HISTORICAL BIOLOGY
https://doi.org/10.1080/08912963.2019.1609957

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ARTICLE

First record of varied archosauriforms from the Upper Triassic of India based on isolated teeth, and their biostratigraphic implications

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ABSTRACT

A new rich and varied assemblage of archosauriform teeth is reported from the Upper Triassic Tiki Formation of India. Twelve morphotypes are identified based on their distinctive morphology, crown proportions, nature of serrations/denticles and serration density. Morphotypes I and II show similarity with that of *Galtonia* and *Protecovasaurus*, respectively, whereas morphotypes III–VI have low, subtriangular or leaf-shaped, asymmetrical, labiolingually compressed crowns with lenticular-subcircular bases and are diagnosed as belonging to different indeterminate archosauriforms. Morphotype VII shows similarity with aetosaur teeth, whereas morphotypes VIII–XII are ziphodont teeth having high, cylindrical, recurved crown with labiolingual compression, serrated carinae and subrectangular serrations, and are theropod-like. Variation in dental histology is noted between these morphotypes based on extent of pulp cavity, dentinal tubules and von Ebner lines of incremental growth. In multivariate analyses, there is considerable overlapping of convex hull polygons with morphospaces of other known archosauriforms such as *Protecovasaurus, Crosbysaurus* and *Tecovasaurus* known from the lower Tecovas Formation of the Chinle Group, USA. Such similarity correlates the two horizons despite wide geographic separation, suggesting that the age of the Tiki Formation may be younger than that previously suggested. Based on the known fossil flora and fauna, a mid-late Carnian age is proposed for the Tiki Formation.

ARTICLE HISTORY
Received 13 March 2019
Accepted 16 April 2019

KEYWORDS
Teeth; archosauriform; Tiki Formation; Gondwana; India

Introduction

The Late Triassic archosauriforms were cosmopolitan and inhabited various environmental niches and adapted to specific dietary niches (Nesbitt 2011). Isolated teeth of these archosauriforms are abundant in the fossil record as these replaced their teeth rapidly with many taxa potentially shedding thousands of teeth in their lifetimes. These teeth are usually preserved in pristine condition because of their enamel coating (Edmund 1960; Sahni 1972; Currie et al. 1990; Martin 1999). There is an abundant literature on isolated archosauriform teeth (Godefroit and Cuny 1997; Heckert 2005; Heckert and Jenkins 2005; Heckert et al. 2006), where some of these were referred to the dinosaurs (Hunt and Lucas 1994) and recovered from the Upper Triassic Chinle Group, USA (Heckert and Lucas 1997; Heckert 2004), Saint-Nicolas-de-Port and Lons-le-Saunier, France (Godefroit and Cuny 1997; Godefroit et al. 1998; Cuny et al. 2000), Habay-la-Vieille, southern Belgium (Godefroit and Knoll 2003), Calcare di Zorzino Formation, Northern Italy (Renesto et al. 2005), Rhaetian bone beds of Hallau, Switzerland (Butler et al. 2006), and Bristol and Tytherington fissures, UK (Foffa et al. 2014).

The Gondwana basins of peninsular India (Figure 1(a)) are rich in vertebrate fossils, most of which are well-preserved, complete and articulated (Bandyopadhyay 1999). An integrated study of the Late Triassic vertebrate fauna of the Tiki Formation, a horizon of the Rewa Gondwana basin (Figure 1(a,b)) has resulted in the recovery of numerous isolated and varied archosauriform teeth. Although isolated teeth are common in the Mesozoic rocks where tetrapod faunas were dominated by polyphyodont taxa (Godefroit and Knoll 2003; Heckert 2004), such an assemblage of Late Triassic archosauriform teeth is the first of its kind from India. The current study gives their detailed description, comparison with similar teeth from coeval horizons in other parts of the world, dental histology and attempts to determine their taxonomic affinities. However, absence of associated skeletal elements limits taxonomic resolution (Larson and Currie 2013), as a result of which quantitative analyses were carried out to facilitate their taxonomic identification. Moreover, the work highlights the biostratigraphic significance and palaeobiogeographic implications of these new finds.

Geological and geographic background

The fossil locality is situated near the village of Tihki (23°56′ N: 81°22′58″ E, Figure 1(b)), and is the type locality of the Tiki Formation (Mukherjee et al. 2012). The latter is about 400 m in thickness, and a fluvial succession, comprising red-coloured, floodplain mudrocks with palaeosol profiles, sheet and channel-fill sandstones and caliche-derived cross-stratified peloidal calcirudite horizons. The Tiki Formation is highly fossiliferous and

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Supplemental data for this article can be accessed here.

Published online 02 May 2019