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Deep faunistic turnovers preceded the rise of dinosaurs in southwestern Pangaea

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SUPPLEMENTARY INFORMATION

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Contents

- 1. Institutional abbreviations**
- 2. The Chañares Formation – geological settings and stratigraphic summary:
description of the fossil provenances, biozones, and taphonomy**
- 3. Further information on *Tarjadia ruthae* and other erpetosuchids**
- 4. Comparative figures of the cynodonts from the *Tarjadia* AZ and closely related species**
- 5. Details of the quantitative phylogenetic analysis of basal archosauromorphs**
- 6. Relative abundance of the vertebrates of the *Tarjadia* and *Massetognathus*-
Chanaresuchus Assemblage Zones of the Chañares Formation**
- 7. Shareholder Quorum Subsampling-based Simulations**
- 8. New U–Pb ages from detrital zircons of the Chañares Formation**
- 9. Supplementary references**

1. Institutional abbreviations

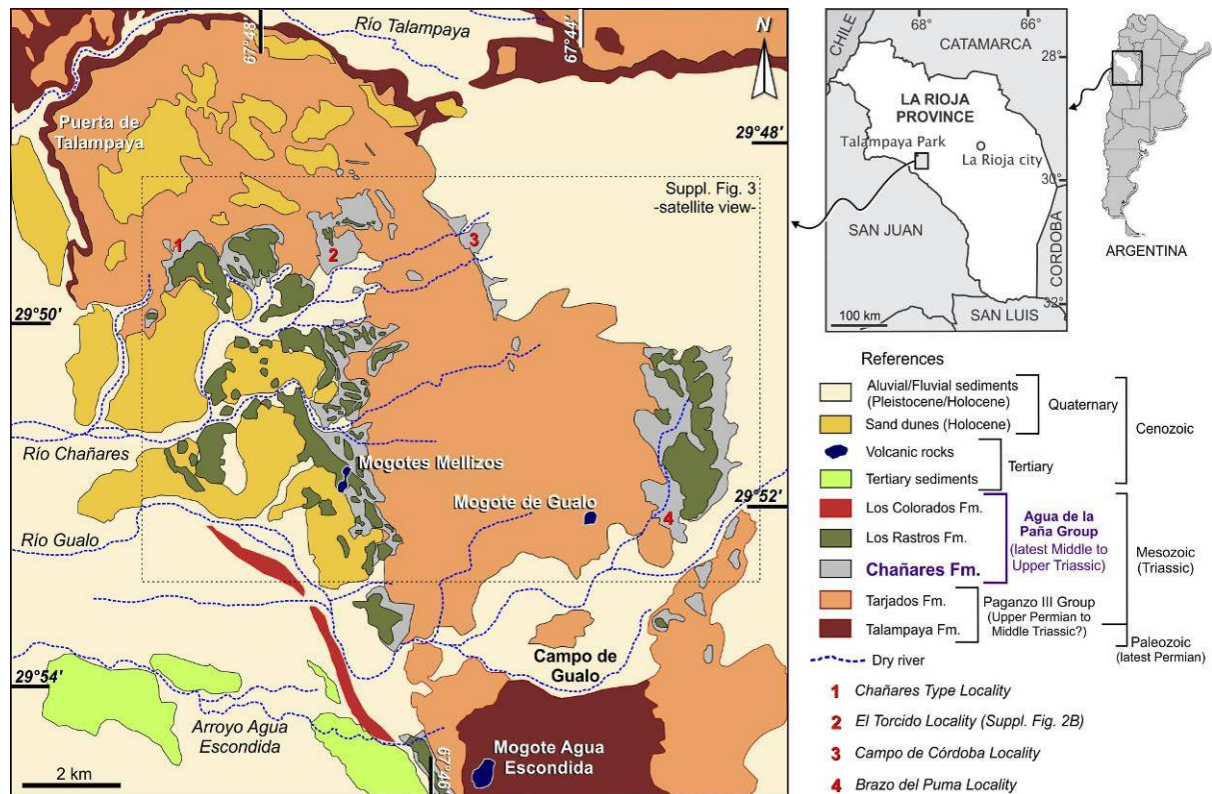
AM, Albany Museum, Grahamstown, South Africa; **AMNH**, American Museum of Natural History, New York, USA; **BRLSI** (formerly BATGM), Bath Royal Literary and Scientific Institution, Bath, UK; **BP**, Evolutionary Studies Institute (formerly Bernard Price Institute for Palaeontological Research), University of the Witwatersrand, Johannesburg, South Africa; **BRSUG**, University of Bristol, School of Earth Sciences, Bristol, United Kingdom; **BSPG**, Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany; **CA**, Colégio Anchieta, Porto Alegre, Brazil; **CPEZ**, Coleção Municipal, São Pedro do Sul, Brazil; **CRILAR**, Centro Regional de Investigaciones y Transferencia Tecnológica de La Rioja, Paleontología de Vertebrados, Anillaco, La Rioja, Argentina; **EXEMS**, Royal Albert Memorial Museum, Exeter, UK; **FG**, Paläontologische und Stratigraphische Sammlung an der Bergakademie Freiberg im Humboldt-Bau, Freiburg, Germany; **FMNH**, Field Museum of Natural History, Chicago, USA; **GHG**, Geological Survey, Pretoria, South Africa; **GMB**, Geological Institute, Beijing, China; **GMPKU**, Geological Museum of Peking University, Beijing, China; **GPIT**, Paläontologische Sammlung der Universität Tübingen, Tübingen, Germany; **GR**, Ghost Ranch Ruth May Museum of Paleontology, New Mexico, USA; **IPB**, Institut für Paläontologie, Universität Bonn, Bonn, Germany; **ISI**, Indian Statistical Institute, Kolkata, India; **IVPP**, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; **KUVP**, Kansas University Museum of Natural History, Lawrence, USA; **MACN-Pv**, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Paleovertebrados, Buenos Aires, Argentina; **MCNAM**, Museo de Ciencias Naturales y Antropológicas de Mendoza (J. C. Moyano), Mendoza, Argentina; **MCP**, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; **MCZ**, Museum of Comparative Zoology, Cambridge, USA; **MHI**, Muschelkalkmuseum, Ingelfingen, Germany;

MLP, Museo de La Plata, La Plata, Argentina; **MMACR-PV-T**, Museu Municipal Aristides Carlos Rodrigues, Paleovertebrates – Triassic Collection, Candelária, Rio Grande do Sul, Brazil; **MNHN**, Muséum national d'Histoire naturelle, Paris, France; **MSNM**, Museo di Storia Naturale, Milano, Italy; **Nat. Kab.**, Naturalienkabinett und Heimatmuseum, Waldenburg, Germany; **NHMUK PV**, The Natural History Museum, Palaeontology Vertebrates, London, UK; **NHMW**, Naturhistorisches Museum Wien, Vienna, Austria; **NMK**, Naturkundemuseum im Ottoneum, Kassel, Germany; **NMS**, National Museums of Scotland (formerly Royal Scottish Museum, RSM), Edinburgh, United Kingdom; **NMQR**, National Museum, Bloemfontein, South Africa; **NMT**, National Museum of Tanzania, Dar es Salaam, Tanzania; **PIMUZ**, Paläontologisches Institut und Museum der Universität Zürich, Zurich, Switzerland; **PIN**, Paleontological Institute of the Russian Academy of Sciences, Moscow, Russia; **PSM**, Privatsammlung W. Munk, Walzbachtal, Germany; **PULR**, Paleontología, Universidad Nacional de La Rioja, La Rioja, Argentina; **PVL**, Paleontología de Vertebrados, Instituto 'Miguel Lillo', San Miguel de Tucumán, Argentina; **PVSJ**, División de Paleontología de Vertebrados del Museo de Ciencias Naturales y Universidad Nacional de San Juan, San Juan, Argentina; **QM**, Queensland Museum, Brisbane, Queensland, Australia; **RC**, Rubidge Collection, Wellwood, Graaff-Reinet, South Africa; **SAM-PK**, Iziko South African Museum, Cape Town, South Africa; **SHYMS**, Shropshire Museum, Ludlow, UK; **SIDMM**, Sidmouth Museum, Sidmouth, United Kingdom; **SMNS**, Staatliches Museum für Naturkunde Stuttgart, Stuttgart, Germany; **TM**, Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria, South Africa; **TMM**, Texas Memorial Museum, Austin, USA; **UA**, University of Antananarivo, Antananarivo, Madagascar; **UCMP**, University of California Museum of Paleontology, Berkeley, USA; **UFRGS**, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil; **UMZC**, University Museum of Zoology, Cambridge, UK; **USNM**, National Museum

of Natural History (formerly United States National Museum), Smithsonian Institution, Washington, D.C., USA; **UTGD**, School of Earth Sciences, University of Tasmania, Hobart, Australia; **WARMS**, Warwickshire Museum, Warwick, UK; **WMsN**, Westfälisches Museum für Naturkunde, Münster, Germany; **YPM**, Yale Peabody Museum, New Haven, Connecticut, USA; **ZAR**, Muséum national d'Histoire naturelle (Zarzaitine collection), Paris, France; **ZMR MB**, Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany; **ZPAL**, Institute of Paleobiology of the Polish Academy of Sciences, Warsaw, Poland.

2. The Chañares Formation – geological settings and stratigraphic summary: description of the fossil provenances, biozones, and taphonomy

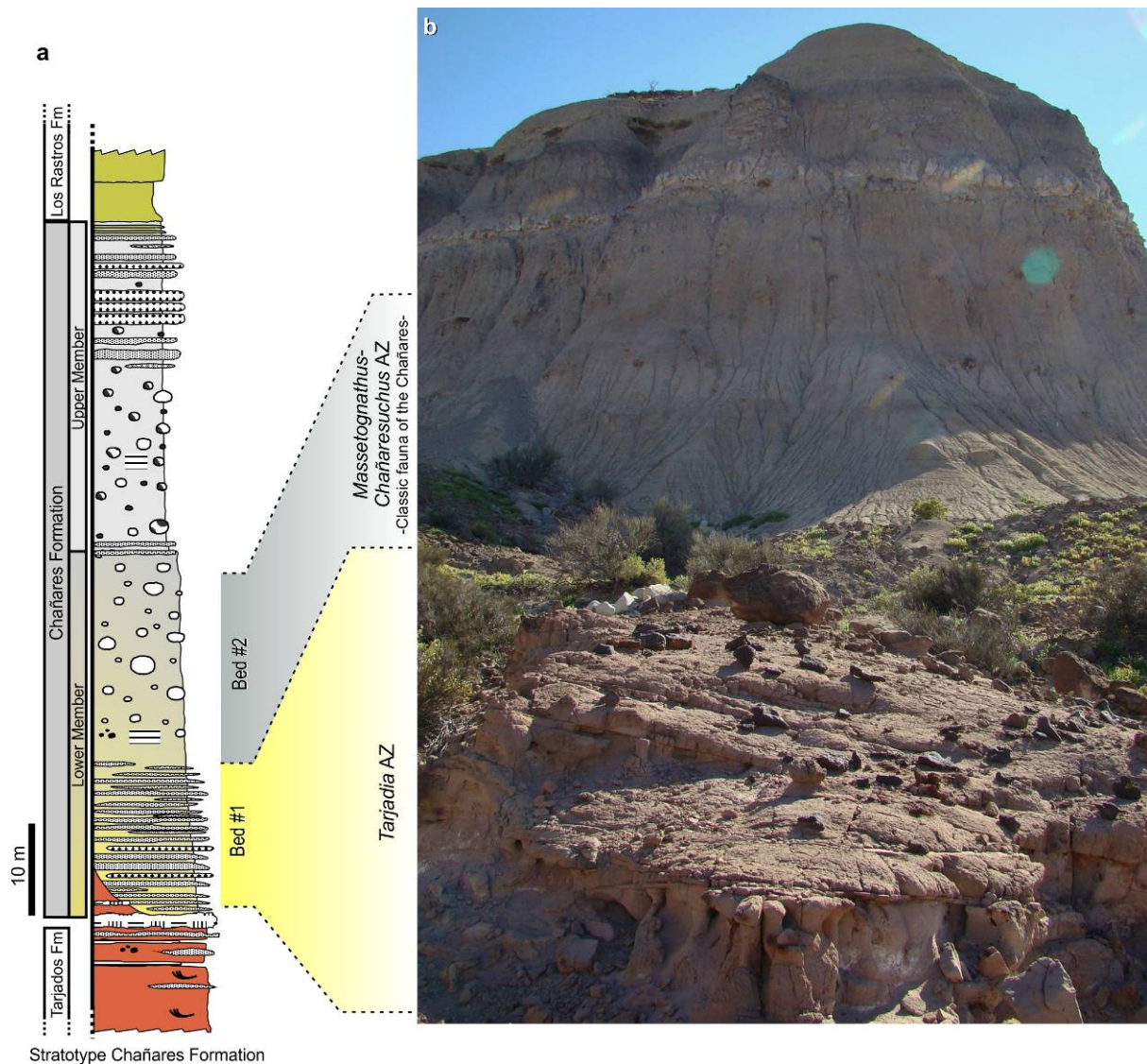
The new vertebrate association described here, which was used to determine the *Tarjadia* Assemblage Zone, comes from several tuffaceous sandstone levels in the first 17 metres of the early Late Triassic Chañares Formation, southwest La Rioja Province, northwestern Argentina (Fiorelli et al. 2013) (Supplementary figure 1). The Chañares Formation is part of the Ischigualasto-Villa Unión Basin (López-Gamundí et al. 1994; Stipanovic and Marsicano 2002), a rift system with a well-defined NW-SE trend that represents an upper Permian to Upper Triassic continental succession of around 4,000 metres of alluvial, fluvial, and lacustrine sediments (López-Gamundí et al. 1994; Milana and Alcober 1994; Kokogian et al. 1999; Gulbranson et al. 2015). This basin and other several Triassic half-graben rift systems located along western Gondwana were associated to the pre-break-up of Pangaea (Uliana and Biddle 1988). Stratigraphically, the Ischigualasto-Villa Unión Basin includes the Permian-Triassic Talampaya and Tarjados formations (Krapovickas et al. 2013; Gulbranson et al. 2015) and the Agua de la Peña Group, which is represented by the Chañares, Los Rastros, Ischigualasto, and Los Colorados formations (Fig. 2). The units of the Agua de la Peña Group are of key importance because they have one of the best records of continental Late Triassic tetrapods worldwide (Langer et al. 2010; Marsicano et al. 2016). In this section, we focus in the description on the Chañares Formation, the lowest unit of the Agua de La Peña Group (Supplementary figure 2). For a geological and palaeontological background of the remaining units, we suggest reading the previously published relevant literature (e.g. Arcucci et al. 2004; Mancuso and Marsicano 2008; Currie et al. 2009; Mancuso and Caselli 2012; Martínez et al. 2012; Kent et al. 2014).



Supplementary figure 1. Location and geological map of the studied area (Los Chañares, La Rioja Province, Argentina). The four studied localities are enumerated as follows: **1**, Chañares, **2**, El Torcido, **3**, Campo de Córdoba, and **4**, Brazo del Puma (red numbers). Modified from Fiorelli et al. (2013).

The upper levels of the Tarjados Formation are important for the present research. These levels are characterized by thick and massive red sandstones and sporadic lenses interspersed by coarse sandy and conglomeratic river channels (Rogers et al. 2001; Fiorelli et al. 2013). Some pebbles, bioturbations (invertebrate burrows), numerous carbonate nodules, and abundant thick silicified rhizoliths with well horizontal development occur together, which suggests the presence of an edaphic organization, pedogenetic alterations, and the development of incipient palaeosols in the upper levels of the Tarjados Formation (Fiorelli et al. 2013). There is a calcrete-silcrete level of uncertain origin upholstering the palaeotopography of the unit (Rogers et al. 2001; Fiorelli et al. 2013; Mancuso et al. 2014), showing some thick vertical veins irrupting the upper levels of the unit. The contact between the Tarjados Formation and the Chañares Formation is a regional unconformity that locally

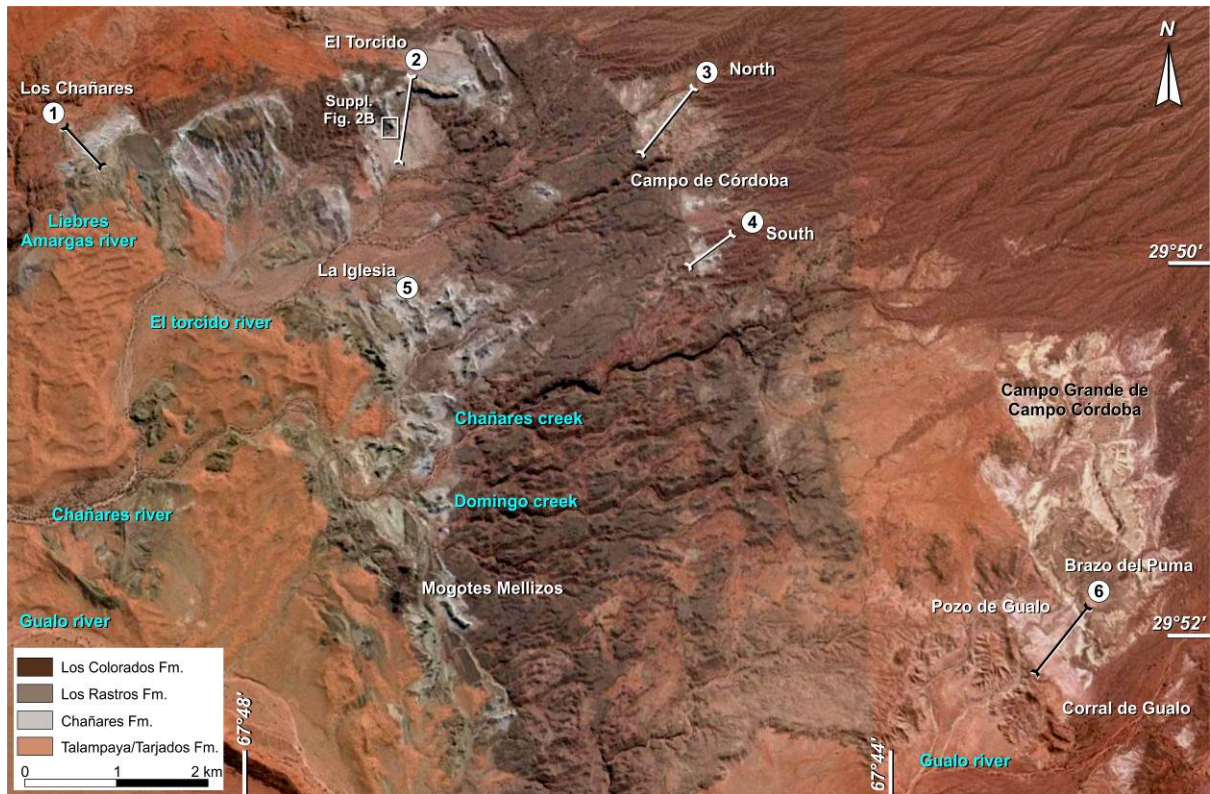
possesses several metres of relief and part of the lower sequence of the latter unit –mainly sandy facies– was not always deposited or is not homogenously laterally present and/or exposed. The paleorelief of the Tarjados Formation was filled by predominately fluvial –after partially pedogenized– sediments consisting of sandstones and conglomerates of the first metres of the Chañares Formation (Supplementary figure 2). As a result, this large regional unconformity and the lowland areas within the high topography of the Tarjados paleorelief (in some cases up to ~10 metres) are remarkably important to understand the stratigraphy of the first metres of the Chañares Formation.



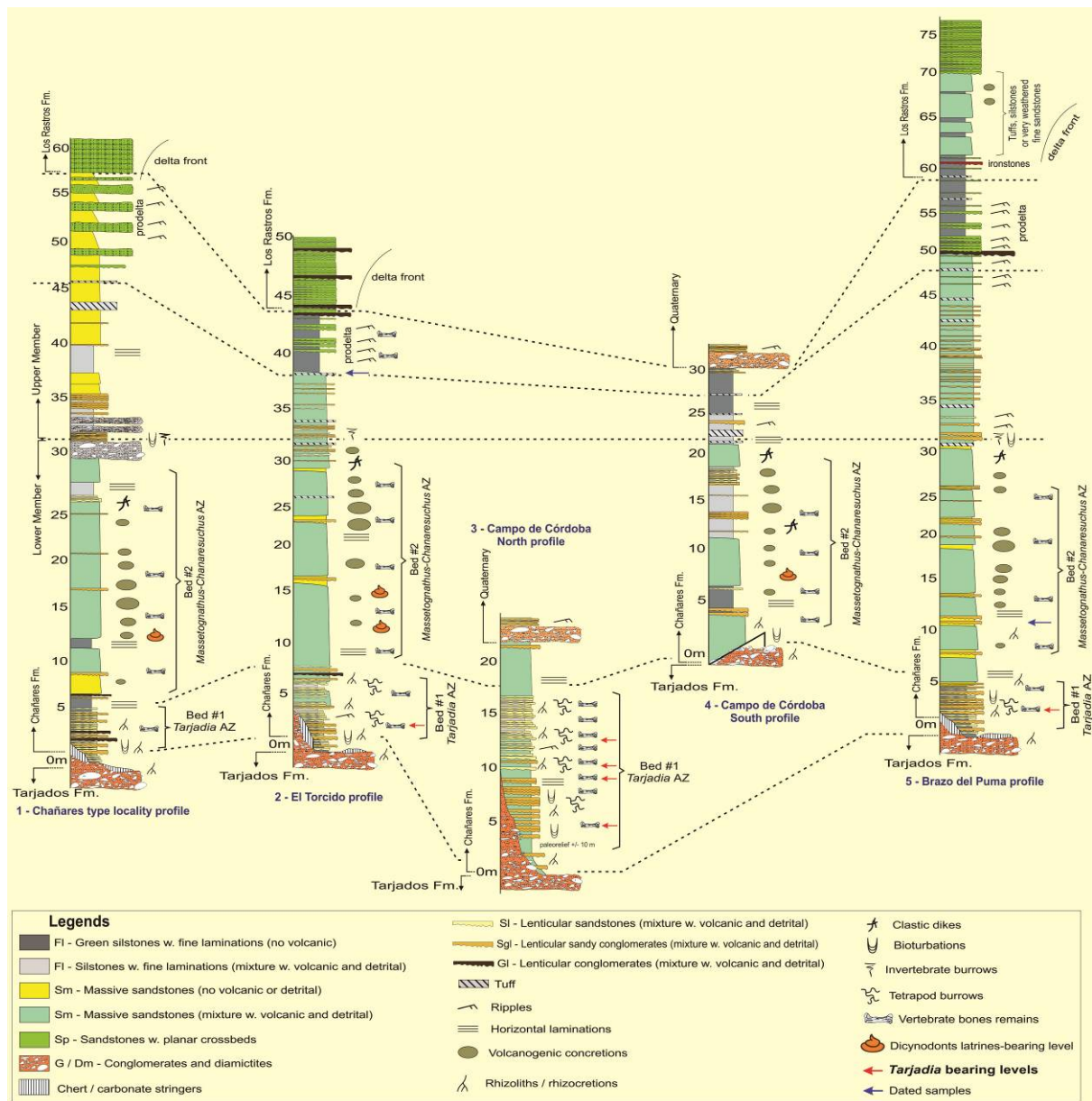
Supplementary figure 2. Stratigraphy and vertebrate Assemblage Zones (AZ) recognized here for the Chañares Formation. **a**, Chrono-stratigraphic profile of the Chañares Formation indicating the members and the beds that correspond to the *Tarjados* AZ and *Massetognathus-Chañaresuchus* AZ, respectively. **b**, Overview of the Chañares Formation in the El Torcido locality (see Supplementary figure 3).

The Chañares Formation (Supplementary figure 2) is characterized mainly by volcanoclastic resedimented deposits emplaced in alluvial and lacustrine settings that represent part of a synrift phase of sedimentation on the basin (Rogers et al. 2001; Mancuso and Caselli 2012; Fiorelli et al. 2013; Marsicano et al. 2016). This formation was originally divided into two sub-units by previous authors (Romer and Jensen 1966; Rogers et al. 2001), which were subsequently considered as different members by more recent authors (Fiorelli et

al. 2013) (Supplementary figures 2–4). The Chañares Formation is one of the most fossiliferous Triassic continental tetrapod-bearing assemblages worldwide (Romer and Jensen 1966; Rogers et al. 2001; Fiorelli et al. 2013; Mancuso et al. 2014) and is key to understand the evolution of terrestrial faunas during the Triassic, including the origin and diversification of dinosaur and mammal precursors. The unit has yielded hundreds of fairly complete and articulated tetrapod specimens preserved in concretions, which have been historically dated as Middle Triassic –Anisian to Ladinian– by several authors (Romer and Jensen 1966; Rogers et al. 2001; Mancuso and Caselli 2012). Desojo et al. (2011) considered the Chañares Formation as Ladinian–early Carnian in age, a proposal that was followed by subsequent researchers (Fiorelli et al. 2013; Ezcurra et al. 2014; Mancuso et al. 2014; Bittencourt et al. 2015). More recently, radioisotopic datings in the lower and middle levels of the Chañares Formation yielded values of 236.1 ± 0.6 and 233.7 ± 0.4 Ma, respectively, indicating an early Carnian age for the unit (Marsicano et al. 2016). Nevertheless, it is probable that the first meters of the Chañares Formation were deposited at the very end of the Ladinian because the lowermost dated level is placed approximately 10 metres above the base of the unit.



Supplementary figure 3. Satellite image of the Chañares region in the Talampaya National Park, southwest of La Rioja province, Argentina. The image shows the different studied localities and areas where stratigraphical profiles were performed.



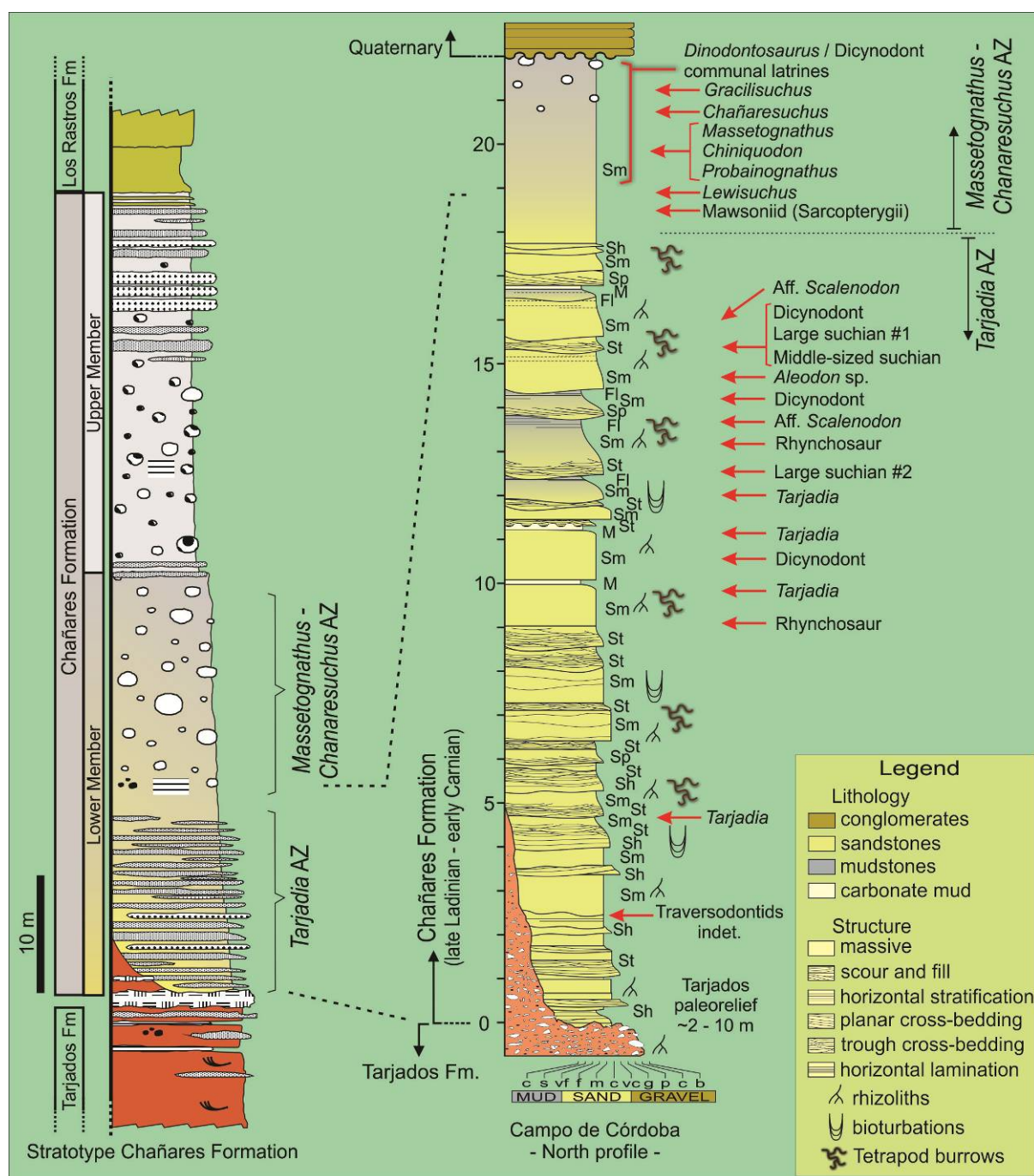
Supplementary figure 4. Stratigraphic profiles of the Chañares Formation. The profiles belong to 1, Los Chañares, 2, El Torcido, 3, Campo de Córdoba North, 4, Campo de Córdoba South (= Romer Reloaded), and 5, Brazodel Puma localities (see Supplementary figure 3). Facies classification modified from Miall (1996).

The best sampled locality of the unit is “Los Chañares”, which was discovered and extensively worked by Alfred S. Romer in the late 1960’s and, subsequently, by José F. Bonaparte in the 1970’s (Supplementary figure 3) (Romer and Jensen 1966; Bonaparte 1975; Rogers et al. 2001). In addition to the “Los Chañares” locality, we have been exploring other fossiliferous localities of the Chañares Formation since 2011: El Torcido, Campo de

Córdoba, Brazo del Puma –headwaters of Gualo River–, and La Iglesia (Supplementary figures 2, 3). As a result of these explorations we increased the number of specimens of already-known groups –i.e., kannemeyeriiforms, eucynodonts, proterochampsids, gracilisuchids, and dinosauriforms– as well as of vertebrates not recorded previously for the unit (e.g., rhynchosaurids: Ezcurra et al. 2014; fishes: Gouiric-Cavalli et al. 2017).

Sedimentary geology of the Chañares Formation and the *Tarjadia* AZ palaeoenvironment

In the studied outcrops of the Talampaya National Park, the Chañares Formation is an approximately 70 metres thick, rather homogeneous fining upward succession, which is composed of sandstones and minor conglomerates and siltstones characterized by a high content of tuffaceous materials (Supplementary figure 4). This unit overlies the red beds of the Tarjados Formation (Supplementary figures 2, 4, 5) through a regional unconformity expressed in form of a mineralized surface of chert and carbonates stringers and horizontal veins of uncertain origin that cover the Tarjados Formation (Milana and Alcober 1994; Rogers et al. 2001; Fiorelli et al. 2013; Mancuso et al. 2014) and by a soft but very irregular palaeorelief with a thickness of up to 10 metres (Supplementary figure 4). The chert and carbonates stringers cover the Tarjados Formation in all the localities where the contact with the Chañares Formation occurs, with the exception of the northern outcrop of the Campo de Córdoba locality (Supplementary figure 5). The palaeosurface determines the presence of a considerable stratigraphic unconformity associated with an early extensional episode occurred during a synrift stage (Synrift I of Milana and Alcober 1994; Synrift II of Mancuso and Caselli 2012), which was an event that led to the deposition of the Chañares-Los Rastros sequence.



Supplementary figure 5. Detailed stratigraphic profile of the Chañares Formation at the Campo de Córdoba North locality. The profile shows the stratigraphic location of the new *Tarjadia* AZ and the provenance of collected fossil specimens in the locality. The taxa indicated in the *Massetognathus*-*Chanaresuchus* AZ summarize the fossil content collected at all the studied locality in the first metres of the AZ (below the concretions).

The two recognized lithological units of Chañares Formation (Romer and Jensen 1966; Rogers et al. 2001), considered by Fiorelli et al. (2013) as two different members, are

described as follows. The lower member is divided into two beds (Bed#1 and Bed#2) based on their different facies characteristics (Supplementary figure 2) and based on the new fossil specimens reported here we show that it possesses two different faunal associations, which we name here the *Tarjadia* Assemblage Zone (AZ) and the *Massetognathus-Chanaresuchus* AZ. The lower member starts with a ~18 metres thick interval that preserves the *Tarjadia* AZ and is composed of massive or stratified bodies formed by grey olive-L yellow green sandstones, conglomeratic sandstones, and siltstones variably mixed with tuffaceous material (Supplementary figure 5). These coarse sandy bodies usually show a variety of tractive sedimentary structures, such as current ripples and horizontal, planar, and/or trough cross-stratification. The geometry of the bed sets is frequently wedge-shaped or lenticular, limited by basal low angle erosive scours. Silicified and carbonatic horizontal root traces – rhizocretions– and bioturbations are common in these basal levels, which also contain several tetrapod-burrows (Supplementary figures 4–6). These structures are consistent with the occurrence of immature and poorly developed palaeosols near fluvial channels or floodplains (Bown and Kraus 1987). Abundant calcium carbonate cement and some highly carbonatic mineralized horizons (calcretes) are present in this facies (Supplementary figure 6). These coarse sandy bodies are lithofacies that correspond to superimposed flood cycles of distally braided sheetflood –multiple-channel– rivers (sensu Miall 1996). The pattern observed in these sandy gravel-rich channels involves rivers with low sinuosity and stability, high to moderate discharge of sediment, and high stream power (Boggs 2006). Sedimentation took place mainly by syneruptive high-sediment-load floods that were later variably redistributed into bedforms at lower stages and subject to pedogenetic processes depending on duration of inter-eruptive periods. When inter-eruptive periods were sufficiently prolonged, normal stream-flow facies developed as consequence of reworking of flood-deposited materials. These facies were subsequently pedogenized, resulting in incipient calcite-bearing palaeosols

with evidence of bioturbations produced by root activity and tetrapod burrowing (Supplementary figures 6, 7). The rhyzoliths are not plant specific but ecophenotypic (i.e., root patterns produced by specific environmental conditions) and, along with the tetrapod burrows, suggests the development of pedogenesis that correspond to a fossil rhizosphere with a certain percentage of humidity (Retallack 2001; Kraus and Hasiotis 2006; Miller 2007). The calcite-bearing palaeosols commonly record arid to subhumid conditions where evaporative loss exceeded the supply of water to the surface by rainfall or flooding.

The *Massetognathus-Chanaresuchus* AZ (Bed#2) of the lower member corresponds to ~25 metres of thick massive sandstones and tuffaceous claystone–siltstone facies of bluish grey color (Supplementary figure 2). The unit shows an increase of tuffaceous content, varying from mixtures of altered volcanic glassy materials and epiclastic grains in the base to purely altered vitreous components (bentonites) on the top. The interval is recognized by its metre thick, massive, and laterally continuous beds with the carbonatic concretions and septarians that typify this part of the formation and bear the vertebrate fossils historically collected in the unit (Rogers et al. 2001; Fiorelli et al. 2013; Mancuso et al. 2014). The increased input of sediment of volcanic origin strongly influenced the style of the alluvial systems as shown by the changes in sediment composition, lithofacies character, and depositional architecture of this section of the Lower Member. High aggradation rates and channel widening and avulsion favoured the development of laterally widespread sheets of detritus. The tuffaceous sand-sized granular deposits that form massive or poorly structured flat beds can represent high flow regime conditions developed in high energy fluvial systems during flooding and discharge events of high energy (torrent flow conditions; Cas and Wright 1987). The deposition occurred when the speed of the current that carried sediments suspended by turbulence and grain interactions decreased and produced high sedimentation rates in aggradational fashion. Similar deposits have been referred as ‘sheetflood’ or ‘shallow

braided stream' facies (Smith and Lowe 1991). High-discharge, sediment-laden flows occur commonly in semiarid regions after heavy rainfalls, and are particularly common in volcanic regions where eruptions trigger heavy rains (Smith and Lowe 1991; Boggs 2006).



Supplementary figure 6. Geological features of the lowermost levels of the Chañares Formation. a, b, Facies of the *Tarjadia* AZ displaying some calcrete horizons. c, d, Horizontal root traces –rhizoconcretions– that suggest typical immature and poorly developed

paleosoils. **e, f**, Tetrapod burrows associated to the pedogenic braided facies, which are the facies levels of the *Tarjadia* AZ.

The Upper Member of the Chañares Formation has a thickness of ~30 metres (Supplementary figure 4). It is represented by very massive and concretioned light-gray sediments bearing mostly siliceous concretions, contrasting with the carbonatic concretions from the Lower Member. The first metres represent amalgamated beds of concretionated massive claystones with abundant bioturbations and subvertical burrows with a width of ~0.5 cm (cf. *Taenidium*). In the uppermost levels of the Chañares Formation occur several massive horizontal coarse sandstone and conglomeratic beds with a thickness of 0.5 to 1 metre. Some of them are lenticular, with erosive surfaces and diverse tractive structures intercalated between claystones-siltstones facies, which are transitional to the prodelta of the top of the Chañares Formation and the delta front facies of Los Rastros Formation (Supplementary figure 4). The conglomeratic and sandy levels have yielded fragmentary remains of an indeterminate cf. pseudobeaconiid neopterygian fish (Gouiric-Cavalli et al. 2017), as well as therapsids and large archosauriform remains (unpublished data). Two or three fine layers of bentonites occur intercalated near the top of the unit (e.g., at Chañares type and Brazo del Puma localities). The first metres of the Upper Member have similar sedimentological features to the Lower Member. The amount of pyroclastic sediments and volcanic influences on the sedimentation diminish progressively towards the top of the unit. The lowermost and uppermost laterally intermittent body sandstones represent meandering wide river systems of medium sinuosity and high discharge, with relative stability and stream power (cf. Rogers et al. 2001; Boggs 2006). The claystones-siltstones facies represent flood plain and lacustrine deposits.

The tectono-sedimentary evolution of the Chañares Formation has not been described in detail by previous authors, perhaps because the unit historically has dubious and varied interpretations. Recent works suggest that the sediments of the Chañares Formation

were accumulated in a fluvial-alluvial to lacustrine setting affected by volcanism within an active rift basin where muddy streams with abundant volcanic detritus were deposited from surrounding highlands (López-Gamundí et al. 1994; Rogers et al. 2001). Although the Chañares Formation has different depositional palaeoenvironments along its stratigraphic sequence, the general pyroclastic features and volcanoclastic materials of the massive and concretionary unit implies a more complex history. A wax-wane volcanic cycle that involves the entire unit is recognized based on sediment composition, texture, and facies geometries. The sedimentation started with flood-deposited volcaniclasts that were distributed in poorly confined shallow braided channels that aggraded and progressively filled the paleo-topographic relief of the older Tarjados Formation with high but sporadic water discharges and abundant sedimentary load. Inter-eruptive periods were sufficiently prolonged to allow the development of normal stream-flow facies and incipient soils where the fauna of the *Tarjadia* AZ developed. As suggested by the facies geometry (type 2 of Smith 1991), subsidence matched or exceeded the volcanism-related sediment input during this stage, resulting in the preservation of both syneruption facies, emplaced due to eruptions, and inter-eruption facies, deposited in response to subsidence.

With the increased volcanic activity large volumes of volcanoclastic sediments became available to the fluvial system and to be redistributed by high-discharge, sediment-laden flows originated during or following eruptions. Enormous volumes of volcanoclastic sediments were transported downslope by mass-flow and high-sediment-concentration flow processes (Lahar-type flood events) and deposited on fluvial-alluvial surfaces that occupied the Ischigualasto-Villa Unión Basin during the syneruptive periods (Orton 1996). This kind of deposits often dominate volcanoclastic sedimentary sequences (Smith 1991 and references therein). The widespread syneruption aggradation resulted in a broad alluvial-plain or volcanoclastic apron and the common features of the Chañares region 236 million years ago.

Facies geometries (type 1 of Smith 1991) suggest that during waxing volcanic activity tectonic subsidence was slower than the volcanic-sediment production that results in an aggradational sequence.

Changes in fluvial style occur with the waning of the volcanic activity and the increase of accommodation in the basin, which exceeded sediment and water input.

Meandering rivers and saline lakes were developed typifying low-stand systems upwards on the Chañares sequence; this is common during times of high rate of generation of space for accommodation, as during the transgressive phase of the base-level cycle (Miall 2010). A balance between creation of accommodation space and water and sediment fluxes developed on the onset of the lacustrine sedimentation of the Los Rastros Formation (cf. Melchor 2007).

3. Further information on *Tarjadia ruthae* and other erpetosuchids

Systematic Palaeontology

Archosauriformes Gauthier et al., 1988

Archosauria Cope, 1871 sensu Gauthier and Padian 1985

Pseudosuchia Zittel, 1887-1890 sensu Gauthier and Padian 1985

Erpetosuchidae Watson, 1917 sensu Nesbitt and Butler 2013

Tarjadia ruthae Arcucci and Marsicano, 1998

Holotype

PULR 063: six dorsal osteoderms (and fragments of another three) and six partial vertebrae.

Referred specimens

CRILAR-Pv 463b: six osteoderm fragments. Associated to rhynchosaur tooth bearing bones (CRILAR-Pv 463a).

CRILAR-Pv 477: partial postcranium that includes fragmentary vertebrae, left coracoid and humerus, right femur, gastralia, and osteoderms.

CRILAR-Pv 478: partial skull that includes premaxillae, maxillae, jugals, quadratojugals, palate, and braincase, both hemimandibles, complete cervical, dorsal and sacral postatlantal vertebral series, some caudal vertebrae, both ilia and ischia, right pubis, incomplete left femur and tibia, some gastralia, paramedian, lateral, and appendicular osteoderms.

CRILAR-Pv 479: anterior end of dentary, seven articulated middle-posterior vertebrae, two partial osteoderms, and rib fragments.

CRILAR-Pv 495: almost complete skull and posterior half of the hemimandibles.

CRILAR-Pv 564: two anterior caudal vertebrae, two tooth crowns, and other bone fragments.

CRILAR-Pv 565: posterior end of left surangular, basioccipital and partial parabasisphenoid, a fragment of tooth crown, middle or posterior dorsal centrum, some other vertebral fragments, right femur, and unidentified bone fragments, including limb bones.

CRILAR-Pv 566: basioccipital and partial parabasisphenoid.

MCZ 4076: posterior end of right hemimandible, a partial vertebral centrum, and several fragments of osteoderms.

MCZ 4077: partial left femur, several osteoderm fragments, and unidentified bone fragments.

MCZ 9319: partial skull roof that includes both frontals, anterior end and posterolateral process of both parietals, left postfrontal, and supraoccipital, posterior end of left surangular, and a fragment of osteoderm. The bones identified by Arcucci and Marsicano (1998) as otoccipitals (=fused opithotic-exoccipital), forming the paraoccipital process, are here reinterpreted as the posterolateral process of the parietals.

Type locality and horizon

Big bend of the Gualo River, near Agua Escondida (Talampaya National Park, La Rioja Province), Lower Member of the Chañares Formation (late Ladinian–earliest Carnian), Ischigualasto Villa Unión Basin (modified from Arcucci and Marsicano 1998). There is no precise stratigraphic information to determine the assemblage zone.

Referred localities and horizon

CRILAR-Pv 463b, 564, 565, 566 – Brazo del Puma locality (Talampaya National Park, La Rioja Province), first 17 metres of the Lower Member of the Chañares Formation (*Tarjadia* AZ, late Ladinian–earliest Carnian), Ischigualasto Villa Unión Basin.

CRILAR-Pv 477, 478, 479, 495 – Campo Córdoba locality (Talpampaya National Park, La Rioja Province), first 17 metres of the Lower Member of the Chañares Formation (*Tarjadia* AZ, late Ladinian–earliest Carnian), Ischigualasto Villa Unión Basin.

MCZ 4076 – about 5 miles east of the mouth of the Chañares River (Talpampaya National Park, La Rioja Province), probably Lower Member of the Chañares Formation (late Ladinian–earliest Carnian), Ischigualasto-Villa Unión Basin.

MCZ 4077 – 1 mile east of the mouth of the Gualo River (Talpampaya National Park, La Rioja Province), Lower Member of the Chañares Formation (late Ladinian–earliest Carnian), Ischigualasto-Villa Unión Basin.

MCZ 9319 – Chañares River, 1.5 kilometres to the north of the type locality (Talpampaya National Park, La Rioja Province), Lower Member of the Chañares Formation (late Ladinian–earliest Carnian), Ischigualasto-Villa Unión Basin.

Emended diagnosis

Arcucci and Marsicano (1998) originally diagnosed *Tarjadia ruthae* as an archosaur with “double row of thick quadrangular paramedial osteoderms and subrounded ?lateral ones; osteoderms and bones of skull table covered by a coarse pitted ornamentation; absence of distinctive articular laminae processes or lateral projections in the osteoderms; parietals with a strong sagittal crest between the supratemporal fenestrae”.

Subsequently, Ezcurra (2016) provided the following emended diagnosis to allow distinguishing the genus and species from *Archeopelta arborensis*: “basal archosauriform that differs from other archosauromorphs by the following combination of features (autapomorphy indicated with an asterisk): dorsoventrally thick skull roof and ornamented by deep pits and grooves of random arrangement*; postfrontal bone present; supraoccipital without median vertical peg; surangular with a strongly laterally developed shelf on the

dorsolateral surface of the bone; dorsal vertebrae with a moderately transversely compressed centrum at mid-length; and femur with a poorly developed fourth trochanter”.

The new specimens reported here allow expanding the diagnosis of *Tarjadia ruthae* as a basal archosauriform that differs from other archosauromorphs by the following combination of features (autapomorphy indicated with an asterisk): dorsoventrally thick skull roof and ornamented by deep pits and grooves of random arrangement*; Y-shaped tuberosity on the dorsal surface of the anterior end of the parietals*; postfrontal bone present; supraoccipital without median vertical peg; surangular with a strongly laterally developed shelf on the dorsolateral surface of the bone; marginal dentition with serrations; spine table of the presacral and anterior caudal vertebrae with a transversely concave dorsal surface; dorsal vertebrae with a moderately transversely compressed centrum at mid-length; and femur with a poorly developed fourth trochanter and a hook-shaped tibial condyle*; thick dorsal osteoderms with a coarse pitted ornamentation and an anterior articular lamina.

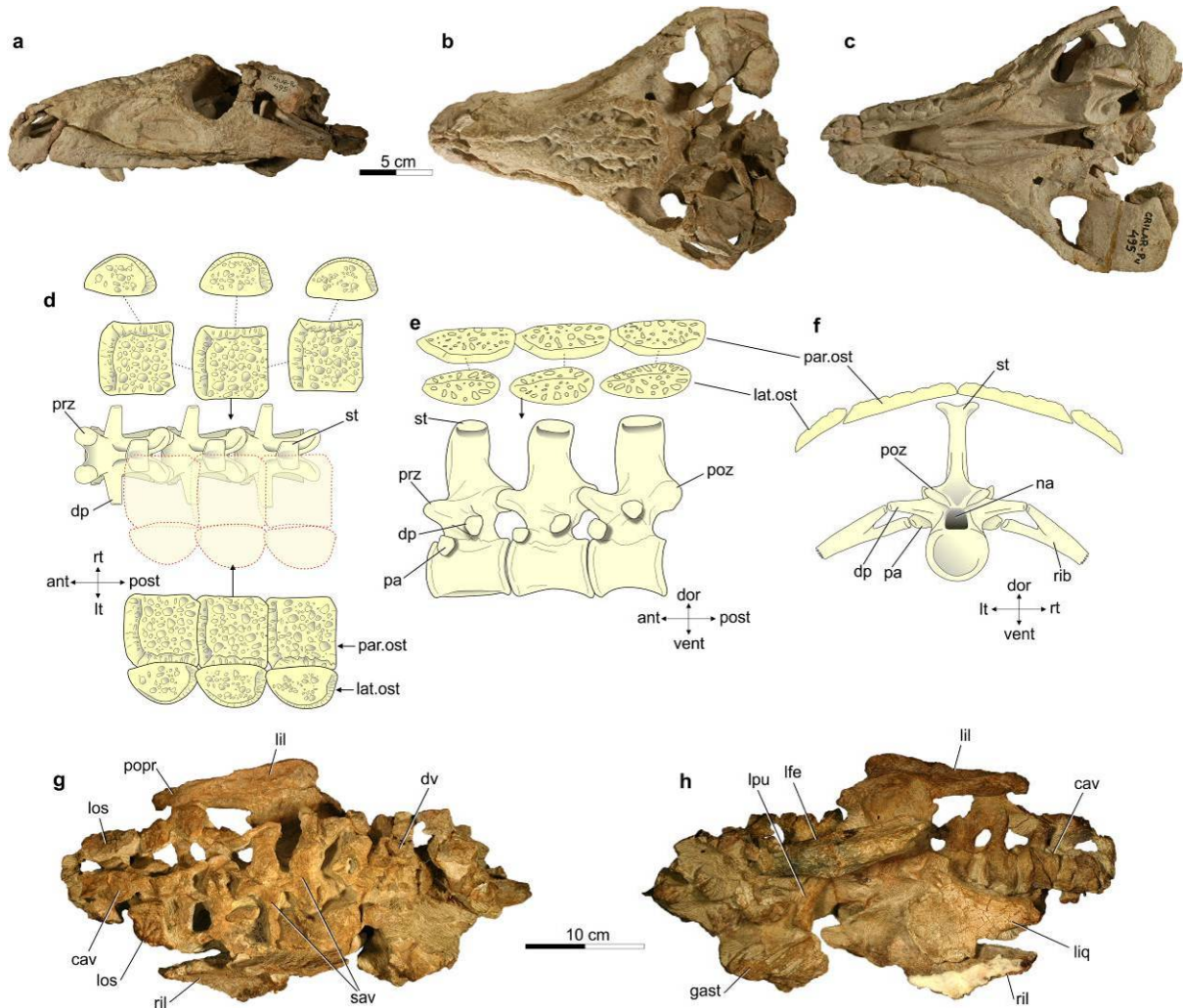
Short description

The largest specimen of *Tarjadia* (CRILAR-Pv 478) has a total skull length of 32 centimetres and a body length of ~2 metres (Fig. 2; Extended Data 1). The skull strikingly resembles in overall morphology that of the erpetosuchid *Erpetosuchus*, in which, for example, the antorbital fenestra extends distinctly more ventrally than the orbit (Benton and Walker 2002) (Fig. 2, Supplementary figure 7). The skull is not strongly dorsoventrally depressed in lateral view, contrasting with some proterochampsids and *Doswellia* (Ezcurra 2016). The premaxilla possesses four tooth positions and the alveolar margin of the maxilla is restricted to the anterior half of the bone, with only six tooth positions, an apomorphic condition of the erpetosuchids *Erpetosuchus* and *Parringtonia* (Benton and Walker 2002; Nesbitt and Butler 2013). As occurs in *Erpetosuchus* and the poorly preserved erpetosuchid *Dyoplax*, the

horizontal process of the maxilla has a well-laterally developed sharp edge that results in an inset ventral margin of the bone and the jugal is dorsoventrally tall (Benton and Walker 2002; Maisch et al. 2013). The jugal possess a well-developed antorbital fossa, similar to *Erpetosuchus* (Benton and Walker 2002) and *Riojasuchus* (Baczko and Desojo 2016). The main axis of the quadrate strongly slants anteriorly at an angle of approximately 45°, as in *Erpetosuchus* and ornithosuchids (Benton and Walker 2002; Baczko and Desojo 2016). The supraoccipital slopes distinctly anteriorly, resembling ornithosuchids (Baczko and Desojo 2016), and the entrance of the internal carotids is placed ventrally on the parabasisphenoid, as occurs in non-archosaurian archosauriforms, the erpetosuchid *Archeopelta* (see below), and some other pseudosuchians (e.g. *Turfanosuchus*) (Nesbitt 2011). The palate lacks teeth, as in most archosaurs, but contrasting with doswelliids (Nesbitt 2011; Ezcurra 2016). The external mandibular fenestra is anteroposteriorly long and the lateral shelf of the surangular is strongly laterally developed. The articular has a very well-developed dorsomedial projection. The tooth crowns are labiolingually compressed, recurved, and finely serrated on both margins, resembling other predatory archosauriforms (Ezcurra 2016).

The presacral and caudal vertebrae are anteroposteriorly short, with spool-shaped centra, and the neural spines have a distally concave spine table (Supplementary figure 7), similar to *Erpetosuchus* (cast of NMS 1992.37.1) and *Parringtonia* (NHMUK PV R8646). This condition differs from the convex or flat distal surface of the neural spine of other archosauriforms (Nesbitt 2011; Ezcurra 2016). The presacral neural arches only possess paradiapophyseal/anterior centrodiapophyseal laminae. The cervical vertebrae have a median keel that projects ventrally to the rims of the centrum, as in proterochampsids, ornithosuchids, *Erpetosuchus* (cast of NMS 1992.37.1), and some saurischians (Ezcurra 2016). The sacrum is composed of two vertebrae (Supplementary figure 7). The neural spines of the caudal

vertebrae are proportionally taller than those of the presacral vertebrae and the transverse processes are long and posteroventrally oriented.



