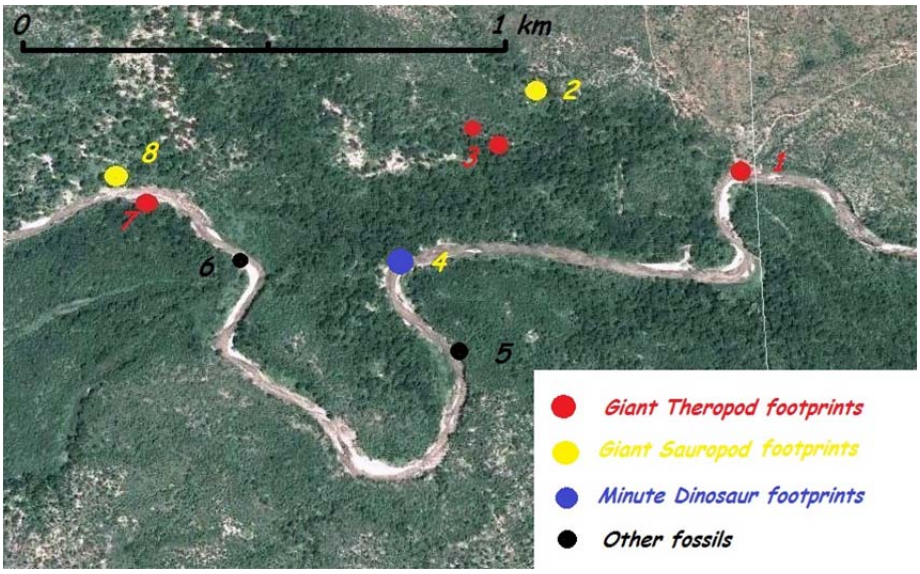


Tim Broderick's air-photo compilation, 1983 and 1987

Footprints are found on top of 5 to 30 cm-thick fine- to medium-grained micaceous sandstone beds. These sandstones are always cross-laminated or trough-cross laminated, showing on their top rib and furrow structures or ripple-marks. They form the lower part of 1 to 3 m-thick finning-upwards sequences comprising very fine-grained sandstone, siltstone, subordinate mudstone and rare limestone horizons. Mudstones may contain freshwater conchostracans (Raath, in Broderick, 1990) or/and scales (and bones?) of Lepidote fishes. Almost all beds show desiccation cracks of variable depth. All measured palaeocurrents indicate flows broadly to the west.

Sedimentological features suggest that the Ntumbe river sediments were deposited in a semi-arid to temperate environment.

Dinosaurs Footprints and Tracks of the Ntumbe River



Satellite Image of the Ntumbe River and its fossil sites

SITE 1 : The very first trackway found in Northern Zimbabwe

The first dinosaur trackway of Northern Zimbabwe was found in 1984 by a hunter in the bed of the Ntumbe River. T. J. Broderick (1984, 1985) described a 15 m-long trail of 14 footprints marked on the sandstone pavement of the river. The trail emerges from beneath the northern bank alluvium, continues in a straight line then disappears beneath the river-bed sand. Prints show clearly 3 forward protruding clawed toes and a heel drag or slip. They are on average 40 cm-long from heel to toe and 33 cm-wide from toe to toe. In 1990, the site was excavated and 31 new prints were discovered underneath the riverbed sand. The trackway was then visible on a length of 48 m. D. Munyikwa (1996) argued that the most likely maker of the trackway is a medium to large theropod carnosaur. He assigned the footprints to ichnogenus Eubrontes (Eubrontes is not a dinosaur species, it's a fossil print) which first appeared in the late Triassic and became abundant in the Jurassic period.

We now think that these prints were made by a large-sized bipedal carnivorous dinosaur, i.e. Allosaurus, (an ancestor of Tyrannosaurus rex), which fossilized bones are found within the Kadzi beds, together with giant sauropod bones, in the Kadzi River, 50 km to the East.

