A Dinosaurian ulna from a new locality of Lameta succession, Salbardi area, districts Amravati, Maharashtra and Betul, Madhya Pradesh

Here we report a dinosaur fossil-bearing locality in Lameta sediments exposed at Salbardi (lat. 21°25′15″N, long. 78°00′00″E), at the boundary of Amravati district, Maharashtra and Betul district, Madhya Pradesh (Figure 1). In the regional set-up, the basement consists of quartz-feldspathic gneiss of Archaean age, over which the Gondwana sediments lie with a sharp boundary. These sediments have been assigned to the early Cretaceous age on the basis of gymnosperm and pteridophytic remains[1,2]. Lameta sediments disconformably overlie the Gondwana rocks and are mainly represented by areno-argillaceous, calc-marl sediments. The Deccan Trap overlying the Lameta beds is mostly melanocratic, massive, fine-grained basalt. However, amygdaloidal structures, occasionally filled with secondary material are developed in a few places. Alluvium and soil make the topmost layers deposited mostly in depressions and low-lying areas. The rocks older than the Deccan Trap are exposed because of fault uplift along a E–W trending fault, namely the Salbaradi Fault.

The litho-column of Lameta sediments is ca. 35 m thick and represented mainly by the sandstone, clay, calcrete and limestone beds (Figure 2). Sandstone constitutes the lower 9 m succession intercalated by 1–2 m thick, dark reddish-brown and greenish-grey clayey layers. Clays are mostly massive; however, at a few places, faint laminations are noticed. The middle 10 m thick succession is mostly represented by calcretes and interbedded clay horizons. The calcretes are light brown to light grey in colour, hard and compact, with clasts of green sandstone, nodular and certified limestone. This litho-unit is overlain by a clayey unit represented by alternation of greenish-grey and dark reddish-brown clays. The upper 16 m thick unit is dominantly calcareous, having easily distinguishable beds of nodular limestone, chertified limestone and brecciated limestone. Overlying this calcareous unit, the topmost 4 m succession is intraformational brecciated limestone, which is micritic in nature and contains subangular to subrounded clasts of nodular limestone, chertified limestone and green sandstone; the clast size may range up to 10 cm.

Srivastava and Mankar[3] identified seven lithofacies in the sediment column exposed in the study area, viz. (i) sandstone lithofacies, (ii) clay lithofacies, (iii) calcrete lithofacies, (iv) alternations of nodular limestone and clay lithofacies, (v) nodular lithofacies, (vi) chertified limestone lithofacies and (vii) brecciated limestone lithofacies. The lithological architecture of the succession depicts point bar, channel and flood-plain environments of deposition in subaerially exposed alluvial setting[3].

Petrological studies, including diagenetic details of major rock types are also supportive of the fluvial environment of deposition[4].

The bone reported in this study is well preserved in sandstone lithofacies represented by green, hard and compact, coarse to medium grained, cross-bedded and parallel-bedded sandstone. Petrographically, the sandstone is a greywacke and consists dominantly of coarse to medium, subangular to subrounded, poorly sorted, monocrystalline quartz grains (Figure 3). Orthoclase and plagioclase are present in small quantities. Occasionally, clasts of greyish-green micrite, irregular pellets and lenses of yellowish-brown to brownish-green clays have also been recorded. Matrix is greyish-brown to black, which is dominantly argillaceous in nature. A few of the quartz grains show growth of isopachous rims of non-ferroan sparry calcite. Development of drusy calcite having straight boundaries and patchy occurrences in the matrix is also noticed.

The collected bone is a fragment of the right ulna measuring 18–20 cm long (Figure 4 *a*). The proximal end is broadly triangular in outline which tends to subovate towards the distal end (Figure 4 *b* and *c*). The anterior side shows marked concavity, whereas the posterior side has prominent convexity throughout the entire length of the specimen. The maximum width measured is 10.8 cm. In the thin section, it shows well-preserved haversian canal which is filled with secondary material[5] (Figure 5).

The establishment of genus and species is a little difficult on the basis of only a bone fragment. However, on the basis of the shape and predicted size, this bone is identified as a part of the right ulna of *Titanosaurus colberti* of the Sauropod family.