Supplementary figure 7. Additional photographs and interpretative drawings based on the new referred specimens of *Tarjadia ruthae*. Almost complete skull (CRILAR-Pv 495) in **a**, left lateral; **b**, dorsal; and **c**, ventral views. Relationship between dorsal armour and presacral vertebrae (based on CRILAR-Pv 478) in **d**, dorsal; **e**, left lateral; and **f**, posterior views. Articulated posterior dorsal, sacral, and anterior caudal vertebrae, and partial gastral basket, pelvis, and left femur (CRILAR-Pv 478) in **g**, dorsal and **h**, ventral views. Abbreviations: ant, anterior; cav, caudal vertebra; dp, diapophysis; dv, dorsal vertebra; gast, gastral basket; lat.ost, lateral osteoderm; lfe, left femur; lil, left ilium; liq, left ischium; los, lateral osteoderm; lpu, left pubis; lt, left; na, neural arch; pa, parapophysis; par.ost, paramedian osteoderm; popr, postacetabular process; post, posterior; poz, postzygapophysis; prz, prezygapophysis; ril, right ilium; rt, right; sav, sacral vertebrae; st, spine table.

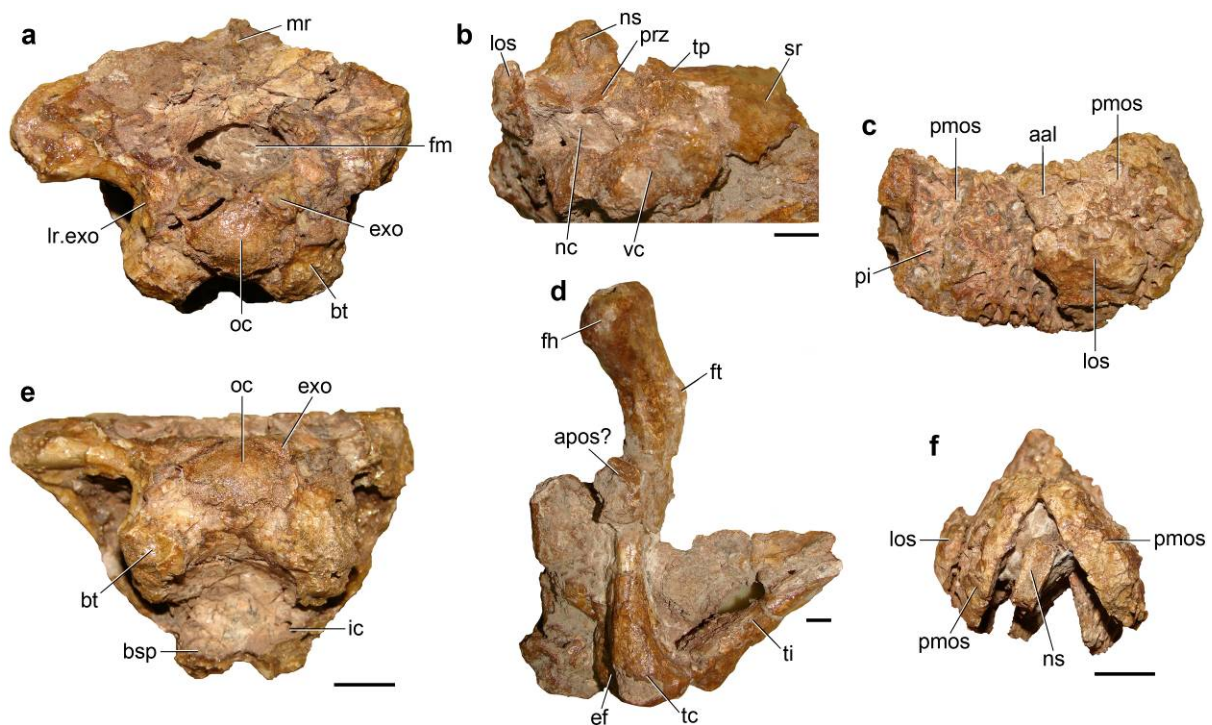
The coracoid is oval in lateral view and the humerus possesses a well medially developed proximal end, as occurs in *Erpetosuchus* (NHMUK PV R3139) and *Archeopelta* (Desojo et al. 2011). The ulna has a well-developed lateral tuber, as occurs in most archosaurs (Nesbitt 2011). The pelvic girdle is formed by a fully closed acetabulum, a short, posteriorly bowed pubic shaft, and a plate-like ischium. The femoral head possesses anterior, posteromedial, and posterior tuberosities, resembling the condition in most archosaurs (Nesbitt 2011). The fourth trochanter is very low and proximodistally short. The tibial condyle is autapomorphically L-shaped in medial view, being strongly posteriorly developed.

The neck and trunk possess two rows of imbricated paramedian osteoderms aligned between each other, as in most archosauriforms (Nesbitt 2011) (Supplementary figure 7). The paramedian osteoderms are very thick, contrasting with the considerably thinner osteoderms of the doswelliids *Doswellia* and *Jaxtasuchus* (Ezcurra 2016), but similar to *Parringtonia* (NHMUK PV R8646) and *Archeopelta* (Desojo et al. 2011). These osteoderms have an anterior articular lamina and their external surface is strongly ornamented by deep, irregular pits, as occurs in aetosaurs, *Doswellia*, *Archeopelta* (Desojo et al. 2011), and *Erpetosuchus* (NHMUK PV R3139). The dorsal armour is also composed of lateral osteoderms, as in *Erpetosuchus*, *Dyoplax*, aetosaurs, and *Archeopelta* (Benton and Walker 2002; Desojo et al. 2011, 2013; Maisch et al. 2013). The hindlimbs possess suboval appendicular osteoderms, as occurs in phytosaurs and aetosaurs (Nesbitt 2011; Desojo et al. 2013). The appendicular osteoderms are scattered on the distal half of the femur and aligned in rows on the tibia. No forelimb appendicular osteoderm is preserved.

Anatomic reinterpretations and comments on the erpetosuchid *Archeopelta arborensis*

Desojo et al. (2011) described *Archeopelta arborensis* from the Ladinian-lower Carnian (*Dinodontosaurus* AZ) of southern Brazil based on a single, partial skeleton. These authors

found *Archeopelta* within Doswelliidae, being closely related to *Tarjadia* and the North American Late Triassic *Doswellia*. Desojo et al. (2011) provided a detailed anatomical description of *Archeopelta*, but the new information available for *Tarjadia* allowed reinterpreting some phylogenetically informative characters that are discussed as follows.



Supplementary figure 8. Selected bones of *Archeopelta arborensis* (CPEZ-239a). **a, e,** Braincase in **a**, posterior and **e**, ventral (and slightly anterior) views. **b**, Sacral vertebra and displaced lateral osteoderm in anterior view. **c, f**, Articulated paramedian osteoderms and neural spines and displaced lateral osteoderm in **c**, left lateral and **f**, posterior views. **d**, Articulated right femur and partial tibia with a probable appendicular osteoderm in medial view. Abbreviations: aal, anterior articular lamina; apos?, probable appendicular osteoderm; bsp, basiptyergoid process; bt, basal tuber; ef, extensor fossa; exo, exoccipital; fh, femoral head; fm, foramen magnum; ft, fourth trochanter; ic, internal carotid artery passage; los, lateral osteoderm; lr.exo, lateral ridge on exoccipital; mr, median ridge; nc, neural canal; ns, neural spine; oc, occipital condyle; pi, pit; pmos, paramedian osteoderm; prz, prezygapophysis; tc, tibial condyle; ti, tibia; tp, transverse process; vc, vertebral centrum. Scale bars equal 1 cm.

The exoccipital possesses a vertical lateral ridge (= metotic strut of Nesbitt 2011; but see Sobral et al. 2016) (Supplementary figure 8a), as occurs in archosaurs (Nesbitt 2011). The passage of the internal carotid artery is placed immediately posterior to the base of the

basipterygoid process (this opening was originally interpreted as the passage of the Cranial Nerve VI) (Supplementary figure 8e), closely resembling the condition in *Tarjadia*. The foramen originally interpreted by Desojo et al. (2011) as the passage of the internal carotid artery was probably associated with minor neurovasculature because of its small size.

Desojo et al. (2011) interpreted an element that is mostly obscured by matrix and other bones as an ilium. These authors described that the morphology of the iliac blade was quite peculiar, with a sigmoid shape in posterior view, which results in a laterally deflected blade, a condition also present in *Doswellia*. Because of the absence of this feature in other pseudosuchians closely related to *Archeopelta* and the fact that the morphology of this bone is extremely difficult to assess, we decided here to be more cautious as reinterpret this element as an indeterminate bone. For example, it is not possible to determine if the sigmoid profile of the putative iliac blade is a result of post-mortem deformation.

The holotype of *Archeopelta arborensis* preserves several osteoderms. The presence of lateral osteoderms in *Tarjadia* reinforces the original identification of such elements in *Archeopelta* (Desojo et al. 2011) (Fig. 8B, c, f). Two plate-like, suboval elements are preserved attached to the femur and they may represent appendicular osteoderms (Supplementary figure 8d), as occurs in *Tarjadia*. However, this interpretation should be considered tentative because of the poor preservation of these bones.

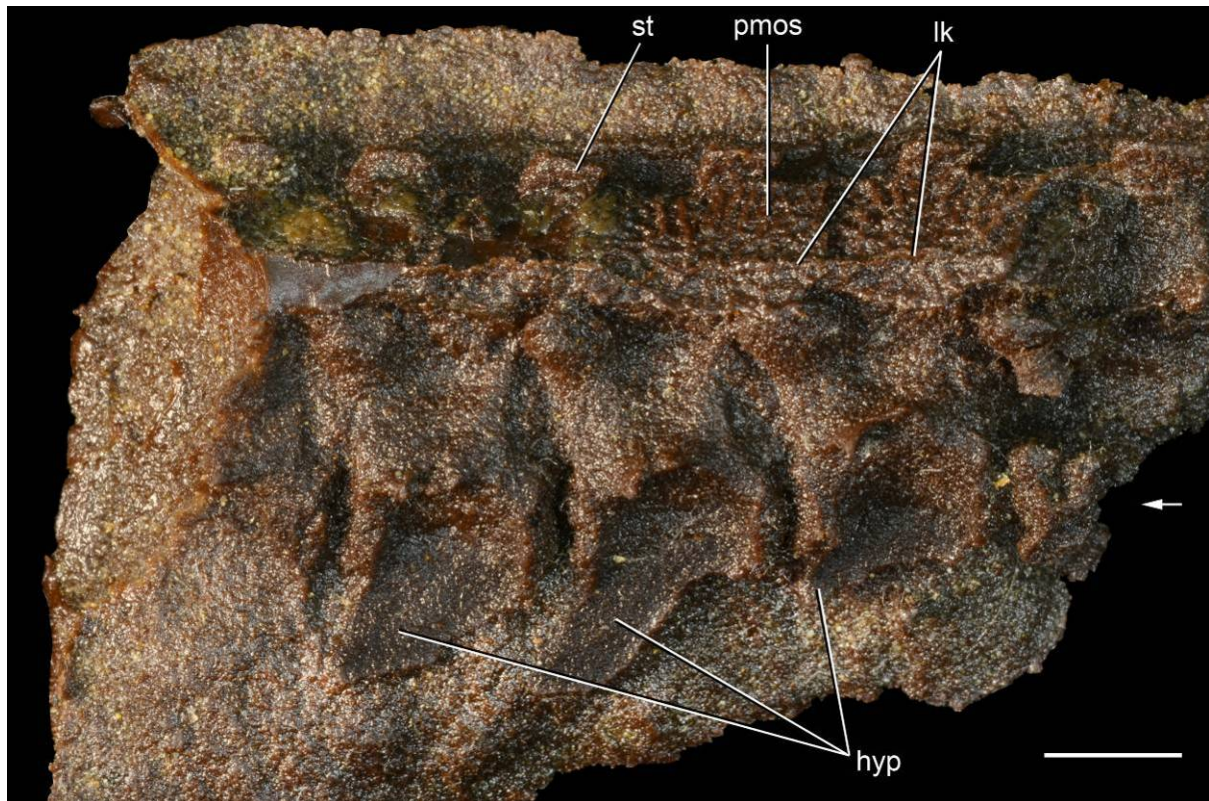
Anatomic reinterpretations of the erpetosuchid *Erpetosuchus granti*

The erpetosuchid *Erpetosuchus granti* from the upper Carnian–lowest Norian Lossiemouth Sandstone Formation (Scotland) was originally described by Newton (1894) and the most recent, comprehensive redescription of the species was published by Benton and Walker (2002). These anatomical information provided by these authors is very detail and accurate,

but some additional comments on the anatomy of *Erpetosuchus granti* are included here because of they are phylogenetically relevant.

The anterior and midde cervical vertebrae, at least from the axis to the sixth cervical, possess non-parallellogram centra and a longitudinal keel on their ventral surface of (cast of NMS 1992.37.1; NHMUK PV R3139). These keels extend along the entire length of the centrum and are well ventrally developed, beyond the ventral margin of the anterior and posterior rims of the centrum in lateral view. In particular, the middle cervical vertebrae of one specimen (NMS 1992.37.1) have the ventral keel developed ventrally as a distinct hypapophysis (Supplementary figure 9), resembling the condition in several basal crocodylomorphs (Clark et al. 2004), but these structures have not been described before for *Erpetosuchus*. The hypapophyses of *Erpetosuchus* are developed as trapezoidal, anteroventrally oriented structures in lateral view. The hypapophysis of NMS 1992.37.1 extends along the entire length of the centrum in the most anterior preserved cervical vertebra and is restricted to the anterior half and to the most anterior portion of the centrum in the subsequent two vertebrae, respectively. The spine tables of the vertebrae of NMS 1992.37.1 are wider than long and posssess a dinstinct transversely concave dorsal surface, as occurs in *Tarjadia* and *Parringtonia* (see above).

The paramedian osteoderms of of NMS 1992.37.1 possesses a radial disposition of the ridges that compose the external ornamentation and a longitudinal keel laterally displaced from the mid-width (Supplementary figure 9). A non-ornamented area is present adjacent to the anterior margin of the osteoderms and seems to correspond to an anterior articular lamina, as occurs in *Tarjadia* and *Archeopelta* (Desojo et al. 2011). The dorsal osteoderms are thin, resembling those of *Parrigntonina* (NHMUK PV R8646), but constrasting with the considerably thicker dorsal dermal plates of *Tarjadia* and *Archeopelta* (Desojo et al. 2011).

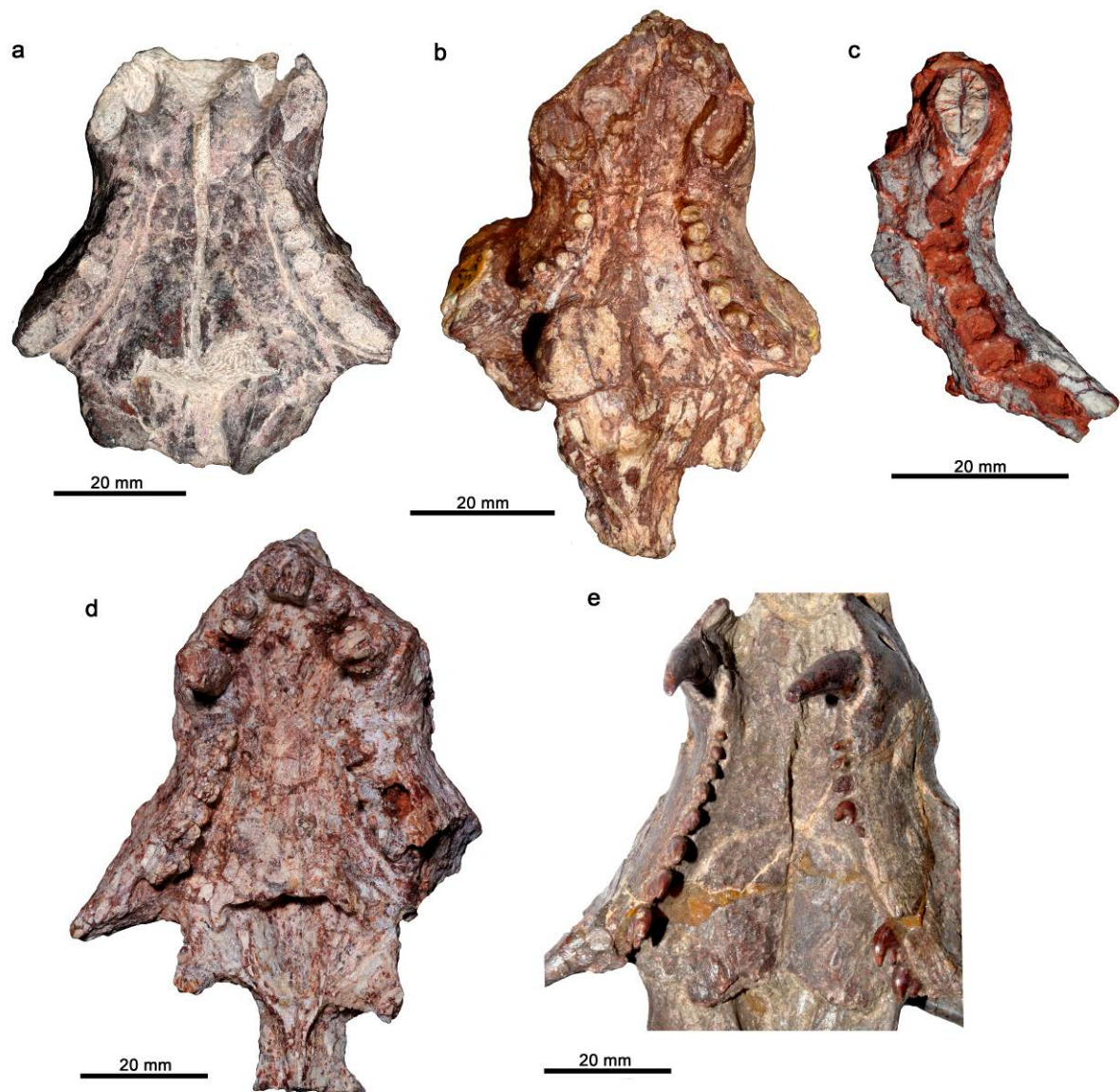


Supplementary figure 9. Middle and posterior cervical series of *Erpetosuchus granti*.

Cast of NMS 1992.37.1 in left lateral view. The arrow indicates anterior direction.

Abbreviations: hyp, hypapophyses; lk, longitudinal keel; pmos, paramedian osteoderm; st, spine table. Scale bar equals 5 mm.

4. Comparative figures of the cynodonts from the *Tarjadia* AZ and closely related species



Supplementary figure 10. Comparisons among chiniquodontids. **a**, cf. *Aleodon* (CRILAR-Pv 567) from the *Tarjadia* AZ, anterior portion of the skull in ventral view. **b**, *Aleodon brachyrhampus* (NHMUK PV R9390), from Manda beds of Tanzania (Crompton 1955), anterior half of the skull in ventral view. **c**, **e**, *Aleodon cromptoni* from the *Dinodontosaurus* AZ of Brazil (Martinelli et al. 2017), **c**, left maxilla in ventral view (MMACR-PV-018-T) and **d**, anterior portion of skull in ventral view (UFRGS-PV-0071-T). **e**, *Chiniquodon thetonicus* (PVL 4167; Abdala and Giannini 2002), from the *Massetognathus-Chanaresuchus* AZ, anterior portion of skull in ventral view. Note the transversely oval postcanine teeth and alveoli of *Aleodon* spp. and cf. *Aleodon*, and the labiolingually narrow crowns and alveoli of *Chiniquodon thetonicus*.



Supplementary figure 11. Comparisons among traversodontids. a, cf.

Scalenodon/Mandagomphodon (CRILAR-Pv 569) from the *Tarjadia* AZ, right jaw in lateral (top) and oclussal (bottom) views. **b**, *Mandagomphodon hirschsoni* (NHMUK PV R8577) from the Manda Beds, Tanzania (Hopson, 2014), left jaw in lateral view (top) and detail of postcanine teeth in oclussal view (bottom). **c**, *Massetognathus pascuali* (NHMUK PV R8429) from the *Massetognathus-Chanaresuchus* AZ, detail of the right postcanine dentition in oclussal view. Note the relative large size of the postcanines of CRILAR-Pv 569 and *Mandagomphodon* and narrow oclussal basin in relation to the transverse crest of *Massetognathus*.

5. Details of the quantitative phylogenetic analysis of basal archosauromorphs

Character list of the phylogenetic data set

1. Skull and lower jaws, interdental plates: absent (0); present, but restricted to the anterior end of the dentary (1); present along the entire alveolar margin of the premaxilla, maxilla and dentary (2), ORDERED.
2. Skull, total length versus length of the presacral vertebral column: 0.22–0.38 (0); 0.44–0.72 (1); 0.94–0.98 (2), ORDERED. This character is inapplicable in taxa with an extremely elongated neck (e.g. *Tanystropheus longobardicus*).
3. Skull, strongly dorsoventrally compressed skull with mainly dorsally facing antorbital fenestrae and orbits: absent (0); present (1).
4. Skull, well developed nodular prominences on the lateral surface of maxilla, jugal, quadratojugal, squamosal and angular: absent (0); present (1).
5. Skull, dermal sculpturing on the dorsal surface of the skull roof: absent (0); shallow or deep pits scattered across surface and/or low ridges (1); prominent ridges or tubercles on frontals, parietals, and nasals (2).
6. Skull, dorsal surface of nasals and/or frontals ornamented by ridges radiating from centres of growth: absent (0); present (1). This character is inapplicable to taxa that lack ridges or tubercles on the dorsal surface of the skull roof.
7. Skull, dorsal orbital margin: orbital margin of the frontal level with skull table or raised slightly (0); orbital margin of the frontal elevated above skull table (1); shelf/ridge elevated above skull table extends along the lateral surface of the lacrimal, prefrontal, frontal portion of orbital rim, and postorbital (2), ORDERED.
8. Skull, dorsal surface of the temporal region: flat (0); supratemporal fossa immediately medial or anterior to the supratemporal fenestra (1); thin, blade-like median sagittal crest (2). This character is inapplicable in taxa lacking supratemporal fenestrae.

9. External naris, confluent with each other: absent (0); present (1), ORDERED.
10. External naris, anteroposterior position in the snout: terminal, on the anterior end of the snout (0); nonterminal, considerably posteriorly displaced, but posterior rim of the naris well anterior to the anterior border of the orbit (1); nonterminal, considerably posteriorly displaced and posterior rim of the naris approximately at level with the anterior border of the orbit (2), ORDERED.
11. External naris, directed: laterally (0); dorsally (1); anteriorly (2).
12. External naris, shape: sub-circular (0); oval (1).
13. Antorbital fenestra: absent (0); present (1).
14. Antorbital fenestra, anterior margin: gently rounded (0); nearly pointed (1). The character is not applicable to taxa that lack an antorbital fenestra.
15. Secondary antorbital fenestra, immediately anterior to the antorbital fenestra: absent (0); present (1).
16. Orbit, shape: anteroposteriorly longer than tall (0); subcircular (1); dorsoventrally taller than long (2).
17. Orbit, elevated rim: absent or incipient (0); present, restricted to the ascending process of the jugal and sometimes also onto the ventral process of the postorbital (1); present, well-developed along the jugal, postorbital, frontal, prefrontal and lacrimal (2), ORDERED.
18. Infratemporal fenestra: present (0); absent (1).
19. Posttemporal fenestra, size: larger than or subequal to the supraoccipital (0); smaller than the supraoccipital (1); developed as a small foramen (2); absent (3), ORDERED.
20. Snout, antorbital length (anterior tip of the skull to anterior margin of the orbit) versus total length of the skull: 0.29–0.40 (0); 0.43–0.64 (1); 0.70–0.76 (2) (modified from Ezcurra 2016: 20), ORDERED.

21. Snout, dorsoventral height at the level of the anterior tip of the maxilla versus dorsoventral height at the level of the anterior border of the orbit: 0.15–0.30 (0); 0.38–0.53 (1); 0.59–0.80 (2); 1.04 (3), ORDERED.
22. Snout, proportions at the level of the anterior border of the orbit: transversely broader than dorsoventrally tall or subequal (0); dorsoventrally taller than transversely broad (1).
23. Snout, lateral margin of the snout anterior to the prefrontal: formed by the nasal (0); formed by the nasal and maxilla with gently rounded transition along the maxilla from the lateral to dorsal side of rostrum (1); formed by the nasal and maxilla with sharp edge along the maxilla between the lateral and dorsal sides of this bone (= box-like snout of Kischlat, 2000) (2). This character is inapplicable in taxa with an extensive contact between premaxilla and prefrontal (e.g. rhynchosaurids).
24. Premaxilla-maxilla, suture: simple continuous contact (0); notched along the ventral margin (1).
25. Premaxilla-maxilla, subnarial foramen between the elements: absent (0); present and the border of the foramen is present on both the maxilla and the premaxilla (1); present and the border of the foramen is present on the maxilla but not on the premaxilla (2).
26. Premaxilla, alveolar margin does not reach the contact with the maxilla and forms a diastema (= subnarial gap): absent (0); present (1). This character is considered inapplicable in taxa without premaxillary teeth (e.g. *Trilophosaurus*).
27. Premaxilla, main body size: small, the premaxillary body forms less than half of snout in front of the posterior border of the external nares (0); large, the premaxillary body forms half or more than half of snout in front of the posterior border of the external nares (1).

28. Premaxilla, anteroposterior length of the main body versus its maximum dorsoventral height: 0.70–0.73 (0); 1.07–2.00 (1); 2.22–3.80 (2); 4.15–4.68 (3); >5.00 (4), ORDERED. This character is inapplicable in taxa with a premaxillary beak.
29. Premaxilla, downturned main body: absent, alveolar margin sub-parallel to the main axis of the maxilla (0); slightly, in which the alveolar margin is angled at approximately 20° to the alveolar margin of the maxilla (1); strongly, prenarial process obscured by the postnarial process in lateral view (if the postnarial process is long enough) and postnarial process parallel or posteroventrally oriented with respect to the main axis of the premaxillary body (2), ORDERED.
30. Premaxilla, angle formed between the alveolar margin and the anterior margin of the premaxillary body in lateral view: acute or right-angled (0); obtuse (1). This character is inapplicable in taxa with a premaxilla modified as a beak.
31. Premaxilla, longitudinal groove placed approximately at mid-height and extending along most of the length of the lateral surface of the main body of the bone: absent (0); present (1).
32. Premaxilla, narial fossa: absent or shallow (0); expanded in the anteroventral corner of the naris (1). This character is inapplicable if the premaxilla does not participate in the border of the external naris.
33. Premaxilla, peg on the posterior edge of the premaxillary body: absent (0); present (1).
34. Premaxilla, prenarial process length: less than the anteroposterior length of the main body of the premaxilla (0); greater than the anteroposterior length of the main body of the premaxilla (1). This character is inapplicable in taxa that lack a prenarial process.
35. Premaxilla, base of the prenarial process: anteroposteriorly shallow (0); anteroposteriorly deep (1). This character is inapplicable if the premaxilla does not participate in the border of the external naris.

36. Premaxilla, postnarial process: absent (0); short, ends well anterior to the posterior margin of the external naris (1); well-developed, forms most of the border of the external naris or excludes the maxilla from participation in the external naris (2), ORDERED.
This character is inapplicable in taxa with non-terminal external nares.
37. Premaxilla, postnarial process: wide, plate-like (0); thin (1). This character is not applicable to taxa that lack a postnarial process.
38. Premaxilla, sharp dorsal flange at the base of the postnarial process delimiting the posteroventral border of the external naris: absent (0); present (1). This character is inapplicable if the premaxilla does not participate in the border of the external naris.
39. Premaxilla, postnarial process: fits between the nasal and the maxilla or lies on the anterodorsal surface of the maxilla (0); overlaps the anterodorsal surface of the nasal (1); fits into slot of the nasal (2). This character is not applicable to taxa that lack a postnarial process or it does not extend behind the external naris.
40. Premaxilla, contact with prefrontal: absent (0); present, marginal (1); present, extensive (2), ORDERED.
41. Premaxilla, palatal process on the medial surface: absent (0); present (1).
42. Premaxilla, number of tooth positions: 10 or more (0); 5 or more (1); 4 (2); 3 (3); 2 (4); 1 or edentulous (5), ORDERED.
43. Premaxilla, orientation of the tooth series or the occlusal surface of premaxilla in ventral view: approximately parasagittal (0); strongly transverse and anterior teeth covering each other in lateral view (1). This character is inapplicable in taxa without maxillary teeth.
44. Premaxilla, lateroventrally opening anterior alveoli in mature individuals: absent (0); present (1). This character is inapplicable in taxa without maxillary teeth.
45. Septomaxilla: present (0); absent (1).

46. Maxilla-nasal, maxillo-nasal tuberosity, delimiting anteriorly the antorbital fossa if present: absent (0); present (1).
47. Maxilla-jugal, anguli oris crest: absent (0); present (1).
48. Maxilla-jugal, anterior extension of the anguli oris crest: restricted to the jugal (0); extending onto the anterior process of the jugal, but not the maxilla (1); extending onto the maxilla, but not the anterior process of the jugal (2). This character is inapplicable in taxa without an anguli oris crest.
49. Maxilla, anterior extent: posterior to the anterior extent of the nasal (0); anterior to the nasal (1).
50. Maxilla, length of the portion of the bone anterior to the antorbital fenestra versus the total length of the bone: 0.12–0.22 (0); 0.29–0.60 (1); 0.64–0.76 (2), ORDERED. This character is not applicable in taxa that lack an antorbital fenestra.
51. Maxilla, posterior border of the subnarial foramen extending posteriorly as a groove on the lateral surface of the anterior process: absent (0); present (1). This character is not applicable in taxa that lack a subnarial foramen bordered by the maxilla.
52. Maxilla, anterior maxillary foramen: absent (0); present (1).
53. Maxilla, neurovascular foramina on the lateral surface of the anterior and horizontal processes: laterally or lateroventrally facing (0); lateroventrally facing and extending ventrally as deep, well-defined grooves (1). This character is inapplicable in taxa lacking neurovascular foramina on the lateral surface of the maxilla.
54. Maxilla, antorbital fossa on the lateral surface of the bone: absent or not exposed in lateral view (0); present on the ascending process of the maxilla, but not along the horizontal process of the maxilla (1); present on the ascending and horizontal processes of the maxilla, but not reaching the posteroventral corner of the fenestra (2); present on the ascending and horizontal processes of the maxilla, reaching the posteroventral corner

of the opening (3), ORDERED. This character is not applicable in taxa that lack an antorbital fenestra.

55. Maxilla, anteroposterior length of the antorbital fossa anterior to the antorbital fenestra versus length of the antorbital fenestra: 0.09–0.23 (0); 0.28–0.53 (1); 0.90–0.94 (2); >2.00 (3) (modified from Ezcurra 2016: 55), ORDERED. This character is inapplicable in taxa that lack an antorbital fossa or is not extended anterior to the antorbital fenestra.
56. Maxilla, secondary antorbital fossa anteriorly to the antorbital fossa and adjacent to the dorsal margin of the anterior process: absent (0); present (1). This character is not applicable in taxa that lack a secondary antorbital fenestra.
57. Maxilla, ascending process: absent (0); present (1).
58. Maxilla, ascending process shape: simply tapers to point dorsally (0); the dorsal apex of the maxilla is a separate, distinct process that has a posteriorly concave margin (1); sub-vertical anterior margin of the base of the process (2).
59. Maxilla, anterodorsal margin at the base of the ascending process: convex or straight (0); concave (1). This character is not applicable in taxa that lack an ascending process or possess a secondary antorbital fenestra.
60. Maxilla, ascending process remains the same width for its length: absent (0); present (1). This character is not applicable in taxa that lack an ascending process or an antorbital fenestra.
61. Maxilla, contact with prefrontal: absent (0); present (1).
62. Maxilla, ventral margin of the antorbital fossa or fenestra (if the antorbital fossa is absent from the horizontal process of the maxilla) in the horizontal process: mainly sub-parallel to the alveolar margin of the bone (0); diagonal, anteroventrally-to-posterodorsally oriented in an angle close to 45° (1). This character is inapplicable in taxa that lack an antorbital fenestra or fossa.

63. Maxilla, shape of the posterior portion of the bone ventral to the antorbital fenestra: tapers posteriorly (0); has a similar dorsoventral depth as the anterior portion ventral to the antorbital fenestra (1); expands dorsoventrally towards the distal end of the horizontal process with a concave ventral margin of the antorbital fenestra (2); expands dorsoventrally towards the distal end of the horizontal process with a straight ventral margin of the antorbital fenestra (3). This character is inapplicable in taxa that lack an antorbital fenestra.
64. Maxilla, posterior end of the horizontal process distinctly ventrally deflected from the main axis of the alveolar margin: absent (0); present (1).
65. Maxilla, triangular dorsal process with clear dorsal apex formed by discrete expansion (= posterodorsal process sensu Butler et al., 2014a) of the posterior end of the horizontal process in lateral view: absent (0); present (1).
66. Maxilla, palatal process on the anteromedial surface of the bone: absent (0); present and both counterparts do not meet at the midline (1); present and both counterparts meet at the midline (2), ORDERED.
67. Maxilla, position of the palatal process: adjacent to the bases of the interdental plates (0); distinctly dorsal to the bases of the interdental plates (1). This character is inapplicable in taxa lacking a palatal process on the maxilla.
68. Maxilla, alveolar margin in lateral view: concave, straight or gently convex (0); distinctly convex (1); sigmoid, anteriorly concave and posteriorly convex (2); sigmoid, anteriorly convex, starting close to mid-length, and posteriorly concave (3).
69. Maxilla, edentulous anterior portion of the ventral margin of the bone: absent (0); present (1).

70. Maxilla, alveolar margin on the anterior third of the bone (anterior to the level of the anterior border of the antorbital fenestra if present): approximately aligned to the posterior half of the alveolar margin (0); distinctly upturned (1).
71. Maxilla, posterior extension in mature individuals in lateral view: level with or posterior to posterior orbital border (0); anterior to posterior orbital border but posterior to anterior orbital border (1); level with or anterior to anterior orbital border (2), ORDERED.
72. Maxilla, tooth plate: absent (0); present (1).
73. Maxilla, number of tooth rows: single row (0); multiple rows (1).
74. Maxilla, lingual teeth: absent (0); scattered teeth (1); large number of teeth on the medial surface of the bone (2) (modified from Ezcurra 2016: 74), ORDERED.
75. Maxilla, number of tooth positions: 4–7 (0); 8–9 (1); 10–14 (2); 15–22 (3); 23–35 (4); 36–40 (5) (modified from Ezcurra 2016: 75), ORDERED. This character is inapplicable in taxa with multiple tooth rows in the maxilla.
76. Nasal, total length versus total length of the frontal: 0.68–0.79 (0); 0.90–2.07 (1); 2.26–3.09 (2) (modified from Ezcurra 2016: 76), ORDERED.
77. Nasal, exposure (excluding descending process if present): largely dorsal element (0); nearly vertical contribution to the snout (1).
78. Nasal, shape of anterior margin at midline: strongly convex with anterior process (0); transverse with little convexity (1).
79. Nasal, anterior portion in lateral view: below or at the same level as skull roof (0); elevated above skull roof, giving the skull a “Roman nose” appearance (1).
80. Nasal, dorsal surface around posterior margin of external naris: smooth or sculpturing of ridges and grooves present (0); depression around entire posterior margin that lacks sculpturing (1).

81. Nasal, descending process, which results from the articulation of the postnasal process of the premaxilla on the anterodorsal surface of the nasal and has an extensive contact with the ascending process of the maxilla: anteroposteriorly narrow (0); anteroposteriorly very broad, being considerably broader than the ascending process of the maxilla (1).
This character is scored inapplicable in taxa that lack a descending process.
82. Nasal, dorsolateral margin of the anterior portion: smoothly rounded (0); distinct longitudinal ridge on the lateral edge (1).
83. Nasal, participation in the dorsal border of the antorbital fossa: absent (0); present (1).
This character is inapplicable in taxa that lack an antorbital fossa.
84. Lacrimal-postorbital, contact between bones: absent (0); present (1). This character is inapplicable in taxa that lost the lacrimal.
85. Lacrimal, facial contribution: forms a portion of lateral surface of the face, reaching anteriorly to the external naris (0); forms a portion of the lateral surface of the face, but does not reach naris (1); limited to orbital margin (2) (modified from Ezcurra 2016: 85).
This character is inapplicable in taxa lacking a lacrimal.
86. Lacrimal, exposure on the skull roof in dorsal view: absent or marginal (0); present (1).
This character is inapplicable in taxa lacking a lacrimal.
87. Lacrimal, anterior process forming the entire or almost the entire dorsal border of the antorbital fenestra: absent (0); present (1). This character is not applicable in taxa that lack an antorbital fenestra or lacrimal.
88. Lacrimal, antorbital fossa forming a distinct inset margin to the antorbital fenestra on the lateral surface of the bone: absent (0); present, but strongly restricted anteriorly (1); present and occupying almost half or more of the anteroposterior length of the ventral process (2). This character is not applicable in taxa that lack an antorbital fenestra or lacrimal.

89. Lacrimal, naso-lacrimal duct: completely enclosed by the lacrimal (0); enclosed by the lacrimal and prefrontal (1).
90. Lacrimal, naso-lacrimal duct position: opens on the posterolateral edge of lacrimal (0); opens on the posterior surface of the lacrimal (1). This character is inapplicable if the prefrontal encloses part of the naso-lacrimal duct.
91. Jugal-quadratojugal, ventral margin in lateral view: straight or convex (0); concave, though nowhere dorsal to tooth row (1). Scored as inapplicable in taxa that lack the posterior process of the jugal.
92. Jugal, anterior process shape in lateral view: continuously tapering or subrectangular, being lower than the portion of the maxilla underneath it (0); subrectangular or slightly dorsoventrally expanded, being higher than the portion of the maxilla underneath it (1); with an ascending subprocess excluding the lacrimal from the anteroventral border of the orbit (2).
93. Jugal, anterior process continuously dorsally curved: absent, straight or curved only at its proximal half (0); present (1).
94. Jugal, ventral border of the orbit: gently concave (0); V-shaped (1). This character is inapplicable in taxa in which the jugal does not contribute to the border of the orbit.
95. Jugal, anterior extension of the anterior process: anterior to the level of mid-length of the orbit (0); up to or posterior to the level of mid-length of the orbit (1).
96. Jugal, participation of the anterior process in the border of the antorbital fenestra: present (0); absent, excluded by contact between the maxilla and lacrimal (1). This character is not applicable in taxa that lack an antorbital fenestra or the anterior process of the jugal does not extend anteriorly to the level of mid-length of the orbit.
97. Jugal, longitudinal ridge or bump(s) on the lateral surface of the main body: absent (0); present (1).

98. Jugal with multiple pits on the lateral surface of its main body: absent (0); present (1).
99. Jugal, ascending process forming the entire anterior border of the infratemporal fenestra: absent (0); present, postorbital excluded from the anterior border of the infratemporal fenestra (1). This character is inapplicable in taxa in which the anterior process of the squamosal possesses an extensive contact with the postorbital and contacts the jugal, or lacks an infratemporal fenestra or an ascending process on the jugal.
100. Jugal, length of the posterior process versus the height of its base: 0.49–1.27 (0); 1.59–3.77 (1); 4.07–5.37 (2), ORDERED.
101. Jugal posterior process with a distinct lateroventral orientation with respect to the sagittal axis of the snout: absent (0); present (1).
102. Jugal, distal half of the posterior process: tapering (0); subrectangular (1). The character is inapplicable if the posterior process of the jugal is forked by the quadratojugal.
103. Jugal, posterior process forms entirely or almost entirely the ventral border of the infratemporal fenestra (it also applies in the lower temporal bar is incomplete): absent (0); present (1). This character is inapplicable in taxa that lack an infratemporal fenestra.
104. Jugal, base of the posterior process with a semi-elliptical, ventral expansion in lateral view: absent (0); present (1).
105. Jugal, posterior process: lies dorsal to the anterior process of the quadratojugal (0); lies ventral to the anterior process of the quadratojugal (1); splits the anterior process of the quadratojugal (2); is split by the anterior process of the quadratojugal (3). This character is inapplicable to taxa that lack a quadratojugal or have an open lower temporal fenestra.

106. Jugal, posterior termination of the posterior process: anterior to or at level with the posterior border of the infratemporal fenestra (0); posterior to the infratemporal fenestra (1). This character is inapplicable in taxa that lack an infratemporal fenestra.
107. Prefrontal, contact its counterpart in the median-line of the skull roof: absent (0); present (1).
108. Prefrontal, suture with the nasal: parasagittal, at least in its posterior third, or anterolateral (0); anteromedial (1). This character is inapplicable if the prefrontals meet each other in the median line.
109. Prefrontal, subtriangular medial process: absent, nasal-frontal suture transversely broad (0); present, nasal-frontal suture strongly transversely reduced (1).
110. Prefrontal, groove on the lateral surface of the main body opening into the orbital border: absent (0); present (1).
111. Prefrontal, lateral surface of the orbital margin: smooth or slight grooves present (0); rugose sculpturing present (1).
112. Frontal, frontals fused to one another: absent (0); present (1).
113. Frontal, suture with the nasal: transverse (0); oblique, forming an angle of at least 60° with long axis of the skull and frontal(s) entering between both nasals (1); oblique, and nasal entering considerably between frontal(s) in a non-interdigitate suture (2). This character is inapplicable if the nasal is received by a slot in the frontal or the nasal does not contact the frontal.
114. Frontal, orbital border in mature individuals: absent or anteroposteriorly short (0); anteroposteriorly long and forms most of the dorsal edge of the orbit (1).
115. Frontal, dorsal surface: flat or slightly depressed (0); with longitudinal ridge along midline (1).

116. Frontal, suture with parietal: mostly transverse or parietals entering slightly between frontals on the median line, forming an obtuse-angled suture (0); parietals entering strongly between both frontals, forming an acute-angled suture (1); W-shaped suture (2).
117. Frontal, participates on the anteromedial corner of the supratemporal fossa: absent (0); present (1). This character is inapplicable in taxa that lack a supratemporal fossa or fenestra.
118. Frontal, dorsal surface adjacent to sutures with the postfrontal (if present) and parietal: flat to slightly concave (0); longitudinally extended groove along most of the surface of the frontal (1); anterolaterally-to-posteromedially extended groove along the posterior half of the frontal (2).
119. Frontal, longitudinal groove: longitudinally extended along most of the surface of the frontal (0); anterolaterally-to-posteromedially extended along the posterior half of the frontal (1). This character is inapplicable in taxa that lack a longitudinal depression with deep pits on the frontal. THIS CHARACTER IS DEACTIVATED
120. Frontal, ventral surface: hourglass-shaped median longitudinal canal for the passage of the olfactory tract and olfactory bulb moulds on the anterior end of the bone (0); median longitudinal canal for the passage of the olfactory tract only slightly constricted, no olfactory bulb moulds and distinct semilunate posteromedially-to-anterolaterally oriented ridge on the orbital roof, extending onto the prefrontal (1).
121. Frontal, olfactory tract on the ventral surface of the frontal: maximum transverse constriction point well posterior to the moulds of the olfactory bulbs and posterolateral margin of the bulbs delimited by a low ridge (0); maximum transverse constriction of the olfactory tract immediately posterior to the moulds of the olfactory bulbs and posterolateral margin of the bulbs well delimited by a thick, tall ridge (1). This character

is inapplicable in taxa that lack olfactory bulb moulds and constriction of the olfactory tract canal.

122. Postfrontal: equivalent in size to postorbital (0); reduced to approximately less than half the dimensions of the postorbital (1); absent (2), ORDERED.
123. Postfrontal, participation in the border of the supratemporal fenestra: absent (0); present (1). Scored as inapplicable in taxa that lack postfrontal.
124. Postfrontal, shape of dorsal surface: flat or slightly concave towards raised orbital rim (0); markedly concave (1). Scoring inapplicable in taxa that lack postfrontal.
125. Postorbital-jugal, postorbital bar: composed both of the jugal and postorbital in nearly equal proportion (0); composed mostly by the postorbital (1).
126. Postorbital-squamosal, upper temporal bar: located approximately at level of the mid-height of the orbit (0); located approximately aligned to the dorsal border of the orbit (1).
127. Postorbital-squamosal, contact: restricted to the dorsal margin of the elements (0); continues ventrally for much or most of the ventral length of the squamosal, but squamosal does not contact jugal (1); continues ventrally for much or most of the ventral length of the squamosal and squamosal contacts jugal (2), ORDERED.
128. Postorbital, lateral boss adjacent to orbital margin: absent (0); present (1).
129. Postorbital, supratemporal fossa extending onto the ascending process: absent (0); present (1). This character is not applicable in taxa that lack a supratemporal fossa medially to the supratemporal fenestra, or the supratemporal fenestra.
130. Postorbital, posterior process extends close to or beyond the level of the posterior margin of the supratemporal fenestrae: absent (0); present (1).
131. Postorbital, extension of the ventral process: ends much higher than the ventral border of the orbit (0); ends close to or at the ventral border of the orbit (1).

132. Postorbital, ventral process in lateral view: continuously anteriorly curved or straight (0); distinctly anteriorly flexed (1).
133. Postorbital, depression on the lateral surface of the ventral process: absent (0); present (1).
134. Postorbital, anteriorly projecting, rounded spur on the anterior edge of the ventral process indicating the lower delimitation of the eye-ball: absent (0); present (1).
135. Squamosal, completely covering the quadrate in lateral view: present (0); absent (1).
136. Squamosal, overhanging quadrate laterally: absent (0); present (1). This character is inapplicable in taxa that the quadrate is completely covered by the squamosal in lateral view.
137. Squamosal, anterior process forms most of the lateral border of the supratemporal fenestra: absent (0); present (1). This character is inapplicable in taxa lacking a supratemporal fenestra.
138. Squamosal, anteroventral process: absent (0); present (1).
139. Squamosal, transition between the anterior and ventral processes: sharp, posterodorsal border of the infratemporal fenestra with square outline (0); gentle, widely rounded posterodorsal border of the infratemporal fenestra (1). This character is inapplicable in taxa that lack a ventral process of the squamosal.
140. Squamosal medial process: short, forming approximately half or less of the posterior border of the supratemporal fenestra (0); long, forming entirely or almost entirely the posterior border of the supratemporal fenestra (1).
141. Squamosal, posterior process length: does not extend posterior to the head of the quadrate (0); extends posterior to the head of the quadrate (1). This character is inapplicable in taxa that the quadrate is completely covered by the squamosal in lateral view.

142. Squamosal, posterior process shape: straight (0); ventrally curved (1). This character is inapplicable in taxa that the quadrate is completely covered by the squamosal in lateral view.
143. Squamosal, ventral process: present (0); absent (1).
144. Squamosal, ventral process shape: anteroposteriorly broad and plate-like (0); anteroposteriorly narrow and strap-like (1). This character is inapplicable in taxa that lack a ventral process in the squamosal.
145. Squamosal, ventral process orientation: posteroventrally directed, vertical, or more than 45° from the vertical (0); anteroventrally directed at 45° or less (1). This character is inapplicable in taxa that lack a ventral process in the squamosal.
146. Squamosal, contribution of the ventral process to the posterior border of the infratemporal fenestra: forms less than half of the border of the fenestra (0); forms more than half of the border, but quadratojugal or quadrate broadly participates in the border of the fenestra (1); forms almost completely the border of the fenestra (2), ORDERED. This character is inapplicable in taxa that lack a ventral process in the squamosal.
147. Squamosal, posterodorsally-to-anteroventrally oriented tuck on the lateral surface of the ventral process: absent (0); present (1). This character is inapplicable in taxa that lack a ventral process in the squamosal.
148. Squamosal, longitudinal ridge on the lateral surface of the ventral process: absent (0); present (1). This character is inapplicable in taxa that lack a ventral process in the squamosal.
149. Squamosal, posterodorsal portion with a supratemporal fossa: absent (0); present (1). This character is inapplicable in taxa lacking a supratemporal fenestra.
150. Quadratojugal: absent or fused to the quadrate (0); present (1).

151. Quadratojugal, shape: L-shaped or strip-like bone (0); subtriangular (1). This character is inapplicable in taxa that lack a quadratojugal or infratemporal fenestra.
152. Quadratojugal-jugal, infratemporal fossa marked by a sharp edge: absent (0); present (1). This character is inapplicable in taxa that lack a quadratojugal or an infratemporal fenestra.
153. Quadratojugal, anterior process: absent, anteroventral margin of the bone rounded (0); incipient, short anterior prong on the anteroventral margin of the bone (1); distinctly present, in which the lower temporal bar is complete, but process finishes well posterior to the base of the posterior process of the jugal (2); distinctly present, in which the lower temporal bar is complete and participates in the posteroventral border of the infratemporal fenestra, and process finishes close to the base of the posterior process of the jugal (3), ORDERED. This character is inapplicable in taxa that lack an infratemporal fenestra or quadratojugal.
154. Quadratojugal, widely concave notch on the anterior margin of the ascending process: absent (0); present (1). This character is inapplicable in taxa that lack a quadratojugal, an anterior process of the quadratojugal or an infratemporal fenestra.
155. Quadratojugal, depression along the posterior half of the ascending process up to the exposed lateral surface of its distal tip: absent (0); present (1).
156. Quadratojugal, posterior process: absent (0); present, but distal condyles of the quadrate broadly visible in lateral view (1); present, overlapping completely or almost completely the distal condyles of the quadrate in lateral view (2), ORDERED. This character is inapplicable in taxa that lack a quadratojugal.
157. Supratemporal: broad element (0); slender, in parietal and squamosal trough (1); absent (2), ORDERED.

158. Supratemporal, bifurcated medial border, in which a ventromedial process extends underneath the posterolateral process of the parietal: present (0); absent (1). This character is inapplicable in taxa lacking a supratemporal.
159. Parietal, median contact between both parietals: suture present (0); fused with loss of suture (1).
160. Parietal, extension over interorbital region: absent or marginal (0); present (1).
161. Parietal, supratemporal fossa medial to the supratemporal fenestra: well exposed in dorsal view and mainly dorsally or dorsolaterally facing (0); poorly exposed in dorsal view and mainly laterally facing (1). This character is inapplicable in taxa that lack a supratemporal fossa.
162. Parietal, pineal fossa on the median line of the dorsal surface: absent (0); present (1).
The character should not be scored for early juveniles.
163. Parietal, position of the pineal fossa: restricted to the parietal (0); extended along frontal and parietal (1). This character is inapplicable in taxa lacking a pineal fossa.
164. Parietal, pineal foramen in dorsal view: considerably large (0); reduced to a small, circular pit (1); absent (2).
165. Parietal, position of the pineal foramen in dorsal view: completely enclosed by parietals in the anterior half of the bone (excluding posterolateral processes and anterior projections of the parietals if present) (0); completely enclosed by parietals close to mid-length or in the posterior half of the bone (excluding posterolateral processes and anterior projections of the parietals if present) (1); enclosed by both frontals and parietals (2).
Scored as inapplicable in taxa that lack a pineal foramen.
166. Parietal, distinct transverse emargination adjacent to the posterior margin of the bone in late ontogeny: absent (0); present (1).

167. Parietal, posterolateral process: nearly vertical (0); ventrally inclined greater than 45° (1).
168. Parietal, posterolateral process height: dorsoventrally low, usually considerably lower than the supraoccipital (0); dorsoventrally deep, being plate-like in occipital view and subequal to the height of the supraoccipital (1).
169. Parietal, posterolateral process with a strongly transversely convex dorsal margin elevated from the median line of the posterior margin of the skull roof: absent (0); present (1).
170. Parietal, tuberosity on the posterior surface of the base of the posterolateral process: absent (0); present (1).
171. Postparietal, size: sheet-like, both together not much narrower than the suproccipital (0); small, splint-like (1); absent as a separate ossification (2), ORDERED.
172. Postparietal, fusion between counterparts: absent (0); present, forming an interparietal (1). This character is inapplicable in taxa that lack postparietals. This character is inapplicable in taxa that lack a postparietal.
173. Tabular: present (0); absent (1).
174. Palpebral/s: absent (0); present (1).
175. Neomorphic bone (= "septomaxilla" of phytosaurs), separate ossification anterior to nasals and surrounded by the premaxilla on the dorsal surface of the snout: absent (0); present (1).
176. Quadrate, shape: straight posteriorly (0); shallowly emarginated (1); with conch (2), ORDERED.
177. Quadrate, angle between the posterior margins of the proximal and distal ends: 41–47° (0); 91–96° (1); 106–137° (2); 143–158° (3), ORDERED. Inapplicable in taxa with a straight posterior margin of the quadrate.