A single print of Site 1

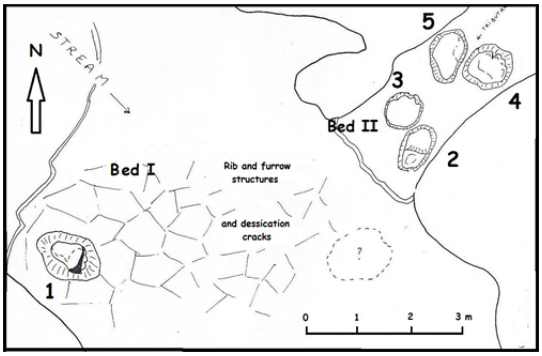
Six visible prints.....

The possible culprit.....

Allosaurus was up to 12 m long and 5 m tall. It weighed about 1400 kg. It had a 3 feet long (90 cm) skull with two short brow-horns and bony knobs and ridges above its eyes and on the top of the head. It had large, powerful jaws with long, sharp, serrated teeth 5 to 10 cm long.

SITE 2: The first Giant Sauropod footprint...

While surveying Site 3, I came across the first Giant Sauropod ever found in Sub-Saharan Africa



Five large rounded footprints are found above two successive 8 to 10 cm-thick sandstone beds dipping at 10° towards 288° N.

***Lower Bed**:* It bored a fairly well preserved 94cm-long, 56cm-wide and included a 30cm-long heel-drag. It had 3 or 4 less-than-10cm-long toes.

Upper Bed: bears 4 footprints at the mouth of a small tributary.

Their size (87, 80 and 60 cm-long, respectively), their rounded shape and the occurrence of a raised ridge, suggest they were made by the same dinosaur species than print 1.

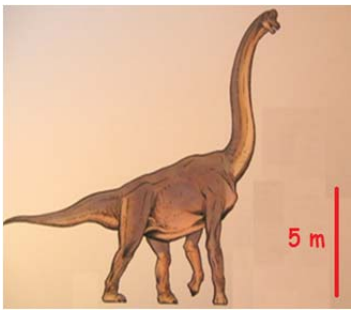
Print 5 is 73cm-long is better preserved and shows 4 clear short toe prints.

Print1

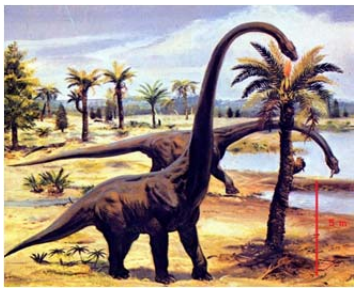
Prints 2,3,4 and 5

Features and shape of these prints suggest that the print-maker could be a sauropod dinosaur, of about 3 to 5 m-height at hip (Alexander, 1976).

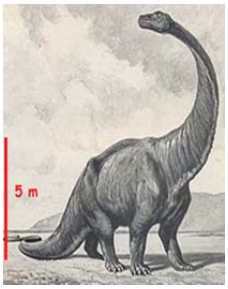
Possible print-makers were all identified in the Kadzi River.



Brachiosaurus (26 m-long, 50-80 t)



Barosaurus (30 m-long, 50 t)



Tornieria (20 m-long, 50 t)

Camaraurus (5-20 m-long, 45-50 t)

When I revisited Site 2 in 2003, Print 1 had unfortunately been destroyed, very likely by elephants and floods in the stream.

SITE 3. The 88 theropod footprint site.

Site 3's strike length is about 150m and lies in a 3 to 8 m-wide stream. Eighty-seven prints lie in 4 successive locations. They range from 25 to 52 cm in length and are significantly longer than wide. All well-marked prints are tridactyle. They show curvated claws and sharp medial curvature of digits II and III, distinctive of theropods.

These prints may well have been made by herds of Allosaurus

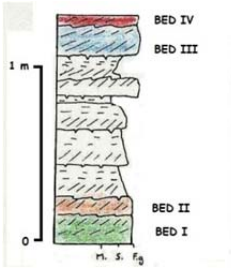
SITE 3-1. This site, the first one upstream to the NW bears only 4 tridigit prints on bed II.

