

Fossil remains of proterosuchian from the Panchet Formation, Damodar valley of India

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Fossils of proterosuchians are known from the Early Triassic beds of many different countries like China, Russia, South Africa and India. Remains of the earliest described proterosuchian *Ankistrodon indicus*, are known from the Lower Triassic beds of the Panchet Formation of India. Later, the genus was renamed as *Chasmatosaurus indicus*. *Chasmatosaurus* is now considered as a junior synonym of *Proterosuchus*. The Early Triassic archosauromorph remains from India are based on rare and poorly preserved proterosuchian jawbones, few vertebrae and an ilium. This article reports the discovery of additional *Proterosuchus* fossil material, humerus and rediscovery of the cervical and caudal vertebrae from the Lower Triassic beds of the Panchet Formation, from the locality near Asansol district, West Bengal, India. *Proterosuchus* humerus has not been described before from India; hence this additional material along with axial materials that are a cervical vertebra and a caudal vertebra will add further information about this Early Triassic proterosuchidae of India.

Keywords: Cervical and caudal vertebrae, fossil remains, humerus, proterosuchian, *Proterosuchus*.

THE sedimentary strata of the Gondwana Supergroup are known from discrete basins in peninsular India. In the E–W-trending Damodar valley several discrete basins of the Gondwana Supergroup occur^{1,2}. Among these, the Raniganj basin is well known for its vertebrate fossils of dicynodonts, cynodonts, amphibians, fishes and proterosuchian from the strata of the Panchet Formation^{3–5}. Based on *Lystrosaurus* and another vertebrate fauna assemblage, the Panchet Formation is assigned Early Triassic in age^{3,6}. Although the Panchet Formation is known for different species of dicynodonts and amphibians, *Proterosuchus* (*Chasmatosaurus*) *indicus*, a proterosuchian from the Lower Triassic horizon of India is known from few isolated and poorly preserved fossilized bones^{3,4,7}.

Remains of *Ankistrodon indicus* from the Panchet Formation, which was originally described by Huxley³ as a ‘thecodont-saurian’, was based on a fragmented

jawbone bearing two hook-shaped teeth is the earliest described proterosuchian in the world⁸. Huene suggested that *A. indicus* belongs to the genus *Chasmatosaurus*⁹. Later, Satsangi⁴ discovered isolated lower jawbone and pelvis associated with fossils of *Lystrosaurus* and labyrinthodonts from the sandstone of the Panchet Formation. The jawbone described by Satsangi⁴ is similar to the *Chasmatosaurus* jawbone described by Huxley³, but more complete and better preserved, Satsangi⁴ considered those materials as *Chasmatosaurus*. Apart from the partial jaw of *A. indicus*, Huxley³ also described many vertebrae which he considered as remains of *Dicynodon orientalis*. Later von Huene⁹ suggested that these vertebrae belong to *Chasmatosaurus*⁹. Romer¹⁰ amended *Chasmatosaurus* as an invalid genus and put all the species of *Chasmatosaurus* under an already established genus *Proterosuchus*.

Proterosuchian remains are known from Early Triassic beds of nearly every part of the world, including South Africa, China, Russia, Australia, Argentina, Germany and India¹¹. Fossil materials of *Proterosuchus* from India are known from very few materials which include part of jawbones, few fragmented axial materials and a pelvic bone, but so far no element of *Proterosuchus* limb bone has been reported or described. This article describes a proterosuchian humerus bone and two rediscovered vertebrae which are similar to the already described vertebrae of *Proterosuchus* by Huxley³.

Systematic palaeontology

Diapsida¹², Sauria¹³, Archosauromorpha¹⁴, Archosauriformes¹⁵, Proterosuchidae¹⁶, *Proterosuchus*¹⁷.

Referred specimens

(i) PGRU/GL/M/VF-001 – Distal half of the left humerus. (ii) PGRU/GL/M/VF-002 – An anterior cervical vertebra. (iii) PGRU/GL/M/VF-003 – A posterior caudal vertebra.

Here, PGRU represents Post Graduation College of the University of Ranchi, GL the Department of Geology and M, the Museum of the Department of Geology, University of Ranchi.

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Methodology: Apart from the three fossil materials mentioned above, various publications are referred here to understand the osteology of proterosuchians and archosaurs. Published diagrams and photographs along with their description were referred to for comparison with the discovered fossil materials described here.

Locality: Southern bank of River Damodar, Madhukunda (15 km southwest of Asansol), Paschim Bardhaman district, West Bengal.

Horizon and age: All the above-described fossil specimens were collected from the pebbly-yellow sandstone of the Panchet Formation of Early Triassic age^{18,19}. Lithology which yielded these vertebrate fossils is the clay pellet-rich, pebbly, micaceous and matrix-supported yellow sandstone which is well known for its vertebrate fossils which include temnospondyl, cynodont, dicynodont, and Proterosuchian^{3,5-7}.