178. Quadrate, proximal head: does not have a sutural contact with the paraoccipital process of the opisthotic (0); has a sutural contact with the paraoccipital process of the opisthotic (1).
179. Quadrate, proximal head: partially exposed laterally (0); completely covered by the squamosal (1). This character is inapplicable in taxa that the quadrate is completely covered by the squamosal in lateral view.
180. Quadrate, proximal end hooked posteriorly in lateral view: absent (0); present (1).
181. Quadrate, foramen on the medial wall of the quadrate foramen: absent (0); present (1).
182. Quadrate, posterior margin of the distal half in lateral view: concave (0); convex (1).
This character is inapplicable in taxa that possess a straight quadrate posteriorly.
183. Quadrate, distal condyles: subequally distally extended (0); medial condyle distinctly more distally projected than the lateral one (1).
184. Neomorph ossification, present between the pterygoid, quadrate and skull roof: absent, the quadrate flange of the pterygoid meets the quadrate but remains free of the skull roof (0); present (1).
185. Vomer, shape: broad, plate-like bone, at least as transversely broad as the choanas (0); stick-like bone, transversely narrower than the choanas (1).
186. Vomer, contact with maxilla: absent (0); present (1).
187. Vomer, teeth: present, more than one row or no rows are distinguishable (0); present, mainly in a single row, but multiple teeth present immediately anterior to the contact with the pterygoid (1); present, single row along entire extension (2); absent (3), ORDERED.
188. Palatine-pterygoid, teeth on the palatine and/or ventral surface of the anterior ramus of the pterygoid: present (0); absent (1).
189. Palatine-pterygoid, height and dimetre of teeth on the palatine, ventral surface of the anterior ramus of the pterygoid and vomer: considerably smaller than those of the

marginal dentition (0); similar to those of the marginal dentition (1). This character is inapplicable in taxa lacking palatine-pterygoid teeth.

190. Palatine, transverse extension: narrow, subequal contribution of the palatine and pterygoid to or pterygoid main component of the palate posteriorly to the choanae (0); broad, the palatine is the main component of the palate posteriorly to the choanae and the anterior ramus of the pterygoid is splint-like (1). This character can be scored also from the shape of the anterior ramus of the pterygoid.
191. Palatine, anterior processes forming the posterior border of the choana: subequal in anterior extension or anterolateral process longer (0); anteromedial process longer (1); single process (2).
192. Pterygoids, contact with each other: present, anteriorly (0); absent, remain separate along their entire length (1).
193. Pterygoid, anterior ramus (= palatal process): extends anterior to the anterior limit of the palatine (0); forms oblique suture with palatine but process ends before reaching anterior limit of palatine (1); forms transverse suture with palatine (2).
194. Pterygoid, anterior ramus (= palatal process) shape: transversely broad at its base, converging gradually with the transverse ramus (0); transversely narrow along its entire extension, converging in a right or acute angle with the transverse ramus, with the bone possessing an overall L-shape contour in ventral or dorsal view (1).
195. Pterygoid, teeth on the ventral surface of the anterior ramus (= palatal process), excluding tiny palatal teeth if present: present in two distinct fields (= T2 and T3 of Welman 1998) (0); present in three distinct fields (= T2, T3a and T3b) (1); present in three distinct fields (= T2a, T2b and T3) (2); present in one field that occupies most of the transverse width of the ramus (= T2 + T3) (3); present in only one posteromedially-to- anterolaterally field (= T2) (4); present in only one field adjacent to the medial margin of

the ramus (= T3) (5). This character is inapplicable in taxa that lack teeth in the palatine and the ventral surface of the anterior ramus of the pterygoid.

196. Pterygoid, number of rows on palatal tooth series T2: more than two or do not dispose on distinct rows (0); two rows parallel to each other (1); single row (2). This character is inapplicable if the tooth field T2 is subdivided in T2a and T2b or is absent.
197. Pterygoid, number of rows on palatal tooth series T3: more than two or do not dispose on distinct rows (0); two parallel rows (1); single row (2). This character is inapplicable if the tooth field T3 is subdivided into T3a and T3b or is absent.
198. Pterygoid, most lateral row of teeth on the ventral surface of the anterior ramus (= palatal ramus) raised on a thick, posteromedially-to-anterolaterally oriented ridge: absent (0); present (1). This character is inapplicable if series T2 is absent.
199. Pterygoid, a row of fang-like teeth on the medial edge of the anterior ramus (= palatal process) (= T4 of Welman 1998): absent (0); present (1).
200. Pterygoid, orientation of the lateral ramus: posterolaterally, forming an obtuse angle with the anterior ramus (0); laterally or anterolaterally, forming a right or acute angle with the anterior ramus (1).
201. Pterygoid, lateral margin of the lateral ramus: posterolateral margin with an acute corner (0); posterolateral margin merges smoothly into anterolateral margin forming a smoothly convex lateral outline (1).
202. Pterygoid, teeth on lateral ramus: present, more than a single row or no rows recognizable (0); present, single row on the posterior edge (= T1 of Welman, 1998) (1); absent (2), ORDERED.
203. Ectopterygoid, body: arcs anteriorly (0); arcs anterodorsally (1).
204. Ectopterygoid, articulation with pterygoid: simple overlap between ectopterygoid and pterygoid (0); interlaced, complex overlap between ectopterygoid and pterygoid (1).

205. Ectopterygoid, suture with pterygoid: transversely does not reach the posterolateral corner of the transverse flange (0); reaches the posterolateral corner of the transverse flange (1).
206. Ectopterygoid, contact with maxilla: absent (0); present (1).
207. Ectopterygoid, posterior expansion in contact with jugal: absent (0); present (1).
208. Supraoccipital, shape in occipital view: plate-like (0); inverted V-shape (1).
209. Supraoccipital, participation in the dorsal border of the foramen magnum: absent (0); present (1).
210. Supraoccipital, posterior surface: smooth or with a low median ridge (0); with a prominent median, vertical peg (1).
211. Otoccipital, fusion between opisthotic and exoccipital: absent or partial (0); present (1).
212. Opisthotic, contact between paraoccipital process and parietal immediately lateral to supraoccipital: absent (0); present (1).
213. Opisthotic, paraoccipital processes orientation: extend laterally forming approximately a 90° angle with the parasagittal plane (0); deflected posterolaterally at an angle of more than 20° from the transverse plane of the skull (1).
214. Opisthotic, paraoccipital process attachment: ends freely (0); contacts supratemporal or proximal end of quadrate and/or squamosal (1); sutured to the pterygoid and the pterygoid wing of the quadrate (2).
215. Opisthotic, paraoccipital process morphology: unflattened and tapered (0); anteroposteriorly-flattened distally (1).
216. Opisthotic, fossa immediately lateral to the foramen magnum: absent (0); present (1).

217. Opisthotic, ventral ramus shape: club-shaped (0); pyramidal, with a tapering distal end (1); rod-like, with a cylindrical distal end and relatively thin (2); rod-like and very robust (3); plate-like (4).
218. Opisthotic, ventral ramus: extends further laterally than the lateralmost edge of the exoccipital in posterior view (0); covered by the lateralmost edge of the exoccipital in posterior view (1).
219. Exoccipital, morphology of the dorsal end: exoccipital columnar through dorsoventral height, forming transversely narrow dorsal contact with more dorsal occipital elements (0); dorsal portion of exoccipital exhibits dorsomedially inclined process that forms transversely broad contact with more dorsal occipital elements (1). This character is inapplicable in taxa without a discernable opisthotic-exoccipital suture.
220. Exoccipital, lateral surface: without subvertical crest (= metotic strut) (0); with clear crest (= metotic strut) present posterior to external foramina for hypoglossal nerve (CN XII) (1); with clear crest (= metotic strut) present anterior to the more posterior external foramina for hypoglossal nerve (CN XII) (2).
221. Exoccipital, medial margin of their distal ends: no contact with its counterpart (0); contact with its counterpart to exclude basioccipital from the floor of the endocranial cavity and diverge from each other on the occipital condyle, exposing the basioccipital dorsally (1); contact with its counterpart along the entire dorsal surface of the basioccipital, excluding the basioccipital from the floor of the endocranial cavity and the dorsal surface of the occipital condyle (2), ORDERED.
222. Exoccipital, number of foramina for the hypoglossal nerve (CN XII): two (0); one (1).
223. Pseudolagenar recess, opening externally between the ventral surface of the ventral ramus of the opisthotic and the basal tubera: present (0); absent (1).

224. Lagenar/cochlea recess: absent or short and strongly tapered (0); present and elongated and tubular (1).
225. Basioccipital-parasphenoid/parabasisphenoid, contact with each other in mature individuals: loose, overlapping suture (0); tightly sutured, sometimes by an interdigitated suture, or both bones fused with each other (1).
226. Basioccipital-parasphenoid/parabasisphenoid, basal tubera: absent (0); present (1).
227. Basioccipital-parasphenoid/parabasisphenoid, basal tubera shape: clearly separated from each other (0); partially in contact with each other (1); medially expanded and nearly or completely connected (2), ORDERED. This character is inapplicable in taxa lacking basal tubera.
228. Basioccipital, position of the posterior margin of the occipital condyle: level with craniomandibular joint (0); anterior to craniomandibular joint (1); posterior to craniomandibular joint (2).
229. Basioccipital, articular surface of the occipital condyle: concave (0); semi-spherical (1).
230. Basioccipital, notochordal scar on the occipital surface of the occipital condyle: absent or developed as a small sub-circular pit (0); developed as a vertical furrow or a large sub-circular fossa that occupies approximately half of the height of the occipital surface of the condyle (1). This character is inapplicable in taxa with a concave articular surface of the occipital condyle.
231. Basioccipital, occipital neck: present, distinctly separating the occipital condyle from the basioccipital body (0); absent or extremely short (1).
232. Basioccipital, shape of the basal tubera: rounded and anteroposteriorly elongated (0); blade-like and anteroposteriorly shortened (1).

233. Basioccipital, orientation of the basal tubera: lateroventral, basal tubera divergent from each other (0); ventral, basal tubera parallel with each other (1).
234. Parasphenoid-basisphenoid/parabasisphenoid, exposure on the median line of the endocranial cavity floor: present (0); absent (1).
235. Parasphenoid/parabasisphenoid, orientation: horizontal (0); oblique, main axis posterodorsally-to-anteroventrally oriented (1).
236. Parasphenoid/parabasisphenoid, posterodorsal portion: incompletely ossified (0); completely ossified (1).
237. Parasphenoid/parabasisphenoid, intertuberal plate: absent (0); present and posterior edge straight (1); present and posterior edge concave (2).
238. Parasphenoid/parabasisphenoid, semilunar depression on the posterolateral surface of the bone: absent (0); present (1). This character is inapplicable in taxa that the posterodorsal portion of the parasphenoid/parabasisphenoid is not ossified, resulting in an unossified gap between this element and the prootic.
239. Parasphenoid/parabasisphenoid, recess (= median pharyngeal recess, = hemispherical sulcus, = hemispherical fontanelle): absent (0); present (1).
240. Parasphenoid/parabasisphenoid, position of the foramina for entrance of the cerebral branches of the internal carotid artery leading to the pituitary fossa: ventral (0); posterolateral (1); anterolateral (2).
241. Parasphenoid/parabasisphenoid, position of the foramina for the entrance of the cerebral branches of the internal carotids on the ventral surface of the bone: immediately medial or posteromedial to the base of the basipterygoid process (0); close to the suture between basioccipital and parabasisphenoid (1). This character is not applicable if foramina for the passage of the internal carotid artery open laterally.

242. Parasphenoid/parabasisphenoid, shape of the cultriform process in lateral view: continuously tapering anteriorly, without dorsoventral constriction at its base (0); dorsoventrally compressed at its base (1).
243. Parasphenoid/parabasisphenoid, base of the cultriform process: relatively dorsoventrally short (0); tall, with the dorsal edge extending up between clinoid processes and ventral parts of the crista prootica (1).
244. Parasphenoid/parabasisphenoid, dentition on cultriform process: present (0); absent (1).
245. Basisphenoid/parabasisphenoid, anterior tympanic recess on the lateral side of the braincase: absent (0); present (1).
246. Basisphenoid/parabasisphenoid, parasphenoid crests: absent such that there is no ventral floor for the vidian canal (0); present as a pair of thick crests running along the ventrolateral border of the basisphenoid body and framing the ventromedial floor of the vidian canal (1).
247. Basisphenoid/parabasisphenoid, basiptyergoid processes: moderately short, finger-like and with short articular facets (0); long, with hemispherical articular facets (1); very short and subcylindrical (2).
248. Basisphenoid/parabasisphenoid, orientation of basiptyergoid processes in the transverse plane: anterolateral or lateral (0); posterolateral (1).
249. Prootic-supraoccipital, floccular (= auricular) recess: largely restricted to the prootic (0); extends onto internal surface of the supraoccipital (1).
250. Prootic-basisphenoid/parabasisphenoid, position of the external foramina for passage of the abducens nerves (CN VI): within the dorsum sellae (0); track between the dorsum sellae and prootic, grooving the articular facets (1); within the prootic (2). Scored as inapplicable in taxa without distinct abducens nerves foramina.

251. Prootic-basisphenoid/parabasisphenoid, orientation of the external foramina for passage of the abducens nerves (CN VI): open anteriorly (0); open dorsally (1). Scored as inapplicable in taxa without distinct abducens nerves foramina.
252. Prootic, extensive contact with parietal: absent (0); present (1).
253. Prootic, contact with its counterpart on the median line of the floor of the endocranial cavity: absent (0); present (1).
254. Prootic, lateral surface: continuous and slightly convex (0); crista prootica present (1).
255. Prootic, anterior inferior process: absent or developed as a small, peg-like projection (0); well developed (1).
256. Prootic, ridge on the lateral surface of the inferior anterior process ventral to the trigeminal foramen: present (0); absent (1). This character is scored as inapplicable in taxa that lack an anterior inferior process.
257. Prootic, medial surface of vestibule: incompletely ossified (0); almost completely ossified (1).
258. Laterosphenoid, ossification: absent (0); present (1).
259. Laterosphenoid, anterodorsal channel: absent (0); present (1). Character inapplicable in taxa lacking an ossified laterosphenoid.
260. Lower jaw, symphysis: formed largely by dentary (0), formed only by splenial (1).
261. Lower jaw, distinct dorsal process behind the alveolar margin: absent, with a slightly convex dorsal margin behind the alveolar portion (0); present, formed by a dorsally well-developed surangular (1); present, formed by a dorsally well-developed posterodorsal ramus of the dentary and sometimes a dorsally well-developed coronoid bone (2).
262. Lower jaw, external mandibular fenestra: absent (0); present (1).
263. Lower jaw, anteroposterior length of the external mandibular fenestra versus anteroposterior length of the dentary anterior to the fenestra: 0.07–0.36 (0); 0.44–0.53

(1); 0.62–0.78 (2); 0.88–0.94 (3) (modified from Ezcurra 2016: 263), ORDERED. This character is inapplicable in taxa that lack an external mandibular fenestra.

264. Lower jaw, Meckelian fossa orientation: dorsomedially (0); mostly dorsally due to greatly expanded prearticular resulting in a ventral border of the fossa situated dorsal to the half-height of the lower jaw at that level (1).
265. Dentary-splenial, mandibular symphysis length: positioned distally (0); present along one-third of the lower jaw (1).
266. Dentary, minimum height of the bone versus length of the alveolar margin (including edentulous anterior end if present): 0.05–0.14 (0); 0.16–0.19 (1); 0.22–0.29 (2); 0.32–0.36 (3) (modified from Ezcurra 2016: 266), ORDERED.
267. Dentary, shape of the tooth bearing portion: mostly straight (0); distinctly dorsally curved for all or most of its anteroposterior length (1); ventrally curved or deflected (2).
268. Dentary, large foramina aligned in two distinct rows starting on the anteroventral corner of the bone: absent (0); present (1).
269. Dentary, longitudinal groove approximately centred on the lateral surface: absent (0); present (1).
270. Dentary, position of the Meckelian groove on the anterior half of the bone: dorsoventral centre of the dentary (0); restricted to the ventral border (1).
271. Dentary, dorsal margin of the anterior portion compared to the dorsal margin of the posterior portion: horizontal (in the same plane) (0); dorsally expanded (1).
272. Dentary, posterodorsal process, in which its dorsal margin is confluent with the dorsal margin of the lower jaw: absent (0); present (1).
273. Dentary, posterocentral process, in which its margins are not confluent with the dorsal or ventral margin of the lower jaw: absent (0); present (1).

274. Dentary, distal end of the posteroventral process: tapering (0); rounded (1). This character is inapplicable in taxa that lack a posteroventral process in the dentary.
275. Dentary, posteroventral process, in which its ventral margin is confluent with the ventral margin of the lower jaw: absent (0); present and excluded from the border of the external mandibular fenestra (1); present and contributing to the border of the external mandibular fenestra (2).
276. Dentary, posteroventral process length: extended anteriorly to the level of the posterodorsal or posteroventral processes (0); extended posteriorly beyond the level of the posterodorsal and posteroventral processes (1). This character is inapplicable in taxa that lack a posteroventral process in the dentary.
277. Posterior-most dentary teeth: on the anterior half of lower jaw (0); on the posterior half of lower jaw (1).
278. Dentary, alveolar margin: present along entire length of the dentary (0); absent in the anterior portion (1); completely absent (2) (modified from Ezcurra 2016: 278),
ORDERED.
279. Dentary, number of tooth rows: one (0); two (1); more than two (2), ORDERED.
280. Dentary, occlusion with cranial teeth: single-sided overlap (0); flat occlusion (1); blade and groove (2).
281. Surangular-angular, suture: even with lateral surface of mandible (0); elevated and separates dorsal concave area on surangular from concave area on angular (1).
282. Surangular-angular, suture along the anterior half of the bones in lateral view: anteroposteriorly convex ventrally (0); anteroposteriorly concave ventrally (1).
283. Surangular-articular, retroarticular process: absent (0); anteroposteriorly short, being poorly developed posteriorly to the glenoid fossa (1); anteroposteriorly long, extending considerably posterior to the glenoid fossa (2), ORDERED.

284. Surangular-articular, retroarticular process: not upturned (0); upturned (1). This character is scored as inapplicable in taxa that lack a retroarticular process.
285. Surangular, anterior extension: beyond coronoid eminence (0); posterior to reaching the anterior border of the coronoid eminence (1).
286. Surangular, lateral shelf: absent (0); present, low ridge near dorsal margin (1); present, presence of laterally or ventrolaterally projecting shelf with straight or gently convex lateral edge (2); present, presence of laterally projecting shelf with strongly convex lateral edge (3).
287. Surangular, dorsal margin in lateral view: straight or gently convex (0); strongly convex (1).
288. Surangular, anterior surangular foramen on the lateral surface of the bone, positioned near surangular-dentary contact: absent (0); present (1).
289. Surangular, posterior surangular foramen on the lateral surface of the bone, positioned directly anterolateral to the glenoid fossa: absent (0); present (1).
290. Angular, lateral exposure in the lower jaw: wide (0); narrow (1).
291. Angular, ventrolateral surface: continuous with lateral surface of angular (0); laterally projecting ridge present that separates lateral and ventral sides of the angular (1).
292. Angular, posteroventral surface: ridged or keeled (0); transversely convex (1).
293. Articular, fused to the prearticular: absent (0); present (1).
294. Articular, foramen on the medial side: absent (0); present (1).
295. Articular, ventromedially directed process: absent (0); present (1).
296. Stape, shape: robust, with thick shaft (0); slender, rod-like shaft (1).
297. Stape, stapedial foramen piercing the columellar process: present (0); absent (1).

298. Teeth, posterior extent of mandibular and maxillary tooth rows: subequal (0); maxillary tooth extending further posteriorly (1). This character is not applicable in taxa with the maxillary tooth row restricted to the anterior half of the bone.
299. Teeth, tooth implantation: subthecodont (= protothecodont) (0); ankylothecodont (teeth fused to the bone at the base of the crown by bony ridges and the root can be discerned; there is tooth replacement) (1); pleurodont (2); acrodon (teeth fused to the bone in adults so that no root can be discerned; no tooth replacement) (3); thecodont (4).
300. Teeth, maxillary and/or dentary tooth crowns: generally homodont (0); markedly heterodont (gross change in morphology) (1).
301. Teeth, enlarged caniniform region in maxilla: present (0); absent (1).
302. Teeth, maxillary tooth crowns in labial view: all the tooth crowns possess a rather similar distal edge morphology along the entire alveolar margin (0); the distal edge of the posterior tooth crowns possess a distinct different morphology from those of the anterior tooth crowns, with the posterior edge usually convex (1).
303. Teeth, distal edge of the maxillary tooth crowns in labial view: concave along the entire alveolar margin (0); straight or gently sigmoid (1); convex in at least some anterior tooth crowns (2). This character is not applicable to taxa with the posterior edge of the posterior tooth crowns different from those of the anterior tooth crowns or that possess multiple tooth rows in the maxilla.
304. Teeth, serrations on the maxillary/dentary crowns: absent (0); distinctly present on the distal margin and usually apically restricted, low or absent on the mesial margin (1); present and distinct on both margins (2).
305. Teeth, labiolingual compression of the marginal dentition: only distally or nowhere (0); present (1).

306. Teeth, multiple maxillary or dentary tooth crowns with longitudinal labial or lingual striations or grooves: absent (0); present (1).
307. Teeth, multiple maxillary and dentary tooth crowns with extensive wear facets: absent (0); present (1).
308. Teeth, multiple maxillary and dentary tooth crowns distinctly mesiodistally expanded above the root: absent (0); present (1).
309. Hyoid apparatus, length and orientation of the ceratobranchial: short, directed to quadrate region (0); long, directed posteriorly and extending posteriorly beyond the quadrate condyles (1).
310. Cervical, dorsal, sacral and caudal vertebrae, notochordal canal piercing completely the centrum: present throughout ontogeny (0); absent in adults (1).
311. Cervical and dorsal vertebrae, anteroposterior compression of centra in the cervico-dorsal transition (= pectoral centra): moderate (0); very strong, being considerably anteroposteriorly shorter than tall (1).
312. Cervical and dorsal vertebrae, neurocentral sutures: close in adults (0); remain open in sub-adults and adults (1).
313. Cervical and dorsal vertebrae, at least one or more cervical or anterior dorsal with a parallelogram centra in lateral view, in which the anterior articular surface is situated higher than the posterior one: absent (0); present (1).
314. Cervical and dorsal vertebrae, one or more vertebrae with an accessory rib articular facet between the diapophysis and parapophysis in the cervico-dorsal transition: absent (0); present (1).
315. Cervical and dorsal vertebrae, anterior centrodiapophyseal or paradiapophyseal lamina in posterior cervicals or anterior dorsals: absent (0); present (1).

316. Cervical and dorsal vertebrae, posterior centrodiapophyseal lamina in cervicals and/or anterior dorsals: absent (0); present (1).
317. Cervical and dorsal vertebrae, prezygodiapophyseal lamina in posterior cervicals and/or anterior dorsals: absent (0); present (1).
318. Cervical and dorsal vertebrae, postzygodiapophyseal lamina in posterior cervicals and/or anterior dorsals: absent (0); present (1).
319. Cervical and dorsal vertebrae, thick, anteroventrally-to-posterodorsally oriented tuberosity immediately below the transverse process, but both structures are not connected with each other, in posterior cervicals and anterior dorsals: absent (0); present (1).
320. Cervical and dorsal vertebrae, gradual transverse expansion of the distal half of the neural spine: absent (0); present, but lacking distinct mammillary processes on the lateral surface of the neural spine (1); present, with distinct mammillary processes on the lateral surface of the neural spine (2).
321. Cervical and dorsal vertebrae, spine table on the distal end of the postaxial neural spines (not mammillary process): absent (0); present in cervicals, but not in dorsals (1); present in dorsal, but not in cervicals (2); present in both cervicals and dorsals (3).
322. Cervical and dorsal vertebrae, distal surface of transverse expansion of the neural spine: convex (0); approximately flat (1); concave (2) (modified from Ezcurra 2016: 322). This character is inapplicable in taxa that lack a transverse expansion of the distal end of the neural spine or possess mammillary processes.
323. Cervical and dorsal vertebrae, outline of the spine tables in dorsal view: sub-oval or sub-rectangular (0); sub-triangular or heart-shaped (1). Character inapplicable in taxa that lack spine tables.

324. Cervical vertebrae, number of vertebrae in the neck: less than eight (0); eight to ten (1); more than ten (2), ORDERED.
325. Cervical vertebrae, atlantal articulation facet in the axial intercentrum: saddle-shaped (0); concave with upturned lateral borders (1).
326. Cervical vertebrae, centrum of atlas in mature individuals: separate from axial intercentrum (0); fused to axial intercentrum (1).
327. Cervical vertebrae, ventral surface of the centrum in anterior cervicals: transversely convex (0); with a low median longitudinal keel (1); with a median longitudinal keel that extends ventral to the centrum rim in at least one anterior cervical (2), ORDERED.
328. Cervical vertebrae, height of neural spine of the axis: dorsoventrally tall (0); strongly dorsoventrally short (1).
329. Cervical vertebrae, shape of the neural spine of the axis: expanded posterodorsally or the height of the anterior portion is equivalent to the posterior height (0); expanded anterodorsally (1).
330. Cervical vertebrae, dorsal margin of the neural spine of the axis: mostly dorsally convex (0); mostly straight or dorsally concave (1).
331. Cervical vertebrae, lengths of the fourth or fifth cervical centra versus the heights of their anterior articular surfaces: 0.63–2.67 (0); 2.92–4.12 (1); 6.09–6.80 (2); 14.16–14.33 (3), ORDERED. The character can be scored only for adults in tanystropheids.
332. Cervical vertebrae, diapophysis and parapophysis of anterior to middle cervical postaxial vertebrae: single facet or both situated on the same process (0); situated on different processes and well separated (1); situated on different processes and nearly touching (2).

333. Cervical vertebrae, position of diapophysis or dorsal margin of synapophysis in anterior postaxial cervicals: at or near dorsoventral level of pedicles (0); near the dorsoventral mid-point of the centrum (1).
334. Cervical vertebrae, longitudinal lamina or tuberosity extended posteriorly from the base of the transverse process in postaxial anterior and middle cervicals: absent or poorly developed, not well laterally developed (0); strongly developed, flaring laterally as a prominent and thick, wing-like shelf (1).
335. Cervical vertebrae, posterior portion of the neural arch ventral to the postzygapophysis in postaxial cervicals: flat (0); with a shallow, posterolaterally facing fossa (1).
336. Cervical vertebrae, epipophysis in postaxial cervicals: absent (0); present in at least the third to fifth cervical vertebrae (1).
337. Cervical vertebrae, excavation immediately lateral to the base of postaxial cervical neural spines: absent (0); shallow (1); represented by a deep pocket or pit (2),
- ORDERED.
338. Cervical vertebrae, anterior and middle cervical vertebrae postzygapophyses: separated posteriorly (0); connected through a horizontal lamina (= transpostzygapophyseal lamina) with a notch at the midline (1).
339. Cervical vertebrae, shape of the postaxial neural spines in lateral view: sub-triangular (0); rectangular (1).
340. Cervical vertebrae, distinct longitudinal lamina extending along the lateral surface of the centrum at mid-height in anterior and middle postaxial cervical vertebrae: absent (0); present (1).
341. Cervical vertebrae, longitudinal lamina connecting the prezygapophysis and postzygapophysis in the third cervical neural arch: absent (0); present (1).

342. Cervical vertebrae, shape of postaxial anterior cervical neural spines: tall, with height and length approximately equal or larger (0); long and low, with height lower than length (1).
343. Cervical vertebrae, anterior and middle postaxial cervical neural spines with an anterior overhang: absent (0); present (1).
344. Cervical vertebrae, relative location of dorsal margin of anterior and middle cervical postaxial neural spines: spines are equivalent in height and length to other cervical neural spines (0); spines are dorsoventrally depressed at their anteroposterior midpoints, leaving them little more than midline dorsal ridges (1).
345. Cervical vertebrae, position of the mammillary processes of the neural spines along the neck: present from the fourth presacral (0); present from the fifth presacral (1); present from the sixth or seventh presacral (2); present from the eighth or ninth presacral (3), ORDERED. Character inapplicable in taxa that lack mammillary processes.
346. Cervical vertebrae, postaxial cervical intercentra: present (0); absent (1).
347. Cervical and dorsal ribs, tuberculum in posterior cervical or anterior dorsal ribs: short (0); long and distinct (1).
348. Cervical and dorsal ribs, at least one rib of the cervico-dorsal transition with a thin lamina webbing tuberculum and capitulum: absent (0); present (1). This character is inapplicable in taxa with holocephalous ribs or poorly differentiated tuberculum and capitulum.
349. Cervical ribs, shape: short, being less than two times the length of its respective vertebra, and tapering at a high angle to the neck (0); short, being less than two times the length of its respective vertebra, and shaft parallel to the neck (1); very long, being two times the length of its respective vertebra, and parallel to the neck (2).

350. Cervical ribs, accessory process on anterolateral surface of anterior cervical ribs: absent (0); present (1).
351. Dorsal vertebrae, length of the centrum versus height of the centrum in anterior dorsals: 0.45–1.10 (0); 1.18–2.00 (1); 2.19–2.74 (2), ORDERED.
352. Dorsal vertebrae, length of the centrum versus height of the centrum in posterior dorsals: 0.66–1.39 (0); 1.48–1.86 (1); 1.95–2.04 (2); 2.39–2.46 (3), ORDERED.
353. Dorsal vertebrae, ventral surface of middle and posterior centra: transversely convex (0); ridged, with slightly swollen sides (1); single keel (2); double keel (3).
354. Dorsal vertebrae, lateral fossa on the centrum below the neurocentral suture: absent (0); present, but not well-rimmed (1); present and well-rimmed (2), ORDERED.
355. Dorsal vertebrae, subcentral foramen on the lateral surface of the centra: absent (0); present (1).
356. Dorsal vertebrae, diapophysis and parapophysis in anterior dorsals: close to the body of the midline (0); expanded on stalks (1).
357. Dorsal vertebrae, ratio between transverse width of diapophysis and length of the centrum in anterior dorsals: <0.70 (0); >0.75 (1).
358. Dorsal vertebrae, development of the transverse process in middle and posterior dorsals: short (0); moderately long (1); extremely long, being considerably broader than their respective centra (2).
359. Dorsal vertebrae, hyposphene-hypantrum accessory intervertebral articulation in middle-posterior dorsals: absent (0); present (1).
360. Dorsal vertebrae, zygosphene-zygantrum articulation: absent (0); present (1).
361. Dorsal vertebrae, dorsally opening pit lateral to the base of the neural spine: absent (0); shallow (1); developed as a deep pit (2), ORDERED.

362. Dorsal vertebrae, anterior and middle dorsal neural spines: sub-rectangular, with the anterior margin vertical, anterodorsally or slightly posterodorsally inclined (0); sub-triangular, with the anterior margin strongly posterodorsally oriented (1).
363. Dorsal vertebrae, fan-shaped neural spine in lateral view: absent (0); present (1).
364. Dorsal vertebrae, position of middle dorsal neural spines: situated at mid-length between the zygapophyses (0); posteriorly displaced from mid-length between the zygapophyses (1).
365. Dorsal vertebrae, position of the mammillary processes of the neural spines in the trunk: extend up to the tenth presacral (0); extend up to the eleventh presacral (1); extend up to the twelfth presacral (2); extend up to the thirteenth presacral (3); extend up to the sixteenth presacral or beyond (4), ORDERED. This character is inapplicable in taxa that lack mammillary processes.
366. Dorsal vertebrae, intercentra: present (0); absent (1).
367. Dorsal ribs, angle between heads and shaft in anterior dorsal ribs: close to 90° (0); low, gentle posteroventral bowing of the base of the shaft (1). This character is inapplicable in taxa that the cervical rib is directed in a high angle to the neck.
368. Dorsal ribs, proximal end of middle dorsal ribs: dichcephalous (0); holocephalous (1).
369. Sacral vertebrae-sacral ribs, ratio between the width of the neural arch + ribs of the first primordial sacral and the length of the neural arch across the zygapophyses: less than three times (0); three times or more (1).
370. Sacral vertebrae, number: two (0); three (1); four or more (2), ORDERED.
371. Sacral ribs: almost entirely restricted to a single sacral vertebra (0); shared between two sacral vertebrae (1).

372. Sacral ribs, anteroposterior length of the first primordial sacral rib versus the second primordial sacral rib, dorsal view: primordial sacral rib one is longer anteroposteriorly than primordial sacral rib two (0); primordial sacral rib two is about the same length or longer anteroposteriorly than primordial sacral rib one (1).
373. Sacral ribs, second rib shape: single unit (0); bifurcates distally into anterior and posterior processes (1).
374. Sacral ribs, morphology of posterior process: pointed bluntly (0); pointed sharply (1).
This character is inapplicable in taxa without a bifurcated second sacral rib.
375. Sacral and caudal vertebrae, transverse processes and ribs of sacral and/or anterior caudal vertebrae in mature individuals: not fused to each other (0); fused to each other (1).
376. Caudal vertebrae, autotomic septa within the centrum: absent (0); present (1).
377. Caudal vertebrae, length of the transverse process + rib versus length across zygapophyses in anterior caudal vertebrae: 0.29–0.41 (0); 0.62–1.20 (1); 1.51–1.73 (2); 2.20–2.72 (3) (modified from Ezcurra 2016: 377), ORDERED.
378. Caudal vertebrae, distal end of the transverse processes + ribs of anterior caudals: tapering or squared (0); anteroposteriorly expanded (1).
379. Caudal vertebrae, neural spine height versus anteroposterior length at its base in anterior caudals: 0.66–2.21 (0); 2.36–2.65 (1); 2.92–3.05 (2); 3.21–3.54 (3) (modified from Ezcurra 2016: 379), ORDERED. This character is inapplicable a sail-backed taxa (e.g. *Ctenosauriscus*).
380. Caudal vertebrae, accessory laminar process on the anterior face of the neural spine on middle caudals: absent (0); present (1).
381. Caudal vertebrae, prezygapophysis of posterior caudals: not elongated (0); elongated more than a quarter of the adjacent centrum (1).

382. Chevrons, distal anteroposterior width of anterior and middle haemal spines in lateral view: equivalent to proximal width (0); tapering distally (1); longer than proximal width (= paddle-like haemal spine) (2).
383. Gastralium: present, forming an extensive ventral basket with closely packed elements (0); present, well separated (1); absent (2).
384. Scapula-coracoid, both bones fuse with each other in mature individuals: present, without a complete line of suture (0); absent (1).
385. Scapula-coracoid, notch on the anterior margin at level of the suture between both bones: absent (0); present (1).
386. Scapula-coracoid, glenoid fossa orientation: posterolateral (0); posteroventral (1).
387. Scapula, total length of the scapula versus minimum anteroposterior width of the scapular blade: 1.23–6.73 (0); 7.92–11.31 (1) >13.0 (2) (modified from Ezcurra 2016: 387), ORDERED.
388. Scapula, large fenestra between scapula and coracoid immediately anterior to the glenoid region: absent (0); present (1).
389. Scapula, strong curvature or inflexion between the proximal end and the posterior margin of the scapular blade: absent (0); present, the angle formed is close to 90° (1).
390. Scapula, anterior margin of the scapular blade in lateral view: straight or convex along entire length (0); distinctly concave (1).
391. Scapula, constriction distal to the glenoid: minimum anteroposterior length greater than half the proximodistal length of the scapula (0); minimum anteroposterior length less than half the proximodistal length of the scapula (1).
392. Scapula, supraglenoid foramen: absent (0); present (1).
393. Scapula, lateral tuber on the posterior edge, just dorsal of the glenoid fossa: absent (0); present (1).

394. Scapula, diagonal ridge adjacent to the anterior margin on the medial surface of the scapular blade: absent (0); present (1).
395. Scapula, acromion process: in about the same plane as the ventral edge of the scapula (0); distinctly raised above the ventral edge of the scapula (1).
396. Scapula, acromion process: gently raised from the anterior margin of the scapular blade (0); sharply raised in an angle between 50–90° from the anterior margin of the scapular blade (1).
397. Coracoid, anterior border in lateral view: rounded (0); distinctly hooked (1).
398. Coracoid, posterior border in lateral view: unexpanded posteriorly (0); moderately expanded posteriorly (1); strongly expanded posteriorly - the entire border, not only the posteroventral region as is the case in the postglenoid process - and, as a result, the articulated scapula and coracoid are L-shaped in lateral view (2), ORDERED.
399. Coracoid, subglenoid lip posterior extension: as developed as or less developed than the supraglenoid lip on the scapula (0); more extended than the supraglenoid lip on the scapula (1).
400. Coracoid, subglenoid lip lateral extension: poorly developed, resembling the development of the supraglenoid lip on the scapula (0); strongly developed as a shelf-like structure, more developed than the supraglenoid lip on the scapula (1).
401. Coracoid, biceps process on the lateral surface: absent or small (0); large (1).
402. Coracoid, postglenoid process separated from the glenoid fossa by a notch: absent (0); present (1).
403. Coracoid, postglenoid process shape: rounded posterior margin in lateral view (0); tapering posterior margin in lateral view (1). This character is inapplicable in taxa that lack a postglenoid process.
404. Cleithrum: present (0); absent (1).

405. Interclavicle: present (0); absent (1).
406. Interclavicle, anterior process: present (0); absent (1).
407. Interclavicle, anterior margin with a median notch: absent (0); present (1).
408. Interclavicle, lateral processes: well developed (0); reduced or absent (1).
409. Interclavicle, webbed between lateral and posterior processes: present, proximal half of the bone sub-triangular or diamond-shaped (0); absent, rather sharp angles between processes (1).
410. Interclavicle, transverse width at mid-length of the posterior process versus the length of the posterior process: 0.07–0.14 (0); 0.20–0.27 (1), ORDERED.
411. Interclavicle, posterior ramus: little change in width along entire length (0); gradual transverse expansion present (1).
412. Clavicle, articulation with interclavicle: on the anteroventral surface of the interclavicle (0); on the anterodorsal surface of the interclavicle (1); into a deep socket (2).
413. Sternum: not mineralized (0); mineralized (bone or calcified cartilage) (1). Scored as missing data in taxa without sufficiently articulated specimens.
414. Forelimb-hindlimb, length ratio: >0.55 (0); <0.55 (1).
415. Humerus, torsion between proximal and distal ends: approximately 45° or more (0); 35° or less (1).
416. Humerus, transverse width of the proximal end versus total length of the bone in mature individuals: 0.20–0.41 (0); 0.44–0.70 (1).
417. Humerus, proximal articular surface in proximal view: subrectangular to crescent-shape (0); sub-oval (1).
418. Humerus, proximal articular surface: continuous with the deltopectoral crest (0); separated by a gap from the deltopectoral crest (1).

419. Humerus, proximal end in anterior view: approximately symmetric (0); medially expanded, being asymmetric (1).
420. Humerus, conical process on the proximal surface, placed immediately adjacent to the base of the deltopectoral crest: absent (0); present (1).
421. Humerus, internal tuberosity distinctly separated from the proximal articular surface in anterior or posterior views: absent (0); present (1).
422. Humerus, shape of the deltopectoral crest in lateral view: rounded or subtriangular (0); subrectangular or trapezoidal (1).
423. Humerus, ventral margin of the deltopectoral crest developed as a thick subcylindrical tuberosity that is well differentiated from the thinner dorsal margin: present (0); absent (1).
424. Humerus, length of the deltopectoral crest versus total length of the bone in mature individuals: 0.16–0.18 (0); 0.24–0.49 (1); 0.52–0.55 (2), ORDERED.
425. Humerus, entepicondyle size in mature individuals: moderately large (0); strongly developed (1).
426. Humerus, entepicondylar foramen: present (0); absent (1).
427. Humerus, ectepicondylar region: foramen present (0); foramen absent, supinator process and groove present (1); supinator process, groove or foramen absent (2).
428. Humerus, capitellum (radial condyle) and trochlea (ulnar condyle): ball-shaped structures distinct from the ectepicondyle and entepicondyle (0); absent or incipient (1).
429. Humerus, trochlea (ulnar condyle) situated approximately at mid-width on the distal end of the bone: present (0); absent, being considerably laterally displaced (1). This character is inapplicable for taxa that lack or have incipient radial and ulnar condyles.

430. Ulna, olecranon process: absent, not ossified or very low (0); prominent but lower than its anteroposterior depth at base (1); strongly developed, being higher than its anteroposterior depth at base (2), ORDERED.
431. Ulna, olecranon process in lateral view: tapering toward its distal end (0); subrectangular or slightly expanded towards its distal end (1). This character is inapplicable in taxa without an olecranon process (e.g. *Macrocnemus*).
432. Ulna, olecranon process as a separate ossification: absent (0); present (1).
433. Ulna, lateral tuber (= radius tuber) on the proximal portion: absent (0); present (1).
434. Ulna, distal end in posterolateral view: rounded and convex (0); squared off where the distal surface is nearly flat (1).
435. Radius, total length versus total length of the humerus: 0.62–0.66 (0); 0.69–0.92 (1); 0.95–0.97 (2); 1.05–1.17 (3) (modified from Ezcurra 2016: 435), ORDERED.
436. Radius, length in comparisons with that of the ulna: shorter (0); longer or subequal (1). The olecranon process of the ulna should not be taken into account if present.
437. Radius, shape: straight (0); twisted in lateral view (1).
438. Radius, distal end: unexpanded or poorly anteroposteriorly expanded (0); strongly anteroposteriorly expanded (1).
439. Carpals, intermedium: present (0); absent (1).
440. Carpals, perforating foramen between intermedium and ulnare: present (0); absent (1).
This character is inapplicable in taxa that lack an intermedium.
441. Carpals, medial centrale carpal: present (0); absent (1).
442. Carpals, lateral centrale carpal: large (0); small or absent (1).
443. Carpals, pisiform: present (0); absent (1).
444. Carpals, distal carpal five: absent (0); present (1).

445. Manus, longest metacarpal + digit: longer than humeral length (0); subequal to shorter than humeral length (1).
446. Metacarpus, length of the longest metacarpal versus length of the longest metatarsal: 0.34–0.45 (0); 0.54–0.59 (1); 0.74–0.98 (2) (modified from Ezcurra 2016: 446), ORDERED.
447. Metacarpus, proximal ends: overlap (0); abut one another without overlapping (1).
448. Metacarpus, width of the distal end of the metacarpal I versus its total length: 0.26–0.33 (0); 0.36–0.45 (1); 0.48–0.53 (2); 0.58–0.64 (3); 0.73–0.75 (4); >1.00 (5), ORDERED.
449. Metacarpus, extensor pits on the dorsodistal portion of the metacarpals I-III: absent or shallow and symmetrical (0); deep and asymmetrical (1).
450. Metacarpus, metacarpal IV: longer than metacarpal III (0); equal or shorter than metacarpal III (1).
451. Manual digits, unguals length: about the same length or shorter than the last non-ungual phalanx of the same digit (0); distinctly longer than the last non-ungual phalanx of the same digit (1).
452. Manual digits, unguals of manual digits I-III: blunt on at least digits II and III (0); trenchant on digits I-III (1).
453. Manual digits, second phalanx of manual digit II: shorter than the first phalanx of manual digit II (0); longer than the first phalanx of manual digit II (1).
454. Manual digits, number of phalanges in digit IV: five (0); four (1); three or less (2), ORDERED.
455. Pelvic girdle, acetabulum: completely closed (0); perforated (1).
456. Pelvic girdle, acetabulum orientation: mainly laterally facing (0); lateroventrally or mainly ventrally facing (1).

457. Pelvic girdle, acetabular antitrochanter: absent (0); present (1).
458. Ilium, maximum height of the ilium versus length of the femur: 0.12–0.17 (0); 0.21–0.47 (1); 0.54–0.57 (2), ORDERED.
459. Ilium, laterally deflected iliac blade: absent (0); present (1).
460. Ilium, preacetabular process: absent or incipient (0); present, being considerably anteroposteriorly shorter than its dorsoventral height (1); present, being longer than two thirds of its height and not extending beyond the level of the anterior margin of the pubic peduncle (2); present and extending beyond the level of the anterior margin of the pubic peduncle (3), ORDERED.
461. Ilium, preacetabular process in lateral view: semicircular (0); subtriangular or finger-like (1). This character is inapplicable in taxa that lack a preacetabular process.
462. Ilium, lateral crest dorsal to the supraacetabular crest/rim: absent (0); present and divides the preacetabular process from the postacetabular process (1); confluent with the anterior extent of the preacetabular process (2).
463. Ilium, length of the postacetabular process versus anteroposterior length of the acetabulum: 0.31–0.63 (0); 0.79–1.24 (1); 1.31–1.37 (2); 1.49–1.55 (3), ORDERED.
464. Ilium, main axis of the postacetabular process in lateral or medial view: posterodorsally oriented (0); mainly posteriorly oriented (1).
465. Ilium, caudifemoralis brevis muscle origin on the lateroventral surface of the postacetabular process: not dorsally or laterally rimed by a brevis shelf (0); dorsally rimed by a brevis shelf, but lacking a brevis fossa (1); dorsolaterally rimed by a brevis shelf and with a lateroventrally facing brevis fossa (2); laterally rimed by a brevis shelf and with a ventrally facing brevis fossa (3).
466. Ilium, dorsal margin of the iliac blade: convex (0); mostly straight (1); concave (2).

467. Ilium, angle between anterior margin of the pubic peduncle and the horizontal plane of the pelvic girdle: lower than 45° (0); equal or higher than 45° (1).
468. Ilium, posteriorly projected heel on the posterior margin of the ischiadic peduncle in lateral view: absent (0); present, the dorsal margin of which is set at 45° or less to the longitudinal axis of the bone (1).
469. Ilium, acetabulum shape: irregular, marked by posterodorsal invasion by finished bone (0); roughly circular, no posterodorsal invasion by finished bone (1).
470. Pubis-ischium, contact: present and extended ventrally (0); present and reduced to a thin proximal contact (1); absent (2), ORDERED.
471. Pubis-ischium, thyroid fenestra: absent (0); present (1).
472. Pubis, total length versus anteroposterior length of the acetabulum: 1.15–2.58 (0); 2.73–3.43 (1); 3.94–4.87 (2) (modified from Ezcurra 2016: 472), ORDERED.
473. Pubis, anterior and posterior portions of the acetabular margin: continuous (0); recessed (1).
474. Pubis, tuberosity for the attachment of the ambiens muscle in mature individuals: prominent (0); incipient or absent (1).
475. Pubis, shaft orientation: anteroventral (0); vertical or posteroventral (1).
476. Pubis, form of the shaft (= pubic tubercle, = pectineal tuberosity) in lateral view: plate-like (0); rod-like and curved posteriorly (1); rod-like and straight (2).
477. Pubis, pubic apron: absent, symphysis extended along the ventral margin of the pelvic girdle and visible in lateral view (0); present, symphysis restricted anteriorly and obscured by the pubic shaft in lateral view (1).
478. Pubis, transverse width of conjoined aprons versus total length of the bone: 0.27–0.59 (0); 0.77–0.97 (1); 1.12–1.28 (2); 1.48–1.94 (3), ORDERED. This character is not applicable in taxa in which the pubic apron is absent.

479. Pubis, pectineal process: absent (0); present (1).
480. Pubis, distal end in lateral or medial view: unexpanded or gently expanded anteroposteriorly (0); sharply expanded anteroposteriorly, forming a distinct pubic boot (1). This character is inapplicable in taxa that lack a rod-like pubic shaft.
481. Pubis, transverse width of the distal portion: nearly as broad as the proximal width (0); significantly narrower than the proximal width (1). This character is inapplicable in taxa that lack a rod-like pubic shaft.
482. Ischium, total length versus anteroposterior length of the acetabulum: 1.04–1.24 (0); 1.55–2.50 (1); 2.72–3.53 (2); 4.31–4.48 (3), ORDERED.
483. Ischium, proximal articular surface: articular surface with the ilium and pubis continuous (0); articular surfaces with the ilium and pubis separated by a fossa (1); articular surfaces with the ilium and pubis separated by a non-articulating notched surface (2), ORDERED.
484. Ischium, longitudinal groove on the dorsal surface of shaft: absent (0); present (1).
485. Ischium, medial contact with antimere: restricted to the medial edge (0); extensive contact but the dorsal margins are separated (1); extensive contact and the dorsal margins contact each other (2), ORDERED.
486. Ischium, symphysis raised on a distinct low peduncle: absent (0); present (1).
487. Ischium, cross section of the distal portion: plate-like (0); semicircular or subtriangular (1).
488. Ischium, shape of posterior margin: linear posterior margin (0); posterior process extends from posterodorsal ischiadic margin (1).
489. Femur, total length versus total length of the humerus: 0.92–0.97 (0); 1.09–1.56 (1); 1.62–1.74 (2); 1.86–1.96 (3), ORDERED.

490. Femur, minimum transverse width versus minimum transverse width of the humerus:
<0.80 (0); 0.95–1.01 (1); 1.08–1.32 (2); 1.46–1.80 (3); 1.93–2.00 (4), ORDERED.
491. Femur, proximal articular surface: well ossified, being flat or convex (0); partially ossified, being concave and sometimes with a circular pit (1).
492. Femur, femoral head: not distinctly offset from the shaft (0); distinctly offset from the shaft (1).
493. Femur, femoral head orientation (long axis of the femoral head angle with respect to the transverse axis through the femoral condyles Parrish, 1986): anterior (60°–90°) (0); anteromedial (20°–60°) (1).
494. Femur, proximal articular surface (= posterolateral portion of the head sensu Nesbitt 2011): limited to the proximal surface of the bone (0); extends under the proximal surface of the bone (1).
495. Femur, proximal surface: rounded and smooth (0); transverse groove present (1).
496. Femur, posteromedial tuber (= anteromedial tuber of Nesbitt 2011) on the femoral head: absent (0); present (1).
497. Femur, posterior tuber (= posteromedial tuber of Nesbitt 2011) on the femoral head: present and small (0); present and largest of the proximal tubera (1); absent (2). This character is inapplicable in taxa in which the internal trochanter reaches the proximal margin of the bone.
498. Femur, anterior tuber (= anterolateral tuber of Nesbitt 2011) on the femoral head: present as an expansion (0); absent (1).
499. Femur, trochanteric fossa (sensu Novas 1996) on the ventral/posterior surface of the proximal end: present (0); absent (1).

500. Femur, dorsolateral trochanter on the anterolateral surface of the proximal end: absent (0); present (1). This character is inapplicable in taxa with a wing-like anterior trochanter that extends proximally close to the greater trochanter.
501. Femur, transition between femoral head and shaft: smooth (0); notch (1); concave emargination (2).
502. Femur, anterior trochanter (= lesser or minor trochanter, = iliofemoralis cranialis muscle insertion): absent (0); present (1).
503. Femur, trochanteric shelf (= iliofemoralis externus muscle insertion): absent (0); present in mature individuals (1).
504. Femur, attachment of the caudofemoralis musculature on the posterior surface of the bone: crest-like and with intertrochanteric fossa (= internal trochanter), and convergent with proximal end (0); crest-like and with intertrochanteric fossa (= internal trochanter), and not convergent with proximal end (1); crest-like and without intertrochanteric fossa (= fourth trochanter), and not convergent with proximal end (2), ORDERED. Scored as inapplicable in taxa without a distinct process for the attachment of the caudofemoralis musculature.
505. Femur, shape of the process for the attachment of the caudofemoralis musculature: mound-like and rounded (0); sharp flange (1). Scored as inapplicable in taxa without a distinct process for the attachment of the caudofemoralis musculature.
506. Femur, process for the attachment of the caudofemoralis musculature in medial or lateral view: symmetrical, with the proximal and distal margins forming similar low-angle slopes to the shaft (0); asymmetrical, with the distal margin forming a steeper angle to the shaft (1). Scored as inapplicable in taxa without a distinct process for the attachment of the caudofemoralis musculature.

507. Femur, proximodistal extension of the process for the attachment of the caudofemoralis musculature: restricted to the proximal half of the shaft and low (0); distally extended beyond mid-shaft and well posteriorly developed (1). Scored as inapplicable in taxa without a distinct process for the attachment of the caudofemoralis musculature.
508. Femur, bone wall thickness at or near midshaft: thickness/diameter >0.3 (0); thin, thickness/diameter <0.3 (1).
509. Femur, shaft: diameter constant or widening distally (0); diameter distally narrowed (1).
510. Femur, distal transverse width versus total length: 0.08–0.11 (0); 0.13–0.24 (1); 0.26–0.36 (2); 0.39–0.41 (3), ORDERED.
511. Femur, distal condyles: prominent, strong dorsoventral expansion (in sprawling orientation) restricted to the distal end (0); not projecting markedly beyond shaft and expand gradually if there is any expansion (1).
512. Femur, distal articular surface: uneven, lateral (= fibular) condyle projecting distally distinctly beyond medial (= tibial) condyle (0); both condyles prominent distally and approximately at same level (1); both condyles do not project distally (distal articular surface concave or almost flat) (2).
513. Femur, anterior extensor groove: absent, anterior margin of the bone straight or convex in distal view (0); present, anterior margin of the bone concave in distal view (1).
514. Femur, surface between the lateral (=fibular) condyle and crista tibiofibularis on the distal surface: smooth (0); deep groove (1).
515. Femur, shape of lateral (=fibular) condyle in distal view: lateral surface is rounded and mound-like (0); lateral surface is triangular and sharply pointed (1).