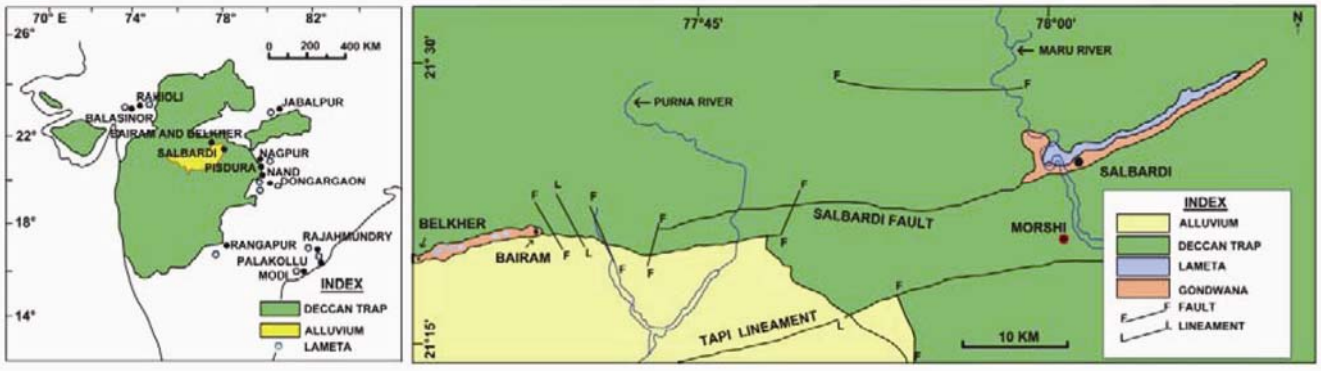

Figure 1. (Left) Map of central and western India showing geographical distribution of dinosaurs bearing Lameta successions. (Right) Geological map of the study area.

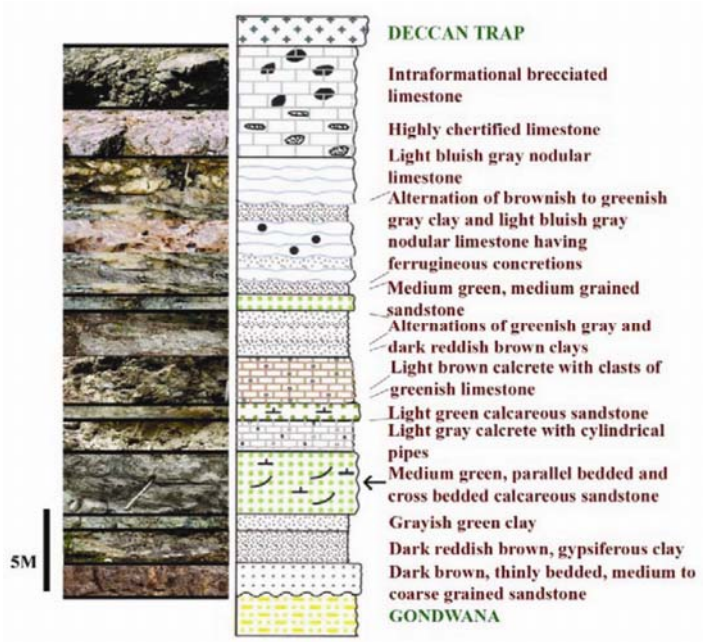

Figure 2. Detailed litholog of the Lameta sediments exposed in the study area. Arrow indicates the horizon having dinosaur remains.

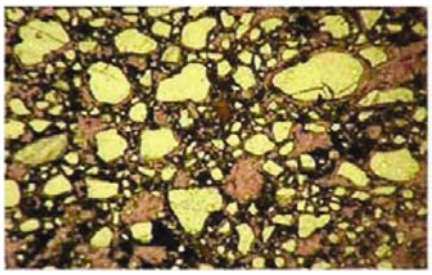

Figure 3. Photomicrograph showing subrounded to subangular grains of quartz floating in the fine-grained matrix. The quartz grains show development of isopachus rim of non-ferroan calcite (4X; plain-polarized light).