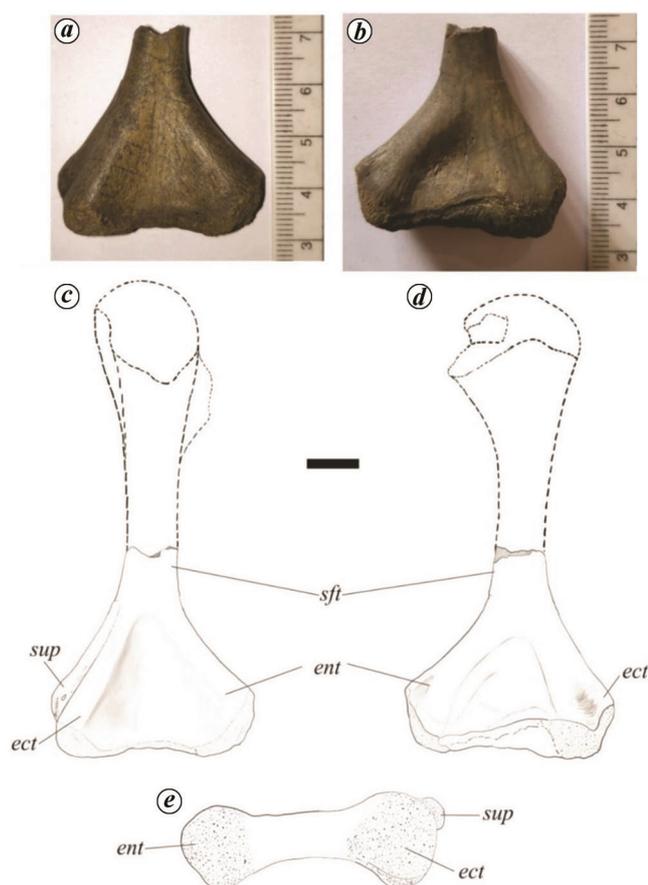


Figure 1. *Proterosuchus* – humerus from the Panchet Formation, India. (a–e) Distal half of the left humerus (PGRU/GL/M/VF-001). (a) and (c) from posterior view; (b) and (d) from anterior view and (e) from distal view. In (c and d) reconstructed missing part of the humerus is represented as a dashed line by taking reference of the humerus (IVPP V2719) of Proterosuchidae *Proterosuchus* (*Chasmatosaurus*) *yuani*²⁰. Scale bar = 1 cm. ect, Ectepicondyle; ent, Entepicondyle; sft, Shaft; sup, Supinator process.

Description

Humerus (PGRU/GL/M/VF-001)

Only the distal half of the left humerus is preserved (Figure 1). Entepicondyle and ectepicondyle are large and strongly developed; the supinator process is also well developed. The distal half of the humerus is broad compared to the part of the shaft preserved. The anterior distal fossa is well developed and covers a large area. The absence of entepicondylar and ectepicondylar foramen rules out the possibility of its cynodont origin. The cross-section of the shaft is square-shaped. The length of the preserved part is 3.6 cm, width of the preserved shaft is 0.9 cm and width of the distal end of the humerus is 3.9 cm. This specimen shows remarkable similarity to the humerus of *Proterosuchus* (*Chasmatosaurus*) *yuani* (IVPP V2719), from the *Lystrosaurus* bed of the Early Triassic from Sinkiang, China²⁰.

Anterior cervical vertebra (PGRU/GL/M/VF-002)

In the single isolated cervical vertebra, one of the prezygapophyses and posterior part of the centrum are not preserved (Figure 2). The neural spine of the vertebra is flat and broad, where the dorsoventral height of the neural spine (1.4 cm) nearly equals its anteroposterior length (1.5 cm). Diapophysis and parapophysis are indistinguishable and present as a single facet low down near the anterior most margin of the centrum. Based on the position of the rib facet, the position of the vertebra is considered as anterior cervical. The anterior articular surface of the centrum is concave, but it is not possible to comment on the posterior articular surface of the centrum as the posterior end of the vertebra is not preserved. The specimen described here shows a close resemblance to the cervical vertebra of proterosuchians based on the description provided by Hughes²¹ and Ezcurra⁸.

Posterior caudal vertebra (PGRU/GL/M/VF-003)

A single isolated posterior caudal vertebra is completely preserved (Figure 3). The centrum is amphicoelous and elongated; the length (1.3 cm) to posterior height (0.6 cm) ratio is 2.17. Rib facets are reduced and located towards the posterior end of the vertebra. Two parallel laminae run anteroposteriorly on the ventral surface of the centrum. The lateral surface is slightly concave longitudinally. The anterior and posterior articular surface of the centrum has a slightly elliptical shape with a dorsoventrally long axis. The posterior caudal vertebra described here resembles that of *Proterosuchus*^{20,22}.