516. Tibia, total length versus total length of the femur: 0.46–0.55 (0); 0.60–0.65 (1); 0.70–1.27 (2); 1.41–1.46 (3), ORDERED.
517. Tibia, distinctly anteriorly projected process beyond the articular portion for the femur on the proximal end (= cnemial crest): absent or just a slightly bump (0); present and anteriorly straight (1); present and curved anterolaterally (2).
518. Tibia, proximal surface of the lateral condyle: convex or flat (0); depressed (1).
519. Tibia, lateral posterior condyle of the proximal end: offset anteriorly from the medial posterior condyle (0); level with the medial posterior condyle at its posterior border (1).
520. Tibia, lateral surface of the proximal half: smooth (0); with a longitudinal crest (= fibular crest) (1).
521. Tibia, posterolateral process (= lateral malleolus) in the distal end: absent (0); present (1). This character is inapplicable if the distal ends of tibia and fibula are fused to each other.
522. Tibia, posterior surface of the distal end: rounded (0); distinct proximodistally oriented ridge present (1).
523. Tibia, posterior side of the distal portion: smooth and featureless (0); dorsoventrally oriented groove or gap (1).
524. Tibia, lateral side of the distal portion: smooth/rounded (0); proximodistally oriented groove (1). This character is inapplicable if the distal ends of tibia and fibula are fused to each other.
525. Fibula, proximal end in proximal view: round or slightly elliptical (0); transversely compressed (1).
526. Fibula, anterior edge of the proximal portion: rounded (0); tapers to a point and arched anteromedially (1).

527. Fibula, proximal portion in lateral view: symmetrical or nearly symmetrical (0); posterior part expanded posteriorly (1).
528. Fibula, transverse width at mid-length: subequal to transverse width of the tibia (0); distinctly narrower than transverse width of the tibia (1).
529. Fibula, area of attachment of the iliofibularis muscle: not on a prominent process (0); on a low, distinct tubercle (1); on a hypertrophied tubercle (2), ORDERED.
530. Fibula, location of the attachment site of the iliofibularis muscle: near the proximal portion (0); near the midpoint between the proximal and distal ends (1).
531. Fibula, distal end in lateral view: angled anterodorsally (asymmetrical) (0); rounded or flat (symmetrical) (1).
532. Proximal tarsals, articulation between astragalus and calcaneum: roughly flat (0); concavoconvex with concavity on the calcaneum (1); concavoconvex with concavity on the astragalus (2).
533. Proximal tarsals, foramen for the passage of the perforating artery between the astragalus and calcaneum (= perforating foramen): present (0); absent (1).
534. Astragalus, crural facets: separated by a non-articular surface (0); continuous (1).
535. Astragalus, margin between tibial and fibular facets: margin grades smoothly into anterior hollow (0); prominent ridge separates margin from anterior hollow (1). This character is inapplicable in taxa with confluent tibial and fibular facets.
536. Astragalus, tibial facet: concave, flat or flexed (0); divided into distinct posteromedial and anterolateral basins (1).
537. Astragalus, ascending process (= anterior ascending process): absent (0); present, occupying most of the anteroposterior depth of the astragalus (1); present, restricted to the anterior half of the astragalar depth (2), ORDERED.

538. Astragalus, anterior hollow: shallow depression (0); reduced to a foramen (= extensor canal) or absent (1).
539. Astragalus, posterior groove: present (0); absent (1).
540. Astragalus, anteromedial corner in proximal view: obtuse (0); acute (1).
541. Astragalus, dorsolateral margin: overlaps the anterior and posterior portions of the calcaneum equally (0); posterior corner dorsally overlaps the calcaneum much more than the anterior portion (1).
542. Astragalus, articulation with distal tarsal 4: poorly defined (0); well defined (1).
543. Calcaneum, articular facet for the astragalus: lies completely medial to the fibular facet (0); lies partially ventral to the fibular facet (1).
544. Calcaneum, development of lateral margin: calcaneum terminating in unthickened margin (0); roughened tuberosity present laterally (1).
545. Calcaneum, calcaneal tuber (= expansion of the lateral margin of the bone): absent or incipient (0); prominent (1).
546. Calcaneum, orientation of calcaneal tuber: lateral, between 0°–35° (0); posterolateral, deflected between 36°–70° (1); posterior, between 71°–90° (2), ORDERED. This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.
547. Calcaneum, proportions of calcaneal tuber at the midshaft: taller than broad (0); about the same or broader than tall (1); just less than twice the transverse width of the fibular facet (2). This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.
548. Calcaneum, calcaneal tuber distal end: rounded and unexpanded (0); flared, dorsally and/or ventrally (1). This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.

549. Calcaneum, calcaneal tuber distal end in proximal or distal view: tapering or squared (0); expanded (1). This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.
550. Calcaneum, distal surface of calcaneal tuber with a vertical median depression: absent (0); present (1). This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.
551. Calcaneum, ventral notch between the main body and the calcaneal tuber: absent (0); present (1). This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.
552. Calcaneum, ventral articular surface for distal tarsal 4 and the distal end of the calcaneal tuber: continuous (0); separated by a clear gap (1); separated by a gap with a laterally and medially delimited ventral fossa (2), ORDERED. This character is inapplicable in taxa that lack or have an incipient a calcaneal tuber.
553. Calcaneum, fibular facet: slightly convex or flat (0); hemicylindrical (1); concave (2).
554. Calcaneum, articular facets for the fibula and astragalus: connected by a continuous surface (0); separated (1).
555. Calcaneum, articular surfaces for fibula and distal tarsal 4: separated by a non-articular surface (0); continuous (1).
556. Calcaneum, transverse width of the distal articular surface versus transverse width of the astragalus: 0.28–0.33 (0); 0.42–1.22 (1); >1.50 (2), ORDERED.
557. Distal tarsals, medial pedal centrale: present and does not contact tibia (0); present and contacts the tibia (1); absent as a separate ossification (2), ORDERED.
558. Distal tarsals, distal tarsal 1: present (0); absent (1).
559. Distal tarsals, distal tarsal 2: present (0); absent (1).

560. Distal tarsals, distal tarsal 4 transverse width: broader than distal tarsal 3 (0); subequal to distal tarsal 3 (1).
561. Distal tarsals, articular facet for metatarsal V on distal tarsal 4: more than half of the lateral surface of the bone (0); less than half of the lateral surface of the bone (1).
562. Distal tarsals, proximal surface of distal tarsal 4: flat (0); distinct, proximally raised region on the posterior portion (= heel of Sereno and Arcucci 1994) (1).
563. Distal tarsals, distal tarsal 5: present (0); absent (1).
564. Pes, foot length (articulated fourth metatarsal and digit) versus tibia-fibula length: >1 (0); <1 (1).
565. Metatarsus, configuration: metatarsals diverging from ankle (0); compact, metatarsals I–IV tightly bunched (1).
566. Metatarsus, metatarsals overlapping proximally: absent (0); present (1).
567. Metatarsus, length of the longest metatarsal versus length of the tibia: 0.20–0.23 (0); 0.29–0.34 (1); 0.37–0.59 (2); 0.62–0.65 (3), ORDERED.
568. Metatarsus, metatarsals I and V mid-shaft diameters: subequal or greater (0); lower (1) than those of metatarsals II–IV.
569. Metatarsus, length of metatarsal I versus metatarsal III: 0.17–0.21 (0); 0.27–0.42 (1); 0.46–0.79 (2); 0.93–0.97 (3) (modified from Ezcurra 2016: 569), ORDERED.
570. Metatarsus, anteromedial portion of the shaft of the metatarsal I: smooth or slight ridge (0); distinct, rugose ridge present (1).
571. Metatarsus, length of the metatarsal II versus length of the metatarsal IV: 0.49–0.85 (0); 0.90–1.02 (1); 1.06–1.15 (2) (modified from Ezcurra 2016: 571), ORDERED.
572. Metatarsus, metatarsal II midshaft diameter: less than or equal to the midshaft diameter of the metatarsals I–IV (0); more than the midshaft diameter of metatarsal I (1).

573. Metatarsus, metatarsal IV mid-shaft diameter: subequal to (0); lower than (1) that of metatarsal III.
574. Metatarsus, length of metatarsal IV versus length of metatarsal III: 0.85–1.00 (0); 1.04–1.08 (1); 1.11–1.28 (2); 1.31–1.34 (3), ORDERED.
575. Metatarsus, distal articular surface of metatarsal IV: broader than deep (nearly symmetrical) (0); as broad as deep as or deeper than broad (asymmetrical) (1).
576. Metatarsus, dorsal prominence separated from the proximal surface by a concave gap in metatarsal V: absent (0); present (1).
577. Metatarsus, metatarsal V with a hook-shaped proximal end: absent, articular face for distal tarsal 4 aligned to the medial margin of the shaft (0); present, with a gradually medially curved proximal process (1); present, with a sharply medially flexed proximal process and, as a result, the metatarsal acquires a L-shape in dorsal or ventral view (2).
578. Metatarsus, metatarsal V outer process on the proximal lateral margin: absent, smooth curved margin (0); present, prominent pointed process (1).
579. Metatarsus, metatarsal V lateral plantar tubercle in mature individuals: absent (0); present (1).
580. Metatarsus, metatarsal V medial plantar tubercle in mature individuals: absent (0); present (1).
581. Pedal digits, length of digit III versus length of digit IV: 0.64–0.77 (0); 0.81–0.83 (1); 0.87–1.44 (2), ORDERED.
582. Pedal digits, phalanges on pedal digit V: present and “fully” developed first phalanx (0); present and “poorly” developed first phalanx (1); absent (2), ORDERED.
583. Pedal digits, ratio of lengths of pedal digits V and I: 0.30–0.85 (0); 1.13–3.07 (1) (modified from Ezcurra 2016: 583). This character is inapplicable in taxa lacking digit V.

584. Pedal digits, phalanx V-1: subequal or shorter than other non-ungual phalanges (0); metatarsal-like, considerably longer than other non-ungual phalanges (1). This character is inapplicable in taxa lacking a fifth digit.
585. Pedal digits, distal articular portion of distal pedal phalanges: lateral and medial sides parallel or near parallel (0); lateral and medial sides converging anteriorly (1).
586. Pedal digits, pedal unguals: weakly transversely compressed, rounded and triangular in cross-section (0); dorsolaterally compressed (1); strongly transversely compressed, with a sharp dorsal keel (2).
587. Pedal digits, ventral tubercle in unguals: absent or small (0); well developed and extended ventral to the articular portion of the ungual (1).
588. Osteoderms, dorsal osteoderms: absent (0); present, one row (1); present, two rows (2); present, more than two rows (3), ORDERED.
589. Osteoderms, sculpture on their external surface: absent (0); present (1). This character is inapplicable in taxa that lack osteoderms.
590. Osteoderms, coarse and incised ornamentation composed of central regular pits of subequal size and contour on the external surface of the dorsal osteoderms: absent (0); present (1). This character is inapplicable in taxa that lack osteoderms or sculpture on the external surface of the osteoderms.
591. Osteoderms, dorsal prominence in paramedian osteoderms: absent (0); longitudinal keel, extending along all or most of the anteroposterior length of the osteoderm as a transversely compressed flange (1); blunt, anteroposteriorly restricted eminence (2).
592. Osteoderms, paramedian osteoderms: thin (0); very thick (1). This character is inapplicable in taxa that lack osteoderms.

593. Osteoderms, relation between paramedian dorsal osteoderms and presacral vertebrae: one to one (includes pairs) (0); more than one osteoderm (1). This character is inapplicable in taxa that lack osteoderms.
594. Osteoderms, dorsal osteoderm alignment dorsal to the dorsal vertebrae: staggered (0); one to one (1). This character is inapplicable in taxa that lack osteoderms or have a single row of osteoderms.
595. Osteoderms, dimensions of presacral dorsal osteoderms: square-shaped, about equal dimensions (0); longer than wide (1); wider than long (2). This character is inapplicable in taxa that lack osteoderms.
596. Osteoderms, unornamented anterior articular lamina in paramedian osteoderms: absent (0); present (1). This character is inapplicable in taxa that lack osteoderms.
597. Osteoderms, anterior edge of paramedian presacral dorsal osteoderms: straight or rounded (0); with a distinct anterior process (= leaf shaped) (1). This character is inapplicable in taxa that lack osteoderms.
598. Osteoderms, presacral paramedian osteoderms with a distinct longitudinal bend near the lateral edge: absent (0); present (1). This character is inapplicable in taxa that lack osteoderms or possess a single row of osteoderms.
599. Osteoderms, appendicular osteoderms: absent (0); present (1).
600. Osteoderms, ventral osteoderms: absent (0); present, scattered, not forming a carapace (1); present, forming a carapace (2).

Characters added by Nesbitt et al. (2017) to the character list of Ezcurra (2016).

601. Primordial sacral vertebra two, sacral rib: consist of a single body in one plane (could contain a lateral notch) (0); has a separate posterolateral process positioned dorsal and posterior to the main body of the sacral rib (1).

602. Scapula, posterior edge of the blade just dorsal to the glenoid region: smoothly transversely convex (0); with a distinct, longitudinal sharp ridge (1).
603. Ilium, ventral portion, ischial peduncle, lateral view: nearly straight or slightly concave (0); distinct notch (= dorsal concavity) between the posterior and anterior ends (1).
604. Femur, distal end, medial condyle in posterior view: smooth surface or a small depression (0); well-defined proximodistally oriented scar extending from the posterior portion of the condyle well proximally (1).
605. Fibula, posterior edge: gently rounded (0); distinct ridge paralleling the shaft (1).
606. Proximal tarsals, fusion between astragalus and calcaneum: absent (0); present (1).

Additional characters

607. Skull, dimensions: longer than broad (0); broader than long (1) (Benton 1984; Butler et al. 2015: 1).
608. Skull, height: < 50% of the midline length (0); > 50% of the midline length (1) (Hone and Benton 2008; Butler et al. 2015: 2).
609. Skull, orbital medial margin: rounded (0); forming a marked angle (1) (Montefeltro et al. 2010; Butler et al. 2015: 6).
610. Skull, elements forming the border of the suborbital fenestra: ectopterygoid, palatine, and maxilla (0); ectopterygoid and palatine only (1) (Dilkes 1995; Butler et al. 2015: 47).
611. Maxilla, anterolateral surface: smooth (0); slot for the premaxillary process (1) (Nesbitt 2011: 20).
612. Maxilla, dentition: present (0); absent (1) (Nesbitt and Norell 2006; Nesbitt 2011: 18).
613. Maxilla, position of the tooth row: confluent with the lateral surface of the bone (0); deeply inset from the lateral surface of the bone (1) (New character).

614. Maxilla, medial maxillary groove: absent (0); present but not reaching the anterior half of the maxilla (1); present and reaching the anterior half of the maxilla (2) (Benton 1984; Butler et al. 2015: 64). This character is not applicable in taxa lacking a maxillary tooth plate or a main groove.
615. Maxilla, curvature of the maxillary posterior border in lateral view: posterior border of maxillae curves gentle towards the jugal (0); posterior border of maxillae curves strongly towards the jugal so that the posterior teeth face posteroventrally (1) (Schultz et al. 2016: 107). This character is not applicable in taxa lacking a strongly convex maxillary alveolar margin.
616. Maxilla, size of occlusal teeth: enlarged teeth with each longitudinal row formed by reduced number of teeth (0); reduced teeth with each longitudinal row formed by great number of teeth (1) (Schultz et al. 2016: 110). This character is not applicable in taxa lacking a maxillary tooth plate.
617. Maxilla, lingual teeth: restricted to caudal half of the maxilla (0); extending to the anterior half of maxillary length (1) (Schultz et al. 2016: 111). This character is not applicable in taxa lacking lingual teeth in the maxilla.
618. Maxilla, lingual tooth crown orientation: medially oriented, perpendicular to maxillary medial wall (0); ventrally directed parallel to maxillary medial wall (1) (Schultz et al. 2016: 112). This character is not applicable in taxa lacking lingual teeth in the maxilla.
619. Maxilla, cross-section lateral to main groove: crest-shaped (0); cushion-shaped (1) (Langer et al. 2000; Butler et al. 2015: 66). This character is not applicable in taxa lacking a maxillary tooth plate or a main groove. This character is considered non-independent to the cross-section medial to the main groove (Schultz et al. 2015: 109).

620. Maxilla, number of tooth rows medial to main or medial maxillary groove: two rows and scattered teeth (0); three or more tooth rows (1) (Langer et al. 2000; Butler et al. 2015: 68). This character is not applicable in taxa lacking a maxillary tooth plate or a maxillary groove.
621. Maxilla, occlusal tooth rows on the anterior half: four or more tooth rows (0); fewer than four tooth rows (1) (Whatley 2005; Butler et al. 2015: 69). This character is not applicable in taxa with only row of marginal teeth on the maxilla.
622. Nasal-prefrontal, contact: present (0); absent (1) (Sereno 1991; Nesbitt 2011: 33).
623. Jugal, lacrimal contact: minimal (0); extensive contact of the jugal anterior process (1) (Whatley 2005; Butler et al. 2015: 12).
624. Jugal, participation in a well posteriorly rimmed antorbital fossa: absent (0); present (1) (New character). This character is inapplicable in taxa that lack an antorbital fenestra.
625. Jugal, height below the most ventral level of the orbit in lateral view: lower than half the maximum height of the orbit (0) equal or higher than half of the maximum height of the orbit (1) (New character).
626. Jugal, shallow depression on the lateral surface of the transition between of the main body and the ascending process: absent (0); present (1) (taken from França et al. 2013).
627. Jugal, orientation of the ascending process in lateral view: mainly dorsal to posterodorsal in an angle higher than 45° (0); strongly posterodorsally oriented in an angle equal to or lower than 45° (1) (New character). This character is inapplicable in taxa that lack an infratemporal fenestra.
628. Prefrontal, dorsomedial surface near the orbital rim: flat or slightly concave (0); deeply concave (1) (Whatley 2005; Butler et al. 2015: 21).

629. Frontal, well-marked 'V'-shaped crest along the postfrontal contact, anterior to the margin of the supratemporal fossa: absent (0); present (1) (Montefeltro et al. 2010; Butler et al. 2015: 25).
630. Frontal, midline length: frontal longer than parietal (0); parietal longer than frontal (1) (Benton 1987; Butler et al. 2015: 26).
631. Postfrontal, medial contact with frontal and parietal: postfrontal forms broad contact with midline skull elements, without bifurcation (0); postfrontal bifid, fitting broadly across both parietal and frontal (1) (Gauthier et al. 1988; Pritchard et al. 2015: 18).
632. Postorbital, suture with parietal: visible in dorsal view (0); hidden in dorsal view (1) (Dilkes 1998; Butler et al. 2015: 32).
633. Parietal, body: not expanded laterally at midlength (0); expanded laterally at midlength (1) (Montefeltro et al. 2010; Butler et al. 2015: 36).
634. Parietal, orientation of posterolateral process: strong posterolateral angling (0); roughly transverse (1) (Merck 1997; Butler et al. 2015: 37; Pritchard et al. 2015: 21).
635. Parietal, distal tip of the posterolateral process: not anteriorly curved (0); anteriorly curved (1) (Montefeltro et al. 2010; Butler et al. 2015: 38).
636. Quadratojugal, orientation of the main axis of the ascending process in lateral view: approximately vertical or moderately anterodorsally to posteroventrally oriented in an angle higher than 40° (0); strongly anterodorsally to posteroventrally slanted in an angle equal or lower than 40° (1) (New character). This character is inapplicable in taxa that lack a quadratojugal or this bone is indistinguishably fused to the quadrate or lack an infratemporal fenestra.
637. Quadrate, dorsal head position in posterior view: approximately at level with the upper temporal bar (0); distinctly medially displaced, beyond the level of the lateral border of the supratemporal fenestra (1) (New character).

638. Palatine-pterygoid, fenestra: absent (0); present (1) (Sereno 1991; Nesbitt 2011: 85).
639. Supraoccipital, rugose ridge on the anterolateral edges: absent (0); present (1) (Nesbitt 2011: 127).
640. Foramen or groove passing above and into the dorsal end of the metotic foramen: absent (0); present (1) (Gower 2002; Nesbitt 2011: 132).
641. Opisthotic, paroccipital processes: no or slight dorsal and ventral expansion distally (0); markedly expanded dorsally at the distal ends (1) (Clark et al. 2000; Olsen et al. 2000; Benton and Walker 2002; Sues et al. 2003; Clark et al. 2004; Nesbitt 2011: 108).
642. Exoccipital, relative positions of the exits of the hypoglossal nerve (XII): aligned in a nearly anteroposterior plane (0); aligned subvertically (1) (Nesbitt 2011: 113). This character is inapplicable if there is one exit for the CN XII.
643. Basioccipital, length: basisphenoid/parabasisphenoid longer than basioccipital (0); basioccipital longer than basisphenoid/parabasisphenoid (1) (Langer and Schultz 2000; Butler et al. 2015: 50).
644. Parasphenoid/parabasisphenoid, between basal tubera and basipterygoid processes: approximately as wide as long or wider (0); significantly elongated, at least 1.5 times longer than wide (1) (Rauhut 2003; Nesbitt 2007; Nesbitt 2011: 103).
645. Prootic, paroccipital contribution: does not contribute to anterior surface of paroccipital process (0); contributes laterally tapering lamina to the anterior surface of the prootic (1) (Merck 1997; Pritchard et al. 2015: 75).
646. Dentary, anterior extent of the Meckelian groove: ends well short of the dentary symphysis (0); present through the dentary symphysis (1) (Nesbitt 2011: 153). This character is not applicable in taxa that lack a dentary symphysis.
647. Dentary, anterior extremity: rounded (0); tapers to a sharp point (1) (Nesbitt 2011: 155).

648. Dentary, lingual teeth: absent (0); present and forming one row (1); present and forming more than one row (2) (Benton 1984; Butler et al. 2015: 75), ORDERED.
649. Dentary, teeth on lingual surface: scattered (0); crowded (1) (Benton 1985; Butler et al. 2015: 76). This character is not applicable in taxa lacking lingual teeth on the dentary.
650. Surangular-angular, lateral ridge that curves from the external mandibular fenestra to the posterior end of the lower jaw, delimiting a ventrolaterally facing surface: absent (0); present (1) (New character). This character is inapplicable in taxa that lack an external mandibular fenestra.
651. Angular, exposure on lateral mandibular surface: terminates anterior to the glenoid (0); extends to the glenoid (1) (Gauthier 1984; Pritchard et al. 2015: 82).
652. Articular, medial surface: without dorsomedial projection posterior to the glenoid fossa (0); with dorsomedial projection separated from glenoid fossa by a clear concave surface (1); with dorsomedial projection continuous with the glenoid fossa (2) (Clark et al. 2000; Olsen et al. 2000; Benton and Walker 2002; Sues et al. 2003; Clark et al. 2004; Nesbitt 2011: 156), ORDERED.
653. Teeth, serrations: present as small fine knifelike serrations (0); present and enlarged and coarser (lower density) = denticles (1) (Gauthier et al. 1988; Juul 1994; Dilkes 1998; Irmis et al. 2007; modified from Nesbitt 2011: 168). This character is not applicable in taxa lacking serrations in the tooth crowns.
654. Cervical and dorsal vertebrae, neural spines in posterior cervicals and anterior dorsals: straight (0); arc anteriorly (1) (modified from Nesbitt 2011: 194).
655. Cervical vertebra, centrum length of third cervical: subequal to the axis centrum (0); longer than the axis centrum (1) (Gauthier 1986; Langer and Benton 2006; Nesbitt 2011: 183).

656. Cervical vertebrae, epipophyses: absent in posterior cervical vertebrae (6–9) (0); present in posterior cervical vertebrae (6–9) (1) (Serenio et al. 1993; Langer and Benton 2006; Nesbitt 2011: 187). This character is not applicable in taxa lacking epipophyses in the cervical vertebrae.
657. Cervical vertebrae, shape of neural spine base of anterior post-axial cervicals: elongate, subequal in length to the neural arch (0); short, spine restricted to posterior half of neural arch (1) (Benton and Allen 1997; Pritchard et al. 2015: 113).
658. Cervical vertebrae, neural spine shape in cross-section of anterior post-axial cervicals: transversely narrow (0); elliptical or circular (1) (Merck 1997; Pritchard et al. 2015: 114).
659. Dorsal vertebra, position of parapophysis (or ventral margin of dorsal synapophysis) in posterior dorsals: positioned partially on lateral margin of centrum (0); positioned entirely on neural arch (1) (Merck 1997; Pritchard et al. 2015: 121).
660. Dorsal vertebrae, position of diapophysis: anterior portion of the neural arch/centrum (0); anteroposterior middle of the neural arch/centrum (1) (Nesbitt et al. 2015: 215).
661. Dorsal vertebra, ribs and vertebrae in posterior dorsals: unfused (0); fused (1) (Benton and Allen 1997; Pritchard et al. 2015: 124).
662. Dorsal vertebrae, neural spines: about the same height as the posterior cervical vertebrae neural spines (0); 2–4 times taller as the posterior cervical vertebrae neural spines (1); more than 4 times taller than the posterior cervical vertebrae neural spines (2) (Nesbitt 2011: 198), ORDERED.
663. Sacral vertebrae, centra: separate (0); coossified at the ventral edge (1) (Rowe 1989; Nesbitt 2011: 200).
664. Sacral vertebrae, primordial sacral one rib: does not or weakly articulates with anteriorly directed process (= preacetabular process) of the ilium (0); an anterior process

of the rib articulates with the anteriorly directed process of the ilium (1) (Nesbitt 2005, 2007, 2011: 202).

665. Caudal vertebrae, median longitudinal groove on the ventral surface of the centrum of the first two caudals: absent (0); present (1) (Dilkes 1998; Ezcurra et al. 2016: 95).
666. Caudal vertebrae, neural spines in anterior caudals: inclined posteriorly (0); vertical (1) (Dilkes 1998; Nesbitt et al. 2015: 217).
667. Ilium, supraacetabular crest: crest absent, posterodorsal margin of acetabulum similar in development of anterodorsal margin (0); prominent anterodorsal bony lamina frames the anterodorsal margin of the acetabulum (1) (Gauthier et al. 1988; Pritchard et al. 2015: 166).
668. Pubis, expansion of the distal end: mediolaterally thick and rounded (0); mediolaterally thin (1) (Gauthier 1986; Juul 1994; Benton 1999; Nesbitt 2011: 284). This character is inapplicable in taxa lacking an expanded distal end of the pubis.
669. Pubis, pubic apron, proximal portion: similar anteroposterior thickness as the rest of the pubic apron (0); thickened process (1) (Nesbitt 2005, 2007, 2011: 288). This character is inapplicable in taxa lacking a pubic apron.
670. Ischium, distal portion: unexpanded (0); expanded relative to the ischial shaft (= ischial boot) (1) (Smith and Galton 1990; Holtz 1994; Hutchinson 2001; Rauhut 2003; Langer and Benton 2006; Nesbitt 2011: 294).
671. Femur, medial articular facet of the proximal portion: rounded (0); straight (1) (Nesbitt 2011: 309).
672. Femur, angle between the lateral condyle and the crista tibiofibularis in distal view: obtuse (0); about a right angle (1) (Parker and Irmis 2005; Nesbitt 2011: 319).

673. Femur, medial condyle of the distal portion: tapers to a point on the medial portion in distal view (0); smoothly rounded in distal view (1) (Nesbitt 2011: 320; Pritchard et al. 2015: 182).
674. Femur, distal condyles of the femur divided posteriorly: less than 1/4 the length of the shaft (0); between 1/3 and 1/4 the length of the shaft (1) (Nesbitt 2011: 324).
675. Tibia, crest on anteromedial region of shaft: absent (0); present (1) (Montefeltro et al. 2013; Butler et al. 2015: 91).
676. Heterotopic ossifications: absent in a minimum of 5 individuals (0); present (1) (Pritchard et al. 2015: 200).

Calculated ratios for the discretization of meristic characters

Character 2:

- Arizonasaurus babbitti* (Nesbitt 2005: fig. 28): ca. 0.45
Chanaresuchus bonapartei (PVL 4575): 0.53
Decuriasuchus quartacolonina (França et al. 2011: fig. 1, specimen a): 0.31
Decuriasuchus quartacolonina (França et al. 2011: fig. 1, specimen d): 0.35
Diandongosuchus fuyuanensis (Li et al. 2012: fig. 1): 0.56
Dimorphodon (Nesbitt 2011: character 134): >0.50
Dyoplax arenaceous (SMNS 4760): 0.27
Euparkeria (SAM-PK-5867): 0.38
Heterodontosaurus (SAM-PK-K1332): 0.34
Macrocnemus bassanii (PIMUZ T4355): ca. 0.22
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 1): 0.22
Mesosuchus (SAM-PK-5882; Dilkes 1998: fig. 23): 0.31
Parasuchus hislopi (Chatterjee 1978: fig. 1: ISI R42): 0.72
Petrolacosaurus (Reisz 1981: fig. 1): 0.24
Prestosuchus chiniquensis (UFRGS-PV-0629-T): ca. 0.34
Prolacerta broomi (Gow 1975: fig. 27): 0.27
Proterochampsia barrionuevoi (PVSJ 606): 0.96
Proterosuchus alexanderi (NMQR 1484): ca. 0.34
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361, skull length based on lower jaw length between its anterior tip and anterior border of the glenoid fossa): 0.34
Pseudochampsia ischigualastensis (PVSJ 567): 0.59
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 0.29
Rhychosaurus articeps (NHMUK PV R1237, R1238): ca. 0.32
Silesaurus opolensis (ZPAL AbIII/1930): 0.25
Tropidosuchus romeri (PVL 4601): ca. 0.44
Turfanosuchus dabanensis (IVPP V3237): ca. 0.29
Vancleavea campi (Nesbitt et al. 2009: fig. 18): ca. 0.28

Youngina (SAM-PK-K7710a): 0.36

Discretization by the cluster analysis: (1) 0.22–0.38; (2) 0.44–0.72; (3) 0.94–0.98. (5%=0.04). The first group is more inclusive than obtained in order to include several taxa with estimated ratio and proportionally small skulls.

Character 20:

Azendohsaurus madagaskarensis (Flynn et al. 2010: fig. 13a): 0.49
Bentonyx (BRSUG 27200): 0.33
Boreopricea (Tatarinov 1978: fig. 1b): 0.40
Brasinorhynchus mariantensis (Schultz et al. 2016: fig. 4): ca. 0.30–0.35
Cerritosaurus binsfeldi (CA s/n): 0.50
Chanaresuchus bonapartei (MCZ 4039): 0.54
Chanaresuchus bonapartei (MCZ 4037): 0.55
Chanaresuchus bonapartei (PVL 4586): 0.59
Chanaresuchus bonapartei (PVL 4575): 0.57
“*Chasmatosaurus*” *yuani* (IVPP V4067): 0.52
Decuriasuchus quartacolonina (França et al. 2013: fig. 2): 0.56
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 0.65
Dyoplax arenaceous (SMNS 4760): 0.52
Erpetosuchus granti (Benton and Walker 2002: fig. 2a): 0.47
Erythrosuchus africanus (BP/1/5207): 0.52
Dimorphodon (Padian 1983: fig. 5d): 0.72
Dinocephalosaurus orientalis (Rieppel et al. 2008: fig. 2): 0.60
Euparkeria (SAM-PK-5867): 0.47
Fugusuchus (Cheng 1980: fig. 22): 0.43
Garjainia prima (PIN 2394/5): 0.55
Gephyrosaurus (Evans 1980: fig. 1): 0.36
Gracilisuchus (MCZ 4117): 0.51
Gualosuchus reigi (PULR 05): 0.57
Gualosuchus reigi (PVL 4576): 0.55
Herrerasaurus (PVSJ 407): 0.57
Heterodontosaurus (AM unnumbered): 0.39
Heterodontosaurus (SAM-PK-K337): 0.38
Heterodontosaurus (SAM-PK-K1332): 0.37
Isalorhynchus genovefae (Whatley 2005: fig. 1-7): ca. 0.29
Jesairosaurus lehmani (ZAR 06): ca. 0.47
Lotosaurus adentus (IVPP V4880, V4881): ca. 0.48
Macrocnemus bessanii (PIMUZ T4822): 0.56
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): 0.56
Mesosuchus (Dilkes 1998: fig. 2c): 0.29
Nicrosaurus kapffi (SMNS 4379: Hungerbühler 1998: table 2.2.1): 0.73
Nicrosaurus kapffi (SMNS 4378: Hungerbühler 1998: table 2.2.1): 0.70
Nicrosaurus kapffi (SMNS 5727: Hungerbühler 1998: table 2.2.1): 0.70
Nicrosaurus kapffi (SMNS 5726: Hungerbühler 1998: table 2.2.1): 0.72
Ornithosuchus (Sereno 1991: fig. 11a): 0.56
Parasuchus hislopi (ISI R42): 0.76

Petrolacosaurus (Reisz 1981: fig. 2): 0.35
Planocephalosaurus (Fraser 1982: fig. 1a): 0.35
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 0.56
Prolacerta (BP/1/471): 0.45
Prolacerta (SAM-PK-K10797): 0.45
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: fig. 4): 0.59
Proterochampsia barrionuevoi (PVL 2063): 0.62
Proterochampsia barrionuevoi (PVSJ 606): 0.58
Proterochampsia nodosa (MCP 1694-Pv): 0.61
Proterosuchus goweri (NMQR 880): 0.51
Proterosuchus fergusi (RC 846): 0.50
Proterosuchus fergusi (SAM-PK-11208): 0.51
Protorosaurus (USNM 442453, cast of NMK S 180): 0.56
Pseudochampsia ischigualastensis (PVSJ 567): 0.50
Qianosuchus mixtus (Li et al. 2006: fig. 2a): 0.64
Rhynchosaurus articeps (SHYMS 3): ca. 0.34
Riojasuchus tenuisiceps (PVL 3827): 0.50
Shansisuchus (Wang et al. 2013: fig. 2c): 0.49
Simodinosaur lemoinei (Russell-Sigogneau and Russell 1978: fig. 1): 0.39
Smilosuchus gregorii (UCMP 27200): 0.70
Smilosuchus adamanensis (Camp 1930: fig. 11a): 0.72
Smilosuchus lithodendrorum (Camp 1930: fig. 11c): 0.70
Stenaulorhynchus stockelyi (GPIT/RE/7192): 0.32
Tanystropheus longobardicus (Wild 1973: fig. 10b): 0.52
Tropidosuchus romeri (PVL 4601): 0.49
Turfanosuchus dabanensis (IVPP V3237): ca. 0.50
Vancleavea campi (USNM 508579 cast of GR 138): 0.30–0.34
Yonghesuchus sangbiensis (IVPP V 12378): 0.48
Youngina (GHG K 106): 0.49
Youngosuchus sinensis (IVPP V3239): 0.59

Discretization by the cluster analysis: (1) 0.29–0.40, (2) 0.43–0.64; (3) 0.70–0.76.
 (5%=0.02).

Character 21:

Azendohsaurus madagaskarensis (Flynn et al. 2010: fig. 13a): 0.62
Batrachotomus kupferzellensis (Gower 1999: fig. 2a): 0.78
Bentonyx (BRSUG 27200): 0.49
Boreopricea (Tatarinov 1978: 1b): 0.48
Brasinorhynchus mariantensis (Schultz et al. 2016: fig. 3): ca. 0.56
Cerritosaurus binsfeldi (CA s/n): 0.39
Chanaresuchus bonapartei (MCZ 4037): 0.27
Chanaresuchus bonapartei (MCZ 4039): <0.22
Chanaresuchus bonapartei (PVL 4575): 0.15
Chanaresuchus bonapartei (PVL 4586): 0.21
“Chasmatosaurus” yuani (IVPP V4067): ca. 0.42

Decuriasuchus quartacolonina (França et al. 2013: fig. 2): 0.72
Dimorphodon (Padian 1983: fig. 5d): 0.63
Erpetosuchus granti (Benton and Walker 2002: fig. 2a): 0.42
Erythrosuchus (BP/1/5207): 0.52
Euparkeria (SAM-PK-5867): ca. 0.71
Garjainia prima (PIN 2394/5): 0.70
Gephyrosaurus (Evans 1980: fig. 1): 0.30
Gracilisuchus (MCZ 4117): ca. 0.54
Gualosuchus reigi (PULR 06): 0.26
Gualosuchus reigi (PVL 4576): 0.22
Herrerasaurus (PVSJ 407): 0.65
Heterodontosaurus (SAM-PK-K1332): 0.61
Lotosaurus adentus (IVPP V4880, V4881): 0.67
Macrocnemus bessanii (PIMUZ T4822): ca. 0.28
Mesosuchus (SAM-PK-6536): 0.50
Nicrosaurus kapffi (SMNS 4379: Hungerbühler 1998: fig. 2.10): 1.04
Ornithosuchus (Sereno 1991: fig. 11a): 0.52
Parasuchus hislopi (ISI R42): 0.39
Petrolacosaurus (Reisz 1981: fig. 2): 0.44
Planocephalosaurus (Fraser 1982: fig. 1a): 0.45
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 0.69
Prolacerta (BP/1/471): 0.42
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: fig. 5a, b): 0.38
Proterochampsia barrionuevoi (PVL 2063): 0.41
Proterochampsia nodosa (MCP 1694-Pv): 0.59
Proterosuchus fergusi (RC 846): 0.39
Proterosuchus goweri (NMQR 880): <0.44
Qianosuchus mixtus (Li et al. 2006: fig. 2a): 0.31
Rhynchosaurus articeps (SHYMS 1): ca. 0.44
Riojasuchus tenuisiceps (PVL 3827): 0.73
Shansisuchus (Wang et al. 2013: fig. 2b): 0.59
Smilosuchus gregorii (UCMP 27200): 0.65
Smilosuchus adamanensis (Camp 1930: fig. 11a): 0.72
Smilosuchus lithodendrorum (Camp 1930: fig. 11c): 0.74
Stenaulorhynchus stockelyi (GPIT/RE/7192): ca. 0.50
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 20a, TMM 31025-207): 0.80
Turfanosuchus dabanensis (IVPP V3237): ca. 0.57
Vancleavea campi (USNM 508579 cast of GR 138): ca. 0.50
Youngosuchus sinensis (IVPP V3239): 0.53

Discretization by the cluster analysis: (1) 0.15–0.30; (2) 0.38–0.53; (3) 0.59–0.80; (4) 1.04. (5%=0.04).

Character 28:

Aetosauroides scagliai (PVL 2059): >3.27
Archosaurus holotype (PIN 1100/55): 3.72

Asperoris (NHMUK PV R36615): 1.26
Azendohsaurus madagaskarensis (UA 8-7-98-284): 1.40
Azendohsaurus madagaskarensis (FMNH PR 2751): 1.25
Batrachotomus kupferzellensis (SMNS 52970): 1.51
Batrachotomus kupferzellensis (SMNS 80260): 1.83
Boreopricea (Tatarinov 1978: 1b): 2.73
Cerritosaurus binsfeldi (CA s/n): ca. 1.50
Chanaresuchus bonapartei (MCZ 4039): 3.18
Chanaresuchus bonapartei (MCZ 4037): 3.19
Chanaresuchus bonapartei (PVL 4586): 4.15
Chanaresuchus bonapartei (PVL 4575): 3.27
“*Chasmatosaurus*” *yuani* (IVPP V4067): 3.49
“*Chasmatosaurus*” *yuani* (IVPP V90002): 4.37
Chasmatosuchus vjushkovi (PIN 2394/4): 2.78
Cteniogenys sp. (NHMUK PV R11730): >3.91
Decuriasuchus quartacolonina (França et al. 2013: fig. 4b): 1.56
Decuriasuchus quartacolonina (França et al. 2013: fig. 4f): 1.61
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 5.68
Dimorphodon (NHMUK PV R41212-13): 4.68
Dinocephalosaurus orientalis (Li 2003: fig. 1): 3.00
Erpetosuchus granti (Benton and Walker 2002: fig. 2a): 3.36
Erythrosuchus (BP/1/5207): 1.50
Erythrosuchus (BP/1/4526): 1.65
Euparkeria (UMZC T692): 1.24
Euparkeria (SAM-PK-6047a): 1.24
Euparkeria (SAM-PK-13665): 1.66
Garjainia madiba (BP/1/6232N): 2.22
Garjainia madiba (BP/1/6232L): 2.83
Garjainia prima (PIN 2394/5): 1.82
Gephyrosaurus (Evans 1980: fig. 29): 1.49
Gracilisuchus (MCZ 4117): 1.93
Gualosuchus reigi (PULR 05): 3.40
Gualosuchus reigi (PVL 4576): 3.22
Herrerasaurus (PVSJ 407): 1.22
Heterodontosaurus (AM unnumbered): 1.86
Heterodontosaurus (SAM-PK-K337): 1.49
Heterodontosaurus (SAM-PK-K1332): 1.91
Lotosaurus adentus (IVPP V4880, V4881): 2.49
Macrocnemus bessanii (PIMUZ T4822): 3.24
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): 3.02
Mesosuchus (Dilkes 1998: fig. 7a): 1.39
Nicrosaurus kapffi (SMNS 4379; Hungerbühler 1998: fig. 2.10): 2.46
Ornithosuchus (NHMUK PV R2409): 3.20
Parasuchus hislopi (ISI R42): 8.89
Petrolacosaurus (Reisz 1981: fig. 2): 3.00
Planocephalosaurus (Fraser 1982: plate 70, fig. 1): 2.83
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 0.71

Prestosuchus chiniquensis (UFRGS-PV-0152-T): 1.14
Prolacerta (BP/1/471): 3.80
Prolacerta (BP/1/4504): 2.93
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: fig. 5a, b): 2.33
Proterosuchus fergusi (RC 59): 3.50
Proterosuchus fergusi (SAM-PK-K140): 2.39
Proterosuchus fergusi (SAM-PK-11208): 3.19
Proterosuchus fergusi (BP/1/3993): 3.03
Proterosuchus fergusi (TM 201): 3.03
Proterosuchus goweri (NMQR 880): ca. 3.64
Protorosaurus (USNM 442453, cast of NMK S 180): 2.59
Pseudochampsia ischigualastensis (PVSJ 567): 3.10
Qianosuchus mixtus (Li et al. 2006: fig. 2a): 3.47
Riojasuchus tenuisiceps (PVL 3827): 2.50
Sarmatosuchus (PIN 2865/68): 2.29
Shansisuchus shansisuchus (Young 1964: figs. 8, 9): 1.07–1.33
Shansisuchus shansisuchus (Wang et al. 2013: fig. 2c): 1.30
Shansisuchus kuyeheensis (Cheng 1980: fig. 24): ca. 1.57
Silesaurus opolensis (ZPAL AbIII/361/34): 2.00
Smilosuchus gregorii (UCMP 27200): 3.24
Smilosuchus adamanensis (Camp 1930: fig. 11a): 4.32
Smilosuchus lithodendrorum (Camp 1930: fig. 11c): 3.00
Tanystropheus longobardicus (Wild 1973: fig. 10b): 2.44
Trachelosaurus fischeri (University of Halle unnumbered): >3.74
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 20a, TMM 31025-207): 2.58
Turfanosuchus dabanensis (IVPP V3237): 1.69
Xilousuchus sapingensis (Nesbitt et al. 2011: fig. 3a): 1.67
Vancleavea campi (USNM 508579 cast of GR 138): 1.75
Youngina (SAM-PK-K7578): 2.00
Yonghesuchus sangbiensis (IVPP V 12378): 1.85
Youngosuchus sinensis (IVPP V3239): 1.44

Discretization by the cluster analysis: (1) 0.70–0.73; (2) 1.07–2.00; (3) 2.22–3.80; (4) 4.15–4.68. (5%)=0.20).

Character 50:

Aetosauroides scagliai (PVL 2059): <0.62
Batrachotomus kupferzellensis (SMNS 52970): <0.41
Cerritosaurus binsfeldi (CA s/n): 0.76
Chalishevia (PIN 4366/1): <0.47
Chanaresuchus bonapartei (MCZ 4039): 0.49
Chanaresuchus bonapartei (MCZ 4037): 0.65
Chanaresuchus bonapartei (PVL 4586): 0.51
Chanaresuchus bonapartei (PVL 4575): 0.47
“Chasmatosaurus” yuani (IVPP V4067): 0.36
Decuriasuchus quartacolonía (França et al. 2013: fig. 5f): 0.30

Decuriasuchus quartacolonias (França et al. 2013: fig. 5a): 0.32
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 0.52
Dimorphodon (NHMUK PV R41212-13): 0.54
Erpetosuchus granti (Benton and Walker 2002: fig. 2a, c): 0.29
Erpetosuchus sp. (Olsen et al. 2000: fig. 2): 0.51
Erythrosuchus (BP/1/5207): 0.43
Euparkeria (SAM-PK-5867): 0.22
Euparkeria (SAM-PK-6047a): 0.17
Euparkeria (SAM-PK-13665): 0.16
Fugusuchus (GMB V313 unpublished picture): >0.33
Garjainia prima (PIN 2394/5): 0.35
Gracilisuchus (MCZ 4117): 0.12
Gualosuchus reigi (PULR 05): 0.53
Gualosuchus reigi (PVL 4576): 0.58
Guchengosuchus (IVPP V8808-1): 0.36
Herrerasaurus (PVSJ 407): 0.42
Heterodontosaurus (SAM-PK-K1332): 0.47
Jaxtasuchus salomoni (SMNS 91083): 0.60
Kalisuchus (QM F8998): <0.37
Lewisuchus (PULR 01): <0.35
Marasuchus lilloensis (PVL 3870): <0.41
Nicrosaurus kapffi (SMNS 4379: Hungerbühler 1998: fig. 2.10): 0.56
Ornithosuchus (Sereni 1991: fig. 11a): 0.35
Parasuchus hislopi (ISI R42): 0.64
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.38
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 0.43
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: figs. 4, 5): 0.73
Proterosuchus alexanderi (NMQR 1484): 0.43
Proterosuchus fergusi (BP/1/3993): 0.39
Proterosuchus fergusi (BSPG 1934 VIII 514): 0.33
Proterosuchus fergusi (GHG 231): 0.32
Proterosuchus fergusi (RC 59): 0.34
Proterosuchus fergusi (RC 846): 0.36
Proterosuchus fergusi (SAM-PK-11208): 0.35
Proterosuchus fergusi (SAM-PK-K140): 0.36
Proterosuchus goweri (NMQR 880): 0.31
Pseudochampsia ischigualastensis (PVSJ 567): 0.67
Qianosuchus mixtus (Li et al. 2006: fig. 2a): 0.46
Rhadinosuchus gracilis (BSPG AS XXV 50): 0.52
Riojasuchus tenuisiceps (PVL 3827): 0.39
Shansisuchus shansisuchus (Wang et al. 2013: fig. 2a): 0.36
Silesaurus opolensis (ZPAL AbIII/361/26, 1218): ca. 0.29
Smilosuchus gregorii (UCMP 27200): 0.54
Smilosuchus adamanensis (Camp 1930: fig. 11a): 0.47
Smilosuchus lithodendrorum (Camp 1930: fig. 11c): 0.48
Tasmaniosaurus (UTGD 54655): >0.29
Tropidosuchus romeri (PVL 4606): 0.39

Turfanosuchus dabanensis (IVPP V3237): ca. 0.19
Xilousuchus sapingensis (Nesbitt et al. 2011: fig. 3c): 0.32
Yonghesuchus sangbiensis (IVPP V 12378): 0.32
Youngosuchus sinensis (IVPP V3239): 0.34

Discretization by the cluster analysis: (1) 0.12–0.22; (2) 0.29–0.60; (3) 0.64–0.76.
(5%=0.03).

Character 55:

Aetosauroides scagliai (PVL 2052): 0.21
Aetosauroides scagliai (PVL 2059): 0.18
Batrachotomus kupferzellensis (Gower 1999: fig. 2a): 0.17
Cerritosaurus binsfeldi (CA s/n): 0.28
Decuriasuchus quartacolonias (França et al. 2013: fig. 2): 0.55
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 0.06
Dimorphodon (NHMUK PV R41212-13): 0.11
Dyoplax arenaceous (SMNS 4760): 0.41
Erpetosuchus granti (Benton and Walker 2002: fig. 2a): 0.23
Erpetosuchus sp. (Olsen et al. 2000: fig. 2): 0.83
Erythrosuchus (BP/1/5207): 0.11
Euparkeria (SAM-PK-6047a): 0.10
Gracilisuchus (MCZ 4117): 0.23
Herrerasaurus (PVSJ 407): 0.09
Heterodontosaurus (SAM-PK-K1332): 3.00
Lotosaurus adentus (IVPP V4880 o V4881): 0.34
Luperosuchus fractus (PULR 04): ca. 0.19
Ornithosuchus (Sereno 1991: fig. 11a): 0.43
Parasuchus angustifrons (BSPG 1931 X 502): 0.18
Parasuchus hislopi (ISI R42): 0.23
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 0.14
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: figs. 4): 0.90–0.94
Qianosuchus mixtus (Li et al. 2006: fig. 2a): 0.07
Riojasuchus tenuisiceps (PVL 3827): 0.51
Shansisuchus shansisuchus (Wang et al. 2013: fig. 2a): 0.18
Tropidosuchus romeri (PVL 4601): 0.18
Turfanosuchus dabanensis (IVPP V3237): 0.12
Venaticosuchus rusconii (PVL 2578): 0.53
Yonghesuchus sangbiensis (IVPP V 12378): 0.39

Discretization by the cluster analysis: (1) 0.06–0.23; (2) 0.28–0.53; (3) 0.83–0.94.
(5%=0.04). *Heterodontosaurus* was excluded from the cluster analysis because of a strongly reduced antorbital fenestra.