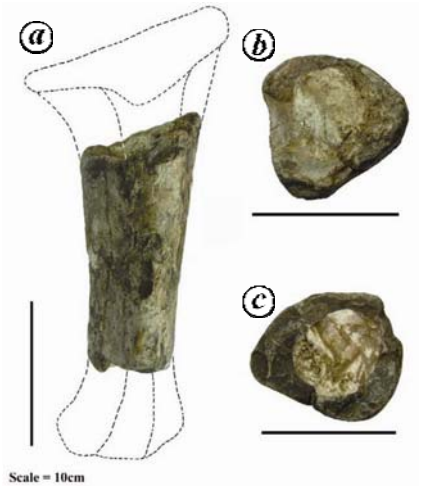

Figure 4. ***a***, Reconstruction of right ulna of *Titanosaurus colberti*. ***b***, Triangular cross-section (proximal end). ***c***, Subovate cross-section (distal end).

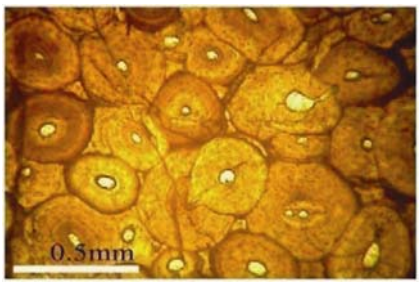

Figure 5. Photograph showing transverse section of the bone having well-preserved haversian system.

Recently, Wilson and Upchurch[6], and Wilson *et al.*[7] re-examined various genera and species reported from Argentina, Europe, Madagascar, India and Laos. They discarded most of the species described from India due to lack of diagnostic material and hence, considered it invalid. The valid species include *Titanosaurus colberti* (Sauropod), and *Indosuchus matleyi*, *Indosuchus raptorius* and *Rajasaurus narmadensis* (Theropod). The record of dinosaurian remains from the fluvial succession of the present area is significant. It indicates the extension of dinosaur inhabitation further northwest up to an aerial distance of approximately 200 km, as the earlier reported localities were mostly south of Nagpur, i.e. Pisdura and Nand-Dongargaon[8,9].

1. Srivastava, A. K., Banubakode, P. D., Kale, V. M. and Patil, G. V., *Curr. Sci*., 1995, **69**, 397–400.
2. Srivastava, A. K., Banubakode, P. D., Kale, V. M., Patil, G. V. and Manik, S. R., *Palaeobotanist*, 1999, **48**, 39–48.
3. Srivastava, A. K. and Mankar, R. S., *Gondwana Geol. Mag., Spec. Vol.*, 2010, **12**, 209–224.
4. Srivastava, A. K. and Mankar, R. S., *Gondwana Geol. Mag*., 2012, **27**, 31–42.
5. Sahni, A., *Curr. Sci*., 2003, **85**, 904–910.
6. Wilson, J. A. and Upchurch, P., *J. Syst. Palaeont*., 2003, **1**, 125–160.
7. Wilson, J. A., Sereno, P. C., Srivastava, S., Bhatt, D. K., Khosla, A. and Sahni, A., *Contrib. Mus. Palaeontol, Univ. Mich.*, 2003, **31**, 1–42.
8. Mohabey, D. M., *Geol. Surv. India, Spec. Publ*., 2001, **64**, 605–615.
9. Mohabey, D. M. and Samant, B., *Gondwana Geol. Mag., Spec. Vol*., 2005, **8**, 37–52.

ACKNOWLEDGEMENTS. We thank UGC, New Delhi for providing financial support in the form of a major research project (F. 40/295/2011 (SR) to A.K.S. and CSIR, New Delhi for providing Senior Research Fellowship to R.S.M. (F-09/855(0003)/2012).

Received 19 June 2013; revised accepted 16 August 2013

ASHOK K. SRIVASTAVA*
RUPESH S. MANKAR

P.G. Department of Geology,
SGB Amravati University,
Amravati 444 602, India
**For correspondence.*
e-mail: ashokamt2000@hotmail.com