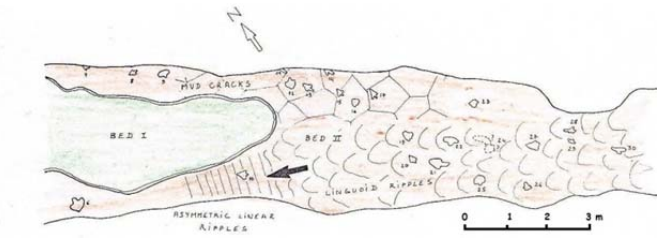
SITE 3-2. A 15 m-long pavement (bed II) bears 25 footprints. They range from 25 to 46 cm in length . A particular elongated print could be related to a short tail drag. In the middle of the site, footprints would belong to a same N-S theropod trackway. The bed II surface shows at that place two distinctive sedimentary structures. To the NE bed II is marked by desiccation cracks while to the SW it shows linguoid current ripples then linear-crested current ripples indicating a paleocurrent to the WNW (black arrow). It means that while the water was still flowing in a part of the site, the sediment was already drying up, few meters away.

SITE 3-3. The stream pavement consists of beds III and IV, 20 and 8 cm in thickness, respectively. Upstream, bed IV is eroded and restricted to both sides of the stream, the central part of it showing the surface of bed III . The surface of bed III is covered by linguoid ripples while bed IV shows in places small linear crested ripples. These two consecutive sedimentological structures indicate a decrease in the speed and the depth of the water from deposition of bed III to deposition of bed IV. Paleocurrents are to the WSW and the WNW. Forty-one dinosaur footprints are marked on bed IV. They range from 25 to 52 cm in length. More than half of them are the biggest tridigit footprints recorded in the area. Most of them are deep and very well preserved, showing prints of sharp claws and sometimes long heel drags. In two cases, two prints are superposed. In the centre of the site, numerous prints with almost the same bearing could represent several crossing trackways.

SITE 3-4. Sixteen tridigit footprints are borne by bed IV, now restricted to 0.5 to 1.5 m in width at one side of the stream. Bed IV also shows here an area of linear crested asymmetrical ripples indicating a paleocurrent to the W.

Bed III shows only one isolated and poorly marked footprint (No 72) that is likely the bottom part of a print made in fact on bed IV that is only 5 to 6 cm-thick at that place.





Beds of Site 3. One of my survey maps of 2001.