Character 75:

Acerosodontosaurus (Bickelmann et al. 2009; MNHN 1908-32-57): > 36
Aetosauroides scagliai (PVL 2059): ≥10
Amotosaurus (SMNS unnumbered): 25

Arizonasaurus babbitti (Nesbitt 2005: 25): 10–12
Asperoris (NHMUK PV R36615; Nesbitt et al. 2013a: 8): ≥ 10
Azendohsaurus madagaskarensis (Flynn et al. 2010: 676): 14
Batrachotomus kupferzellensis (Gower 1999: 15): 11
Boreopricea (Tatarinov 1978: 510): 33
Cerritosaurus binsfeldi (CA s/n): 10–14
Chalishevia (PIN 4366/1): 12–13
Chanaresuchus bonapartei (Romer 1971a: 13): 18
“*Chasmatosaurus ultimus*” (IVPP V2301): 13–14
“*Chasmatosaurus*” *yuani* (IVPP V2719): 29
Decuriasuchus quartacolonina (França et al. 2013): 17
Diandongosuchus fuyuanensis (Li et al. 2012: 1070): 15
Dimorphodon (NHMUK PV R41212-13): 8
Doswellia kaltenbachii (USNM 186989, based on the dentary tooth count): > 25
Erpetosuchus granti (Benton and Walker 2002): 4
Erpetosuchus sp. (Olsen et al. 2000): 5/6
Erythrosuchus (BP/1/5207): 11
Euparkeria (Ewer 1965): 13
Fugusuchus (Cheng 1980: fig. 22): 17–18
Garjainia prima (PIN 2394/5): 13–14
Gephyrosaurus (Evans 1980: 225): 40
GHG 7433MI: 8–10
Gracilisuchus (MCZ 4117): 15
Gualosuchus reigi (PULR 05): 14
Gualosuchus reigi (PVL 4576): 14
Guchengosuchus (IVPP V8808-1): 14
Herrerasaurus (PVSJ 407): 17–18
Heterodontosaurus (AM unnumbered): 12
Heterodontosuarus (AM 4765): 13
Jaxtasuchus salomoni (SMNS 91083): 16
Jesairosaurus lehmani (ZAR 06): ca. 20–21
Kalisuchus (QM F8998): ≥ 14
Lewisuchus (PULR 01): 20
Macrocnemus bessanii (PIMUZ T4355): 26
“*Mandasuchus tanyauchen*” (NHMUK PV R36889): ca. 12–14
Marasuchus lilloensis (PVL 3870): ca. 12
Nicrosaurus kapffi (SMNS 5727: Hungerbühler 2000: table 1): 19–21
Ornithosuchus (NHMUK PV R2409): 9
Parasuchus angustifrons (BSPG 1931 X 502): 16–17
Pamelaria dolichotrachelos (ISI R316/1, based on maxillary and dentary tooth counts): ca. 12–18
Parasuchus hislopi (ISI R42): 21–22
Petrolacosaurus (Reisz 1981: 12): 35
Planocephalosaurus (Fraser 1982: 714): 17
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 11
Prolacerta (Modesto and Sues, 2004): 24–25
Prolacertoides jimusarensis (IVPP V3233): ca. 19
Proterochampsia barrionuevoi (MACN-Pv 18165): 12
Proterochampsia nodosa (MCP 1694-Pv): 10
Proterosuchus alexanderi (NMQR 1484): 27

“Proterosuchus fergusi” (SAM-PK-591): >20
Proterosuchus fergusi (RC 846): 31
Proterosuchus goweri (NMQR 880): 29
Protorosaurus (Gottmann-Quesada and Sander 2009: 141): 28 ± 1
Pseudochampsia ischigualastensis (PVSJ 567): ≥ 15 (but lower than 30)
Qianosuchus mixtus (Li et al. 2006: fig. 2b): 2.53
Riojasuchus tenuisiceps (PVL 3827): 8
Sarmatosuchus (PIN 2865/68, based on the dentary tooth count): ca. <18
Shansisuchus (Young 1964; Wang et al., 2013): 10–13
Silesaurus opolensis (Dzik 2003: 561): 11
Smilosuchus gregorii (UCMP 27200): 21
Smilosuchus adamanensis (Camp 1930: 41): 23
Smilosuchus lithodendrorum (Camp 1930: fig. 48): 21–22
Tanystropheus longobardicus (Wild 1973: table 2): 14
Tarjadia ruthae (CRILAR-Pv 495): 6
Tasmaniosaurus (UTGD 54655): >21
Trilophosaurus buettneri (Spielmann et al. 2008: 27): 13
Tropidosuchus romeri (PVL 4606): ca. 12–13
Turfanosuchus dabanensis (IVPP V3237): ca. ≥ 13
Uralosaurus magnus (PIN 2973/71, based on dentary tooth count): <14
Vancleavea campi (Nesbitt et al. 2009: 820): 13
Xilousuchus sapingensis (Nesbitt et al. 2011: 272): 15
Youngina (Gow 1975: 91): ca. 30
Youngosuchus sinensis (IVPP V3239): 11

Character 76:

Aetosauroides scagliai (PVL 2059): >1.57
Bentonyx (BRSUG 27200): 1.06
Boreopricea (Tatarinov 1978: fig. 1a; Benton and Allen 1997): <0.94
Brasinorhynchus mariantensis (Schultz et al. 2016: fig. 3): 0.90
Chanaresuchus bonapartei (MCZ 4039): 1.46
Chanaresuchus bonapartei (MCZ 4037): 1.19
Chanaresuchus bonapartei (PVL 4586): 1.45
“Chasmatosaurus” yuani (IVPP V4067): 2.58
Decuriasuchus quartacolonina (França et al. 2013: fig. 6b): 1.79
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 2.59
Erpetosuchus granti (Benton and Walker 2002: fig. 2b): 2.19
Erythrosuchus (BP/1/5207): 1.42
Euparkeria (SAM-PK-13665): 1.26
Garjainia prima (PIN 2394/5): ca. 2.75
Gephyrosaurus (Evans 1980: fig. 1): 0.77
 GHG 7433MI: >1.81
Gracilisuchus (MCZ 4117): ca. 1.35
Gualosuchus reigi (PULR 05): 1.84
Gualosuchus reigi (PVL 4576): 2.04
Heterodontosaurus (Norman et al. 2011: fig. 12): 1.36
Luperosuchus fractus (PULR 04): 1.66
Mesosuchus (SAM-PK-6536): 0.79
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): ca. 1.13

Nicrosaurus kapffi (SMNS 5276: Hungerbühler 1998: fig. 2.15): 2.26
Ornithosuchus (Sereno 1991: fig. 11a): 1.36
Parasuchus hislopi (ISI R42): 1.79
Petrolacosaurus (Reisz 1981: fig. 3): 0.68
Planocephalosaurus (Fraser 1982: fig. 1c): 0.68
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 3.08
Prolacerta (SAM-PK-K10797): 1.14
Proterochampsa barrionuevoi (Dilkes and Arcucci 2012: fig. 4b): >2.05
Proterochampsa nodosa (MCP 1694-Pv): >2.27
Proterosuchus alexanderi (NMQR 1484): >1.44
Proterosuchus fergusi (BP/1/3993): 3.09
Proterosuchus fergusi (GHG 231): 2.66
Proterosuchus fergusi (RC 846): 2.78
Protorosaurus speneri (USNM 442453, cast of cast of NMK S 180): 1.84
Pseudochampsa ischigualastensis (PVSJ 567): ca. 2.46
Riojasuchus tenuisiceps (PVL 3827): 2.07
Rhynchosaurus articeps (NHMUK PV R1236): 1.00
Shansisuchus shansisuchus (Wang et al. 2013: fig. 3b): 2.38
Simoedosaurus lemoinei (Russell-Sigogneau and Russell 1978: fig. 1): 1.26
Smilosuchus lithodendrorum (Camp 1930: fig. 2a): 1.05
Stenaulorhynchus stockelyi (GPIT/RE/7192): 1.33
Tanystropheus longobardicus (Wild 1973: fig. 9a): 1.85
Tarjadia ruthae (CRILAR-Pv 495): 1.83
Turfanosuchus dabanensis (IVPP V3237): slightly >1.45
Vancleavea campi (USNM 508579 cast of GR 138): 0.79
Youngina (GHG K 106): 0.92
Youngosuchus sinensis (IVPP V3239): 2.96

Discretization by the cluster analysis: (1) 0.68–0.79; (2) 0.90–1.46; (3) 1.78–1.91; (4) 2.04–2.07; (5) 2.26–2.78; (6) 2.96–3.09. (5%=0.12). The character was discretized in three states: (1) 0.68–0.79; (2) 0.90–2.07; (3) 2.26–3.09.

Character 100:

Acerosodontosaurus (MNHN 1908-32-57): 1.27
Amotosaurus (SMNS 90601): <1.50
Arizonasaurus babbitti (Nesbitt 2005: fig. 9a): >2.54
Azendohsaurus madagaskarensis (Flynn et al. 2010: fig. 13a): 1.59
Batrachotomus kupferzellensis (SMNS 52970): >2.58
Boreopricea (Tatarinov 1978: fig. 1b): 0.49
Cerritosaurus binsfeldi (CA s/n): 2.87
Chanaresuchus bonapartei (PVL 4586): 2.84
Chanaresuchus bonapartei (MCZ 4039): 2.68
“Chasmatosaurus” yuani (IVPP V4067): 5.37
Cteniogenys sp. (NHMUK PV R11735): 1.76
Cuyosuchus (MCNAM 2669): >4.29
Decuriasuchus quartacolonina (França et al. 2013: fig. 3b): 2.82
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 1.72
Erpetosuchus granti (NHMUK PV R3139): 2.72
Erpetosuchus sp. (Olsen et al 2000: fig. 2): 4.53

Erythrosuchus (BP/1/5207): 3.32
Euparkeria (SAM-PK-6047a): 3.17
Fodonyx spenceri (EXEMS 60/1985.292): 1.25
Fugusuchus (Cheng 1980: fig. 22): 3.19
Garjainia madiba (BP/1/5760): 3.76
Garjainia prima (PIN 2394/5): 3.77
Gephyrosaurus (Evans 1980: fig. 14a): 1.81
Gracilisuchus (PULR 08): 3.64
Gracilisuchus (MCZ 4117): 2.23
Gualosuchus reigi (PULR 05): 2.90
Gualosuchus reigi (PVL 4576): 1.83
Herrerasaurus (PVSJ 407): 2.17
Heterodontosaurus (AM unnumbered): 0.85
Heterodontosaurus (SAM-PK-K337): 0.94
Isalorhynchus genovefae (Whatley 2005: fig. 1-7): 2.26
Jesairosaurus lehmani (ZAR 08): ca. 2.60
Lewisuchus (PULR 01): 3.64
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): 1.72
Mesosuchus (SAM-PK-6536): 2.95
Nicrosaurus kapffi (NHMUK PV R42743): 4.91
Ornithosuchus longidens (NHMUK PV R3562): >3.42
Parasuchus angustifrons (BSPG 1931 X 502): 4.75
Parasuchus hislopi (ISI R43): 4.24
Petrolacosaurus (Reisz 1981: fig. 2): 0.62
Planocephalosaurus (Fraser 1982: figs. 2a, 3b): 3.45–3.48
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 3.07
Prolacerta (BP/1/5375): 2.64
Prolacerta (SAM-PK-K10797): 2.07
Prolacerta (Modesto and Sues 2004: fig. 8a, BP/1/3575): 3.11
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: fig. 5d): 1.91
“*Proterosuchus fergusi*” (SAM-PK-591): >1.35
Proterosuchus alexanderi (NMQR 1484): 4.07
Proterosuchus goweri (NMQR 880): ca. 4.32
Proterosuchus fergusi (RC 846): 4.51
Protorosaurus (USNM 442453, cast of cast of NMK S 180): 0.70
Pseudochampsia ischigualastensis (PVSJ 567): 2.85
Qianosuchus mixtus (Li et al. 2006: fig. 2b): 1.90
Rhynchosaurus articeps (NHMUK PV R1236): 2.15
Riojasuchus tenuisiceps (PVL 3827): 2.27
Eohyosaurus wolvaardti (SAM-PK-K10159): 2.46
Sarmatosuchus (PIN 2865/68): >2.96
Shansisuchus shansisuchus (Young 1964: fig. 12c): 2.48
Silesaurus opolensis (ZPAL AbIII/1930): >1.70
Simoedosaurus lemoinei (Russell-Sigogneau and Russell 1978: fig. 10): 3.25
Smilosuchus gregorii (Camp 1930: fig. 11b): 4.15
Smilosuchus adamanensis (Camp 1930: fig. 11a): 3.45
Smilosuchus lithodendrorum (Camp 1930: fig. 11c): 4.40
Stenaulorhynchus stockelyi (NHMUK PV R2270): 1.27
Stenaulorhynchus stockelyi (NHMUK PV R36840): 0.98
Tanystropheus longobardicus (PIMUZ T2189): 1.78

Tarjadia ruthae (CRILAR-Pv 478): 2.32
Tropidosuchus romeri (PVL 4606): 4.1
Turfanosuchus dabanensis (IVPP V3237): ca. 3.55
Vancleavea campi (USNM 508579 cast of GR 138): 2.37
Yonghesuchus sangbiensis (IVPP V 12378): 4.81
Youngina (Gow 1975: fig. 5): 2.43
Youngosuchus sinensis (IVPP V3239): 2.69

Discretization by the cluster analysis: (1) 0.49–1.27; (2) 1.59–3.77; (3) 4.07–5.37.
(5%=0.24).

Character 177:

Aetosaurus ferratus (Schoch 2007: fig. 4b): 107.7°
Azendohsaurus madagaskarensis (UA 7-20-99-653): 108°
Batrachotomus kupferzellensis (SMNS 52970): 133°
Boreopricea (Tatarinov 1978: fig. 1b): 118°
Brasinorhynchus mariantensis (Schultz et al. 2016: fig. 4): 115°
Cerritosaurus binsfeldi (CA s/n): 150°
Chanaresuchus bonapartei (MCZ 4039): 132°
Chanaresuchus bonapartei (PVL 4586): 136°
Chanaresuchus bonapartei (PVL 4575): 134°
“*Chasmatosaurus*” *yuani* (IVPP V4067): 155°
Cteniogenys sp. (NHMUK PV R11753): 150°
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 81°
Doswellia kaltenbachii (USNM 214823): 117°
Erythrosuchus (BP/1/5207): 128°
Euparkeria (SAM-PK-6047a): 129°
Fodonyx spenceri (EXEMS 60/1985.292): 110°
Garjainia prima (PIN 2394/5): 136°
Gephyrosaurus (Evans 1980: fig. 17d): 91°
Gracilisuchus (MCZ 4117): 158°
Gualosuchus (PVL 4576): 130°
Howesia (SAM-PK-5885): 108°
Herrerasaurus (PVSJ 407): 148°
Heterodontosaurus (SAM-PK-K337): 112°
Jesairosaurus lehmani (ZAR 06): 130°
Lewisuchus (PULR 01): 125°
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): 95°
Marasuchus lilloensis (Bonaparte 1975: fig. 3): 110°
Mesosuchus (SAM-PK-6536): 116°
Nicrosaurus kapffi (SMNS 4379: Hungerbühler 1998: fig. 2.10): 133°
Ornithosuchus (NHMUK PV R2409): ca. 140°
Parasuchus angustifrons (BSPG 1931 X 502): 123°
Paliguana (AM 3585): 110°
Pamelaria dolichotrachelos (ISI R316/1): 135°
Parasuchus hislopi (ISI R43): 110°
Planocephalosaurus (Fraser 1982: fig. 1a): 129°
Prestosuchus chiniquensis (UFRGS-PV-0156-T): 96°
Prolacerta (BP/1/471): 95°

Prolacerta (BP/1/2675): 126°
Prolacerta (BP/1/4504a): 107°
Prolacerta (BP/1/5375): 92°
Prolacerta (GHG 431): 114°
Prolacerta (SAM-PK-K10018): 136°
Prolacerta (SAM-PK-K10797): 106°
Proterosuchus alexanderi (NMQR 1484): 149°
Proterosuchus fergusi (BP/1/4016): 124°
Proterosuchus fergusi (SAM-PK-K140): 122°
Proterosuchus fergusi (SAM-PK-11208): 125°
Proterosuchus fergusi (RC 846): 126°
Proterosuchus fergusi (BSPG 1934 VIII 514): 120°
Proterosuchus fergusi (GHG 231): 126°
Proterosuchus goweri (NMQR 880): 149°
Protorosaurus (USNM 442453, cast of cast of NMK S 180): 137°
Qianosuchus mixtus (Li et al. 2006: fig. 2b): 94°
Riojasuchus tenuisiceps (PVL 3827): 132°
Eohyosaurus wolvaardti (SAM-PK-K10159): 128°
Sarmatosuchus (PIN 2865/68): 121°
Shansisuchus shansisuchus (Young 1964: fig. 13a): 130°
Silesaurus opolensis (ZPAL AbIII/1930): 135°
Smilosuchus gregorii (UCMP 27200): 123°
Smilosuchus adamanensis (Camp 1930: fig. 11a): 135°
Smilosuchus lithodendrorum (Camp 1930: fig. 11c): 137°
Stagonolepis robertsoni (Walker 1961: fig.4c): 107°
Tanystropheus longobardicus (Nosotti 2007: fig. 43, PIMUZ T2484): 95°
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 18a): 108°
Tropidosuchus romeri (PVL 4601): 126°
Tropidosuchus romeri (PVL 4606): 143°
Turfanosuchus dabanensis (IVPP V3237): 108°
Vancleavea campi (USNM 508579, cast of GR 138): 44°
Youngina (SAM-PK-K6205): 131°
Youngosuchus (IVPP V3239): 134°

Discretization by the cluster analysis: (1) 41–47°; (2) 91–97°; (3) 106–137°; (4) 143–158°. (5%=5.7).

Character 263:

Aetosaurus ferratus (Schoch 2007: fig. 9b) 0.77
Batrachotomus kupferzellensis (Gower 1999: fig. 18a): 0.36
Cerritosaurus binsfeldi (CA s/n): >0.39
Chanaresuchus bonapartei (PVL 4586): 0.51
Decuriasuchus quartacolonina (França et al. 2013: fig. 2): 0.20
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 2, 3): 0.36
Erpetosuchus granti (NHMUK PV R3139): 0.62
Erythrosuchus (BP/1/5207): 0.48
Euparkeria (BP/1/5867): ca. 0.32
Garjainia prima (PIN 2394/5): ca. 0.20
Gracilisuchus (MCZ 4118): 0.21

Gualosuchus (PVL 4576): 0.71
Herrerasaurus (PVSJ 407): 0.53
Heterodontosaurus (SAM-PK-K1332): 0.16
Lotosaurus adentus (Holliday and Nesbitt 2013: fig. 6a): 0.78
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): 0.26
Nicrosaurus kapffi (NHMUK PV R42744: Hungerbühler 1998: fig. 2.26b): 0.51
Parasuchus hislopi (ISI R42): 0.33
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.28
Proterochampsia nodosa (MCP 1694-Pv): 0.29
Proterosuchus alexanderi (NMQR 1484): 0.11
Proterosuchus fergusi (RC 59): 0.17
Proterosuchus fergusi (RC 846): 0.07
Proterosuchus fergusi (SAM-PK-11208): 0.13
Qianosuchus mixtus (Li et al. 2006: fig. 2b): 0.13
Riojasuchus tenuisiceps (PVL 3827): 0.88
Silesaurus opolensis (ZPAL AbIII/1930): 0.24
Smilosuchus gregorii (UCMP 27200): 0.44
Stagonolepis robertsoni (Walker 1961: fig. 2c) 0.93
Tarjadia ruthae (CRILAR-Pv 478): 0.26
Tropidosuchus romeri (PVL 4601): 0.47
Turfanosuchus dabanensis (IVPP V3237): ca. 0.20
Venaticosuchus rusconii (PVL 2578): 0.91–0.94
Yonghesuchus sangbiensis (IVPP V 12378): 0.31
Youngosuchus (IVPP V3239): 0.18

Discretization by the cluster analysis: (1) 0.07–0.36; (2) 0.44–0.53; (3) 0.62–0.78; (4) 0.88–0.94. (5% = 0.04).

Character 266:

Aetosauroides (PVL 2059): <0.09
Arizonasaurus babbitti (Nesbitt 2005: fig. 13): ca. 0.17
Azendohsaurus (FMNH PR 2751): 0.24
Batrachotomus (SMNS 80260): ca. 0.18
Chanaresuchus bonapartei (PVL 4575): 0.09
Chanaresuchus bonapartei (PVL 4586): 0.08
“Chasmatosaurus ultimus” (IVPP V2301): <0.14
“Chasmatosaurus” yuani (IVPP V90002): 0.16
Dimorphodon (NHMUK PV R41212-13): 0.11
Dinocephalosaurus orientalis (Li 2003: fig. 1): 0.05
Doswellia kaltenbachii (USNM 186989): 0.09
Erpetosuchus granti (NHMUK PV R3139): 0.14
Euparkeria (SAM-PK-K8309): 0.16
Fuyuanosaurus acutirostris (Fraser et al. 2013: fig. 2): <0.09
Garjainia madiba (BP/1/7153): 0.26
Garjainia prima (PIN 2394/5-8, 5-9): ca. 0.22
Garjainia prima (PIN 951/30): 0.24
Gephyrosaurus (Evans 1980: fig. 41a): 0.11
Gualosuchus (PVL 4576): 0.12
Herrerasaurus (MACN-Pv 18060): 0.19

Herrerasaurus (PVSJ 53): 0.24
Heterodontosaurus (AM unnumbered): 0.22
Heterodontosaurus (SAM-PK-K1332): 0.23
Isalorhynchus genovefae (Whatley 2005: fig. 1-7): 0.22
Langeronyx brodiei (WARMS G6097/2): 0.32
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 2): 0.07
Nicrosaurus kapffi (NHMUK PV R42744): 0.05
Nundasuchus (Nesbitt et al. 2014: fig. 3a): <0.19
 Otter Sandstone archosaur (SIDMM G 1 2010): <0.17
Pamelaria dolichotrachelos (ISI R316/1): 0.18
Parasuchus hislopi (ISI R42): 0.05
Petrolacosaurus (Reisz 1981: fig. 12): 0.10
Planocephalosaurus (Fraser 1982: plate 70, fig. 2): 0.23
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.22
Prolacerta (BP/1/471): 0.08
Proterosuchus alexanderi (NMQR 1484): 0.12
Proterosuchus fergusi (RC 846): 0.17
Proterosuchus fergusi (BSPG 1934 VIII 514): 0.13
Rhadinosuchus (BSPG AS XXV 50): 0.08
Riojasuchus (PVL 3827): 0.36
Sarmatosuchus (PIN 2865/68-11): 0.22
Shansisuchus shansisuchus (Young 1964: fig. 17c): 0.22
Silesaurus (ZPAL AbIII/437/1): 0.16
Silesaurus (ZPAL AbIII/1930): 0.18
Simoedosaurus lemoinei (MNHN.F.R4014): 0.07
Smilosuchus gregorii (UCMP 27200): 0.08
Tanystropheus (Nosotti 2007: fig. 49): 0.11
Trilophosaurus (Spielmann et al. 2008: fig. 28b): 0.29
Turfanosuchus dabanensis (IVPP V3237): 0.09
Uralosaurus (PIN 2973/1): ca. 0.27
Vancleavea campi (USNM 508579, cast of GR 138): 0.35
Xilousuchus sapingensis (Nesbitt et al. 2011: fig. 6a): 0.12
Youngosuchus (Young 1973: fig. 1, 2): 0.23

Discretization by the cluster analysis: (1) 0.05–0.14; (2) 0.16–0.19; (3) 0.22–0.29; (4) 0.32–0.36. (5%=0.015).

Character 331:

Aetosauroides scagliai (PVL 2059): 1.35
Aetosauroides scagliai (PVL 2091): 0.91
Amotosaurus (SMNS 50830): 6.09–6.80
Arizonasaurus babbitti (Nesbitt 2005: fig. 17a): 2.23
Augustaburiania vatagini (Sennikov 2011: table 1): 6.3–6.5
Azendohsaurus madagaskarensis (UA-7-20-99-653): 2.67–2.92
Batrachotomus kupferzellensis (SMNS 80288, middle cervical): 0.82
Batrachotomus kupferzellensis (MHI 1895, SMNS cast, fifth cervical): 0.97
Boreopricea (Benton and Allen 1997: fig. 6a, PIN 3708/1): 1.92–2.00
Chanaresuchus bonapartei (MCZ 4037): 1.03
Chasmatosuchus rossicus (PIN 3200/217): 1.62

Decuriasuchus quartacolonias (França et al. 2011: fig. 3a): 1.56–1.75
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 4a): 1.10
Dinocephalosaurus orientalis (Rieppel et al. 2008: fig. 7): 3.07–3.57
Doswellia kaltenbachii (Weems 1980: table 3): 2.46
Erpetosuchus granti (NHMUK PV R3139): 1.02–1.03
Eryrhtosuchus (BP/1/4680, Gower 2003: table 1): 0.63–0.72
Eryrhtosuchus (SAM-PK-K3028, Gower 2003: table 1): 0.70
Euparkeria (SAM-PK-5867): 1.45
Euparkeria (UMZC T692): 1.09–1.48
Gamosaurus (PIN 3361/13): 1.92
Garjainia madiba (BP/1/5360): 0.89
Garjainia prima (PIN 2394/5-12, 5-13): 1.07–1.11
Gephyrosaurus (Evans 1980: fig. 4): 1.20
Gracilisuchus (PULR 08): 1.76–1.95
Gracilisuchus (MCZ 4118): 1.41
Gualosuchus (PVL 4576): 1.16–1.24
Herrerasaurus (MACN-Pv 18060): 2.23–2.63
Herrerasaurus (PVSJ 373): 1.82
Heterodontosaurus (SAM-PK-K1332): 1.50–1.53
Jaxtasuchus salomoni (SMNS 91083): 2.98
Jesairosaurus lehmani (ZAR 07): <2.00
Lewisuchus (PULR 01): 2.31
Macrocnemus bessanii (PIMUZ T4822): 3.70–4.12
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 4): 3.64–3.90
“*Mandasuchus tanyauchen*” (NHMUK PV R6793): 2.00–2.07
Marasuchus lilloensis (PVL 3870): 1.56–1.87
Marasuchus lilloensis (PVL 3872): 1.51–2.00
Mesosuchus (SAM-PK-5882, fourth cervical): 2.01
Nicrosaurus kapffi (SMNS 12671): 0.89
Nundasuchus (Nesbitt et al. 2014: fig. 4c): 0.87
Nyasasaurus parringtoni (Nesbitt et al. 2013b: fig. 1i): ca. 3.3–4.00
Pamelaria dolichotrachela (ISI R316): 3.77–3.98
Pamelaria dolichotrachela (ISI field number BI/33): 3.80–3.81
Parasuchus hislopi (ISI R42: fifth cervical): 0.87
Petrolacosaurus (Reisz 1981: fig. 14): 2.05–2.41
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 1.39
Prolacerta (BP/1/2675): 3.29–3.50
Protanystropheus antiquus (Sennikov 2011: fig. 6, anterior-middle postaxial cervical, if it is not Cv4 or Cv5 this elements may have been proportionally longer): ≥ 4.24
Proterochampsia barrionuevoi (Dilkes and Arcucci 2012: fig. 11c): 1.56
Proterosuchus alexanderi (NMQR 1484): 1.38–1.53
Proterosuchus fergusi (BP/1/3993): 1.73
Proterosuchus fergusi (SAM-PK-11208): 1.67
Protorosaurus (BSPG AS VII 1207; BSPG 1995 I 5, cast of WMsN P 47361): 3.12–3.24
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 2.08–2.30
Rhynchosaurus articeps (Benton 1990: fig. 8b): 1.81
Riojasuchus tenuisiceps (PVL 3827): 1.07–1.16
Sarmatosuchus (PIN 2865/68): 0.94–1.08
Shansisuchus kuyeheensis (Cheng 1980: fig. 25): 0.85
Shansisuchus shansisuchus (Wang et al. 2013: fig. 4a): 0.77

Silesaurus opolensis (ZPAL AbIII/361): 2.18–2.35
Simoesosaurus lemoinei (MNHN.F.BL9425): 0.88
Smilosuchus gregorii (Camp 1930: plate III): 0.75–0.77
Stagonosuchus nyassicus (GPIT/RE/3831): 0.98–1.18
Stenaulorhynchus stockleyi (Huene 1938: plate III, figs. 4a, 5a): 1.12–1.15
Tanystropheus longobardicus (PIMUZ T2818, fourth cervical): 14.25
Teleocrater rhadinus (NHMUK PV R6795): 3.79
Trachelosaurus fischeri (University of Halle unnumbered, anteriormost preserved cervical): ca. 3.69 (ca. because the position is indeterminate but likely an anterior cervical and there are no longer cervicals)
Trilophosaurus buettneri (Spielmann et al. 2008: appendix 10): 1.84–2.50
Tropidosuchus romeri (PVL 4601): 2.07–2.15
Xilousuchus sapingensis (Nesbitt et al. 2011: table 1): 2.00
Yarasuchus deccanensis (ISI R334): 2.05–3.10
Youngosuchus (IVPP V3239): 1.30

Discretization by the cluster analysis: (1) 0.63–2.67; (2) 2.92–4.12; (3) 6.09–6.80; (4) 14.16–14.33. (5%=0.17). *Amotosaurus* and *Tanystropheus* were not included in the cluster analysis and the 5% variation calculation.

Character 351:

Acerosodontosaurus (MNHN 1908-32-57): 1.71
Aenigmastropheus (UMZC T836): 1.35
Aetosauroides scagliai (PVL 2052): 0.92–0.93
Aetosauroides scagliai (PVL 2059): 1.28–1.34
Aetosauroides scagliai (PVL 2073): 1.10
Amotosaurus (SMNS 54784b): 1.93
Augustaburiania vatagini (Sennikov 2011: table 1): 1.6–1.9
Archeopelta arborensis (CPEZ-239a): 0.88
Asilisaurus kongwe (NMT specimen): 1.65
Azendohsaurus madagaskarensis (UA 8-26-98-250): 1.38
Azendohsaurus madagaskarensis (UA 8-26-98-265): 1.51
Batrachotomus kupferzellensis (SMNS 80309): 1.09
Batrachotomus kupferzellensis (SMNS 80296): 1.18
Bromsgroveia walkeria (Benton and Gower 1997: fig. 4e): 1.05
Boreopricea (PIN 3708/1): 1.56–1.67
Chalishevia (PIN 4188/98): 0.95
Chanaresuchus bonapartei (MCZ 4037): 1.04–1.19
Chanaresuchus bonapartei (PVL 4575): 1.60
“Chasmatosaurus” yuani (IVPP V2719): 1.18–1.30
Cteniogenys sp. (NHMUK PV R11787): 2.00
Cuyosuchus (MCNAM 2669): 1.25–1.39
“Dongusia colorata” (PIN 268/2): 1.10
Doswellia kaltenbachii (Weems 1980: table 4): 1.93–2.00
Eorasaurus olsoni (PIN 156/100): ca. 1.65
Erythrosuchus (NHMUK PV R3592 large, Gower 2003: table 1): 0.55
Erythrosuchus (BP/1/4680, Gower 2003: table 1): 0.48
Erythrosuchus (SAM-PK-Kun-no, Gower 2003: table 1): 0.45–0.60
Euparkeria (UMZC T692): 1.39–1.89

Fuyuanosaurus acutirostris (Fraser et al. 2013: fig. 4): 1.97
Halazhaisuchus qiaoensis (IVPP V6027-1): ca. 1.07
Herrerasaurus (PVSJ 373): 1.02–1.30
Hypselorhachis mirabilis (NHMUK PV R16586): 1.02
Jaxtasuchus salomoni (SMNS 91352): 1.66
Jesairosaurus lehmani (ZAR 10): 2.45
Garjainia madiba (BP/1/7135): 1.08
Garjainia prima (PIN 2394/5-14, 5-16): 0.80–0.96
Gracilisuchus (MCZ 4118): 1.48–1.50
Gualosuchus (PVL 4576): 0.95
Lewisuchus (PULR 01): 1.73–1.85
Macrocnemus bessanii (PIMUZ T2472): 1.40–1.53
Macrocnemus bessanii (PIMUZ T4355): 1.52–1.62
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 4): 1.81
“*Mandasuchus tanyauchen*” (NHMUK PV R6792): 1.25–1.45
“*Mandasuchus tanyauchen*” (NHMUK PV R6793): 1.19–1.27
Marasuchus lilloensis (PVL 3870): 1.90–2.19
Marasuchus lilloensis (PVL 3872): 1.32–1.71
Mesosuchus (SAM-PK-6046: second vertebra of the axial series): 1.26
Nicrosaurus kapffi (SMNS 12671): 0.89
Pamelaria dolichotrachela (ISI R316): 1.38–1.39
Pamelaria dolichotrachela (ISI field number BI/33): 1.64
Pamelaria dolichotrachela (ISI field number BI/53): 1.42–1.55
Parasuchus hislopi (ISI R42): 1.20
Petrolacosaurus (Reisz 1981: fig. 15a, b): 1.76
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.90–0.93
Prolacerta (BP/1/2675, first and second dorsals): 1.78
Proterosuchus alexanderi (NMQR 1484): 1.00
Proterosuchus fergusi (SAM-PK-K140): 0.96–1.01
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361; ZMR MB R2172): 1.70–1.73
Pseudochampsia ischigualastensis (PVSJ 567): 1.40
Qianosuchus mixtus (Li et al. 2006: fig. 1a): ca. 1.43
Rhynchosaurus articeps (SHYMS 2): 1.83
Riojasuchus tenuisiceps (PVL 3827): 0.84–0.92
Shansisuchus kuyeheensis (Cheng 1980: fig. 26): 1.00–1.10
Shansisuchus shansisuchus (Wang et al. 2013: fig. 4a): 0.72
Shansisuchus shansisuchus (Young 1964: fig. 23a-c): 0.68–0.84
Silesaurus opolensis (ZPAL AbIII/1302): 1.37
Simoedosaurus lemoinei (MNHN.F.BR12208): 1.23
Smilosuchus gregorii (UCMP 26699): 0.89–0.98
Spondylosoma absconditum (GPIT 479/30): 1.48
Stagonosuchus nyassicus (GPIT/RE/3831): 0.76
Stenaulorhynchus stockleyi (Huene 1938: plate III, figs. 11, 12): 1.06–1.09
Tanystropheus longobardicus (PIMUZ T2817, first to third dorsal): 2.39–2.74
Tasmaniosaurus (UTGD 54655, anterior-middle dorsal): 1.29
Teleocrater rhadinus (NHMUK PV R6795): 1.71–1.92
Ticinosuchus ferox (PIMUZ T2817): 1.23–1.44
Trilophosaurus buettneri (Spielmann et al. 2008: appendix 10, postaxial vertebrae 8–11): 1.23–1.79
Tropidosuchus romeri (PVL 4601, 12–13th presacral): 1.34–1.51

Vancleavea campi (Nesbitt et al. 2009: fig. 11b): 1.67
Yarasuchus deccanensis (ISI R334): 1.56–1.82
Youngina (BP/1/3859): 1.77–1.85

Discretization by the cluster analysis: (1) 0.45–1.10; (2) 1.18–2.00; (3) 2.19–2.74. (5%=0.11). In this case, the difference between ranges of the states (0) and (1) is lower than the variation of 5%, but it was discretized to capture the information provided by the anteroposteriorly short vertebrae of some erythrosuchids and suchians.

Character 352:

Acerosodontosaurus (MNHN 1908-32-57): 1.50
Aetosauroides scagliai (PVL 2073, dorsals 14–16): 1.38–1.54
Amotosaurus (SMNS 54783): 1.60–1.95
Archeopelta arborensis (CPEZ-239a): 1.31
Arizonasaurus babbitti (Nesbitt 2005: fig. 19f): 1.30
Azendohsaurus madagaskarensis (UA 8-29-98-325): 0.97
Azendohsaurus madagaskarensis (UA 7-20-99-654): 1.02
Azendohsaurus madagaskarensis (UA 8-27-98-270): 0.77
Batrachotomus kupferzellensis (SMNS 80300): 1.14
Chanaresuchus bonapartei (MCZ 4037): 1.23–1.35
“*Chasmatosaurus*” *yuani* (IVPP V2719): 1.28–1.31
Chasmatosuchus rossicus (PIN 3200/212): 1.16
Cteniogenys sp. (NHMUK PV R11788): 1.76
Cuyosuchus (MCNAM 2669): 1.18–1.21
Dimorphodon (NHMUK PV R41212-13): 1.38–1.48
Dinocephalosaurus orientalis (Rieppel et al. 2008: fig. 10): 1.02–1.07
Doswellia kaltenbachii (Weems 1980: table 4): 1.86–2.00
Erythrosuchus (NHMUK PV R3592 large, Gower 2003: table 1): 0.83
Erythrosuchus (NHMUK PV R3592 small, Gower 2003: table 1): 0.78
Erythrosuchus (SAM-PK-905, Gower 2003: table 1): 0.79
Euparkeria (SAM-PK-6047A): 1.26–1.48
Fuyuanosaurus acutirostris (Fraser et al. 2013: fig. 1): 1.85
Garjainia madiba (BP/1/6232aj): 1.00
Garjainia prima (Huene 1960: plate 13, figs. 13, 14): 1.00–1.23
Gephyrosaurus (Evans 1980: fig. 7): 2.39
Gracilisuchus (MCZ 4118): 1.30–1.39
Gualosuchus (PVL 4576): 1.39–1.49
Halazhaisuchus qiaoensis (IVPP V6027-2): 1.07–1.16
Herrerasaurus (MACN-Pv 18060): 0.85
Herrerasaurus (MCZ 7064): 0.66
Herrerasaurus (PVSJ 373): 0.85
Heterodontosaurus (AM unnumbered): 1.49–1.70
Howesia (SAM-PK-5886): 1.25–1.36
Isalorhynchus genovefae (Whatley 2005: fig. 1-15a): 1.59
Jesairosaurus lehmani (ZAR 12): 1.84–2.04
Jesairosaurus lehmani (ZAR 14): 1.27
Lagerpeton chanarensis (PVL 4625): 1.54–2.42
Lewisuchus (PULR 01): 2.03
Lotosaurus adentus (Zhang 1975: plate I): 1.09–1.21

Macrocnemus bessanii (PIMUZ T4822): 2.46
“Mandasuchus tanyauchen” (NHMUK PV R6792): 1.19–1.25
Marasuchus lilloensis (PVL 3870): 1.59–1.77
Mesosuchus (SAM-PK-6046): 1.18–1.38
Noteosuchus (AM 3591, ninth vertebra of preserved series): 1.39
Nundasuchus (Nesbitt et al. 2014: fig. 4o): 0.83–0.91
Ornithosuchus (Walker 1964: fig. 8j): 1.67
Pamelaria dolichotrachela (ISI field number BI/33): 1.63
Parasuchus hislopi (ISI R42): 1.19–1.29
Parringtonia gracilis (NHMUK PV R3139): 1.56
Petrolacosaurus (Reisz 1981: fig. 15e): 1.32–1.33
Planocephalosaurus (Fraser and Walkden 1984: fig. 7b): 1.96
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.87–0.93
Prolacerta (BP/1/2675, 20th presacral): 1.70
Proterochampsia barrionuevoi (Trotteyn 2011: fig. 5): 1.60
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361): 1.38
Pseudochampsia ischigualastensis (PVSJ 567): 1.73
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 1.19–1.35
Riojasuchus tenuisiceps (PVL 3827): 1.00–1.01
Sarmatosuchus (PIN 2865/68-23, 68-24): 0.87–0.94
Shansisuchus shansisuchus (Young 1964: fig. 23a-c): 1.07–1.26
Silesaurus opolensis (ZPAL AbIII/1832/1): 1.13
Simoedosaurus lemoinei (Sigogneau-Russell 1981: fig. 11c–e): 1.07–1.18
Smilosuchus gregorii (UCMP 26699): 0.85–0.94
Stenaulorhynchus stockleyi (Huene 1938: plate IV, figs. 24, 25): 0.89–1.11
Teleocrater rhadinus (NHMUK PV R6795): 1.29–1.31
Ticinosuchus ferox (PIMUZ T2817): 1.35–1.38
Trilophosaurus buettneri (Spielmann et al. 2008: appendix 10, presacral vertebrae 21–24): 1.36–1.79
Tropidosuchus romeri (PVL 4601, 21th presacral): 1.72
Yarasuchus deccanensis (ISI R334): 1.20
Youngina (BP/1/3859): 1.73

Discretization by the cluster analysis: (1) 0.66–1.39; (2) 1.48–1.86; (3) 1.95–2.04; (4) 2.39–2.46. (5%=0.09).

Character 377:

Aetosauroides scagliai (PVL 2052): >1.12
Amotosaurus (SMNS 90600): ca. 1.62
Azendohsaurus madagaskarensis (UA 8-25-98-220): 0.67
Azendohsaurus madagaskarensis (UA 8-29-97-169): 0.62
Chañares rhynchosaur (CRILAR-Pv 496): >0.87
Chanaresuchus bonapartei (PVL 4575): 1.68
“Chasmatosaurus” yuani (Young 1936: fig. 6): 2.20
Cuyosuchus (MCNAM 2669): 0.85–1.08
Doswellia kaltenbachii (USNM 244214): 2.72
Gracilisuchus (PVL 4597): 0.72–0.81
Herrerasaurus (PVL 2566: first caudal): 1.04
Isalorhynchus genovefae (Whatley 2005: fig. 1-16c): ca. 1.36

Jesairosaurus lehmani (ZAR 09): 0.79
Macrocnemus bessanii (PIMUZ T4355): ca. 1.64
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 6): 1.73
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 1.15
Marasuchus lilloensis (PVL 3871): ca. 0.65
Mesosuchus (SAM-PK-7416: first caudal): ca. 1.51
Noteosuchus (AM 3591, first and second caudal): 1.53–1.58
Parringtonia gracilis (NHMUK PV R3139): 0.67
Petrolacosaurus (Reisz 1981: fig. 15h, i): 2.46
Prolacerta (Gow 1975: fig. 22, 1st-2nd caudals): 0.80–1.01
Proterosuchus alexanderi (NMQR 1484): 0.71–0.89
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361): 0.35
Pseudochampsia ischigualastensis (PVSJ 567): 1.18
Silesaurus opolensis (Dzik 2003: fig. 12a): 0.92
Simoedosaurus lemoinei (MNHN.F.R2241): 1.20
Stagonosuchus nyassicus (GPIT/RE/3831, 3832): 1.05
Stenaulorhynchus stockleyi (Huene 1938: plate V, fig. 1b): >1.39
Tanystropheus longobardicus (Wild 1973: fig. 59d): >0.92
Tarjadia ruthae (CRILAR-Pv 564): >1.44
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 50): 0.74
Tropidosuchus romeri (PVL 4601, third caudal): ca. 1.45
Youngina (BP/1/3859): 1.15

Discretization by the cluster analysis: (1) 0.29–0.41; (2) 0.62–1.20; (3) 1.51–1.73; (4) 2.20–2.72. (5%=0.12).

Character 379:

Aetosauroides scagliai (PVL 2073): >1.00
Azendohsaurus madagaskarensis (UA 8-29-97-169): 1.36
Batrachotomus kupferzellensis (SMNS 80337): 3.42
Chanaresuchus bonapartei (PVL 4575): 1.49
“Chasmatosaurus” yuani (IVPP V4067): 2.09
Cuyosuchus (MCNAM 2669): 1.94–2.46
Dorosuchus (PIN 1579/64): >1.15
Erythrosuchus (NHMUK PV R3592, Gower 2003: table 1): >1.25
Euparkeria (SAM-PK-K8050): 2.21–2.36
Doswellia kaltenbachi (Weems 1980: table 5): 0.47–0.53
Garjainia madiba (BP/1/5360): >1.30
Garjainia prima (Huene 1960: plate 13, fig. 17): 1.94
Gracilisuchus (PVL 4597): 1.68
Heterodontosaurus (SAM-PK-K1332): 2.03
Howesia (SAM-PK-5886): 2.65–2.98
Isalorhynchus genovefae (Whatley 2005: fig. 1-16a): 1.22
Jesairosaurus lehmani (ZAR 09): 1.61–1.74
Lagerpeton chanarensis (PVL 4625): 1.47
Lewisuchus (PULR 01): 0.84
Lutungutali sitwensis (Peacock et al. 2013: fig. 5): 1.72
“Mandasuchus tanyauchen” (NHMUK PV R6792): 1.95–2.16
Mesosuchus (SAM-PK-6046: second to fourth caudal): 2.99–3.54

Nicrosaurus kapffi (SMNS 12671): 2.98
Noteosuchus (AM 3591): 2.11
Ornithosuchus (Walker 1964: fig. 8j, 2nd-4th caudal): 1.81–2.05
Ornithosuchus (Walker 1964: fig. 8l, 1st-2nd caudal): 1.45–1.81
Pamelaria dolichotracela (ISI R316/12): 1.45
Parringtonia gracilis (NHMUK PV R3139): 1.59
Petrolacosaurus (Reisz 1981: fig. 15h): 1.22
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 1.61
Prolacerta (Gow 1975: fig. 22, 1st-2nd caudals): 1.51–1.54
Proterosuchus alexanderi (NMQR 1484): 1.52–1.96
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361): 2.13
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 3.21–3.31
Rhynchosaurus articeps (BRLSI M20a: caudals 1–5): 1.52–2.56
Silesaurus opolensis (ZPAL Ab/unnumbered): 1.79
Simoedosaurus lemoinei (MNHN.F.R2241): 0.66
Smilosuchus gregorii (UCMP 26699): 2.44–2.53
Stagonolepis robertsoni (Walker 1961: fig. 10b): 3.31
Stagonosuchus nyassicus (GPIT/RE/3831, 3832): 2.65
Tanystropheus longobardicus (Wild 1973: fig. 59a): 1.48
Tarjadia ruthae (CRILAR-Pv 564): 2.92
Ticinosuchus ferox (PIMUZ T2817): 1.90–2.21
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 50e, h): 1.60–2.14
Tropidosuchus romeri (PVL 4601, first and second caudals): 0.96–1.07
Turfanosuchus dabanensis (IVPP V3237): 1.91
Yarasuchus deccanensis (ISI R334): 3.54
Youngina (Currie 1981: fig. 1d): 1.19

Discretization by the cluster analysis: (1) 0.66–2.21; (2) 2.36–2.65; (3) 2.92–3.05; (4) 3.21–3.54. (5%=0.144).

Character 387:

Aetosauroides scagliai (PVL 2073): 5.02
Amotosaurus (SMNS 50830): 1.46
Amotosaurus (SMNS 54810): 1.33
Arizonasaurus babbitti (Nesbitt 2005: fig. 27a): >8.00
Azendohsaurus madagaskarensis (UA 9-8-98-501): 4.88
Batrachotomus kupferzellensis (SMNS 80271): 6.36
Boreopricea funerea (PIN 3708/1): ca. 2.28
Chanaresuchus bonapartei (PVL 4575): 7.92
Chanaresuchus bonapartei (MCZ 4035): 8.97
 “*Chasmatosaurus*” *yuani* (IVPP V2719): ca. 2.04
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 5a): 6.19
Dimorphodon (NHMUK PV R41212-13): ca. 8.80
Erpetosuchus granti (Benton and Walker 2002): 13.2
Erythrosuchus (SAM-PK-905): 5.60
Erythrosuchus (NHMUK PV R3592): 5.90
Euparkeria (SAM-PK-5867): 4.44
Fuyuansaurus acutirostris (Fraser et al. 2013: fig. 4): 1.39
Garjainia madiba (BP/1/7152): 4.45

Garjainia prima (PIN 2394/5-32, 5-33): 3.73–3.74
Garjainia prima (Huene 1960: table 14, fig. 10): 4.17
Gracilisuchus (PULR 08): >5.62
Gualosuchus (PVL 4576): >6.46
Guchengosuchus (Peng 1991: fig. 7): 5.28
Halazhaisuchus qiaoensis (IVPP V6027-3): 4.73
Herrerasaurus (PVSJ 053): 8.64
Heterodontosaurus (SAM-PK-K1332): 9.79
Isalorhynchus genovefae (Whatley 2005: fig. 1-21): 6.32
Jesairosaurus lehmani (ZAR 09): > 7.00
Lewisuchus (PULR 01): ca. 9.10
Lotosaurus adentus (Zhang 1975: plate I): 6.36
Macrocnemus bessanii (PIMUZ T4355): 1.47
“*Mandasuchus tanyauchen*” (NHMUK PV R6792): 5.76
Mesosuchus (SAM-PK-6536): >3.56
Nundasuchus (Nesbitt et al. 2014: table 1): 5.32
Ornithosuchus (Walker 1964: fig. 9f): 8.76
Pamelaria dolichotrachela (ISI R316): <2.50
Parasuchus hislopi (Chatterjee 1978: fig. 10a): 4.34
Parringtonia gracilis (NHMUK PV R3139): >7.4
Planocephalosaurus (Fraser and Walkden 1984: fig. 13a): ca. 5.10
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 4.87
Prolacerta (BP/1/2675): ca. 1.79
Proterosuchus alexanderi (NMQR 1484): 2.13
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361): 2.61
Qianosuchus mixtus (Li et al. 2006: fig. 3b): 3.73
Rhynchosaurus articeps (SHYMS 2): 4.69
Sarmatosuchus (PIN 2865/68): 2.10
Shansisuchus kuyeheensis (Cheng 1980: fig. 27): 5.47
Shansisuchus shansisuchus (Young 1964: fig. 26a): 6.08
Shansisuchus shansisuchus (Young 1964: fig. 26b): 6.00
Shansisuchus shansisuchus (Young 1964: fig. 26b): 5.81
Shansisuchus shansisuchus (Young 1964: fig. 26d): 5.96
Silesaurus opolensis (ZPAL AbIII/2534): 11.31
Simoedosaurus lemoinei (MNHN.F.BR1009): 5.00
Simoedosaurus lemoinei (MNHN.F.BR1013): 6.27
Smilosuchus gregorii (UCMP 26699): 6.29
Stenaulorhynchus stockleyi (Huene 1938: plate VI, fig. 1a): 3.87
Tanystropheus longobardicus (Nosotti 2007: fig 20): 1.40
Tanystropheus longobardicus (Wild 1973: plate 17): 1.23
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 65b): >6.15
Tropidosuchus romeri (PVL 4601): 6.73
Vancleavea campi (Nesbitt et al. 2009: fig. 12): 4.46
Youngina (BP/1/3859): 3.25
Youngosuchus (IVPP V3239): >5.40

Discretization by the cluster analysis: (1) 1.23–6.73; (2) 7.92–10.45; (3) 13.2. (5%=0.60).

Character 410:

Aetosauroides scagliai (PVL 2073): 0.11
Azendohsaurus madagaskarensis (UA 8-27-98-271): 0.08
“Chasmatosaurus” yuani (IVPP V4067): 0.22
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 5a): 0.20
Doswellia kaltenbachi (USNM 244214): 0.14
Erpetosuchus granti (Benton and Walker 2002: fig. 5d): 0.09
Euparkeria (SAM-PK-5867): <0.09
Garjainia prima (PIN 2394/5-34): 0.21
Jesairosaurus lehmani (ZAR 09): 0.10
Macrocnemus bessanii (PIMUZ T4355): 0.09
Mesosuchus (SAM-PK-6536): 0.10
Nicrosaurus kapffi (SMNS 5705/1): 0.27
Parasuchus hislopi (ISI collection): 0.22
Petrolacosaurus (Reisz 1981: fig. 17b): 0.11
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.20
Prolacerta (BP/1/2675): 0.08
Proterosuchus alexanderi (NMQR 1484): 0.25
Proterosuchus fergusi (GHG 363): 0.24
Protorosaurus (Gottmann-Quesada and Sander 2009: fig. 19): <0.17
Rhynchosaurus articeps (NHMUK PV R1239): 0.11
Simoedosaurus lemoinei (MNHN.F.R1413): 0.12
Stenaulorhynchus stockleyi (Huene 1938: plate VI, fig. 2a): 0.22
Tasmaniosaurus (UTGD 54655): 0.07
Trilophosaurus buettneri (Gregory 1945: fig. 8b): 0.13
Youngina (SAM-PK-K7710): 0.13

Discretization by the cluster analysis: (1) 0.07–0.14; (2) 0.20–0.27 (5%=0.01).

Character 416:

Aetosauroides scagliai (PVL 2073): 0.34
Aetosauroides scagliai (PVL 2091): 0.58
Amotosaurus (SMNS 54783): 0.22
Azendohsaurus madagaskarensis (UA 7-13-99-578): 0.53
Azendohsaurus madagaskarensis (UA 8-29-97-151): 0.53
Batrachotomus kupferzellensis (SMNS 80276): 0.41
Chanaresuchus bonapartei (PVL 4575): 0.38
“Chasmatosaurus” yuani (IVPP V2719): 0.48
“Chasmatosaurus” yuani (IVPP V4067): 0.50
Cuyosuchus (MCNAM 2669): 0.41
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 5a): 0.36
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.24
Dimorphodon (Padian 1983: table 1, YPM 350): 0.37
Erpetosuchus granti (NHMUK PV R3139): 0.25
Erythrosuchus (SAM-PK-905): 0.70
Euparkeria (SAM-PK-5867): 0.37
Euparkeria (SAM-PK-7696): 0.46
Euparkeria (SAM-PK-8050): 0.38
Euparkeria (SAM-PK-13666): 0.35
Garjainia madiba (BP/1/5360): 0.63

Garjainia prima (PIN specimen): 0.57
Gracilisuchus (CRILAR-Pv 490a): 0.23
Gualosuchus (PVL 4576): 0.35
Halazhaisuchus qiaoensis (IVPP V6027-5): 0.30
Herrerasaurus (MACN-Pv 18060): 0.29
Heterodontosaurus (SAM-PK-K1332): 0.25
Isalorhynchus genovefae (Whatley 2005: fig. 1-24b): 0.50
Jaxtasuchus salomoni (SMNS 91002): 0.31
Jesairosaurus lehmani (ZAR 09): 0.39
Koilamasuchus (MACN-Pv 18119): >0.41
Lewisuchus (PULR 01): ca. 0.28
Macrocnemus bessanii (PIMUZ T2472): 0.21
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 0.27
“*Mandasuchus tanyauhen*” (NHMUK PV R6793): 0.34
Marasuchus lilloensis (PVL 3871): >0.18
Nyasaosaurus parringtoni (NHMUK PV R6856): <0.52
Nicrosaurus kapffi (SMNS unnumbered): 0.38
Nundasuchus (Nesbitt et al. 2014: table 1): 0.54
Pamelaria dolichotrachela (ISI R316/51): 0.44
Pamelaria dolichotrachela (ISI R324/35, 36): 0.44–0.45
Parasuchus hislopi (ISI collection): 0.38
Petrolacosaurus (Reiz 1981: 43): 0.27
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.38
Prolacerta (BP/1/2675): 0.32
Proterochampsia barrionuevoi (Trotteyn 2011: table 2): 0.41
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, FG 2666/2004b): 0.20
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, WMsN P 47361): 0.33
Rhynchosaurus articeps (NHMUK PV R1239): 0.38
Riojasuchus tenuisiceps (PVL 3826): 0.46
Shansisuchus kuyeheensis (Cheng 1980: fig. 28): 0.57
Shansisuchus shansisuchus (Young 1964: table 7, 27a): 0.60
Shansisuchus shansisuchus (Young 1964: table 7, 27b): 0.60
Shansisuchus shansisuchus (Young 1964: table 7, 27c): 0.58
Shansisuchus shansisuchus (Young 1964: table 7, 27d): 0.62
Silesaurus opolensis (ZPAL AbIII/361): 0.22
Silesaurus opolensis (ZPAL AbIII/362): 0.21
Silesaurus opolensis (ZPAL AbIII/452): 0.20
Simoedosaurus lemoinei (MNHN.F.BR1236): 0.34
Simoedosaurus lemoinei (MNHN.F.CRL2203): 0.34
Smilosuchus gregorii (USNM 18313): 0.34
Stagonosuchus nyassicus (GPIT/RE/3832): 0.45
Stenaulorhynchus stockleyi (Huene 1938: plate VII, fig. 3b): 0.57
Tanystropheus longobardicus (PIMUZ T2817): 0.20
Tanystropheus longobardicus (Nosotti 2007: fig. 7): 0.20
Ticinosuchus ferox (PIMUZ T2817): 0.35
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 66a): 0.31
Tropidosuchus romeri (PVL 4601): 0.24
Turfanosuchus dabanensis (IVPP V3237): 0.39
Vancleavea campi (Parker and Barton 2008: fig. 8.4): 0.28
Yarasuchus deccanensis (ISI R334/53): 0.40

Youngina (BP/1/3859): 0.32
Youngosuchus (IVPP V3239): 0.41

Discretization by the cluster analysis: (1) 0.20–0.41; (2) 0.44–0.70 (5%=0.025).