Discussion and conclusion

Materials described here belong to a species of *Proterosuchus*, based on common characteristics with other

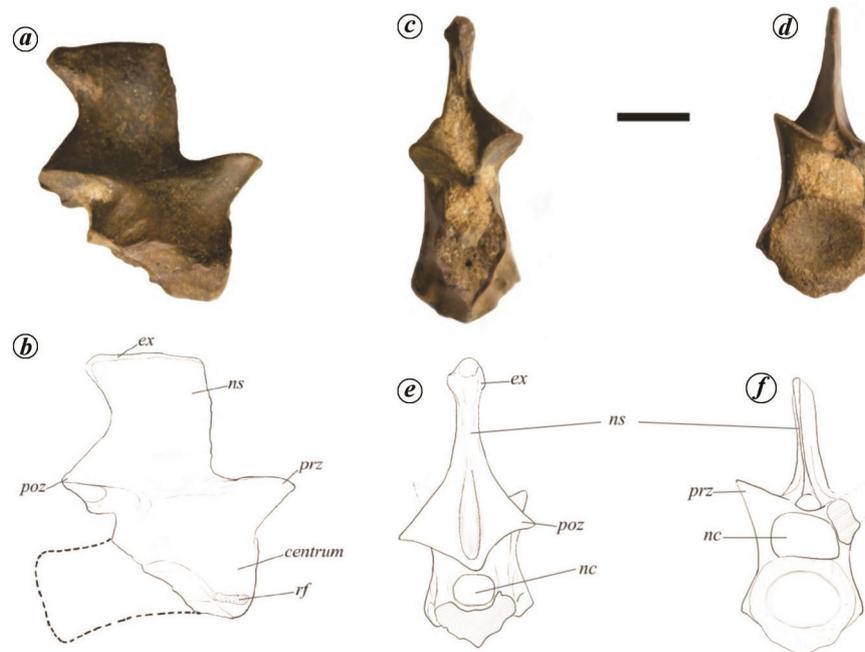


Figure 2. *Proterosuchus* – cervical vertebra from the Panchet Formation, India. Anterior cervical vertebra (PGRU/GL/M/VF-002). (a) and (b) from right lateral view; (c) and (e) from posterior view and (d) and (f) from anterior view. Scale bar = 1 cm. ex, Expansion; nc, Neural canal; ns, Neural spine; poz, Postzygapophysis; prz, Prezygapophysis and rf, Rib facet.

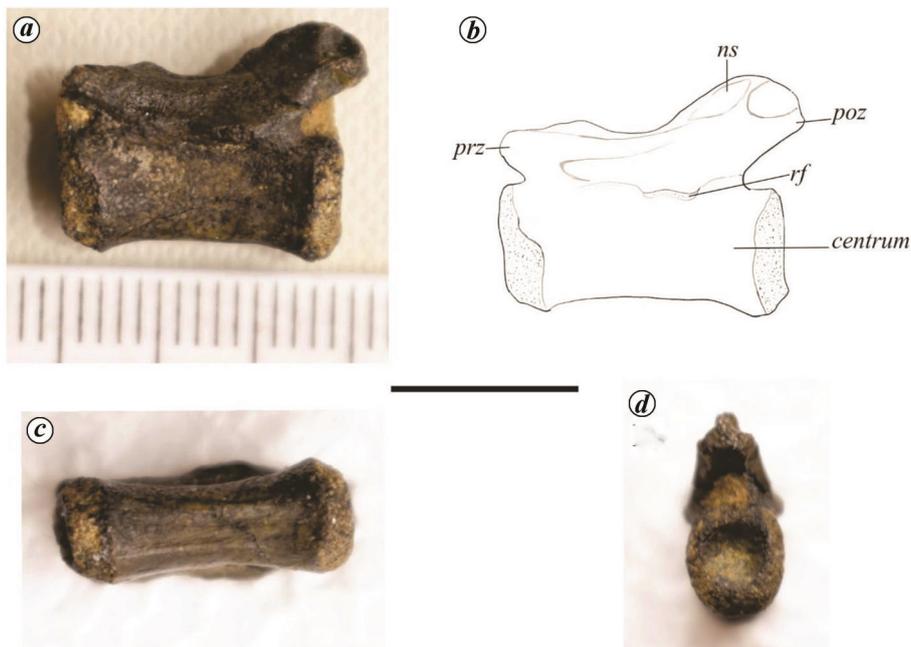


Figure 3. *Proterosuchus* – caudal vertebra from the Panchet Formation, India. Posterior caudal vertebra (PGRU/GL/M/VF-003). (a) and (b) from left lateral view; (c) from ventral view showing two ventral lamellae and (d) from posterior view. Scale bar = 1 cm. ns, Neural spine; poz, Postzygapophysis; prz, Prezygapophysis and rf, Rib facet.

overlapping *Proterosuchus* fossil materials discovered from the Early Triassic *Lystrosaurus* zone of the Karoo basin of South Africa²¹ and the *Lystrosaurus* bed of Sinkiang, China²⁰. Species of this *Proterosuchus* must be considered as *P. indicus*, as it is the only species of this

genus so far known from India. As the earlier described *Proterosuchus* fossils from India do not include any limb elements, hence the humerus bone described here increases the completeness of the skeletal material^{3,4}. The addition in the records of *Proterosuchus* fossil remains

strengthens the idea of the *Proterosuchus* population in India during the Early Triassic. Further exploration and research are required to recover and study more vertebrate fossils from the Early Triassic beds of India, to increase the skeletal completeness of extinct species.

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