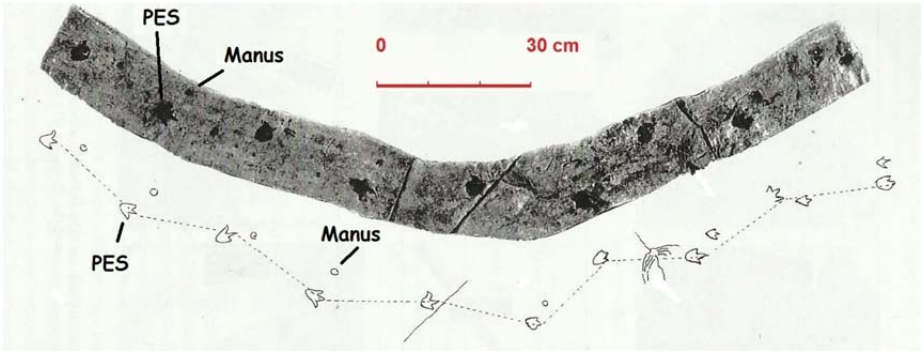
Print on bed II

Print on bed IV

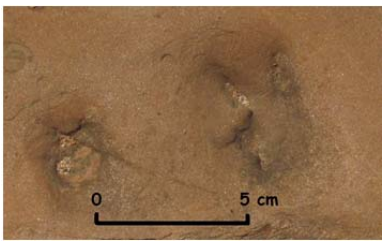
A track way on bed II

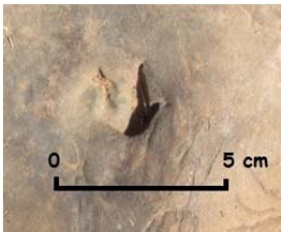
SITE 4. Very small dinosaur footprints

On a very small outcrop on the right bank of the river, can be seen 2 types of minute prints on less than 5 cm in length. One type forms a track way of 10 main prints made by an immature theropod dinosaur using a quadrupedal gait, while pes and manus prints are present. A second trailway of slightly larger footprints is also recorded (T. Lingham-Soliar and T Broderick, 2000)



Cast of track way showing pes and manus

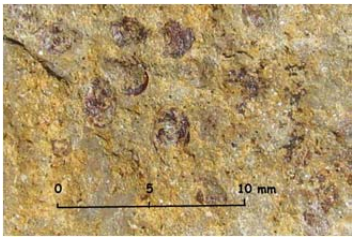




Size of single prints

SITES 5 and 6. Other Fossils.

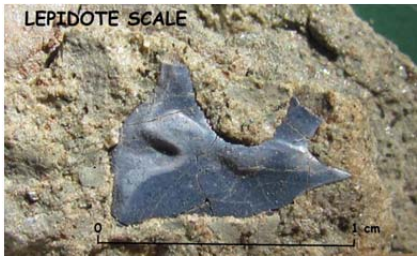
On site 5 can be found tiny shells named "Concostrachans". They are bivalved branchiopod crustaceans, resembling to unrelated bivalved molluscs. They are known from at least the Devonian. Current ones are known as "Clam-Shrimps".

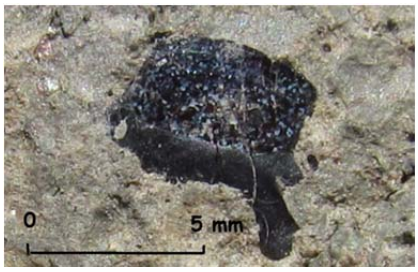


Concostrachans

Current Clam-shrimps

On site 6, fine-grained sandstones and shales comprise thick enamelled scales of fishes named Lepidotes.





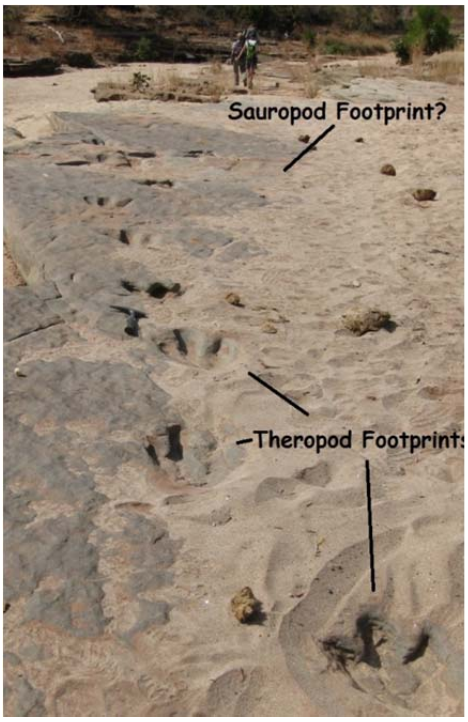
Lepidote scales from the Ntumbe River

Fossil Lepidote fish about 40 cm-long

Lepidotes are known to usually eat Conchostracans. They were themselves eaten by fishing dinosaurs, with crocodile-like jaws (i.e :Baryonyx)

SITE 7. A new Theropod Dinosaur track way

Site 7 is located on the southern bank of the River and is very similar to the one of Site 1.. A thick sandstone pavement bears a dozen of Theropod tridactyl footprints forming a straight trackway, about 15 m-long. Near its end, a rounded print could had been made by a Sauropod dinosaur. Below this level, fine-grained sandstones are heavily bioturbated and contain some fish bones (?).