Character 424:

Aetosauroides scagliai (PVL 2073): 0.33
Aetosauroides scagliai (PVL 2091): 0.30
Asilisaurus kongwe (NMT specimen): 0.46
Azendohsaurus madagaskarensis (UA 8-29-97-151): 0.30
Batrachotomus kupferzellensis (SMNS 80276): 0.46
Chanaresuchus bonapartei (PVL 4575): 0.31
“*Chasmatosaurus*” *yuani* (IVPP V2719): 0.37
“*Chasmatosaurus*” *yuani* (IVPP V4067): 0.42
Cuyosuchus (Rusconi 1951: fig. 38c): 0.48
Diandongosuchus fuyuanensis (Li et al. 2012: figs. 5a): 0.38
Dimorphodon (Padian 1983: fig. 8, YPM 350): 0.46
Erythrosuchus (SAM-PK-905): 0.55
Euparkeria (SAM-PK-5867): 0.38
Garjainia madiba (BP/1/5360): 0.43
Garjainia prima (PIN specimen): 0.48
Gracilisuchus (CRILAR-Pv 490a): 0.49
Halazhaisuchus qiaoensis (IVPP V6027-5): 0.46
Herrerasaurus (MACN-Pv 18060): 0.52
Heterodontosaurus (SAM-PK-K1332): 0.42
Isalorhynchus genovefae (Whatley 2005: fig. 1-24b): 0.48
Jaxtasuchus salomoni (SMNS 91002): 0.36
Lewisuchus (PULR 01): >0.37
“*Mandasuchus tanyauchen*” (NHMUK PV R6793): 0.47
Marasuchus lilloensis (PVL 3871): ca. 0.40
Nicrosaurus kapffi (SMNS unnumbered): 0.32
Nundasuchus (Nesbitt et al. 2014: fig. 7b): 0.43
Pamelaria dolichotrachela (ISI R316/51): 0.42
Pamelaria dolichotrachela (ISI R324/35, 36): 0.45–0.46
Parasuchus hislopi (ISI collection): 0.35
Petrolacosaurus (Reisz 1981: fig. 19): 0.17
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.34
Prolacerta (BP/1/2675): 0.27
Proterochampsia barrionuevoi (Trotteyn 2011: fig. 9): 0.25
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361): 0.26
Rhynchosaurus articeps (NHMUK PV R1239): 0.34
Riojasuchus tenuisiceps (PVL 3826): 0.43
Silesaurus opolensis (ZPAL AbIII/452): 0.39
Shansisuchus kuyeheensis (Cheng 1980: fig. 28): 0.46
Shansisuchus shansisuchus (Young 1964: table 7, 27a): 0.40
Shansisuchus shansisuchus (Young 1964: table 7, 27b): 0.40
Shansisuchus shansisuchus (Young 1964: table 7, 27c): 0.42
Shansisuchus shansisuchus (Young 1964: table 7, 27d): 0.48
Simoedosaurus lemoinei (MNHN.F.BL9626): 0.38

Smilosuchus gregorii (USNM 18313): 0.28
Stagonosuchus nyassicus (GPIT/RE/3832): 0.37
Stenaulorhynchus stockleyi (Huene 1938: plate VII, fig. 3b): 0.52
Ticinosuchus ferox (PIMUZ T2817): >0.34
Trilophosauurs buettneri (Spielmann et al. 2008: fig. 66d): 0.24
Turfanosuchus dabanensis (IVPP V3237): 0.37
Vancleavea campi (Parker and Barton 2008: fig. 8.4): 0.33
Yarasuchus deccanensis (ISI R334/53): 0.49
Youngina (SAM-PK-K7710): 0.28
Youngosuchus (IVPP V3239): 0.43

Discretization by the cluster analysis: (1) 0.16–0.18; (2) 0.24–0.49; (3) 0.52–0.55 (5%=0.02).

Character 435:

Aetosauroides scagliai (PVL 2059): 0.90
Aetosauroides scagliai (PVL 2073): 0.73
Boreopricea (Benton and Allen 1997: 941, 942): 0.79
Chanaresuchus bonapartei (Romer 1972a: 12): 0.92
“Chasmatosaurus” yuani (Young 1978: table 1; IVPP V4067): 0.76
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 0.79
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.66
Erpetosuchus granti (Benton and Walker 2002: 34): 0.79
Erythrosuchus (SAM-PK-905): 0.75
Euparkeria (SAM-PK-5867): 0.84
Euparkeria (SAM-PK-13666): 0.83
Halazhaisuchus qiaoensis (IVPP V6027-5, 7): 0.74
Herrerasaurus (PVSJ 407): 0.92
Heterodontosaurus (SAM-PK-K1332): 0.70
Isalorhynchus genovefae (Whatley 2005: fig. 1-24b, 1-25b): 0.74
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2477): 0.95
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2472): 0.92
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T4355): 0.96
Macrocnemus fuyuanensis (Li et al. 2007: table 2, IVPP V15001): 0.83
Macrocnemus fuyuanensis (Jiang et al. 2011: table 1, GMPKU-P-3001): 0.84
Marasuchus lilloensis (PVL 3871): >0.72
Ornithosuchus (Huene 1914: 17): 0.79
Pamelaria dolichotrachela (ISI R316/51, 53): 0.89
Parasuchus hislopi (Chatterjee 1978: table 2): 0.67
Petrolacosaurus (Reisz 1981: 45): 0.92
Prolacerta (Gow 1975: 111, BP/1/2675): 0.88
Proterochampsia barrionuevoi (Trotteyn 2011: table 2): 0.76
Protorosaurus (Gottmann-Quesada and Sander, 2009: appendix I, FG 2666/2004b): 0.84
Protorosaurus (Gottmann-Quesada and Sander, 2009: appendix I, NHMW 1943I4): 0.79
Protorosaurus (Gottmann-Quesada and Sander, 2009: appendix I, WMsN P 47361): 0.86
Rhynchosaurus articeps (NHMUK PV R1238): 0.71
Rhynchosaurus articeps (SHYMS 6): 0.84
Riojasuchus tenuisiceps (Bonaparte 1972): ca. 0.75
Silesaurus opolensis (ZPAL AbIII/361): 1.12
Tanystropheus longobardicus (Nosotti 2007: table 6, MSNM BES SC 1018): 0.66

Tanystropheus longobardicus (Nosotti 2007: table 4, MSNM BES SC 265): 0.70
Ticinosuchus ferox (PIMUZ T2817): 1.05
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 72d, appendix 10, TMM 31025-140): 0.81
Tropidosuchus romeri (Arcucci 1990: 373): 0.78
Vancleavea campi (Nesbitt et al. 2009: fig. 13): 0.62
Youngina (Gow 1975: 97): 0.78
Youngina (SAM-PK-K7710): 0.70
Youngosuchus (IVPP V3239): 0.97

Discretization by the cluster analysis: (1) 0.62–0.66; (2) 0.69–0.92; (3) 0.95–0.97; (4) 1.05–1.17. (5%=0.03).

Character 446:

Amotosaurus (SMNS 54783): 0.34
Boreopricea (Tatarinov 1978: fig. 2): 0.74
Diandongosuchus fuyuanensis (Li et al. 2012: fig. 1): 0.55
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.93
 GHG 7433MI: 0.39
Herrerasaurus (PVSJ 373): 0.38
Heterodontosaurus (SAM-PK-K1332): 0.34
Isalorhynchus genovefae (Whatley 2005: fig. 1-26d, 1-32a): 0.56
Jaxtasuchus salomoni (SMNS 91352): 0.58
Macrocnemus bassanii (PIMUZ T2472): 0.43
Macrocnemus fuyuanensis (Jiang et al. 2011: table 1, GMPKU-P-3001): 0.41
Macrocnemus fuyuanensis (Li et al. 2007: table 2, IVPP V 15001): 0.39
Noteosuchus (AM 3591): 0.45
Pamelaria dolichotrachela (ISI R136): 0.56
Proterosuchus fergusi (SAM-PK-K140): 0.59
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Nat. Kab. 191): 0.97
Tanystropheus longobardicus (Nosotti 2007: tables 5, 6, MSNM BES SC 1018): 0.38
Ticinosuchus ferox (PIMUZ T2817): 0.41
Trilophosaurus buettneri (Spielmann et al. 2008: figs. 74a, 91a): 0.59
Vancleavea campi (Nesbitt et al. 2009: 831, 836): 0.75
Youngina (based on extrapolations between the forelimb of BP/1/3859 and the hindlimb of SAM-PK-K7710d): 0.54

Discretization by the cluster analysis: (1) 0.34–0.45; (2) 0.54–0.59; (3) 0.74–0.75; (4) 0.93–0.98. (5%=0.03). The last three clusters were merged together because the last two were restricted to a single terminal.

Character 448:

Acerosodontosaurus (MNHN 1908-32-57): 0.44
Amotosaurus (SMNS 54783): 0.26
Azendohsaurus madagaskarensis (UA 7-16-99-607): 0.53
Dimorphodon (NHMUK PV R41212-13): <0.12
Dinocephalosaurus orientalis (Rieppel et al. 2008: fig. 11b): 0.45
Erythrosuchus (NHMUK PV R3592): 0.74

Euparkeria (SAM-PK-13666): 0.52–0.60
Herrerasaurus (PVSJ 373): 0.40
Herrerasaurus (PVSJ 380): 0.50
Heterodontosaurus (SAM-PK-K1332): 0.31
Isalorhynchus genovefae (Whatley 2005: fig. 1-26d): 1.16
Jaxtasuchus salomoni (SMNS 91352): 0.64
Mesosuchus browni (SAM-PK-6046): 0.48
Noteosuchus (AM 3591): 0.48
Ornithosuchus (Walker 1964: fig. 10f): 0.33
Pamelaria dolichotrachela (ISI R136/54): 0.31
Petrolacosaurus (Reisz, 1981): 0.48
Prolacerta (BP/1/2675): 0.36
Proterosuchus fergusi (SAM-PK-K140): 0.50
Protorosaurus (BSPG 1995 I 5, cast of WMsN P 47361): 0.50
Rhynchosaurus articeps (SHYMS 4): 0.43
Rhynchosaurus articeps (SHYMS 6): 0.39
Riojasuchus tenuisiceps (PVL 3827): 0.37
Shansisuchus shansisuchus (Young 1964: table 9): 0.58–0.63
Stenaulorhynchus stockleyi (Huene 1938: plate VIII, fig. 3): 1.09
Tanystropheus longobardicus (Nosotti 2007: fig. 23, MSNM BES SC 1018): 0.38
Ticinosuchus ferox (PIMUZ T2817): 0.44
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 74a): 0.50
Vancleavea campi (Nesbitt et al. 2009: fig. 13): 0.45
Youngina (BP/1/3859): 0.42

Discretization by the cluster analysis: (1) 0.26–0.33; (2) 0.36–0.45; (3) 0.48–0.53; (4) 0.58–0.64; (5) 0.73–0.75; (6) 1.09–1.16. (5%=0.02).

Character 458:

Acerosodontosaurus (MNHN 1908-32-57): 0.33
Aetosauroides scagliai (PVL 2073): 0.39
Archeopelta arborensis (CPEZ-239a): 0.43
Chanaresuchus bonapartei (Romer 1972a: plate 1): 0.38
Cuyosuchus (MCNAM 2669): <0.38
Dimorphodon (NHMUK PV R1034): 0.12
Dorosuchus (PIN 1579/61): 0.47
Lagerpeton chanarensis (PVL 4619): 0.26
Gracilisuchus (PVL 4597): ca. 0.24–0.30
Herrerasaurus (PVL 2566): 0.37
Heterodontosaurus (AM unnumbered): 0.25
Heterodontosaurus (SAM-PK-K1332): 0.30
Isalorhynchus genovefae (Whatley 2005: fig. 1-27a, 1-29a): 0.28
Macrocnemus bessanii (PIMUZ T2472): 0.24
Macrocnemus bessanii (Besano II specimen): 0.25
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 0.12
Macrocnemus obristi (Fraser and Furrer 2013: fig. 2): 0.16
Marasuchus lilloensis (PVL 3870): 0.31
Mesosuchus (Haughton 1922: 86, 87; SAM-PK-6046): 0.56
Noteosuchus (Carroll 1976: figs. 2, 3): 0.38

Ornithosuchus (NHMUK PV R3561): 0.34
Pamelaria dolichotrachela (ISI R136/49, 50, 55): 0.21
Parasuchus hislopi (Chatterjee 1978: figs. 12, 13): 0.24
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 0.47
Prolacerta (BP/1/2676): 0.41
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 0.25
Riojasuchus tenuisiceps (PVL 3828): 0.35
Silesaurus opolensis (ZPAL AbIII/361): >0.28
Tanystropheus longobardicus (Nosotti 2007: fig. 27, MSNM BES SC 1018): 0.29
Teleocrater rhadinus (NHMUK PV R6795): 0.17
Ticinosuchus ferox (PIMUZ T2817): 0.35
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 76a, appendix 10: TMM 31025-140): >0.31
Turfanosuchus dabanensis (IVPP V3237): ca. 0.40
Yarasuchus deccanensis (ISI R334/56, 67): 0.17
Youngina (BP/1/3859): 0.40

Discretization by the cluster analysis: (1) 0.12–0.17; (2) 0.21–0.47; (3) 0.54–0.57 (5%=0.022).

Character 463:

Acerosodontosaurus (MNHN 1908-32-57): 1.24
Aetosauroides scagliai (PVL 2059): 0.31
Aetosauroides scagliai (PVL 2073): 0.35
Amotosaurus (SMNS 90544): 1.08
Arizonasaurus babbitti (Nesbitt 2005: fig. 23a): 0.98
Asilisaurus kongwe (Peacock et al. 2013: fig. 6e): 0.81
Azendohsaurus madagaskarensis (UA 8-30-98-375): 1.04
Azendohsaurus madagaskarensis (UA 9-5-98-448): 1.03
Azendohsaurus madagaskarensis (UA 8-29-97-155): 0.98
Batrachotomus kupferzellensis (SMNS 80273): 1.13
Bromsgroveia walkeri (NHMUK PV R2549): 1.49
Chanaresuchus bonapartei (MCZ 4035): 0.85
“Chasmatosaurus” yuani (Young 1936: fig. 10): ca. 0.92
Cuyosuchus (Rusconi 1951: fig. 31a): 0.91
Dagasuchus santacruzensis (Lacerda et al. 2015: fig. 3): 1.12
Diandongosuchus fuyuanensis (Li et al. 2012: fig. 6a): 1.16
Dimorphodon (NHMUK PV R1034): 1.18
Dorosuchus (PIN 1579/61): 1.03
Doswellia kaltenbachii (USNM 244214): 1.22
Erythrosuchus (NHMUK PV R3592): 0.87
Erythrosuchus (SAM-PK-905): 0.90
Euparkeria (SAM-PK-7696): 1.21
Fuyuansaurus acutirostris (Fraser et al. 2013: fig. 5): 1.36
Garjainia madiba (BP/1/5525): 1.19
Garjainia prima (PIN specimen): 0.98
Gracilisuchus (PVL 4597): 1.11
Herrerasaurus (PVL 2566): 0.79
Herrerasaurus (MCZ 4381): 0.94

Herrerasaurus (MLP-61-VIII-2-2): 0.94
Heterodontosaurus (SAM-PK-K1332): 1.19
Howesia (NHMUK PV R5872, cast of SAM-PK-5886): ca. 0.92
Isalorhynchus genovefae (Whatley 2005: fig. 1-27a): 0.91
Koilamasuchus (MACN-Pv 18119): 0.55–0.85
Lagerpeton chanarensis (PVL 4619): 0.89
Lutungutali sitwensis (Peacock et al. 2013: fig. 2): >0.67
Macrocnemus bessanii (Besano II specimen): 1.00
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 1.13
“*Mandasuchus tanyauchen*” (NHMUK PV R6792): 1.31
“*Mandasuchus tanyauchen*” (NHMUK PV R6793): 1.22
Marasuchus lilloensis (PVL 3870): 0.89
Mesosuchus (SAM-PK-7416): 0.82
Noteosuchus (AM 3591): 1.11
Ornithosuchus (Walker 1964: fig. 11f): 1.00
Pamelaria dolichotrachela (ISI R136/49, 50): 1.00
Panchet proterosuchid (NHMUK PV R10149): 1.01
Parasuchus hislopi (ISI collection): 1.02
Petrolacosaurus (Reisz 1981: fig. 18): 1.00
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.96
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 0.96
Prolacerta (BP/1/2676): >1.07
Planocephalosaurus (Fraser and Walkden 1984: fig. 17b): 0.92
Qianosuchus mixtus (Li et al. 2006: fig. 3d): 1.31
Riojasuchus tenuisiceps (PVL 3827): 1.36
Riojasuchus tenuisiceps (PVL 3828): 1.52
Shansisuchus shansisuchus (Young 1964: fig. 30b): 1.34
Silesaurus opolensis (ZPAL AbIII/361): 1.02
Silesaurus opolensis (ZPAL AbIII/404/1):
Simoedosaurus lemoinei (MNHN.F.BR12090): 1.24
Smilosuchus gregorii (UCMP 26699): 1.03
Stagonosuchus nyassicus (GPIT/RE/3832): 0.94
Stenaulorhynchus stockleyi (Huene 1938: plate VIII, fig. 5a): 0.99
Tanystropheus longobardicus (Nosotti 2007: fig. 24, MSNM BES SC 1018): 1.32
Trachelosaurus fischeri (University of Halle unnumbered): >0.73
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 76a): 0.82
Turfanosuchus dabanensis (IVPP V3237): 1.34
Vancleavea campi (Nesbitt et al. 2009: fig. 14b): 0.63
Yarasuchus deccanensis (ISI R334/56): 1.11
Yarasuchus deccanensis (ISI R334): 1.04
Youngina (BP/1/3859): 0.45

Discretization by the cluster analysis: (1) 0.31–0.63; (2) 0.79–1.24; (3) 1.31–1.37; (4) 1.49–1.55. (5%=0.06).

Character 472:

Acerosodontosaurus (Currie 1980: fig. 7): 1.82
Aetosauroides scagliai (PVL 2052): 2.19
Aetosauroides scagliai (PVL 2073): 2.14

Amotosaurus (SMNS 50830): ca. 2.17
Chanaresuchus bonapartei (PVL 4575): 1.86
Cuyosuchus (Rusconi 1951: fig. 37): 2.47
Diandongosuchus fuyuanensis (Li et al. 2012: fig. 6a): 2.17
Dimorphodon (NHMUK PV R41212-13): 1.90
Doswellia kaltenbachii (USNM 244214): 1.75
Erythrosuchus (SAM-PK-905): 1.52
Euparkeria (SAM-PK-7696): 2.27
Fuyuansaurus acutirostris (Fraser et al. 2013: fig. 5): 1.52
Garjainia prima (PIN specimen): 1.97
Gracilisuchus (PVL 4597): 2.37
Herrerasaurus (MCZ 4381): 3.43
Herrerasaurus (PVL 2566): 4.22
Heterodontosaurus (SAM-PK-K1332): 4.87
Howesia (SAM-PK-5886): 1.65
Isalorhynchus genovefae (Whatley 2005: fig. 1-27a, b): 1.50
Lagerpeton chanarensis (PVL 4619): 1.58
Macrocnemus bessanii (Besano II specimen): 1.44
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 2.09
“*Mandasuchus tanyauchen*” (NHMUK PV R6792): 2.57
“*Mandasuchus tanyauchen*” (NHMUK PV R6793): 2.19
Marasuchus lilloensis (PVL 3870): 2.84
Mesosuchus (SAM-PK-7416): 1.66
Mesosuchus (SAM-PK-6046): ca. 1.35
Noteosuchus (Carroll 1976: figs. 1, 3h): 1.69
Ornithosuchus (Walker 1964: fig. 11f): 3.94
Pamelaria dolichotrachela (ISI R136/49, 50): 1.64
Parasuchus hislopi (Chatterjee 1978: fig. 12a): 1.15
Petrolacosaurus (Reisz 1981: fig. 18): 2.16
Planocephalosaurus (Fraser and Walkden 1984: fig. 16): 2.58
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 2.36
Prolacerta (BP/1/2676): 2.01
Qianosuchus mixtus (Li et al. 2006: fig. 3c): 2.73
Riojasuchus tenuisiceps (PVL 3827): 3.40
Silesaurus opolensis (ZPAL AbIII/361): 4.59
Smilosuchus gregorii (Long and Murry 1995: fig. 31a): 1.61
Stagonosuchus nyassicus (GPIT/RE/3831): 2.94
Tanystropheus longobardicus (Nosotti 2007: fig. 24, MSNM BES SC 1018): 2.34
Trilophosaurus buettneri (Spielmann et al. 2008: figs. 76a, 78a): 1.39
Tropidosuchus romeri (PVL 4601): 1.92
Turfanosuchus dabanensis (IVPP V3237): 3.06
Yarasuchus deccanensis (ISI R334): 2.84
Youngina (BP/1/3859): 1.20

Discretization by the cluster analysis: (1) 1.15–2.58; (2) 2.73–3.43; (3) 3.94–4.87. (5%=0.186).

Character 478:

Aetosauroides scagliai (PVL 2052): 0.86

Aetosauroides scagliai (PVL 2073): 0.77
Azendohsaurus madagaskarensis (UA 8-30-98-375): 0.97
Batrachotomus kupferzellensis (SMNS 80269): 0.34
Chanaresuchus bonapartei (PVL 4575): 1.80
Cuyosuchus (MCNAM 2669): >0.85
Doswellia kaltenbachii (USNM 244214): 1.69
Erythrosuchus (NHMUK PV R3592): 0.88
Erythrosuchus (SAM-PK-905): 0.96
Garjainia prima (PIN specimen): 1.12
Gracilisuchus (PVL 4597): 0.27
Herrerasaurus (PVL 2566): 0.41
Isalorhynchus genovefae (Whatley 2005: fig. 1-27a): 1.85
Lagerpeton chanarensis (PVL 4619): 1.68
"Mandasuchus tanyauchen" (NHMUK PV R6792): 0.54
Marasuchus lilloensis (PVL 3870): 0.56
Mesosuchus (SAM-PK-6046): 1.94
Noteosuchus (Carroll 1976: fig. 1): 1.54
Nundasuchus (Nesbitt et al. 2014: fig. 8b): slightly >1.07
Ornithosuchus (Walker 1964: fig. 11h): 0.47
Pamelaria dolichotrachela (ISI R136/49, 50): 1.19
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 0.43
Riojasuchus tenuisiceps (PVL 3827): 0.59
Shansisuchus shansisuchus (Young 1964: fig. 29e): 1.13
Silesaurus opolensis (Dzik 2003: fig. 12d): 0.49
Stagonosuchus nyassicus (GPIT/RE/3831): 0.45
Ticinosuchus ferox (PIMUZ T2817): ca. 0.49
Tropidosuchus romeri (PVL 4601): 1.48
Turfanosuchus dabanensis (IVPP V3237): ca. 0.52
Yarasuchus deccanensis (ISI R334): 0.56

Discretization by the cluster analysis: (1) 0.27–0.59; (2) 0.77–0.97; (3) 1.12–1.28; (4) 1.48–1.94. (5%=0.08).

Character 482:

Aetosauroides scagliai (PVL 2052): 1.79
Aetosauroides scagliai (PVL 2073): 1.77
Amotosaurus (SMNS 50830): ca. 2.17
Chanaresuchus bonapartei (MCZ 4035): 1.65
Cuyosuchus (MCNAM 2669): 2.19
Dagasuchus santacruzensis (Lacerda et al. 2015: fig. 5a): 3.48
Diandongosuchus fuyuanensis (Li et al. 2012: fig. 6a): 2.22
Dimorphodon macronyx (NHMUK PV R41212-13): 1.72
Doswellia kaltenbachii (USNM 244214): 1.66
Erythrosuchus (SAM-PK-905): 1.90
Euparkeria (SAM-PK-7696): 2.72
Garjainia madiba (BP/1/5525): 2.40
Garjainia prima (PIN specimen): 2.43
Gephyrosaurus (Evans 1981: fig. 20): ca. 2.00
Gracilisuchus (PVL 4597): 1.99–2.36

Herrerasaurus (MCZ 4381): 1.64
Heterodontosaurus (SAM-PK-K1332): 4.4
Howesia (NHMUK PV R5872, cast of SAM-PK-5886): ca. 1.79
Lagerpeton chanarensis (PVL 4619): 2.17
Lutungutali sitwensis (Peacock et al. 2013: fig. 2): >1.90
Macrocnemus bessanii (Besano II specimen): 1.55
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 2.19
“*Mandasuchus tanyauchen*” (NHMUK PV R6793): 2.37
Marasuchus lilloensis (PVL 3870): 2.18
Mesosuchus (SAM-PK-6046): 1.24
Noteosuchus (Carroll 1976: figs. 1, 3h): 2.31
Ornithosuchus (Walker 1964: fig. 11g): 2.96
Pamelaria dolichotrachela (ISI R136/49, 50): 1.56
Parasuchus hislopi (Chatterjee 1978: fig. 12a): 1.55
Petrolacosaurus (Reisz 1981: fig. 18): 2.72
Planocephalosaurus (Fraser and Walkden 1984: fig. 16): 2.35
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 2.24
Prolacerta (BP/1/2676): 1.92
Qianosuchus mixtus (Li et al. 2006: fig. 3d): 3.02
Rhynchosaurus articeps (SHYMS 5): 1.58
Silesaurus opolensis (ZPAL AbIII/361): 3.53
Smilosuchus gregorii (Long and Murry 1995: fig. 31a): 2.03
Tanystropheus longobardicus (Nosotti 2007: fig. 25, MSNM BES SC 1018): 2.50
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 82a): 1.66
Tropidosuchus romeri (PVL 4601): 1.71
Vancleavea campi (Nesbitt et al. 2009: fig. 14b, c): 2.43
Yarasuchus deccanensis (ISI R334): 2.78
Youngina (BP/1/3859): 1.04

Discretization by the cluster analysis: (1) 1.04–1.24; (2) 1.55–2.50; (3) 2.72–3.53; (4) 4.31–4.48. (5% = 0.17).

Character 489:

Aetosauroides scagliai (PVL 2073): 1.62
Boreopricea (Tatarinov 1978: 511; Benton and Allen 1997: 941, 942): 1.19–1.25
Chanaresuchus bonapartei (PVL 4575): 1.63
Chanaresuchus bonapartei (MCZ 4035): 1.51
“*Chasmatosaurus*” *yuani* (IVPP V2719): 1.50
“*Chasmatosaurus*” *yuani* (table 1, IVPP V4067): 1.38
Cuyosuchus (MCNAM 2669): >1.31
Decuriasuchus quartacolonina (França et al. 2011: fig. 1, specimen b): 1.33
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 1.35
Dimorphodon (Padian 1983: table 1, YPM 9182): 0.94
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.96
Euparkeria (SAM-PK-5867): 1.47
Euparkeria (SAM-PK-7696): 1.31
Gualosuchus (PVL 4576): 1.46
Herrerasaurus (MACN-Pv 18060): 1.86–1.96
Heterodontosaurus (SAM-PK-K1332): 1.35

Isalorhynchus genovefae (Whatley 2005: fig. 1-24b, 1-29a): 1.12
Jaxtasuchus salomoni (SMNS 91002): 1.62
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2477): 1.32
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2472): 1.25
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T4355): 1.23
Macrocnemus fuyuanensis (Jiang et al. 2011: table 1, GMPKU-P-3001): 1.23
Macrocnemus fuyuanensis (Li et al. 2007: table 2, IVPP V15001): 1.26
Marasuchus lilloensis (PVL 3871): 1.44
Nundasuchus (Nesbitt et al. 2014: table 1): 1.37
Pamelaria dolichotrachela (ISI R136/51, 55): 1.09
Parasuchus hislopi (Chatterjee 1978: table 2): 1.32
Petrolacosaurus (Peabody 1952: table 4, estimated femoral length of 1427 based on the ratio between the radii of 1427 and 1428): 1.15
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 1.53
Proterochampsia barrionuevoi (Trotteyn 2011: table 2): 1.67
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, BSPG AS VII 1207): 1.55
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NHMW 1943I4): 1.41
Silesaurus opolensis (ZPAL AbIII/362): 1.39
Tanystropheus longobardicus (Nosotti 2007: tables 4, 5, MSNM BES SC 265): 1.44
Tanystropheus longobardicus (Wild 1973: plate 7, specimen g): 1.53
Tanystropheus longobardicus (Wild 1973: plate 7, specimen a): 1.42
Tanystropheus longobardicus (PMIUZ T2817): 1.45
Ticinosuchus ferox (PIMUZ T2817): 1.69
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-140): 1.21
Tropidosuchus romeri (PVL 4601): 1.40
Turfanosuchus dabanensis (IVPP V3237): 1.56
Vancleavea campi (Nesbitt et al. 2009: figs. 13, 15): 1.74
Yarasuchus deccanensis (ISI R334/53, 67): 1.64
Youngina (BP/1/3859): 1.48

Discretization by the cluster analysis: (1) 0.92–0.97; (2) 1.09–1.56; (3) 1.62–1.74; (4) 1.86–1.96 (5%=0.05).

Character 490:

Acerosodontosaurus (MNHN 1908-32-57): 1.14
Aetosauroides scagliai (PVL 2052): 1.67
Aetosauroides scagliai (PVL 2073): 1.73
Boreopricea (Benton and Allen 1997: fig. 2): 1.46
Chanaresuchus bonapartei (PVL 4575): 2.00
“Chasmatosaurus yuani” (IVPP V2719): 1.24
“Chasmatosaurus yuani” (IVPP V4067): 1.08–1.18
Cuyosuchus (MCNAM 2669): 1.24
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.78
Euparkeria (SAM-PK-5867): 1.53
Euparkeria (SAM-PK-7696): 1.65
Gracilisuchus (CRILAR-Pv 490a): 0.95
Gualosuchus (PULR 05): 1.57
Heterodontosaurus (SAM-PK-K1332): 1.29

Isalorhynchus genovefae (Whatley 2005: fig. 1-24a, 1-29a): 1.28
Jaxtasuchus salomoni (SMNS 91002): 1.93
Macrocnemus bessanii (PIMUZ T2472): 1.80
Macrocnemus bessanii (PIMUZ T4355): 1.29
Macrocnemus fuyuanensis (Li et al. 2007: fig. 2): 1.08
Marasuchus lilloensis (PVL 3871): 1.57
Nundasuchus (Nesbitt et al. 2014: table 1): 1.32
Pamelaria dolichotrachela (ISI R136/51, 55): 1.01
Parasuchus hislopi (Chatterjee 1978: table 2): 1.18
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 1.59
Proterochampsia barrionuevoi (Trotteyn 2011: fig. 3): ca. 1.09
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 1.50
Rhynchosaurus articeps (NHMUK PV R1239): 1.50
Riojasuchus tenuisiceps (PVL 3828): 1.70
Tanystropheus longobardicus (Nosotti 2007: plate IV, MSNM BES SC 1018): 1.18
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-140): 1.13
Turfanosuchus dabanensis (IVPP V3237): 1.46
Vancleavea campi (Nesbitt et al. 2009: figs. 13, 15): 1.21
Yarasuchus deccanensis (ISI R334/53, 67): 1.26
Youngina (SAM-PK-K7710): 1.09

Discretization by the cluster analysis: (1) 0.78; (2) 0.95–1.01; (3) 1.08–1.32; (4) 1.46–1.80; (5) 1.93–2.00. (5%=0.05).

Character 510:

Aetosauroides scagliai (PVL 2073): 0.26–0.27
Augustaburiania vatagini (Sennikov 2011: fig. 2l): 0.18
Archeopelta arborensis (CPEZ-239a): 0.26
Asilisaurus kongwe (NMT specimen): 0.19
Azendohsaurus madagaskarensis (UA 9-8-98-502): 0.29
Batrachotomus kupferzellensis (SMNS 52970): 0.24
Boreoprincea (Benton and Allen 1997: 942): 0.22
Chanaresuchus bonapartei (PVL 4575): 0.16
Chanaresuchus bonapartei (MCZ 4035): 0.20
“Chasmatosaurus” yuani (IVPP V2719): 0.31
“Chasmatosaurus” yuani (IVPP V4067): 0.32
Cuyosuchus (MCNAM 2669): <0.29
Dimorphodon (Padian 1983: table 1, YPM 9182): 0.14
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.27
Dongusuchus (PIN 952/15-1): 0.18
Dongusuchus (PIN 952/15-2): 0.18
Dorosuchus (PIN 1579/61): 0.27
Doswellia kaltenbachii (USNM 186989): ca. 0.18
Erythrosuchus (NHMUK PV R3592): 0.40
Euparkeria (SAM-PK-5867): 0.19
Euparkeria (SAM-PK-5867): 0.24
Euparkeria (SAM-PK-6047B): 0.27
Euparkeria (SAM-PK-7868): 0.20
Garjainia madiba (BP/1/5767): 0.32

Garjainia prima (PIN specimen): 0.34
Gracilisuchus (PVL 4597): 0.08
Gualosuchus (PULR 05): ca. 0.24
Gualosuchus (PVL 4576): ca. 0.22
Herrerasaurus (MACN-Pv 18060): 0.17
Herrerasaurus (PVL 2566): 0.22
Herrerasaurus (PVSJ 373): 0.21
Isalorhynchus genovefae (Whatley 2005: fig. 1-29b): 0.35
Lagerpeton chanarensis (MCZ 4121): 0.20
Lagerpeton chanarensis (PVL 4619): 0.21
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 6): 0.16
Marasuchus lilloensis (PVL 3870): 0.15
Mesosuchus (SAM-PK-7416): 0.31
Noteosuchus (Carroll 1976: fig. 5b): 0.29
Nundasuchus (Nesbitt et al. 2014: table 1): 0.30
Ornithosuchus (Walker 1964: fig. 12c): 0.18
Pamelaria dolichotrachela (ISI R136/55): 0.29
Parasuchus hislopi (Chatterjee 1978: ISI collection): 0.22
Petrolacosaurus (Reisz 1981: 45): 0.30
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.23
Prolacerta (BP/1/2676): 0.23
Proterosuchus fergusi (SAM-PK-K140): 0.36
Proterochampsia barrionuevoi (Trotteyn 2011: table 2): 0.18
Protorosaurus (SMNS 55387, cast of Simon/Bartholomäus specimen): 0.23
Riojasuchus tenuisiceps (PVL 3827): 0.33
Riojasuchus tenuisiceps (PVL 3828): 0.24
Shansisuchus shansisuchus (Young 1964: table 8, 31a): 0.30
Shansisuchus shansisuchus (Young 1964: table 8, 31b): 0.28
Shansisuchus shansisuchus (Young 1964: table 8, 31c): 0.32
Silesaurus opolensis (ZPAL AbIII/361/25): 0.16
Simoedosaurus lemoinei (MNHN.F.R3404): 0.24
Simoedosaurus lemoinei (MNHN.F.BR1348): 0.24
Smilosuchus gregorii (Long and Murry 1995: fig. 36b): 0.20
Stenaulorhynchus stockleyi (Huene 1938: plate X, fig. 1a): 0.41
Tanystropheus longobardicus (SMNS unnumbered): 0.13
Tarjadia ruthae (CRILAR-Pv 565): 0.26
Teleocrater rhadinus (NHMUK PV R6795): 0.21
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-140): 0.21
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-694): 0.21
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-067): 0.15
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-826): 0.19
Trilophosauurs buettneri (Spielmann et al. 2008: appendix 10, TMM 31025-67-RR):
0.18
Tropidosuchus romeri (PVL 4601): 0.13
Turfanosuchus dabanensis (IVPP V3237): 0.19
Vancleavea campi (AMNH 30884, cast): 0.22
Yarasuchus deccanensis (ISI R334): 0.21
Youngina (BP/1/3859): 0.11

Discretization by the cluster analysis: (1) 0.08–0.11; (2) 0.13–0.24; (3) 0.26–0.36; (4) 0.39–0.41. (5%=0.02).

Character 516:

Aetosauroides scagliai (PVL 2052): <0.95
Aetosauroides scagliai (PVL 2073): >0.74
Amotosaurus (SMNS 54810): 1.03
Boreopricea (PIN 3708/1 and Tatarinov 1978: 511): 0.80
Chanaresuchus bonapartei (MCZ 4035): 0.74
Chanaresuchus bonapartei (PVL 4575): 0.74
“*Chasmatosaurus*” *yuani* (IVPP V2719): 0.88
“*Chasmatosaurus*” *yuani* (IVPP V4067): 0.63
Cuyosuchus (MCNAM 2669): <0.79
Decuriasuchus quartacolonina (França et al. 2011: fig. 1, specimen b): 0.74
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 0.79
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.55
Dimorphodon (Padian 1983: table 1, YPM 9182): 1.44
Dorosuchus (PIN 1579/61): 0.74
Euparkeria (SAM-PK-5867): 0.86
Euparkeria (SAM-PK-7696): 0.81
Euparkeria (SAM-PK-7707): 0.83
Gracilisuchus (PVL 4597): 0.91
Gualosuchus (PVL 4576): 0.74
Herrerasaurus (MACN-Pv 18060): 0.90
Herrerasaurus (PVL 2566): 0.87
Herrerasaurus (PVSJ 373): 0.91
Heterodontosaurus (SAM-PK-K1332): 1.14
Isalorhynchus genovefae (Whatley 2005: fig. 1-29a, 1-30a): 0.80
Jaxtasuchus salomoni (SMNS 91352): 0.72
Jesairosaurus lehmani (ZAR 15): <0.98
Lagerpeton chanarensis (PULR 06): 1.19
Lagerpeton chanarensis (PVL 4619): 1.17
Macrocnemus bessanii (Rieppel 1989: table 2, AIII/208): 1.01
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2477): 1.06
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2472): 1.08
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T4355): 1.11
Macrocnemus bessanii (Peyer 1937: 91, Alla Cascina): 0.97
Macrocnemus bessanii (Peyer 1937: 91, Besano II): 0.99
Macrocnemus bessanii (Peyer 1937: 94, Tre Fontane 1936): 1.05–1.06
Macrocnemus fuyuanensis (Jiang et al. 2011: table 1, GMPKU-P-3001): 0.98–0.99
Macrocnemus fuyuanensis (Li et al. 2007: table 2, IVPP V 15001): 0.97
Macrocnemus obristi (Fraser and Furrer 2013: table 1): 1.26
Marasuchus lilloensis (PVL 3870): 1.11–1.19
Marasuchus lilloensis (PVL 3871): 1.22–1.27
Mesosuchus (Haughton 1922: 87, SAM-PK-6046): 0.98
Mesosuchus (Dilkes 1998: 518, SAM-PK-7416): 0.83
Noteosuchus (Carroll 1976: 48): 0.90
Nundasuchus (Nesbitt et al. 2014: table 1, length of fibula instead of tibia): 0.71
Pamelaria dolichotrachela (ISI R136/55, 56): 0.84

Parasuchus hislopi (Chatterjee 1978: table 2): 0.64
Petrolacosaurus (Peabody 1952: table 4 for KUV 1428): 1.16
Prestosuchus chiniquensis (UFRGS-PV-0629-T): 0.82
Prolacerta (Gow 1975: 111, BP/1/2676): 1.07
Proterochampsia barrionuevoi (Trotteyn 2011: table 2): 0.70
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, IPB R 535): 0.89
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Nat. Kab. 191): 0.87
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NHMW 1943I4): 0.93
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Simon/Bartholomäus specimen): 0.91
Pseudochampsia ischigualastensis (PVSJ 567): 0.83–0.89
Qianosuchus mixtus (Li et al. 2006: fig. 1b): 0.86
Rhynchosaurus articeps (SHYMS 5): 0.96
Riojasuchus tenuisiceps (PVL 3827): 0.83
Silesaurus opolensis (ZPAL AbIII/362): 0.91
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 265): 0.85–0.88
Tanystropheus longobardicus (PIMUZ T2817): 0.74
Tasmaniosaurus (UTGD 54655): <0.89
Teleocrater rhadinus (NHMUK PV R6795): 0.83–0.86
Ticinosuchus ferox (PIMUZ T2817): 0.72
Trilophosaurus buettneri (Spielmann et al. 2008: fig. 85b): 0.82
Tropidosuchus romeri (PVL 4601): 0.92
Vancleavea campi (Nesbitt et al. 2009: fig. 15): 0.48
Yarasuchus deccanensis (ISI R334): 0.71
Yarasuchus deccanensis (ISI unnumbered): 0.84
Youngina (SAM-PK-K7710a): 1.00
Youngina (SAM-PK-K7710b): 0.95
Youngina (SAM-PK-K7710d): 0.95
Youngina (SAM-PK-K7710e): 1.00

Discretization by the cluster analysis: (1) 0.46–0.55; (2) 0.60–0.65; (3) 0.70–1.27; (4) 1.41–1.46. (5% = 0.05).

Character 556:

Aetosauroides scagliai (PVL 2052): 1.05
Aetosauroides scagliai (PVL 2073): 1.03
Amotosaurus (SMNS 54783a): 0.85
Asilisaurus kongwe (Nesbitt et al. 2010: fig. 2i, j): 0.42
Azendohsaurus madagaskarensis (UA 8-25-98-231): 0.61
Dinocephalosaurus orientalis (Rieppel et al. 2008: fig. 13b): 1.05
Erythrosuchus (NHMUK PV R3592): 0.58
Euparkeria (UMZC T692): 0.48
Gracilisuchus (PVL 4597): 0.89
Herrerasaurus (PVSJ 373): 0.30
Howesia (Carroll 1976: fig. 8): 0.56
Isalorhynchus genovefae (Whatley 2005: fig. 1-31c): ca. 0.28
Macrocnemus bessanii (PIMUZ T4822): 1.20
Macrocnemus bessanii (Rieppel 1989: fig. 8c, PIMUZ T2473): 1.08
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 7): 1.61

Macrocnemus obristi (Fraser and Furrer 2013: fig. 5): 1.70
Marasuchus lilloensis (Serenio and Arcucci 1994: fig. 11): 0.42
Mesosuchus (SAM-PK-7416): 0.55
Nundasuchus (Nesbitt et al. 2014: fig. 12a): 0.63
Pamelaria dolichotrachela (ISI collection): 0.48
Parasuchus hislopi (Chatterjee 1978: ISI collection): 0.59
Petrolacosaurus (Reisz 1981: fig. 24): 0.87
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.64
Prolacerta (BP/1/2676): 0.56
Proterosuchus alexanderi (NMQR 1484): 0.44
Protorosaurus (SMNS 55387, cast of the Simon/Bartholomäus specimen): 0.75
Riojasuchus tenuisiceps (PVL 3827): 0.73
Silesaurus opolensis (ZPAL AbIII/361/18, 20): 0.42–0.43
Smilosuchus gregorii (USNM 18313): 0.54
Stenaulorhynchus stockleyi (Huene 1938: plate XI, fig. 1a): 0.45
Tanystropheus longobardicus (Nosotti 2007: fig. 63, PIMUZ T2480): 0.58
Trilophosauurs buettneri (Spielmann et al. 2008: fig. 91b): 0.71
Tropidosuchus romeri (PVL 4601): 0.44
Vancleavea campi (Nesbitt et al. 2009: fig. 17): 0.46
Youngina (Broom 1921: fig. 20): 0.74

Discretization by the cluster analysis: (1) 0.28–0.33; (2) 0.42–1.22; (3) 1.70. (5%=0.071).

Character 567:

Aetosauroides scagliai (PVL 2052): 0.46
Amotosaurus (SMNS 54783): 0.37
Chanaresuchus bonapartei (Romer 1972a: fig. 2): 0.55
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 0.46
Dimorphodon (Padian 1983: table 1, YPM 350): 0.31
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.55
Euparkeria (SAM-PK-7696): 0.43
Gracilisuchus (PVL 4597): 0.43
Herrerasaurus (PVSJ 373): 0.52
Heterodontosaurus (SAM-PK-K1332): 0.53
Isalorhynchus genovefae (Whatley 2005: fig. 1-28): 0.67
Jaxtasuchus salomoni (SMNS 91352): 0.59
Lagerpeton chanarensis (PULR 06): 0.53
Lagerpeton chanarensis (PVL 4619): 0.53
Macrocnemus bessanii (Rieppel 1989: table 2, A III/208): 0.52
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2473): 0.42
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2477): 0.52
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T2472): 0.47
Macrocnemus bessanii (Rieppel 1989: table 2, PIMUZ T4355): 0.45
Macrocnemus bessanii (Peyer 1937: 91, Alla Cascina specimen): 0.54
Macrocnemus bessanii (Peyer 1937: 94, Tre Fontane specimen 1936): 0.51
Macrocnemus fuyuanensis (Jiang et al. 2011: table 1, GMPKU-P-3001): 0.50–0.51
Macrocnemus fuyuanensis (Li et al. 2007: table 2, IVPP V 15001): 0.50
Macrocnemus obristi (Fraser and Furrer 2013: tables 1, 2, PIMUZ A/III 1467): 0.37
Marasuchus lilloensis (PVL 3870): 0.56

Marasuchus lilloensis (PVL 3871): 0.58
Mesosuchus (SAM-PK-7416): 0.53
Noteosuchus (AM 3591): 0.48
Nundasuchus (Nesbitt et al. 2014: table 1, fibula used instead of tibia): 0.43
Pamelaria dolichotrachelos (ISIR 316/56, 58): 0.37
Parasuchus hislopi (Chatterjee 1978: figs. 12, 13): 0.57
Petrolacosaurus (Peabody 1952: fig. 6a): 0.43
Prestosuchus chiniquensis (UFRGS-PV-0152-T): 0.41
Prolacerta (BP/1/2676): 0.38
Proterochampsia barrionuevoi (Trotteyn 2011: table 2): >0.50
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, IPB R 535): 0.54
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Nat. Kab. 191): 0.21
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NHMW 1943I4):
 0.45–0.51
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Simon/Bartholomäus
 specimen): 0.47
Pseudochampsia ischigualastensis (PVSJ 567): 0.39–0.43
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 0.34
Rhynchosaurus articeps (SHYMS 5): 0.51
Rhynchosaurus articeps (NHMUK PV R1238): 0.52
Riojasuchus tenuisiceps (PVL 3827): 0.45
Silesaurus opolensis (ZPAL AbIII/363): 0.50
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 1018): 0.51
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 265): 0.50–0.51
Tasmaniosaurus (UTGD 54655): >0.41
Ticinosuchus ferox (PIMUZ T2817): 0.40
Trilophosaurus buettneri (Spielmann et al. 2008: figs. 85b, 91a): 0.43
Tropidosuchus romeri (PVL 4601): 0.49
Tropidosuchus romeri (PVL 4606): 0.52
Vancleavea campi (Nesbitt et al. 2009: fig. 15): 0.63
Youngina (Smith and Evans 1996: table 1, SAM-PK-K7710a): 0.54
Youngina (Smith and Evans 1996: table 1, SAM-PK-K7710d): 0.50

Discretization by the cluster analysis: (1) 0.20–0.23; (2) 0.29–0.34; (3) 0.37–0.59; (4)
 0.62–0.67. (5%=0.022).

Character 569:

Aetosauroides scagliai (PVL 2052): 0.69–0.74
Amotosaurus (SMNS 54783a): 0.58
Azendohsaurus madagaskarensis (UA 7-13-99-576): 0.68
Azendohsaurus madagaskarensis (UA 8-28-98-295): 0.65
Chanaresuchus bonapartei (Romer 1972a: fig. 2): 0.42
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 0.66
Dimorphodon (Nesbitt 2011: character 387): ≥ 0.85
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.46
Euparkeria (SAM-PK-7696): 0.63
Euparkeria (SAM-PK-8309): 0.56
 GHG 7433MI: ca. 0.61
Gracilisuchus (PVL 4597): 0.79

Herrerasaurus (PVSJ 373): 0.61
Heterodontosaurus (SAM-PK-K1332): 0.56
Isalorhynchus genovefae (Whatley 2005: fig. 1-32a): 0.34
Lagerpeton chanarensis (PULR 06): 0.17
Lagerpeton chanarensis (PVL 4619): 0.20
Macrocnemus bessanii (Peyer 1937: 91, Alla Cascina specimen): 0.46
Macrocnemus bessanii (Peyer 1937: 93, Besano III specimen): 0.75
Macrocnemus bessanii (Peyer 1937: 94, Tre Fontane specimen 1936): 0.56–0.57
Macrocnemus bessanii (PIMUZ T4822): 0.46
Macrocnemus bessanii (PIMUZ T4355): 0.56
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 7): 0.63
Macrocnemus obristi (Fraser and Furrer 2013: tables 2, PIMUZ A/III 1467): 0.68
Macrocnemus obristi (Fraser and Furrer 2013: tables 3, PIMUZ A/III 722): 0.61
Marasuchus lilloensis (PVL 3870): 0.50
Mesosuchus (SAM-PK-7416): 0.41
Noteosuchus (AM 3591): 0.39
Nundasuchus (Nesbitt et al. 2014: table 1): 0.63
Pamelaria dolichotrachelos (Sen 2003: fig. 14i): 0.47
Parasuchus hislopi (ISI collection): 0.65
Parasuchus hislopi (ISI collection): 0.63
Petrolacosaurus (Reisz 1981: fig. 24a): 0.56
Prolacerta (BP/1/2676): 0.72
Proterosuchus fergusi (SAM-PK-K140): 0.47
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Nat. Kab. 191): 0.53
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NHMW 1943I4): 0.47–0.48
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NMK S180): 0.53
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NMK S180): 0.54
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, PSM 7): 0.56
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Simon/Bartholomäus specimen): 0.51
Pseudochampsia ischigualastensis (PVSJ 567): 0.32–0.33
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 0.75
Rhynchosaurus articeps (SHYMS 5): 0.42
Rhynchosaurus articeps (NHMUK PV R1238): 0.38
Riojasuchus tenuisiceps (PVL 3827): 0.60
Silesaurus opolensis (ZPAL AbIII/363): >0.15
Stenaulorhynchus stockleyi (Huene 1938: plate XI): 0.35
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 1018): 0.74
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 265): 0.66
Ticinosuchus ferox (PIMUZ T2817): 0.72
Trilophosauurs buettneri (Spielmann et al. 2008: fig. 91a): 0.52
Tropidosuchus romeri (PVL 4601): 0.28
Tropidosuchus romeri (PVL 4606): 0.27
Vancleavea campi (Nesbitt et al. 2009: 836): 0.71–0.95
Youngina (Smith and Evans 1996: table 1, SAM-PK-K7710b): 0.40
Youngina (Smith and Evans 1996: table 1, SAM-PK-K7710d): 0.40
Youngina (Broom 1921: fig. 20): 0.55

Discretization by the cluster analysis: (1) 0.17–0.21; (2) 0.27–0.42; (3) 0.46–0.79; (4) 0.93–0.97. (5%=0.04).

Character 571:

Aetosauroides (PVL 2073): 0.98
Aetosauroides (PVL 2052): 0.95
Amotosaurus (SMNS 54783a): 0.76
Amotosaurus (SMNS 90563): 0.83
Azendohsaurus madagaskarensis (Nesbitt et al. 2015: fig. 70): 0.83
Chanaresuchus bonapartei (Romer 1972a: fig. 2f): 0.79
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 0.79
Dimorphodon (NHMUK PV R41212-13): 1.06
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 0.84
Erythrosuchus (BP/1/2096): 1.15
Euparkeria (GPIT 1681/1): 0.85
Euparkeria (SAM-PK-K8309): 0.91
GHG 7433MI: 0.84
Gracilisuchus (PVL 4597): 0.97
Herrerasaurus (PVSJ 373): 0.99
Heterodontosaurus (SAM-PK-K1332): 0.97
Isalorhynchus genovefae (Whatley 2005: fig. 1-32a): 0.49
Lagerpeton (PULR 06): 0.52
Lagerpeton (PVL 4619): 0.53
Macrocnemus bassanii (PIMUZ T4822): 0.67
Macrocnemus bassanii (PIMUZ T4355): 0.73
Macrocnemus bassanii (PIMUZ T2472): 0.71
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 7): 0.79
Macrocnemus obristi (Fraser and Furrer 2013: tables 2, PIMUZ A/III 1467): 0.79
Macrocnemus obristi (Fraser and Furrer 2013: tables 3, PIMUZ A/III 722): 0.71
Marasuchus (PVL 3870): 0.90
Marasuchus (PVL 3871): 0.93
Mesosuchus (SAM-PK-7416): 0.63
Noteosuchus (AM 3591): 0.63
Ornithosuchus (NHMUK PV R2410): 1.00
Pamelaria dolichotrachelos (Sen 2003: fig. 14i): 0.79
Parasuchus hislopi (ISI collection): 0.83
Parasuchus hislopi (ISI collection): 0.84
Petrolacosaurus (Reisz 1981: fig. 21): 0.56
Proterosuchus fergusi (SAM-PK-K140): 0.77
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix 1, IPB R 535): 0.61–0.67
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix 1, Nat. Kab. 191): 0.74
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix 1, NHMW 1974/1635): 0.63–0.68
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix 1, NMK S 180): 0.64
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix 1, NMK S182): 0.68
Prolacerta (Gow 1975: fig. 24g): 0.75
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 1.00
Rhynchosaurus articeps (NHMUK PV R1238): 0.72
Pseudochampsia (PVSJ 567): 1.02

Riojasuchus (PVL 3827): 0.93
Silesaurus (ZPAL AbIII/363): 1.02
Silesaurus (ZPAL AbIII/1930): 0.97
Stenaulorhynchus stockleyi (Huene 1938: plate XI): 0.58
Tanystropheus (Nosotti 2007: table 7): 0.95
Ticinosuchus ferox (PIMUZ T2817): 0.94
Trilophosaurus (Spielmann et al. 2008: fig. 91a): 0.71
Tropidosuchus (PVL 4601): 0.84
Tropidosuchus (PVL 4606): 0.82
Youngina (SAM-PK-K7710a): 0.60
Youngina (SAM-PK-K7710d): 0.61

Discretization by the cluster analysis: (1) 0.49–0.85; (2) 0.90–1.02; (3) 1.06–1.15.
(5%=0.031).

Character 574:

Aetosauroides scagliai (PVL 2052): 1.00
Amotosaurus (SMNS 54783a): 1.15
Azendohsaurus madagaskarensis (UA 7-13-99-576): 1.07
Azendohsaurus madagaskarensis (UA 8-28-98-295): 1.08
Boreoprincea (Benton and Allen 1997: 944): 1.04
Chanaresuchus bonapartei (Romer 1972a: fig. 2): 0.95
Decuriasuchus quartacolonina (França et al. 2011: fig. 3g): 0.95
Diandongosuchus fuyuanensis (Li et al. 2012: table 1): 1.18
Dimorphodon (Padian 1983: table 1, YPM 350): 0.98
Dinocephalosaurus orientalis (Rieppel et al. 2008: table 1): 1.04
Erythrosuchus (BP/1/2096): 0.94
Euparkeria (SAM-PK-7696): 1.06
Euparkeria (SAM-PK-8309): 0.91
GHG 7433MI: ca. 1.00
Gracilisuchus (PVL 4597): 0.95
Herrerasaurus (PVSJ 373): 0.87
Heterodontosaurus (SAM-PK-K1332): 0.90
Isalorhynchus genovefae (Whatley 2005: fig. 1-32a): 1.14
Lagerpeton chanarensis (PULR 06): 1.12
Lagerpeton chanarensis (PVL 4619): 1.13
Macrocnemus bessanii (Peyer 1937: 91, Alla Cascina specimen): 1.16
Macrocnemus bessanii (Peyer 1937: 94, Tre Fontane specimen 1936): 1.17–1.19
Macrocnemus bessanii (PIMUZ T4822): 1.16
Macrocnemus bessanii (PIMUZ T4355): 1.13
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 7): 1.11
Macrocnemus obristi (Fraser and Furrer 2013: tables 2, PIMUZ A/III 1467): 1.12
Macrocnemus obristi (Fraser and Furrer 2013: tables 3, PIMUZ A/III 722): 1.15
Marasuchus lilloensis (PVL 3870): 0.99
Marasuchus lilloensis (PVL 3871): 0.89
Mesosuchus (SAM-PK-7416): 1.18
Noteosuchus (AM 3591): 1.22
Pamelaria dolichotrachelos (Sen 2003: fig. 14i): 1.17
Parasuchus hislopi (ISI collection): 1.04

Parasuchus hislopi (ISI collection): 1.06
Petrolacosaurus (Reisz 1981: fig. 24a): 1.26
Prolacerta (BP/1/2676): 1.24
Proterosuchus fergusi (SAM-PK-K140): 1.11
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, IPB R 535): 1.23–1.33
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Nat. Kab. 191): 1.00
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NHMW 1943I4): 1.16–1.24
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, NMK S180): 1.16
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, PSM 7): 1.26
Protorosaurus (Gottmann-Quesada and Sander 2009: appendix I, Simon/Bartholomäus specimen): 1.20
Pseudochampsia ischigualastensis (PVSJ 567): 0.85–0.92
Qianosuchus mixtus (Li et al. 2006: fig. 1a): 0.89
Rhynchosaurus articeps (SHYMS 5): 1.13
Rhynchosaurus articeps (NHMUK PV R1238): 1.17
Riojasuchus tenuisiceps (PVL 3827): 0.93
Silesaurus opolensis (ZPAL AbIII/361): 0.85
Stenaulorhynchus stockleyi (Huene 1938: plate XI): 1.20
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 1018): 0.96
Ticinosuchus ferox (PIMUZ T2817): 0.95
Trilophosauurs buettneri (Spielmann et al. 2008: fig. 91a): 1.22
Tropidosuchus romeri (PVL 4601): 0.96
Tropidosuchus romeri (PVL 4606): 0.99
Youngina (Smith and Evans 1996: table 1, SAM-PK-K7710a): 1.18
Youngina (Smith and Evans 1996: table 1, SAM-PK-K7710d): 1.20
Youngina (Broom 1921: fig. 20): 1.28

Discretization by the cluster analysis: (1) 0.85–1.00; (2) 1.04–1.08; (3) 1.11–1.28; (4) 1.31–1.34. (5%=0.024).

Character 581:

Amotosaurus (SMNS 54783b): 0.83
Azendohsaurus madagaskarensis (UA 8-25-98-231): ca. 0.94
Chanaresuchus bonapartei (Romer 1972a: fig. 2): 1.42
Heterodontosaurus (SAM-PK-K1332): ca. 1.00
Isalorhynchus genovefae (Whatley 2005: fig. 1-32a): ca. 1.00
Lagerpeton chanarensis (PVL 4619): 0.87
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 7): 0.81
Macrocnemus obristi (Fraser and Furrer 2013: tables 2, PIMUZ A/III 1467): 0.81
Parasuchus hislopi (ISI collection): 0.92
Petrolacosaurus (Peabody 1952: fig. 9): 0.64
Prolacerta (BP/1/2676): 1.06
Protorosaurus (SMNS 55387, cast of Simon/Bartholomäus specimen): 0.77
Protorosaurus (NHMW 1943I4): 0.82
Rhynchosaurus articeps (SHYMS 5): 0.82
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 1018): 0.90
Tanystropheus longobardicus (PIMUZ T2817): 0.88
Trilophosauurs buettneri (Spielmann et al. 2008: fig. 91a): 0.73

Youngina (Smith and Evans 1996: fig. 8a): 0.72

Discretization by the cluster analysis: (1) 0.64–0.77; (2) 0.81–0.83; (3) 0.87–1.44. (5%=0.04). Values between 0.87 and 1.44 were merged together because they were not informative discretized separately.

Character 583:

Amotosaurus (SMNS 54783a): 1.84
Azendohsaurus madagaskarensis (UA 8-25-98-231): 1.45
Euparkeria (SAM-PK-8309): 0.78
Herrerasaurus (PVSJ 373): 0.37
Isalorhynchus genovefae (Whatley 2005: fig. 1-32a): ca. 0.50
Macrocnemus bessanii (PIMUZ T4822): 1.73
Macrocnemus fuyuanensis (Jiang et al. 2011: fig. 7): 1.45
Macrocnemus obristi (Fraser and Furrer 2013: tables 2, PIMUZ A/III 1467): 1.66
Macrocnemus obristi (Fraser and Furrer 2013: tables 3, PIMUZ A/III 722): 1.68
Parasuchus hislopi (ISI collection): 1.42
Petrolacosaurus (Peabody 1952: fig. 9): 1.91
Prolacerta (BP/1/2676): 1.87
Protorosaurus (SMNS 55387, cast of Simon/Bartholomäus specimen): 1.42
Protorosaurus (NHMW 1943I4): 1.86
Protorosaurus (Gottmann-Quesada and Sander 2009: fig. 24, PSM 7): 1.44
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 265): 3.07
Tanystropheus longobardicus (Nosotti 2007: table 5, MSNM BES SC 1018): 2.90
Trilophosauurs buettneri (Spielmann et al. 2008: fig. 91a): 1.74
Stenaulorhynchus stockleyi (Huene 1938: plate XI): 1.13
Youngina (Smith and Evans 1996, fig. 8a): 2.11

Discretization by the cluster analysis: (1) 0.30–0.85; (2) 1.13–3.07. (5%=0.135).

Modifications conducted here in the character list of Ezcurra (2016)

Character 20) The range of state (1) was expanded to 0.43–0.64.

Character 48) A third state was added for this character following Schutlz et al. (2016:

character 14): “Maxilla-jugal, anterior extension of the anguli oris crest: restricted to the jugal (0); extending onto the anterior process of the jugal, but not the maxilla (1); extending onto the maxilla, but not the anterior process of the jugal (2).”

Character 55) The range of state (1) was expanded to 0.28–0.53.

Character 71) The wording of the definition of the character was slightly modified as follows:

“Maxilla, posterior extension in mature individuals in lateral view.”

Character 74) This character was modified as follows: Maxilla, lingual teeth: absent (0); scattered teeth (1); large number of teeth on the medial surface of the bone (2).

Character 75) This character was modified as follows: Maxilla, number of tooth positions:

4–7 (0); 8–9 (1); 10–14 (2); 15–22 (3); 23–35 (4); 36–40 (5).

Character 76) The range of state (1) was expanded to 0.90–2.07.

Character 85) This character was modified as follows: Lacrimal, facial contribution: forms a portion of lateral surface of the face, reaching anteriorly to the external naris (0); forms a portion of the lateral surface of the face, but does not reach naris (1); limited to orbital margin (2).

Character 118) This character was merged to character 119, becoming an unordered multistate character as follows: “Frontal, dorsal surface adjacent to sutures with the postfrontal (if present) and parietal: flat to slightly concave (0); longitudinally extended groove along most of the surface of the frontal (1); anterolaterally-to-posteromedially extended groove along the posterior half of the frontal (2).” As a result, character 119 is deactivated from the analysis.

Character 119) This character was deactivated a priori from the analysis (see character 118), but it is kept in the character list to keep the same enumeration of Ezcurra (2016).

Character 124) The wording of state (1) was modified as follows “markedly concave” instead of “depression with deep pits.”

Character 263) The range of the third state (2) was extended to 0.62 and restricted to 0.78 and a fourth state (3) with a range of 0.88–0.94 was added.

Character 266) The range of state (3) was expanded to 0.32–0.36.

Character 278) A third state (2) “completely absent” was added.

Character 322) A third state (2) “concave” was added.

Character 377) The range of state (2) was expanded to 1.51–1.73.

Character 379) The range of state (3) was expanded to 3.21–3.54.

Character 387) A third state “>13.0” was added here to include the condition present in

Erpetosuchus granti. This is now a multistate character and was considered ordered.

Character 435) The range of state (3) was expanded to 1.05–1.17.

Character 446) The range of states of the character were modified as follows: 0.34–0.45 (0), 0.54–0.59 (1) and 0.74–0.98 (2).

Character 470) A third state “absent” was added.

Character 472) The range of state (1) was expanded to 2.73–3.43.

Character 485) A third state “extensive contact and the dorsal margins contact each other” was added.

Character 497) State (0) was reworded as “present and small” and the additional state “present and largest of the proximal tubera” was included. As a result, the modified character is now multistate and non-additive, as in Nesbitt (2011: character 301).

Character 556) The original character states (1) and (2) were merged together and an additional state (>1.50) was added.

Character 567) The range of state (1) was expanded to 0.29–0.34.

Character 569) The original states (1) and (2) were merged into a single state.

Character 571) The states of this character were re-discretized as follows: 0.49–0.85 (0), 0.90–1.02 (1), and 1.06–1.15 (2) based on a new cluster analysis.

Character 583) The range of state (1) was expanded to 1.13–3.07.

Scorings changed here in the data matrix of Ezcurra (2016)

All the scorings changed by Nesbitt et al. (2017) from the original data matrix of Ezcurra (2016) were followed here. In addition, the following changes were conducted here:

Aetosauroides scagliai

Character 588: changed from (2) to (3) due to the presence of lateral osteoderms adjacent to the pair of paramedian osteoderms.

Archeopelta arborensis

Characters 213, 220, 248, and 511: changed from (0) to (1).

Characters 221, 375, 455, 464, 466, 467, and 518: changed from (0) to (?).

Character 321: changed from (0) to (?) because the condition cannot be confidently determined in the very poorly preserved dorsal series of the holotype, neither in the neural spines that are heavily covered with matrix in the block with the articulated osteoderms.

Character 322, 323, and 365: changed from (-) to (?). See discussion in character 321.

Characters 458–460, 517, and 519: changed from (1) to (?).

Characters 498 and 512: changed from (1) to (0).

Character 588: changed from (2/3) to (3) because there are lateral osteoderms preserved in the holotype.

Asperoris mnyama

Character 5: changed from (1) to (2).

Azendohsaurus madagaskarensis

Character 118: changed from (1) to (2).

Bentonyx sidensis

Character 118: changed from (1) to (2).

Character 287: changed from (1) to (?).

Eohyosaurus wolvaardti

Character 48: changed from (1) to (2).

Character 287: changed from (1) to (0).

Gephyrosaurus bridensis and *Planocephalosaurus robinsonae*

Character 85: changed from (1) to (2).

Howesia browni

Character 287: changed from (1) to (0).

Character 330: changed from (0) to (1).

Lagerpeton chanarensis

Character 497: changed from (0) to (1).

Lewisuchus admixtus

Character 299: changed from (4) to (1).

Macrocnemus bassanii

Character 37: changed from (1) to (0).

Character 42: changed from (1) to (0). Kuhn-Schnyder (1962) and Jiang et al. (2011) described the presence of 13 premaxillary teeth in this species.

Character 61: changed from (1) to (?). The condition of this character-state is not clear in studied specimens, neither in the bibliography.

Character 123: changed from (0) to (1) based on the interpretation of Rieppel and Gronowski (1981: fig. 1).

Character 370: changed from (1) to (0).

Mesosuchus browni

Character 45: changed from (?) to (0).

Character 330: changed from (0) to (1). Change based on SAM-PK-6536.

Ornithosuchus woodwardi

Character 94: changed from (0) to (1).

Character 271: changed from (0) to (1).

Prestosuchus chiniquensis

Character 97: changed from (0) to (1).

Proterosuchus fergusi

Character 480: changed from (?) to (0).

Character 481: changed from (?) to (-).

Rhynchosaurus articeps

Character 48: changed from (1) to (2).

Character 118: changed from (1) to (2).

Character 188: changed from (1) to (?).

Character 189: changed from (-) to (?).

Character 287: changed from (1) to (0).

Character 451: changed from (0) to (1) based on NHMUK PV R1238.

Riojasuchus tenuisiceps

Character 94: changed from (0) to (1).

Character 268: changed from (1) to (0).

Character 271: changed from (0) to (1).

Character 294: changed from (?) to (0).

Silesaurus opolensis

Character 497: changed from (0&1) to (0&2).

Smilosuchus spp.

Character 478: changed from (2) to (?).

Tanystropheus longobardicus

Character 37: changed from (1) to (0).

Character 80: changed from (0) to (1). Jiang et al. (2011) described the presence of a nasal groove (an unornamented depression that extends longitudinally on the nasal from the posterior border of the external naris) in this species.

Data matrix used for the phylogenetic analysis

For TNT and NEXUS files of the phylogenetic data set see Extended Data 2 and 3.

Petrolacosaurus kansensis

0000110000010-0000101000000200000100---00[1 2]10000-0--10---0---0---0-000-0001000400000-0-
000--0000000-00000-?03?0100001101-0-000000000-000000-0000--000?0001???1101-0-
0100000000000-0-0?-10001000000000000110?0000010001000?00000?00-00-
10?00?2?0???0?100?--?????0-000-0000101010-0-1000010-
00100000?0000000000001000000?0000020--00010110100?010100100100-0010200000??2[0
1]0110010000?0030000?00?0?010010100?20000-
0001000000000?1000000001012?00011000000010?02000000000?00001001110000000020-10-
20?00001?0000?????00001000??2001??200?00000?000?000000000?0000-----
00010000100001202?0002?101??00100000-----00??00000000000-----00-
00000000000?000?0000?100--10-00-00000000?10--0???000

Acerosodontosaurus piveteaui

0?0?????????0-?0?0???--???--?????--0???0??10005???????-010--
000?000-
??000000?0?????0?1?1???000?00?????00?0?????????0002?????????????1?????????????????0-??0?-
?????????????????????0???0???00-
???2?????????????00?10?0?0?????000??100?00000?000000?0000000--??0?????????00?1???0?-
?0?0011?01000000001-001?????1???????0?????????????????????????0?????????????????????101000-
?00?110000001??0100?????00?100-010000010?001020-00-?????0??2?000??-
??00000000?0??1???0?????????0???
???0-----00??0???0?0?0?-----?0-0?0???0?????????????????0--??-0???00000???1--?????0?

Youngina capensis

?0000-0000010-000011?00000010100?11110-01300000-1--00---0-0-0-00?0001000410000-0-010--
??10100-100100000000000001101-0-000100100-1000010101000000200010020001101-0-
010000000000002000?-00000000100000100101000?00100011001000011001000-1000002-
0000010100?--0000000-000-00?010?[0 1]10-0-?0000110?00000010?00010010[0 1]0[0
1]000?0000?0000000--0??0???0000000100000-00-0?11000000000001-001?00?11[0
1]0100001201000100?0?00020000-?000010001000000000?1101000-
00?11100?00110101000000000100-0000011100001020-00-001000012000000-
0100??0000?00111?0200?00?????0??1000000???0000-----0001000010000120[1
2]00002?00100001000010-001-200-000?0?000000?00-----00-0000000-000000000-000?0??-??-
0?????0?00?011--0000?0?

Paliguana whitei

??000-00?????0-?000???0?????????????????????0?????????--???--?????--???????1?????0?????0??--
???0100-?00??????????00??10?00-??10000?010000010?????????10?00???????2-??-???000002-
1??22?0???0?????????0?????????2?????????????????????????????????????0?????????????????????????????0-
??0-
?0??00?????????00???0?0?????????????????200000???
???
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???000?????
?????????0?0?000-000?0?????????0??-??-?????????????????????????????

Planocephalosaurus robinsonae

0?000-0000000-0000?01000000201000100---00210?00-?-10---10011--000-0001000300000-0-020--
??00001-00-10010?0000001010100-0011000200000001000010001010000-----2-10-0-0100?002-
10022000?00?000001101012-00002000?0??0?????????0??01010-
10??0?0?000????110?????????020-?02200?00110-0000--2010000-011????1301020[0
1]000?0000?0000000--
??1?001?000?00?1??0?0?00?00?2?00000010101?001?00?1111??00?0000001101001020000-
101?01??0??0??0????100????????????????????????000?00-0100101101000000-0--
10???01????0???-??0000000?0?1??????0?????????-1000001??1?00-----
0?0?????????????????01111?????????????????0?00?10000000-----0--0000001-000-
00????00?00---0-????000000??1--0???00?

Gephyrosaurus bridensis

0?00110000010-0000?00000000101000100---00110?00-1--10---10001--000-0001000500000-0-020-
-0000001-00-10000-0000001110000-001100020000000100010100000000[0 1]000--02-10-0-
0100?0?2-10021000?000000001101011-0010200010??0??????0000?01010-
10000?0?000??10110?01??????020-00020010011[1
2]11000012010010101100??12010200010?0000?00000?????1000?00000000000?0?00?00?3001
000010101?001?0011011?0??01[0 1]0?0?01?0110???200?0-
100001??0?0??0????100????????????????????????0?0?00-0?00000101???000-1--
???0000??00?0????00001000?0?1??????0?????0?000?-100000?0?1?00-----
0?0?????00????????????11111?[0 1]??1?1?????????????0?0?010000000-----0--0000001-
000?00??00??100--10-?001000?000?1--00?00?

Cteniogenys sp.

0?10100010??0-??00??00?[0 1]??[3 4]?000?000---00[1 2]00??0-0--10--?1[0 1]101--000-
00010004?0????-010--0100000-000100?00?1-0000-102-0-0?10010?0-
000001?????0??0??10?3??1??00-0-2-?0?0?2-
???130?0000101?000?0??01000??0??10??0??2????0000??010?1000000?0?000?0?0120?01?0??
????000-
?0?01000?11??00001????0?????????0010000100?101??00000?????002????000?????0??????
???110010?????????????????0????00????????????????????????0000000?1111-
1?00?????????????????0?0?00-0?000101?????????????????00?000-
0100000000??
?????????????????[0 1]???0000000-----0--000001100????????000?000--??-
??????0?0?0??1??0?????

Simoesosaurus lemoinei

0?100-0010200-000030?000011?0?000--0---00301?00-0--?0---10001--000-00000005101?0-0-010--
??00000-00-11000201-0000-102-0-002--1000-0000011000010000000110020022-00-0-2-101102-
1001?0100?01010000?0103--0011000010110001200101000101101101000000-
0000010120?01?000-0?000-00010000110[1
2]01000011000000101010??0010100000?101000000010[0 1]-100000001000000100000-
???0010001000000001-?0111010-0?1000?1?1100011101000020000-?01101010??001000100111[0
1]00[1 2]1000?110?????????????000?0000110000100?01000-0--
?000000?00000000100001000?0111001?00100000000?0?0????????????????????????
????????????????????????????????00000?000?000-----00-000001--000010000?00?100--10-
0?01101000?11--000100?

Aenigmastropheus parringtoni

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2]????????????000?1????????????1???100?000?0????????????????????????????????????
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Protorosaurus speneri

?0000-0200010-000011??0000020100?10110-0?300?00-1--10---10???--00??0001000410000-0-01?-
-0000000-0000??00-00000000100-0-??0000000-0000010001?100000000??????2-[0 1]0-0-[0 1
2]?10000??10012?00?0?0?200?????[0
1]????????????010?0110010????????1????????????????????????????????000-?0?2000010-[1
2]010000020000?00010?????0010[0 1]00000?100101111020--0?0[0 1]0011?1000[0
1]?100110310?2110?100010010010101?0000-000000?100000011011?00011010-
?0000000?0010?000000111101201?011000000101202?00010????0[0 1]?0?000??00??1?20-?0-
???0011?00?0??-??0?0000?1101???20??000??010??20000001??0000-----
00010000001001[0 2]020000[0 2 3]?11100[0 1]0100000-----000??0?0000?000-----?0-
00000000000?0?0?0????00--1?-010000000??0?--0???00?

Amotosaurus rotfeldensis

0-?0100????????10????[0 1]0?0????????????0110?00-
???0???1110???00?000?0004???????0??????0000?00?0?000-
00?0?001?0??2000??
003--00102????????????????????0?????????0?0?0????1?000????????000-00?200?010-0-
?0000?0000??0?????100101001?011001?1100?00--1???1112210??0?10?111-1??211[1
2]00?001??0011-[0 1]01000111??20???01?00110000?00010000-????????1?0?0000?1?0??1-
1?[0 1]?0?100??????000?0?0??0???0100111000101001100-0--
10??001???0??????00000000?1??1???20????????01????0??0??0??0?0-----
00012101??1111202?0002?011??1?110[0 1]00-----000?0?0?0?0?000-----
???0000????????????0?00--??-01?0?0?00?0?1--0????0?

Macrocnemus bassanii

00000-0200010-0000?10?0000120000?0020000000?00-?--1?---1110?--00??00010004?0?0?-?0?0-
-???0000-000??????000000110100-01010100000100010?00??????0?0????????01-0-2-
10?0????0?1???0?0?0?0010???001200????????????0?0????????????????????????
????????000-?0?0?000?????0000????00?00??????001000000011001?1?10000--
1???1111210?10?111110-[0 1]?21130?0001000011-1010001111020?00101?0011?000?0??10000-
10110000000?0??000??0111-0-000[1 2]100?????100?0000000?01011011101[0 1]101001020-
00?10??0011[2 3]?0?0????0000----?1??1???2???00?0?0?010??00000001??0000-----
00011100001111202?0002?12011?0100000-----000?0??0000?000-----00-
0000000?000?0??0?0?0?100--10-01100?0?0000?1--0???000

Tanystropheus longobardicus

0-000-0200010-0[0 1]1001?00000120000?0020000010??00-0--00---11101--000-3001000210001-0-
010--0000100-0001?000-0001000111000-01110[0 1]01000[0 1]0001000-1001-----00-----??11-0-0[0
2]1000?2-10011000?0?0002[0 1]1010005-2-
010200??0010101?00??0?00?00?01?10????????0?1?000?11??10-?0-000-?002000010-0-
10000120000000010?01110[0 1]1[0 1][0 1 2]0010[0 1]1100101111000--2?0111132100101110111-
11?212?200001000011-10100010-10[1 2 3]100010110011[0 1]000?00010000-

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?0000-02000010-0[0 1]010?21001-1200010?02000?150-000-0-010---10101--10?01010002?1000-0-
010--??0001-00-0?0?-??-001010110000-??01000001?00001010-1001-----11?-?-??2-00-0-??101002-
10012001?100????1-1???1----
0?????1?0101001?030100010111110000?1101000??1?000?11???????020-
102200?0?????110001111000100?0?01111010200000?100100011000--0?11000021001?1100010-
01???11[0 1]000-11000001-00100000-101000012000[0 1]011101000020100-
100000011?010000110011110110010110000?0001102001110000[2 3]00-0110[0 1]00100001000-1-
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10000001200000100100001000?010000120010000010010?02000000??0001100000000001100000

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1001202?0002?120??00101010-----00000000010?000-----0--10-00000000-00000010??10--10-01100110000001--000000?

Noteosuchus colletti

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1]??0000?1?1??001?0?1000111?0200?0?0????????????????????
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1]0010000??2????01??0?00??100000-
0100000000?0201101200100000?01????200?000?0000110000000000?[0
1]000001?01201?0002?12010?0?000?0-----
000?00?0??00000-1??--000000?

Mesosuchus browni

0000100110210-0110101000201111001--200010400000-0-010---10001--00100101010-00000-0-
010--0100000-01010000-00000001000010??10101001000101000000000010001000-02001010-
00101002-
1001200000000011000000000000112010110100011112010?01?110110100?0101000?10100?1???
110?0-000-00?000?01????002100210110010100???01010-00010?1001?0000000--
1?010010110010?100000-1???110000?01??1001-0010001101020[2 3]?00000[0
1]011100?00010000-10100001000????????????1111-0-
00??10000??0??0200?0?00020100100001100001010-0000000?00??100000-
0100000000?020110120010000010?10?1200?0000?00011000000000011000001?0120100002?120
?0?0?00000-----000?00000000000--0-----00-00000000000000000000?000--10-00110000000101-
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Howesia browni

0?00100210?????[0 1]10[0 1]?000????????????????1????????????????1???1??00??1??1111-
?0100?0?010????00000?010?0000-00000001000-10001010?00-
000?01000?00000000?0?????0?10-0-1??0?0?2-1?0120?0?0?0??000?0[0
1]001000102010010100?1?11??1?0???101???00?0?0?000??1?000?????????0-[0 1]0-
????????????????21??21?0?01?0?0???10?0-00010?1?0?????????????0[1
2]001?????????????????????0?00??1??1???0?000?101??0[1
2]0?0011?000?000??0010?????01001?????1?????????01?????????????????????????0?0?01001
00000100001020-00010??00??0?000-
0??0000000?0?011?1?00100000?0010?1200?00?0?000110?0000000011000001?01?0???00??120?
??0?0???0-----?0?00000000?00--0----00?00000000000??0?0?00?????-?0-????000?0?001--
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Eohyosaurus wolvaardti

?000?02??????110[0 1]????????????????????12????????????????0???1??1111-
????????????????100000?01110000-0??????????-??00[0 1]?0100-
100101000000000011001001002001?-????1?1?02-1??12000000?0?201??0??[0 2
5]??0??????0?0?11????????????????????????????????????00-???1????10-[1
2]0??210021010?1101?????1???-
000101??
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Rhynchosaurus articeps

0000100210210-00200010-12-1-2-000--20002?5--?0121-010---10001--00??1101111-10100-0-010--
0100100-00111000-00000000000-21??1000100-1001010000100000000010010020110-0-2-100002-
1001?00000000?3??0?000----
0102??1111??00111???????0?1?1?0???01?000???0000???0?1?????120-
?0?10000?????0122002?0?000101000?01010-000101100??0000000--1?????0?10?00?10000?-
11???1?000?0100000?-1?00011110?0[0
1]0?0010000011?0?0001000111010000100010?00000011111-
0?000110000????1?01?01?010?0?0100?001[0 1]0100?010?0-
0??10??00?3?0???????000000000??[0
1]???20??0000???1???2?0?00?0?0?110?0?00000?100?0?001201?0002?110?01?000?0-----
-00000?000000000?00??0?00-00000100110000????00??1??-10-00?10110000001--0??????

Bentonyx sidensis

0?000-0210210-00200010-12-1-2-000--20002?5--?0101-010---1000?--00??1?01111-10100-0-010--
01?1000-001?1?????0000000000-21??1010100-100101000?10?00????0???????1110-0-2-100002-
1001?000???00131-0?000----01?2?????1???0111?[0
2]0?????1?110110000?010?1??????100???????????120-
?0?100?01?????122????0?????????????1?1?-
00010??
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??0011000?10110?01-10010101110?000?1?10??120-??-
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Mesodapedon kuttyi

0??0??0????1???112-
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00010??
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Ammorhynchus navajoi

0??0???????0-0????????????????????2??0?????0???-?00---1000?--??0-110?112-??????-???--
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00010??
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2]????-????????????????

Stenaulorhynchus stockleyi

0?000-0210210-00200010-12-1-2-000--2000205--?0121-010---10001--00??1?01112-101?0-0-010--
???1100-00101000-00000000000-21??10001001100101000010000000001?0?102??10-0-2-100002-
1001?000?000?3000?01042-

Brasinorhynchus mariantensis

Chanares rhynchosaur

Langeronyx brodiei

Fodonyx spenceri

[illegible]

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00000-0[1 2]00010-0[0 1]10111001201210?00?0210001100000-?-010---100?0--000-
000100041000?-0-010--0000100-010100[0 1]0-0000000110100-
0010000000100001010000000000001000-011101[0 1]0-[0 1 2]0101002-1001[1
2]00001101000001100000011010110?01000111000110000010110[0
1]000002100010101000110011000-000-0000100010-0-
000000210001110100011110100010001100111010020--1001101121000[0 1][0 1]1011103011[1
2]111000001001001200100011010100?0??0000010000000011000-101100010?000000100010111-
0-0??11000??0??1?01000?000010100[1 2 3]01001100001020-00-1000001??100000-
0100000000001001012001000001??10?120010000?0001100000?00001100000110120200002?120
??20100000-----00000000000?000-----00-000000000000000001000100--10-01000100000011-
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Kadimakara australiensis

???00-?1????0-???01?????????????????????0-?-???-?1000?-0???[0 3]??[0 1]00?????????0-
???-???????-?????????00???0???100-??[0 1]00?00?0?????101000?0000[0 1]00?1000-01[0
1]?0111000101002-
1?????0?????????????????????????????0???10?????????0?????????0?2?000?????100?????????
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00-----?-????0?00000?????0?0?????1?-?????????????????????????????

Boreopricea funerea

??000-0?????0-?0?0[0 1]??00?????????????2???011???00-?-???-1000?-00???0??100?4?0????0-
010--?-?-?00-0?-0-----0000000100?0-0?000?000?000010????00???????1000-?1???????1010?0?2-
10?12000?10?1?[0 1
2]0???1?????1???00?????1?????????????000-
00?200?????????00???0???01?????[0 2 4]01000?0?0?1001?1000020--
???0???0210010010???00[1 2]1???11?00000100100?[2 3
4]?1?????????????0???100001?0000000???????0?00???100?0000000?0111-0-
0???1100???????20?0?00?0?????????????????????????????????????13?0?????????????????010?????2?
0?0?0???1?01?02???000???00110000000000?1???000?01?0?0?001012010?0?0000?????????????
0?0000?0?00-----0?-0?100?00????0?????????????-???0?100?0?0?????????????0?

Archosaurus rossicus holotype

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Proterosuchus fergusi

[0 1]?000-01000110021021110121122001011201001101000-010100--
110000200100000000420000-0-0101100001000000201100[0 1]000000000000-
??100010001000010101000000100010[0 1][0 1]-02110[0 1][0 1]11[1
2]010100011001200001001?0001100000010010110100001111000101?00010110101?012100000
10101?111?11?01?0010001110?01110-00000111010110010101111010011000110011100[0 1]020-
-100[0 1]0010110[0 1]0[1 2]0100000201?210?01001110[1 2]001[0
2]001?????1?????0?0?????????????????????01101100?????????????????01000?1000100???102
00?0?????????????????????????????0-?????????100010-
010000000000201101?001?????????????2001000000001100?????000?1000001?01?02000020?2???0
?0?00000??-----00???0?00000000-----01000000000001000001001?00-010001000?0?00????-
?0000??

Proterosuchus goweri

[0 1]?000-010001100210[2 3]1[0 1]00121122?010?1??1?01101000-010?00--
11?0002001021000004?00???0-01011000???0???00120?10???0000000?0000-
00100?1000?00010?01???000?0001???????000111010100011???130000100112000?1000[0
1]?01???01?0101001111030101?0?010110101?01210000010101???1?110?10?????????????????
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[illegible]

[illegible][illegible][illegible][illegible][illegible]

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Fugusuchus hejiapanensis

?000-00?0??100210[2 3]1?10?????????????????0?????00-[1 2]?00--
110000200??0?010003?0?0?-000?011??00000010010011??00000?200?-0-
??100010001000010?01??00001000???????????-0-2-
1010?011?????0???????????01?????????????????100011111100-
01100011110001?01111001010101??1??110??10100?
10?0?????????????????????0??
???0?00??100?????????????00????????????????
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0100000000000?0?000?001??

Sarmatosuchus otschevi

2?000-0?0001?????0[2 3]???????1220010?0201??110?????????????????????????????????0??[2
3]?????????????????????00?00?[1 2]0??1???????0?0???00?????0???????10?01?00000[1
2]0001?????????????????1?1???????12000110????0001??00?000002?????0?0111?1000-
01?00111110000?1111000?0?0000??1??110???0[0
1]???0211001?????000?????????????????????10???21000?1001110111101-[1 2]?1001011000[0
1]0100000-01????0001??110?00?-?????????????????0????100010000000010000-
?????????????????????????????01000??
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???000010?1?0????????????????

Guchengosuchus shiguaiensis

?001000?00?101???[2 3]?1[0 1]???????????2??20?????0??010010-011-??020?10001[0
1]0002?0000000?1?????????????????????????????0??00-0-00[0 1]?0????-
?????????????????????????????00-0-2-10110[0 1]?1???????????????1-0???0----
00?2?????0?1?11?10??-
?????????????????????????????0??1?1100?????????????????????????0?1??20?????0?1???1010021
000?10011?111?100-???1????[1 2]10001010?010-?11[1 2]1???????10200?-
?00?????????????????1?00?01?00?????????????????????1?????????011??0?0???101????????
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???0????00-----
???????000?00???00?0???1?????00???00?1?0????????????

Cuyosuchus huenei

???0?????????????0??
?????????10?20?0??
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??100111110101-???????1?0001?10?00-
?1???10010011?01001-??00?0111?10[0 1]0??[0 1]1?0?00?0???0010000-
?????????????10000000?10111-0100???0?????????????????0?0[0
1]0110110100100000021?0001?00?0?[1 2 3]210?000001?0???????0[0 1 2]11100[0 1
2]001000001001111??10????????[1
2]00000?????????????????????0?????????????????????????????0?00011?000011-0000100?

Garjainia prima

[illegible]

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4]????????0?1?0?11????????[1
2]???0110????0????????0???00?1?0???1???0?????????????1?0000110???0010000-
????????????1100000?0101?1-
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???????00-----????????????????????????0????????????11????????????????

Chalishevia cothurnata

2?000-???00?101???????[0 1]1[1 2]????????2??20?????1??0?1012?112-
??12??10211?0002??00010??1??
????1????2????????????????01?0?0010????????????????????????????????????
??00?0????????4???021000?110??110?
0????????????1?0?00?0????????0?010????0????????????????????????????
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Youngosuchus sinensis

??000-010001100210[1 2 3]111000001100000011000?200?00-01-012--
111000101??001100?220011-0001002??0101011001001000000000101000-
??100010110001010000010000100010020022-?010-2-101102-
10012000001????????????????0???10?1??111?????????1????????????
?0010?0200??11????000001110200000?????1[0 2 4]010021000?10011??11?0[0
2]??1???00?0110?0101??000-1112????????????0????????????110[0
1]001101??00100110????????100000001101[1 2]1-
0?0?12100??
??0?
?000?000---?---0100000000000?00?0?0????0?0110?000????????????

Uralosaurus magnus

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0002??0???0210001?????000????
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Vancleavea campi

2000100-00110-0100101?110011000001020000?1???00-0--00--11001--0-1?010000?200000-0-----
??00000-01010000?0000000-?02-0-??2--0100--000010-01110000000-10020022-00-0-??00?002-
1011001000? ?????????????????0?1??111???100??0010110000????????????1??1??
1?00???03200?010-[1 2]10000001100???001?????14001-21000?1?0???00?00--
???1???1???10?10???0-1???1?3100?100[0 1]00?-
??0?00??????00?21100001100010????????????000?00000110121-
1?0000100??????2?101????000?00-001010010?0??????10?0?00220000000010000----
00111100010100000100???101010001000011000000000012110??1?0?30[2

[illegible]

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??0010100010010200000112100????????
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??0010??

Teleocrater rhadinus

2?000-0?????100?0?????0????????????????????????[0 1]?0020-
1?0??010021000?0001????????????????????????????????????0?10110-
00??130?0100????????????????
?0?0??1?10???110???10?10000????????????????1????????????????????????????????
????4????21????100111111000--??01001?210010010?010-1???11001?101101001-1???00?0-
1010?00????01?01100010????????????????10000000110111-
00010?00????????????000?0212???0010?0????????011000?00101000100102000001121
00200100000101110011???0????0011010001001????????????????????????????????
??111110?0?000-----?????0????????0?0?0????????00100011?00??1?000100?

Spondylosoma absconditum

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??1?01?1111000--????????0??1?10??10-
1????1??100?110???1?1?0101??1????????1????011000????????????00101????????
????????????????????????????????????0?01?[1
2]1????????????????????????0?11100????????????????????????????????????
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?????000?1?0????????0100?

Proterochampsia barrionuevoi

?21[0 1]202000111001?0311010011210010?021000?100100-?2-0?12-1100100001?0?020002[1
2]000000001000?-000000000100000000000[0 1]100-0-??2--0100-
0000010001000000100010020022-00-0-2-101002-10?1?0?00000102000?01042-
10102?101101011111040-0?01?110111001?0?20001??100000???????1?001?00?0001?10-
110?000?0-031000000?0???40100[1 2]10?0?1000?0000?00--[0 1]?021000110?0?10?000-11?[1
2]?11000?110000?-10000?0-1????0?00?0?001100?00100?0-????????01000000?1101[1 2]1-
0-
???11????????????????0????????????00????????????2001?????1?0002?00?01121?021
00000011??10?2?1-00?0?0????????????????????1[2 3]????????????0000-----
00???000000000-----01010000-0000000000?001?00-0100000011?0????????010??

Proterochampsia nodosa

2?1120200011100110312010?11?10?1??021000?100?00-????0--110010000?0?0200022000100-
01000??000000000?0?00?000000??100-0-????0100-?000010001?00?00?0?0100[2 3]0022-?0-
????10100??1001?00001001?2?0???0???0????????0???1111????????????????????
????????????001000?000????1?0?00?0-
031?0000?0???40100?00?0??
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??000?000---??---010100010-
000000??0????0?010????????????????????

Tropidosuchus romeri

?000202100111[0 1]0010[1 2]1?0100??00010102?000?100?00-11-0000-
110010100??0?0100?2?0001?0001010?0000011012000000000000010000-??2--
01000010101010[0 1]000000100110121022-0?00-2-10100??1001[2 3]000000??00011[0
1]002210102?????0?0??111040?0??1?110111000?0?2?000??1?000?????????0011?0?201?0????
??0?01?2??3????110?0???[0 2 4]0100[1 2]1000?1001?0000000--100200?0110?00?100010-
11???110100?1??0011-10?00010-10[1 2]1000??11000011??0?00000?0-
?0????????10?000?1?0111-
0?0??11????????????????000?0110????00100001011300010?0?001?0010000??00002000?0111
1?02100000011011101211-0001000011101000000012110001?01201001100000???2--00010-101-
0??-0?00?000000?000---??---01000000-00000000?0?00?0?0??000000100000001-0000100?

Cerritosaurus binsfeldi

?0020200011110110[1 2 3]11010??1110?1?10210?0?1???00-12?0011-
110?10100??000100?2?0001?0001002??000000100100000000000001??-0-??2--0100-
010101010??110001001100310?2-0?-0-2-
1010???10013000?00????????????????????0???1111????????????????????????????
??????????11??2????????????00?11?3???001??????[0 2 4]010[0
1]01000????????????1????????000????0????????????1??0?0??0????????????????
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????????????????????????10-???-1??-????????000?000---??---0100?0000??00000??0????0?????-
0?00????????????????????

Gualosuchus reigi

2?0021210011110210[2 3]1002000121001010210001100?00-11-000--
110010300100101000210001-0-01000?01000010[0 1]1000000000000010000-002--
01000000111010[0 1]?11000100110021022-0010-2-101002-
10012000000010200011?002210102011110?01?1110?0-
?0???110111000?0?2?0????1?000????????0012000201?010-
1100001?1003000011000??14010001000?1001?0000000--10020000110?000100000-11?2?0[0
1]0100?1??0001-100????????????0100[0 1]00110001[0 1]010010-?????????10?0100?1?0121-
????????????????????????????????000?????????0?001300100000100002001?0[1
2]1110121000000110110?1????????????????0?????????1?????????????0?10-011-
100-0??0?00?0000000-----010000000-0000[0 1]000?0?00?00-010-00000?0?0????-0000000?

Chanaresuchus bonapartei

21[0 1]0212[0 1]0011100210310020001[2 3]1001010210001100100-1[1 2]-000--
110010100100101000310001-0-01002?-0100001001000000000000010200-??2--010000001[0
1]10100011000100110121022-0010-2-101002-10012000000010200001[0
1]002210002?10110101111020-00?1011011100000121000??1?000??1?????1?00110002010010-
1100001?110300[0 1]011000??14010011000?100001100000--100200[0 1]0110?00?100000-
11?2?[0 1]0010011000001-10000110-102100?0?1101001100010010010-
?????????010001000110121-
?????1????????????????0001011010010010000101130001000000[1
2]400100000100002001001111?021000000110110?1211-
0000000011101000000?2111?0110120100110?000??22--00010-011-000-0000000000000000-----
010000000-00000000000001000-010000000100000001-00000000

Pseudochampsia ischigualastensis

?11021210011110?10[1 2 3]1?020001210010?02100??10??00-?2-000--110?0100?0101000[3
4]20001?0-0??0?0100001001000000000000010000-??2--
010000?01110101000000100110121022-?010-2-

[illegible]

??3111??11101?????
??0001001-----011101000000001?0????00?00??1??-00000???????????????????

Erpetosuchus sp.

??00?????????11??[1 2]0?????????????????????????????????0-?1?00[1 2
3]2?11???010???0?0200?0????????????2??0200001002?010?1?????????????????0????0000???
?0???0??????1002002??
??1????????????21???00110????????????????[0 2
4]0100?0000??
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??001-----
?11?01?????????1?????????????1?????????????????????????????????

Dyoplax arenaceus

?00????00011100???1?0??????[0 1]?0?????????????00-????31-
?????0????????????????????????????2????00?1???1?????????????????00????????????????
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????????????????????????????????????1????????????????[0
1]?00?????0?0??1?11????????????
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??311???12?????????000????????????????1?
?????00?????????????0???????????????????????????????

Jaxtasuchus salomoni

[0 1]?020??????1???0????[0 1]?????????????????????0???100-
1???1100?000010000?0003??0?????
???0???0???0??????0?11??????-
?01??????110????????????????????????????????????1????????????????????1??????0?1??????40?00011
00?1?01?????0[0 2]?1?1?[0 1]?1?1[1 2]10000010?110-???[1 2]?1?[2 3]10?????????-
11?????????????0????????????????????????????????10001010110111-0-
??0?000??????1?300????????????????????????????????2400100?00?0?2000?0?101002
?0?00?011?00001????????????????????????????0????0120???00?00100?1?0?0?311201?010110
???0?????000-----?????????????????0?????????????-?100????????????0010??

Doswellia kaltenbachi

2?1020[0 1]0???????-13?????????????????????????0-?????????????0?????0000[4
5]?????????0?????11?0?00--0--0--?????0???0-0-??2---100-0-0-0100-1110000-0001----022-00-0-
??001002-1??120000000???000???000210112010110111111020-
0011?110011000?010?001??1?000????????????000-
?00200001?????0000120001000010001114???0?0???1001?00000101-1???10?01100000110110-
10?[1 2]11[1 2]010012000000-11011110-??3000?1[0
1]????????????????????00000012??000?111010000
010000101130001000000???01???????0???????011?1????????????????????????????????
????????????????????????????????????31120?1[0 2]101?00?00?00?0?00-----???0-0?-0000-
0?0?0-00?100-010-0?00010?000011-000010??

Parasuchus angustifrons

??10201001111000001?000001?0??-00--1-001[0 1 2]0?100-1?-0?20-
1101002001020020003?0000-0001002??10000110020000110000101???-0-???00100-
0101010100011000100110020022-0?-0-2-101002-1011210001001131-12011----

01020111101010111040-???1?110110000?0?0?1[1 2]-
???1?000????????1??
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????????????????0000000-----01010010???00000?0?0-10????????????????????????

Parasuchus hislopi

2110201001111?00001210000014000-00--1-001000100-12-0020-110100200102002000310000-
0001002??10?00?10020000110000100100-0-001010100-0101010100?11000100110020022-00-
????101002-1011210000001131-12?????????????11010101110??-1111?1111100100010001-
???0001???1011?01?0010?10001?110-2?10000?11010?01010?1??140?1-[0
2]1000?1001011110031[0 1]10010000110000?10000?-11?2?10010111000001-10000010-
1??????00000001100?00100000?100010112001010101011111-[1 2]?000[0
1]100???????0?01100100010110110200100001021?00?10??001200100100100002000?0110100
1001000101001200111-
000000001111110011011211000100120210001011???20100202102001101000000000000?000-----
---?101001000000000?0?00001?00-01000001010?000??1-?000000?

Nicrosaurus kapffi

2?10101001111000001230000012000-00--0-001000?00-11-000--110100200102002000320?10-0-[0
1]1000??100-0100020000110000100100-0-??1000100-1100010000011001000011020022-00-0-[1
2]1101002-1011210000001131-12011---00020111101010111040-01??0111110000?000?0[1 2]-
???1?000?????11????01111100010110-2010000010120110010?1??04011-[1 2][0
1]000?1?01?111100310[1 2]??1???0110000?1??000-1???0?0?1011?10000?-
1?????????1?02????????????????????????????00?1011??010001001111111-[1
2]?000??00100001100002000?0?101?
0?00100000101?210???
0000?0000000-----01010000000000000000-001100-01000?010?0?000?11??000000?

Smilosuchus spp.

??1010100111100000122000001[2 3]000-00--0-001000?00-11-0-0--110000100102002000[3
4]10000-0-11000??100-01000[1 2]0010110000000100-0-001000100-
1100010000011011100011020022-00-0-2-101002-10112100?0001131-12011---
00020111101010111040-0101?112010000?010001-0110000?100?11??1?01111100010110-
20100000110200010101?1?140?1-20100?1101011110031[0 1]1?01001011000001??000-
11?2100010111100001-10010010-1???110?01000001100100111000-
?00010?1??010001010111111-
1?000?100????????????????000?0110110100100001021?0001000000?001000001000020000011
0100?00100000001?210111-
000000001111110011011211??01?0?0?1????00?????????2?210000?0000?0?00000000?000-----
01010[0 1]000000000000?0010?00-01000?00011?000?11-0000000?

Diandongosuchus fuyuanensis

?1?0101001?1100100?1?1?00002000000?20000?100?00-01-
00200110000200??0001000220?0000?01012??1100011001001031000010010000-
??1000100001000101010110111001100100?2-00?0-2-???0?2-
10?12?00?00??????2????????020????010????10????????1???????0???1????????????????
?0?10?00001?0?0-
2010000010?1011001??1?0401??21000?????0? ???????1???00??1???00?1?000?11?11???1???
??????1?0?10?0-??01???0?0?0001101?0011?00-10001010?00?0?????11?111-
1?00?1100?????110????0?0?10???1?0??0?00????1?0?1?0?0?1200??0????0??2000?0?1???

[illegible]

Turfanosuchus dabanensis

?0001001?001100010?1[1 2]?0000110100000210201100?00-00?0020-110000001??0011000[2 3][1
2]001001101111??010001100100100?000000111100-
??100010110011010010?11001000010?20??2-0010-??10?00??100120000000??001???13--
?01?2???????1?1??040-
2?01?110?10000?1100100??0000?10??110??0010000101?0?10??00000111020?0001?????40??
021000?10010?11100310??[1 2]000??10000?10??10-?1?????20??1?01011-???00010-
1???0000?????0???1????????????????????10000000110111-
100????0????????????????00?1021020010?1?01010110000???????13001?0100?00002000?0110
100?01100010101????111-10010?0011221110[1 2]101???????01?0???????010????????20-
101?0011??0000?0000?000-----0-00000000000??00?0001?0?0?000?00011?000?01-??00000?

Gracilisuchus stipanicicorum

2?001[0 1]11000110001011[1 2]0000011010000021020?200?00-00-0020-11[0
1]0001012000110003100000110111??01000110-10-1031000000110000-??10001111100101100-
011001-00110020022-0110-2-10100[1 2]?100130100000???1-1?0?1----01020110101010111040-?[0
1]???010???????1?001[1 2]-
????000?????1???1?001000?10100?10??0000011102000001010??14010[0
1]21000?1?01?11110031010?10?10110102?100010-11?11100200?1001011-100000?0-1?100000[0
1]???[0 1]?1????????????????????10000001110121-
????????????????????001021011000010000102100001?00000?000100100?0000200000011
1002[1 2]?100010???1100111-1000000011221110210112???01??0120201000001000?0?002020-
10100011??0??000000?000-----01000[0 1]0000000001?0?[0 1]?1?000-01000101010?000?01-
0000100?

Yonghesuchus sangbiensis

???0????001100?10?1???010110?0?0??21020110??00-?100031-
1100?0001??0??100?2??0???1?1?110001000100-2001021???0????????????11???01001??0-
???001-00?1002002????????????????1???00??1?00?[0 1]??13--
?01?2????????????????????10???????0?1[1 2]-
????000????????0010?0?0????2?00000111?2???001?11??140?00[1
2]1000????????????????????1?11????????????????????
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????????????????????????0?0?000-----?-0000????????1?????1?00-
0110?1????????????????

Parringtonia gracilis

2?????????1????????????????????0?????10[2 3]?1?0?00??[1
2]000??0000??
??4????00???1?0??1000?0[2
3]20????????????????1200??1000011-????????1000?????0[0
1]001101010??
?????????0??
????????????????[2 3]1111??1001???0???????00-----
????????????????????-?????1100??11????????

Aetosauroides scagliai

2?0011000001100?????100001[2 3 4]0?0?00?21000?100?0??0[0 1]-0030-1110001?1??000?000?[1
2]0001-10?110[1 2]??????1???????000000[0 1]100-0-??[0 1]???0??-
????????????????00-????11?0????????????????1???1?-

?01?????????????????0????10?1000????????????????????21???01?10?10-[1
2]??100????????????????14???0210???100?01111002101?0100?0100?00?101000-11?[1 2]?[0
1][0 1]020011000001-10000010-10[1 2 3]???1?1?0000?100?10?00?01010000?01[0
1]000010111111-
100111100???????0?????010103100001001000010111000100000023001001001000020000021
01002011000101011210111-
100000001122111011112110011?0120201000001000??????31020012000120000000?0?000-----
--?????000????????????000-???00001011?000011-0000000?

Aetosaurus ferratus

20001100000110011011100000140?00000210000200?00?01?00310111000011??010?0000100010
1101001??01000110?00?1020000000[0 1]100000??10010100010001000-0110010--010021022-
0010-2-111002-11?120000100???1-1?0??-----1020111111?1111104?-?0?0?11?0100000110012-
???000?????????0?1200210?001101001000[0
1]11010??1010?0??14010021100?10?0?????????1????????????????????000??1?????
1??00010-10?0??10110000111001001101?010?0???0?01?0000?01??111-
1?010?11011???1????11??00010210[1 2]0000010000101120001000000[1 2]200100??01000-2[0
1]0000110100201?000100011210111-
100?0000112?11?01111121100?1101202010000010??20??02?3102001210012??0?000000000-----
--010001000000000000?0?00?010-01?0???????000?1-0000000?

Stagonolepis robertsoni

20001100000110011011100000140?00000210000200?00?01?003101110001012101010001100010
01010021?010000?0010010?00000001100000??10010100010001000-0110010--010020022-0010-
2-111002-10?1200001001131-10001-----1020111111111111040-200011110100000110012-
0000000??01?11111?021300210?0010-
1001000111010?11010?0??1401002110011010011??0121110020010110?00?10?000-
11?11?0000111000001-10000010-1030300[1
2]0100000111001001101?010?011110?011000010101111-
10010??011????1?0401110?00010210110000100001011100010000001?001000?0100002000?0?1
010020110001?0011210111-
10000000112?11101111121100?11012020100000100?200002?3102001210012?000000000000-----
---0??001000000000000000001010-00100?00011?000011-0000000?

Ticinosuchus ferox

2?00????0??11???????[0
1]????????????????????002??1110?0000??3???0003?0????????????????????????0?
0??0?10??0-??[0
1]?0??
??1?0??001?1?????0?0??????0?????
???40?0021000?1?01?111000[2 3]1?????000?110????1000?0-11?1110?1001?100011-
100?00????0?010201?0?0011?????10???0?????????010?000001[1 2]0111-
1?0113100?????00101?0?0?0??1021??1?100?0?0?0110000???10102?00?0?10???0??2000?0?1[0
1]???20?1000?0??11200111-?0?0??0011221???1??1?21100?1?01202?10000?????????02020-
1010001100?000000?0?000-----??????0?0????????????00-???001?0?11000?0?-?10?00?