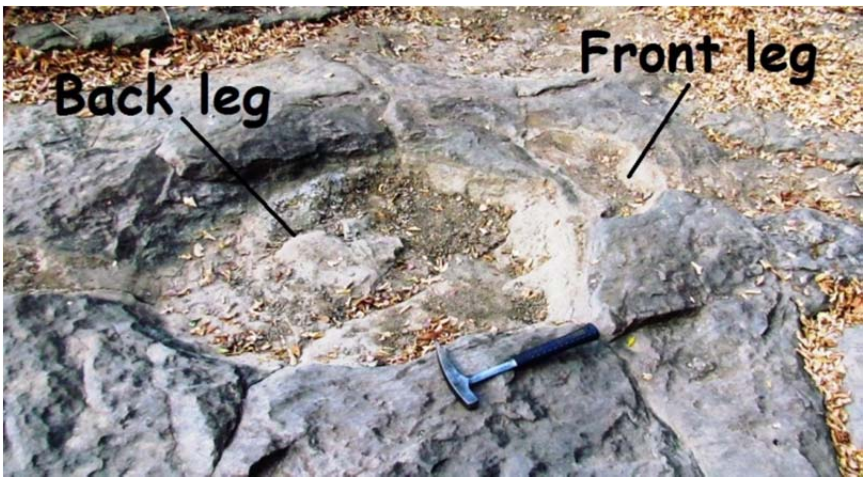
Sauropod Footprint?

Bioturbated sandstone

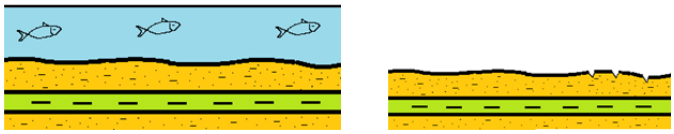
SITE 8.

It was discovered few years ago by P. Broderick. It comprises 7-8 big rounded Sauropod footprints, well preserved. They size from 80 to 95 cm in diameter.

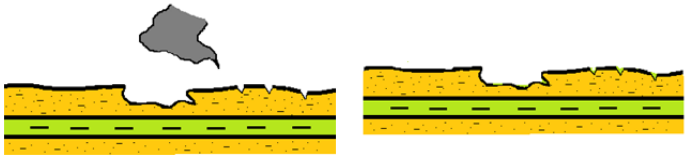
The crescent-shaped Sauropod front legs are here clearly visible.



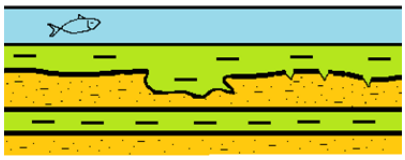
FOSSILISATION of the DINOSAUR FOOTPRINTS



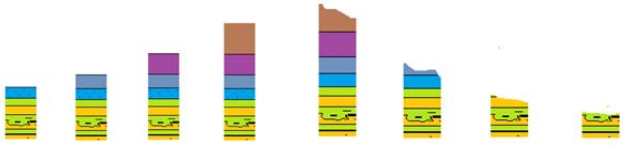
Deposition of fine-grained sand under moderate current. No more water. The surface of the sand bed is still wet, but drying. (ripple marks and dessication cracks formed)



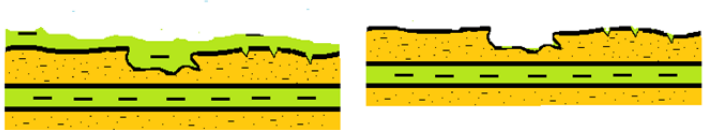
A Dinosaur passes by and leave his print in the wet sand



The next flow is very gentle, bringing only mud to fill the print



Sedimentation: the print is buried, Erosion. Rocks covering the print and protected it for million years are slowly removed.



Mudstone is removed more easily than sandstone. And the print reappears

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