Qianosuchus mixtus

20000-??00011001[0 1]0?10?001012000001010000?10??00-1100020-
1110002002?001100032000?-0001?11??0000011001?0100000000?0100?0-
??1000000?010?010?00?11000100010020012-01?????10???2-?0011000?0??1??1-?????----
01?201?????????1????????????????????0?100????????????????????10????20??101020?0?0001?
02??100?0?????40100210001?001?????00--1?0?00101???0??1??110-1102110???0??10?011-

100?10?????3102011?00011?0?100[0
1]????10??10??????0000?1????????????????????????????010211200200110101001?00?
20?1?00?300?????0?00002000?0?1????20?0?0????0101111-
?00?0?0011221?0?1111?2110??1?01102?10000010???0?002?20-?010001?000010000000100-----
-01?00000?00?00000?0?0?0?0???1?001000?1?0?1?11-11???0??

Arizonasaurus babbitti

21000-01?0?100?10???10???????????1?000????00-???003--
11100000?21001?0002?000?0?01????0?0?100[1 2]00?000????0?10000-
0?1??0100?0010?10000?10000???01002????0010-2-10???2-1??1?000?0????1-?????---
?1?2011?10?01?111000-01011110?10000?1?101000010001020?11111?0????0100?01???[1
2]??0000?10?2???????11???4???021000?1001?11110[0 2]0--10010010110000010?0?0?11???0[0
2]200?1101001?100?10???1?????????1?01001100????100110?0????????????????????????????
????????????????010?01111[0
1]0200120?010?1??11?011010?001011001000020001??10000????????????????????????????
??0?-----?001??000?100-----
????00?00?00?0?0100001000-??101?01011?2?1??11110010??

Lotosaurus adentus

0?000-0100011002[0 1]02120002-121-000102000015--?00-1?01031-1110000001-0-0?0-0-?0001-
0001002??????1100?1???00000000100000-1-100010010?00?000?0?010?00100[1 2 3]???2-
0010-2-101002-10???00????113????????????????0?010111000-
01?1?110110000?1100100?0?0001?201?111?1?001200?2???00????-2--?10??1?1????10??-----
-?1001?????00--10???0??1???0??1?010-11?21?0???0?110?001-100?1010-
????????11100011?0?000???10?????????0???0???????1????11???????????0?01?00000???[
1 2 3]?1?0?0???10?0?????????0?2?1?????01????0000200???1????01?000?001??01111-
?0000?011211?0?1111?2???????0?0?0?00?1[1 2]???0???1?0?-----?001000001?010-----
0100000000000000?0?10001010-0?1-1??10?1?111????00110??

Xilousuchus sapingensis

2?00????001100??????00?01101000?0100001100?0???1?003--111?000021301?0003?00?1-
0001??1??
????????????????????????????????????0?1?1?1000-
01111110?10000?111010?0010001020??1100?0?1?00100011????000?10?2???????11??14???
021000?1?01?1111?00--?00100101110100100010-
?1??1???????10?0???????????0??
????????????????????1??
??
??100-----????????????????0?00001000-?01011110???0????????????

Luperosuchus fractus

2?00101?00?10?210???10???????????2???0????0??????[2
3]0?11010????????????10?10?000110???0?00?100?0????0?00000?0100-
00100010110000?0000???000?00????????00????????????1???0?0????????????????2??
???0111????0?-
??00??1????????????????????????0????????????????????????????????????[1
2]??
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????????????????????????000?000????????1?01000?00????????0????????0
????????????????????

Decuriasuchus quartacolonias

20000-0[0 1]0001110[1 2]10?1210000110?0001021000?20?00-01-0030-
11010010121001100031001?-0001101??010000100100000000000010000-
00100010110100010110[0 1]11000000010020022-0010-2-1010?2-1001?000??0????1-?????----
0102?1???0?1??1?1????????????????????????????????????1?0?1000?00?0?1102??000011
0?2001001?11???4010021?001?001?????03??1???0000110?0??100110-1????????????10?010-
1???0010-
?????1?0???0011????00????????????????0????????????????????????????????????1?0??
0?1?????0???021?00??????01?00??????0????????????2???00????????11???0?0???1122
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Batrachotomus kupferzellensis

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Prestosuchus chiniquensis

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Scleromochlus taylori

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Dimorphodon macronyx

[illegible]

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Silesaurus opolensis

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Heterodontosaurus tucki

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0?0100?

Herrerasaurus ischigualastensis

2?000-0100011011002121001011000100020000?200?00-01001200110000000[1
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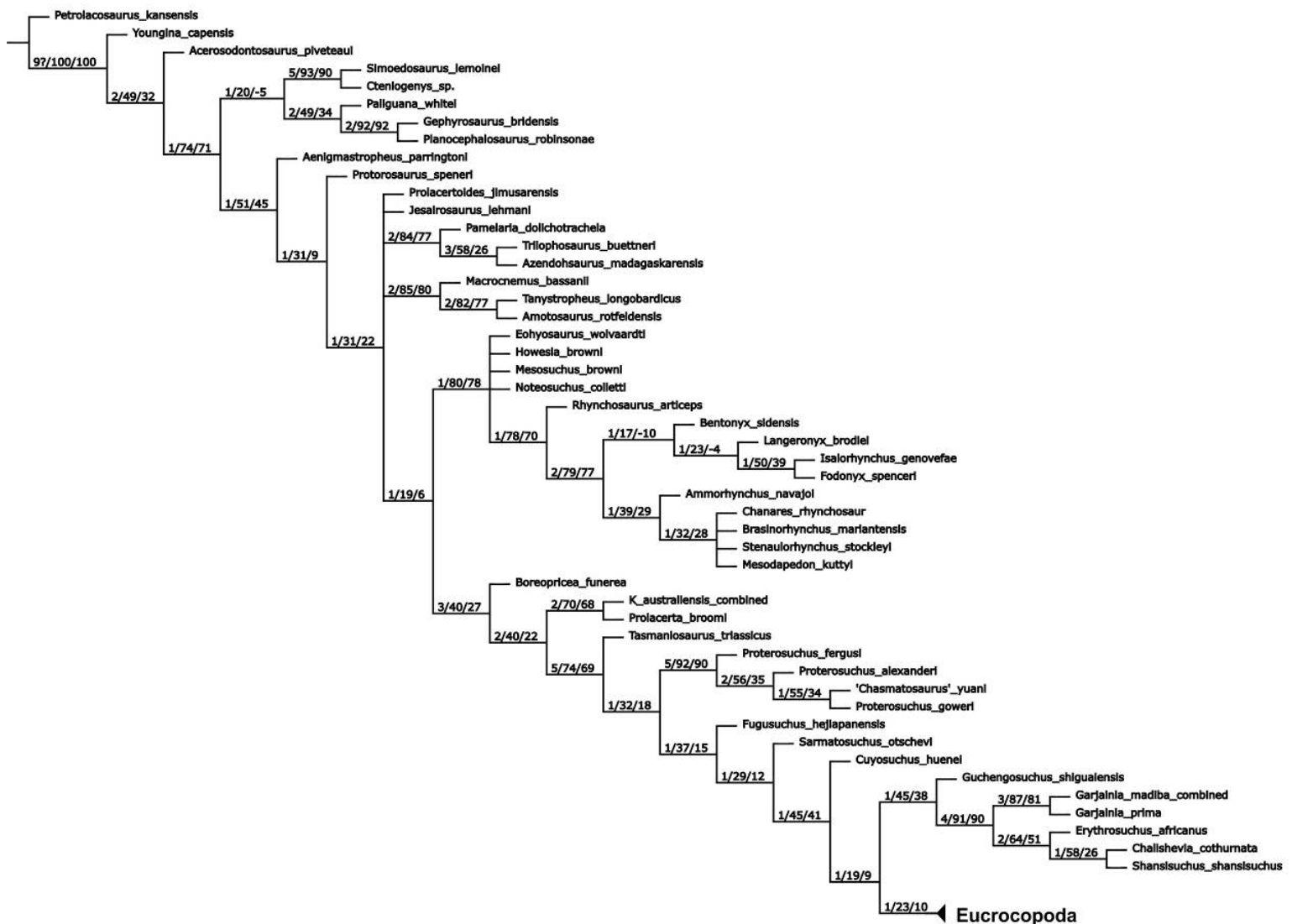
Taxa excluded a priori from the phylogenetic analysis

The analysis conducted here is based on the third analysis of Ezcurra (2016) and as a consequence we excluded a priori from the analysis the following terminals: *Eorasauros olsoni*, *Archosaurus rossicus*, *Vonhuenia fredericki*, *Chasmatosuchus rossicus*,

Chasmatosuchus magnus, “*Chasmatosuchus*” *vjushkovi*, *Kalisuchus rewanensis*, *Shansisuchus kuyeheensis*, *Uralosaurus magnus*, and *Koilamasuchus gonzalezdiazi*. As a result, the taxonomic sampling of the data matrix was reduced from 117 to 107 operational taxonomic units. See Ezcurra (2016) for the logical basis of the exclusion of these terminals.

Results and discussion

The analysis of the dataset recovered 18 most parsimonious trees (MPTs) of 3339 steps, with a consistency index (CI) of 0.2627 and a retention index (RI) of 0.6273. The strict consensus tree (SCT) generated from the MPTs shows a topology mostly congruent with that found by Ezcurra (2016) and the iterative modifications of this data set, namely Stocker et al. (2017) and Nesbitt et al. (2017) (Supplementary figures 12, 13). As a result, the overall topology of the SCT will not be described in detail. The differences recovered here from previous analyses of this data matrix are the placement of Choristodera as the most basal lepidosauromorphs, a polytomy at the base of Rhynchosauria –including all non-rhynchosaurid species–, the recovery of *Tarjadia* and *Archeopelta* within Pseudosuchia rather than within Doswelliidae, and the sister-taxon relationship between Aetosauria and the clade composed of Ornithosuchidae and Erpetosuchidae (see below).

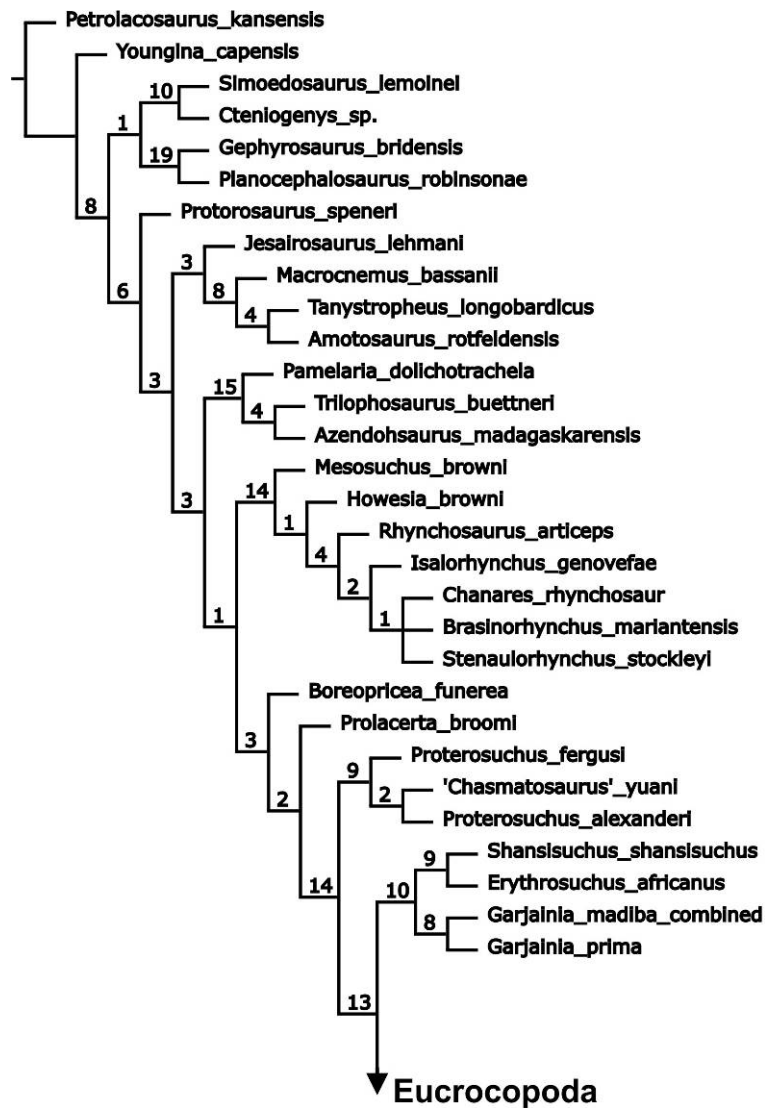


Supplementary figure 12. Strict consensus tree showing the relationships of Permo-Triassic archosauromorphs. The values on each branch represent Bremer support (left) and absolute (centre) and GC (right) bootstrap frequencies, respectively. Eurocopoda has been collapsed to reduce the size of the tree and is shown in Supplementary figure 13.



Supplementary figure 13. Strict consensus tree showing the relationships of Permo-Triassic archosauromorphs. The values on each branch represent Bremer support (left) and absolute (centre) and GC (right) bootstrap frequencies, respectively. Non-eucrocopodan diapsids has been collapsed to reduce the size of the tree and they are shown in Supplementary figure 12.

The rhynchosaur from the Chañares Formation was recovered deeply nested within Rhynchosauria, as a member of Stenaulorhynchinae. Within this clade, the North American *Ammorhynchus* is the sister-taxon of an unresolved clade composed of *Brasinorhynchus* from Brazil, *Mesodapedon* from India, *Stenaulorhynchus* from Tanzania, and the Chañares form. This polytomy is a result of the alternative positions that the Chañares form acquires among the MPTs. The position of the Chañares rhynchosaur as a stenaulorhynchine is supported by the presence of maxillary occlusal teeth reduced, with each longitudinal row formed by a great number of teeth (616: 0->1) and its position as more derived than *Ammorhynchus* is supported by the presence of a medial maxillary groove reaching the anterior half of the bone (614: 0->2). In addition, the presence of crowded teeth on the lingual surface of the dentary (649: 0->1) also supports the placement of the Chañares rhynchosaur within Stenaulorhynchinae, but the optimization of this character at the base of the clade is ambiguous because the character-state is unknown in *Ammorhynchus*. The branch supports of Stenaulorhynchinae and its less inclusive clade are very low, with minimal Bremer supports and bootstrap frequencies below 50% (Supplementary figure 12). The Bremer support of Stenaulorhynchinae remains minimal after pruning fragmentary taxa, but the values for Rhynchosauria and Rhynchosauridae rise to 14 and 4, respectively (Supplementary figure 13). Three additional steps are necessary to recover the Chañares rhynchosaur as a non-stenaulorhynchine rhynchosaur under a topologically constrained search (result = 17 MPTs of 3342 steps, CI: 0.2624, and RI: 0.6269).



Supplementary figure 14. Strict reduced consensus tree (SRCT) showing Bremer supports after the exclusion of fragmentary species. The SRCT was generated from the 18 MPTs after the a posteriori pruning of *Prolacertoides jimusarensis* and *Noteosuchus colletii*. The Bremer supports were calculated after the exclusion of the fragmentary species pruned by Ezcurra (2016) plus the following other species: *Ammorhynchus navajoi*, *Mesodapedon kuttyi*, *Langeronyx brodiei*, *Fodonyx spenceri*, *Venaticosuchus rusconii*, *Erpetosuchus* sp., *Parrigtonia gracilis*, *Dyoplax arenaceus*, and *Xilousuchus sapingensis*. Eucrocopoda is collapsed in this tree and shown in Supplementary figure 15.

The enigmatic archosauriform *Tarjadia ruthae* is recovered here as a member of Erpetosuchidae, together with *Erpetosuchus granti* from Scotland, *Erpetosuchus* sp. from North America, *Parrigtonia gracilis* from Tanzania, *Dyoplax arenaceus* from Germany, and *Archeopelta arborensis* from Brazil. As mentioned, the position recovered here for *Tarjadia* and *Archeopelta* distinctly differs from that of previous, recent phylogenetic analyses, which found them as non-archosaurian doswelliids (Desojo et al. 2011; Ezcurra 2016). The removal of these South American taxa results in a Doswelliidae composed of species only known from the Middle and Late Triassic of the Northern Hemisphere. The exclusion of *Tarjadia* and *Archeopelta* from Doswelliidae is well supported and 23 additional steps are necessary to force a monophyletic Doswelliidae sensu Desojo et al. (2011) under a topologically constrained search (result = 72 MPTs of 3362 steps, CI: 0.2609, and RI: 0.6238; *Vancleavea* and non-South American erpetosuchids were set as floating taxa). It is interesting to note that the monophyly of Erpetosuchidae (including *Tarjadia* and *Archeopelta*) is still retained under this constrained search (Supplementary figure 16).

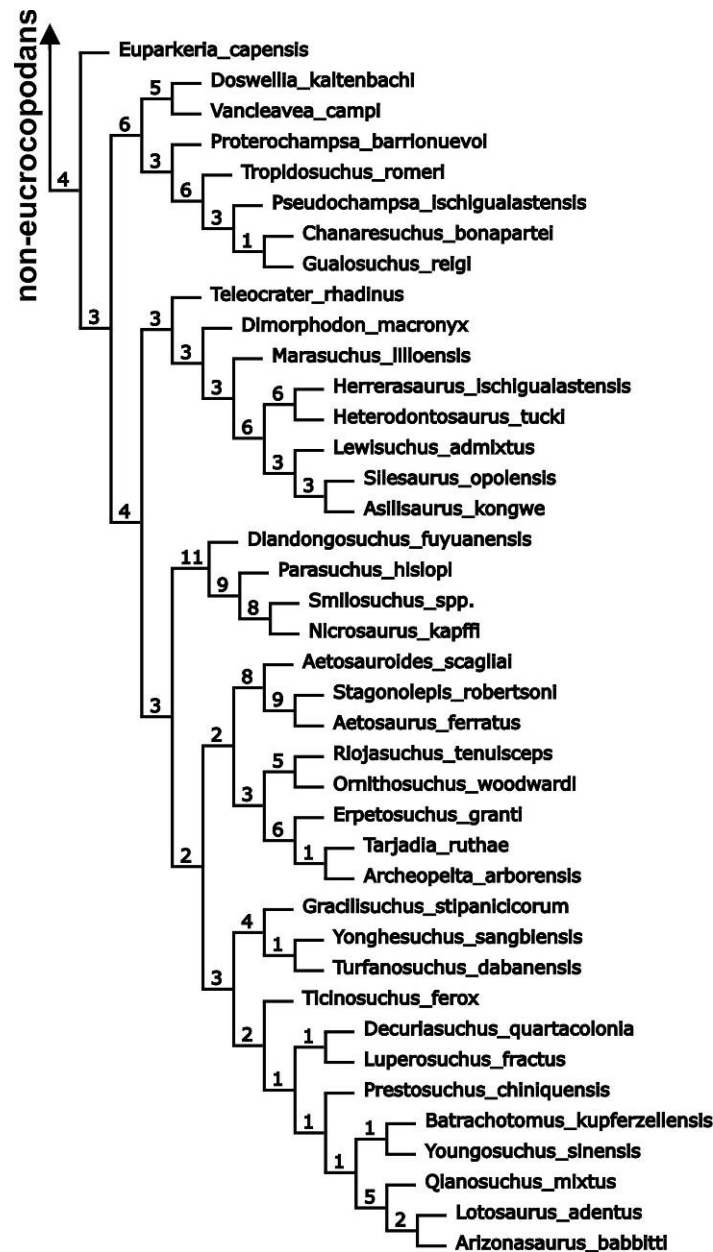
The position of *Tarjadia* within Archosauria is supported by the following synapomorphies: maxillary antorbital fossa present on the ascending and horizontal processes (54: 1->2), palatine and pterygoid without teeth (188: 0->1), exoccipital with a subvertical ridge (= metotic strut of Nesbitt 2011) posterior to external foramina for hypoglossal nerve (CN XII) (220: 0->1), and scapula and coracoid without a notch on the anterior margin at level of the suture between both bones (385: 1->0). The inclusion of *Tarjadia* within Pseudosuchia is a result of the presence of squamosal with an anteroventrally directed ventral process at 45° or less from the vertical (145: 0->1), pterygoid with anterior ramus (= palatal process) transversely narrow along its entire extension, converging in a right or acute angle with the transverse ramus, with the bone possessing an overall L-shaped contour in ventral or dorsal view (194: 0->1), dentary with posteroventral process contributing to the border of the

external mandibular fenestra (275: 1->2), cervical and dorsal vertebrae with spine table on the distal end of the postaxial neural spines (not mammillary process) (321: 0->3), and femoral distal articular surface uneven, lateral (= fibular) condyle projecting distally distinctly beyond medial (= tibial) condyle (512: 1->0). The branch supports of Archosauria and Suchia are very low (minimum Bremer support and bootstrap frequencies below 50%) (Supplementary figure 13), but after pruning fragmentary species the Bremer support of these clades raises to tree and two, respectively (Supplementary figure 15).

Within Suchia, erpetosuchids (including *Tarjadia* and *Archeopelta*), ornithosuchids, and aetosaurs form a clade that is the sister-taxon of the group composed of Gracilisuchidae and more crownward suchians. This result is novel because erpetosuchids have been usually considered as early branching crocodylomorphs or very closely related to them (e.g. Benton and Walker 2002; Brusatte et al. 2010) or as indeterminate archosauriforms in the most recent quantitative phylogenetic analyses that include *Erpetosuchus* and *Parrigtonia* within their taxon sampling (Nesbitt and Butler 2013; Butler et al. 2014). However, Brusatte et al. (2010) recovered *Erpetosuchus* within a clade also composed of aetosaurs, *Gracilisuchus*, and crocodylomorphs, thus partially matching the erpetosuchid-aetosaur relationship found here.

The sister-taxon relationship of taxa historically included within Ornithosuchidae and Erpetosuchidae generates a problem in the taxonomic content of these group if we follow the recent phylogenetic redefinition of Ornithosuchidae proposed by Nesbitt (2011; i.e. the most inclusive clade containing *Ornithosuchus longidens* Huxley, 1877, but not *Rutiodon carolinensis* Emmons, 1856, *Aetosaurus ferratus* Fraas, 1877, *Rauisuchus tiradentes* Huene, 1942, *Prestosuchus chiniquensis* Huene, 1942, *Crocodylus niloticus* Laurenti, 1768, or *Passer domesticus* Linnaeus, 1758). Our result implies that Erpetosuchidae should be included within Ornithosuchidae because of the lacking of an erpetosuchid in the phylogenetic definition of Ornithosuchidae sensu Nesbitt (2011). However, the original

definition of Ornithosuchidae was as follows: *Ornithosuchus*, *Riojasuchus*, *Venaticosuchus*, and all descendants of their common ancestor (Sereno 1991). Under this node-based definition, Erpetosuchidae is not included within Ornithosuchidae, but it represents its sister-taxon. Therefore, the original node-based definition of Sereno (1991) is used here.



Supplementary figure 15. Strict reduced consensus tree (SRCT) showing Bremer supports after the exclusion of fragmentary species. The SRCT was generated from the 18 MPTs after the pruning of *Prolacertoides jimusarensis* and *Noteosuchus colletii*. The Bremer supports were calculated after the exclusion of the fragmentary species pruned by Ezcurra (2016) plus the following other species: *Ammorhynchus navajoi*, *Mesodapedon kuttyi*, *Langeronyx brodiei*, *Fodonyx spenceri*, *Venaticosuchus rusconii*, *Erpetosuchus* sp.,

Parrigtonia gracilis, *Dyoplax arenaceus*, and *Xilousuchus sapingensis*. Non-eucrocopodan diapsids are collapsed in this tree and shown in Supplementary figure 14.

A similar problem occurs with the phylogenetic definition of Aetosauria proposed by Nesbitt (2011). This author defined Aetosauria as a stem-based clade that contains *Aetosaurus ferratus* Fraas, 1877, and *Desmotosuchus haplocerus* Cope, 1892, then to *Rutiodon carolinensis* Emmons, 1856, *Postosuchus kirkpatricki* Chatterjee, 1985, *Prestosuchus chiniquensis* Huene, 1942, *Poposaurus gracilis* Mehl, 1915, *Crocodylus niloticus* Laurenti, 1768, *Gracilisuchus stipanicorum* Romer, 1972b, and *Revueltosaurus callenderi* Hunt, 1989. The phylogenetic definition of Nesbitt (2011) does not include any ornithosuchid or erpetosuchid species and, as a result, it should enclose the entire aetosaur-erpetosuchid-ornithosuchid clade recovered here. However, the phylogenetic analysis of Nesbitt (2011) and iterative modifications of this data set found *Revueltosaurus callenderi* as more closely related to aetosaurs than to other archosaurs. As a result, we follow here this position for *Revueltosaurus* (this taxon was not included in the taxon sampling of our analysis because of the limited anatomical knowledge currently published for the species) and constrain the taxonomic content of Aetosauria to *Aetosauroides scagliai*, *Aetosaurus ferratus*, and *Stagonolepis robertsoni*.

The clade that includes aetosaurs, ornithosuchids, and erpetosuchids possesses the following synapomorphies (character-states present in *Tarjadia* are indicated with an asterisk): maxillary antorbital fossa present on the ascending and horizontal processes of the maxilla, reaching the posteroventral corner of the antorbital fenestra* (54: 2->3), maxilla with less than ten tooth positions* (75: 2->1), lower jaw with an anteroposterior length of the external mandibular fenestra versus anteroposterior length of the dentary anterior to the fenestra equal to 0.62–0.78 (263: 0->2), cervical and dorsal vertebrae without parallelogram centra in lateral view* (313: 1->0), fibula with attachment site of the iliofibularis muscle near

the midpoint between the proximal and distal ends (530: 0->1), dorsal osteoderm alignment dorsal to the dorsal vertebrae one to one (594: 0->1), presacral dorsal osteoderms wider than long* (595: 0->2), and paramedian presacral dorsal osteoderms with straight or rounded anterior edge* (597: 1->0). The clade composed of ornithosuchids and erpetosuchids is supported by the presence of maxillary ascending process remains the same width for its length* (60: 0->1), jugal with anterior process possessing an ascending subprocess excluding the lacrimal from the anteroventral border of the orbit* (92: 1->2), jugal with participation of the anterior process in the border of the antorbital fenestra* (96: 1->0), jugal with a well posteriorly rimmed antorbital fossa* (624: 0->1), squamosal with ventral process forming more than half of the border of the infratemporal fenestra, but quadratojugal or quadrate broadly participates in the border of the fenestra* (146: 0->1), quadratojugal with a strongly anterodorsally to posteroventrally slanted ascending process in an angle equal or lower than 40° in lateral view* (636: 0->1), dentary with posteroventral process extended posteriorly beyond the level of the posterodorsal and posterocentral processes* (276: 0->1), surangular-articular with straight (= not upturned) retroarticular process* (284: 1->0), and scapula with total length of the bone versus minimum anteroposterior width of the scapular blade equal to 7.92–11.31 (387: 0->1) (character-states present in *Tarjadia* are indicated with an asterisk).

Erpetosuchidae possesses the following synapomorphies (character-states present in *Tarjadia* are indicated with an asterisk): snout at level of the anterior border of the orbit transversely broader than dorsoventrally tall or subequal* (22: 1->0) and jugal with posterior process possessing a distinct lateroventral orientation with respect to the sagittal axis of the snout* (101: 0->1); and the clade that includes all erpetosuchids to the exclusion of *Dyoplax* is supported by the following synapomorphy (character-states present in *Tarjadia* are indicated with an asterisk): maxilla with anteroposterior length of the antorbital fossa anterior to the antorbital fenestra versus length of the antorbital fenestra equal to 0.90–0.94 (55: 1-

>2). In particular, *Erpetosuchidae* is also supported by the following synapomorphies if *Dyoplax* is excluded a posteriori from the tree (character-states present in *Tarjadia* are indicated with an asterisk): skull with dermal sculpturing on the dorsal surface of the skull roof composed of prominent ridges or tubercles on frontals, parietals, and nasals* (5: 1->2), maxilla with four to seven tooth positions* (75: 1->0), jugal with posterior termination of the posterior process posterior to the infratemporal fenestra* (106:0->1), suborbital enclosed only by ectopterygoid and palatine* (610: 0->1), parabasisphenoid without recess* (239: 1->0), cervical and dorsal vertebrae with concave distal surface of transverse expansion of the neural spine* (322: 1->2), humerus with sub-oval proximal articular surface in proximal view (417: 0->1), and osteoderms very thick* (592: 0->1).

Our results recovered that *Tarjadia* and *Archeopelta* are more closely related to each other than to other erpetosuchids because of the presence of basioccipital without or with an extremely short occipital neck (231: 0->1) and paramedian osteoderms without a dorsal prominence (591: 1->0). The clade composed of *Erpetosuchus granti*, *Erpetosuchus* sp., and *Parringtonia* has the following synapomorphies (character-states absent in *Tarjadia* are indicated with a black triangle): jugal with ascending process strongly posterodorsally oriented in an angle equal to or lower than 45° in lateral view[▲] (627: 0->1), surangular-angular with a lateral ridge that curves from the external mandibular fenestra to the posterior end of the lower jaw, delimiting a ventrolaterally facing surface[▲] (650: 0->1), maxillary/dentary crowns lacking serrations[▲] (304: 2->0), marginal dentition with labiolingual compression only distally or nowhere[▲] (305: 1->0), and presacral dorsal osteoderms longer than wide[▲] (595: 2->1).

The clade that includes Aetosauria, Ornithosuchidae, and Erpetosuchidae, the clade that is composed of Ornithosuchidae and Erpetosuchidae, and the family Erpetosuchidae have low branch supports, with Bremer supports of two and bootstrap frequencies below 50% in the

former two branches and a absolute bootstrap support of 55% for Erpetosuchidae (Supplementary figure 13). Three additional steps are necessary to force a sister-taxon relationship between Erpetosuchidae and Aetosauria to the exclusion of Ornithosuchidae under a topologically constrained search (result = 36 MPTs of 3342 steps, CI: 0.2624, RI: 0.6269; *Dyoplax* was set as floating taxon). The interrelationships within Aetosauria, Ornithosuchidae, Erpetosuchidae, and among other pseudosuchians are congruent with those of the original result. The branch supports for Aetosauria and its less inclusive clade and for Ornithosuchidae are relatively high, with Bremer supports of 4, 5, and 3, respectively, and both absolute and GC bootstrap frequencies above 90%. The clade composed of *Venaticosuchus* and *Riojasuchus* has a minimal Bremer support, but its bootstrap frequencies are greater than 50%. The minimal Bremer support value of this branch is expected because of low number of characters that can be scored for *Venaticosuchus*. The branch supports within Erpetosuchidae are also low, with minimal Bremer supports and bootstrap frequencies below 50%. The Bremer support of the Ornithosuchidae + Erpetosuchidae clade and of Erpetosuchidae rises to three and six, respectively, after the pruning of fragmentary taxa (Supplementary figure 15). As a result, the monophyly of the *Erpetosuchus-Tarjadia-Archeopelta* clade seems to be robust.

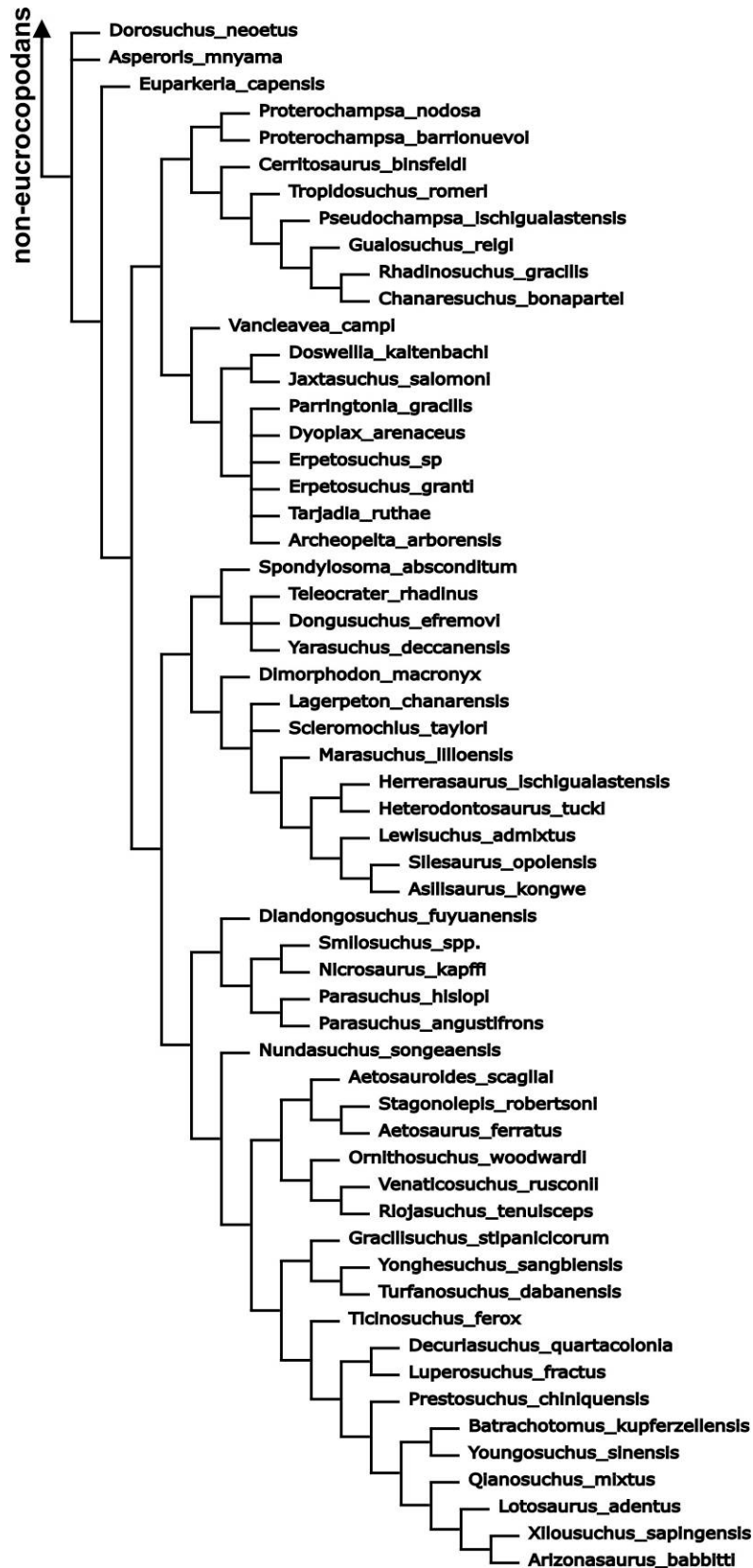
The position of Aetosauria as more closely related to Ornithosuchidae than to other suchian major clades is a relatively unexpected result and the following synapomorphies support the clade that includes Gracilisuchidae and more derived suchians (character-states absent in aetosaurs are indicated with with a black triangle): maxillary alveolar margin on the anterior third of the bone (anterior to the level of the anterior border of the antorbital fenestra if present) distinctly upturned[▲] (70: 0->1), postorbital with a lateral boss adjacent to orbital margin[▲] (128: 0->1), supratemporal fossa extending onto the ascending process of the postorbital[▲] (129: 0->1), centrum length of third cervical longer than axis centrum[▲] (655: 0-

>1), dorsal vertebrae with fan-shaped neural spine in lateral view[▲] (363: 0->1), chevrons with distal anteroposterior width of anterior and middle haemal spines in lateral view equivalent to proximal width[▲] (382: 1->0), scapula with lateral tuber on the posterior edge, just dorsal of the glenoid fossa[▲] (393: 0->1), and humerus with internal tuberosity continuous with the proximal articular surface in anterior or posterior views[▲] (421: 1->0). Four additional steps are necessary to force the exclusion of phytosaurs and ornithosuchids from Suchia –as recovered by Nesbitt (2011) and Ezcurra (2016) – under a topologically constrained search (result = 378 MPTs of 3343 steps, CI: 2623, RI: 6267; all erpetosuchids and *Nundasuchus* were set as floating taxa) (Supplementary figure 17). It is interesting to note that this topologically constrained search also recovered a sister-taxon relationship between Erpetosuchidae and Ornithosuchidae, but they are placed as the most basal pseudosuchians, and phytosaurs and *Nundasuchus* are successive sister-taxa of Suchia. Within Suchia, there is a trichotomy composed of Aetosauria, Gracilisuchidae, and other suchians. This polytomy is a result of the alternative position that the aetosaurs acquire as the sister-taxon of gracilisuchids or of gracilisuchids and more derived suchians.

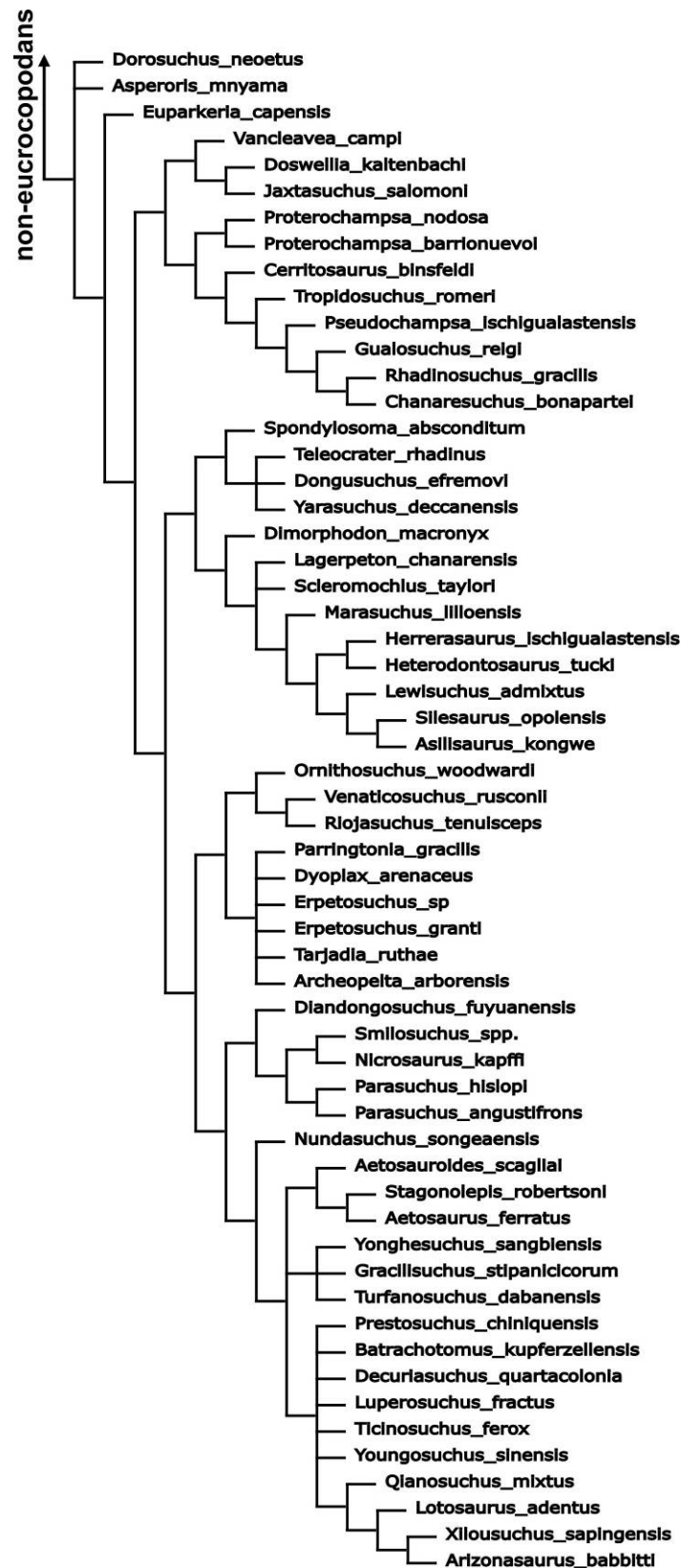
Our phylogenetic analysis recovered strong evidence favouring the monophyly of Erpetosuchidae –including the former South American doswelliids *Tarjadia* and *Archeopelta*– and the sister-taxon relationship between Erpetosuchidae and Ornithosuchidae. In addition, our results also found evidence favouring a close relationship between aetosaurs and the clade composed of erpetosuchids and ornithosuchids, but the support of this hypothesis is still relatively low. Thus, further analyses and new anatomical information, mainly from erpetosuchids such as *Tarjadia* and *Parringtonia*, seem to be critical to shed light on this part of the tree.

Luperosuchus is found within Paracrocodylomorpha and as the sister-taxon of *Decuriasuchus* from Brazil. The placement of *Luperosuchus* as a “rauisuchian-grade”

suchian is consistent with previous hypotheses (e.g. Romer 1971b; Krebs 1976; Galton 1977; Bonaparte 1981; Chatterjee 1985; Benton 1986; Gower 2000) and a recent quantitative phylogenetic analysis focused on the relationships of this genus (Nesbitt and Desojo 2017). However, the analysis of Nesbitt and Desojo (2017) found *Prestosuchus* as more closely related to *Luperosuchus* than to *Batrachotomus*, contrasting with our results –however, Nesbitt and Desojo (2017) did not include *Decuriasuchus* in their taxonomic sample and our taxonomic sample of paracrocodylomorphs is considerably poorer. The clade composed of *Luperosuchus* and *Decuriasuchus* is supported by the following synapomorphy in our phylogenetic analysis: supraoccipital with a prominent median, vertical peg on the posterior surface (210: 0->1). The branch supports among the paracrocodylomorph species more derived than gracilisuchids, with exception of Poposaurioidea, are very low –Bremer supports of 1 and bootstrap frequencies below 50%. The Bremer support for the *Luperosuchus* + *Decuriasuchus* clade remains minimal after pruning fragmentary species (Supplementary figure 15). Only one additional step is necessary to force *Prestosuchus* as more closely related to *Luperosuchus* than to *Batrachotomus* (matching with the hypothesis recovered by Nesbitt and Desojo, 2017) under a topologically constrained search (result = 88 MPTs of 3340 steps, CI: 0.2626, RI: 0.6272; *Ticinosuchus*, *Decuriasuchus*, and *Youngosuchus* were set as floating taxa). As a result, the interrelationships recovered here among the “rauisuchian-grade” species should be considered extremely tentative because of their low branch supports and the fact that can be biased by an incomplete taxonomic and character sample in this part of the archosaur tree.



Supplementary figure 16. Strict consensus tree recovered when *Tarjadia* and *Archeopelta* are forced as members of Doswelliidae. The optimal trees of this search are 23 steps longer than the original MPTs.



Supplementary figure 17. Strict consensus tree recovered when phytosaurs and erpetosuchids are forced as non-suchian archosaurs. The optimal trees of this search are four steps longer than the original MPTs.

6. Relative abundance of the vertebrates of the *Tarjadia* and *Massetognathus-Chanaresuchus* Assemblage Zones of the Chañares Formation

The plots of relative taxonomic abundance of Fig. 1 were based on the following abundance data.

Taxon	<i>Tarjadia</i> AZ	<i>Massetognathus-Chanaresuchus</i> AZ
Dicynodontia	9 (32.14%)	30 (9.23%)
Cynodontia	8 (28.57%)	247 (76%)
Rhynchosauria	2 (7.15%)	0
Pseudosuchia	9 (32.14%)	8 (2.46%)
Proterochampsidae	0	24 (7.38%)
Dinosauromorpha	0	15 (4.62%)
Mawsoniidae	0	1 (0.31%)
Total	28	324

Supplementary table 2. Absolute abundance and percentages of abundance of the main taxonomic clades collected the the Chañares Formation. The values of the *Tarjadia* AZ correspond to specimens sampled only at the Campo Córdoba North locality and those of the *Massetognathus-Chanaresuchus* AZ were modified from Mancuso et al. (2014). The two specimens of *Tarjadia* and one of the specimens of *Luperosuchus* (holotype) were deleted from the list of Mancuso et al. (2014) because very likely have come from the *Tarjadia* AZ.

7. Shareholder Quorum Subsampling-based simulations

Methodology of the Shareholder Quorum Subsampling-based simulations

The differences in the taxonomic abundance and composition between the *Tarjadia* Assemblage Zone (AZ) and the *Massetognathus-Chanaresuchus* AZ are very clear. Indeed, no species or low-level taxon found in one AZ is present in the other and the other way round (with the potential exception of dicynodonts, but this is probably a result of the complex taxonomy currently inherent to this group). Nevertheless, we conducted a series of simulations in order to show quantitatively that it is extremely unlikely to explain the differences observed between both AZs entirely as a result of sampling bias.

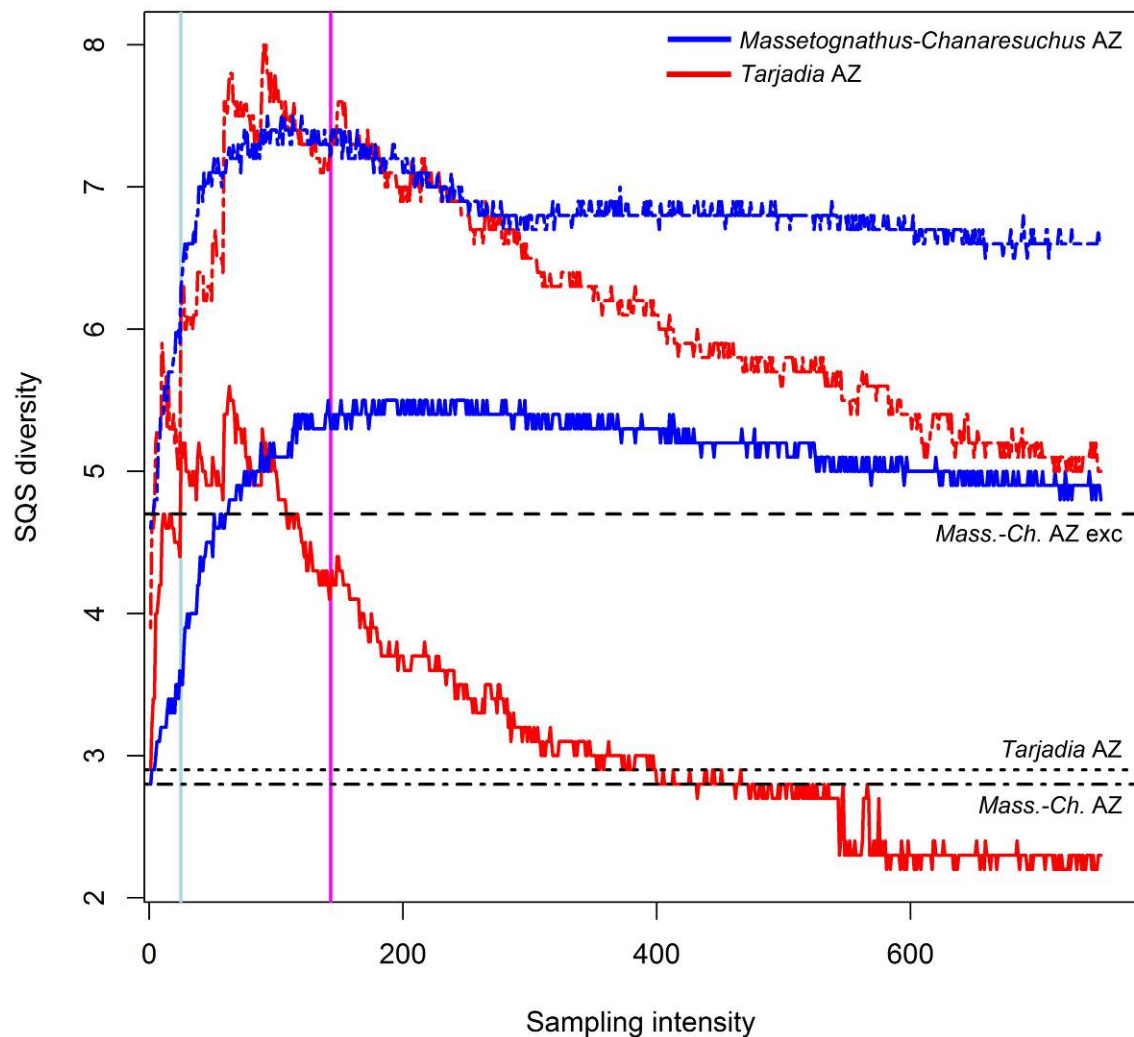
This simulation analysis has its root in the nule hypothesis that sampling bias can explain the differences observed between both AZs. If both AZs are identical to each other, thus, we would expect that they share equal or very similar diversity values. As a result, we simulated Shareholder Quorum Subsampling (SQS) (Alroy 2010) diversity curves after the addition of specimens of the species in an AZ that are not recorded in the other AZ. In other words, it simulates the case that in future fieldworks are collected specimens of *Massetognathus* in the *Tarjadia* AZ and/or specimens of *Tarjadia* in the *Massetognathus-Chanaresuchus* AZ. In order to simplify the simulations and consider an extreme case, we considered that no new specimens of the already recorded species of each AZ (e.g. *Tarjadia* in the *Tarjadia* AZ) are being recovered during the simulated samplings. We did not include new dicynodont collections in the simulations because the taxonomy of the dicynodont specimens of the Chañares Formation is problematic and requieres further work.

The samplings were simulated after 751 replications, each of them representing the iterative collection of one additional specimen of each species (e.g. replication 1 represents the collection of one specimen of *Massetognathus* in the *Tarjadia* AZ and replication 30

represents the collection of 30 specimens of this species in this AZ). The first replication (replication 0) represents the real case based on the currently available sampling (i.e. the collection of zero additional specimens). In order to simulate a more realistic collection of specimens we considered the abundance data available for each AZ and we multiplied the number of simulated collections by their frequency in the AZ in which they occur (Fig. 1; Supplementary table 2) (i.e. *Massetognathus* specimens represent 54% of the total number of specimens that can be identified at a species-level in the *Massetognathus-Chanaresuchus* AZ [Mancuso et al. 2014] and, therefore, we multiplied the number of specimens of each replication by 0.54; e.g. resulting in 0.54 specimens of *Massetognathus* collected in the *Tarjadia* AZ in replication 1). However, the minimum number of specimens that can be collected is one (despite of collecting half of a skeleton we consider it as one specimen) and for that reason we excluded from each replication the species that had less than “one sampled” specimen. In addition, since the frequencies are not whole numbers, the multiplication of the number of replicate by the frequency of the species results in specimen numbers with decimals –and we cannot collect in the practice 2.7 specimens. For that reason, we rounded the number of sampled specimens to its nearest whole number.

After this simple sampling intensity modelling, we calculated SQS values (using the R function written by Steve Holland and available in the *velociraptr* package of Andrew Zaffos; <https://rdrr.io/cran/velociraptr/src/R/subsampleEvenness.R>) for each of the abundance lists generated after each replicate for each AZ of the Chañares Formation and we plot them in a single bivariate plot (Supplementary figure 18). The sampling simulation, SQS calculations, and plotting were conducted in the software environment R (R Core Team 2017). We calculated the SQS values either including the most abundant taxon of the assemblage or excluding it (Alroy 2010) and in both cases after 1,000 replications (= “Trials” in the function). We set the quota of the subsampling in 0.7, which was the highest quota

value allowed by the presence of singletons in the current sampling of the *Tarjadia* AZ. We draw two vertical lines (magenta for the *Tarjadia* AZ and light blue for the *Massetognathus-Chanaresuchus* AZ) in the plot to show the replication in which the sampling intensity successfully recovers for the first time in the AZ all the species currently known in the other AZ (replication 25 for the *Massetognathus-Chanaresuchus* AZ and replication 143 for the *Tarjadia* AZ). As a result, in order to consider both AZs as identical in taxonomic composition we have to take into account the values of the curve to the right of the respective vertical line. The ranges in which the SQS diversities of both AZs overlap to the right of these vertical lines represent the taxonomic abundances, compositions, and diversity in which both AZs are identical to each other (i.e. the cases in which sampling bias completely explains the differences that we currently observe between both AZs). The R code used to conduct the simulations is provided in Extended Data 6.



Supplementary figure 18. Bivariate plot showing the SQS diversity curves simulated for each AZ and both methods (including, solid lines, and excluding, dashed lines, the most abundant taxon). The dashed horizontal lines represent the SQS value recovered for the actual sampling of each AZ (in the case of the *Massetognathus-Chanaresuchus* AZ including (bottom) and excluding (top) the most abundant taxon). The light blue vertical line indicates the sampling intensity in which all the species of the *Tarjadia* AZ are collected in the *Massetognathus-Chanaresuchus* AZ. Conversely, the magenta vertical line indicates the sampling intensity in which all the species of the *Massetognathus-Chanaresuchus* AZ are collected in the *Tarjadia* AZ.

Results

SQS-based simulations excluding the most abundant taxon

The simulated SQS diversity curves of both AZs closely approach each other (SQS values = 7.2 and 7.4) in the first replicate (replication=143) in which the sampling intensity successfully recovers the eleven currently valid species of the *Massetognathus*-

Chanaresuchus AZ in the *Tarjadia* AZ (i.e. the less common taxon is represented by one individual) (Supplementary figure 18). Under this sampling intensity, both AZs would have the same taxonomic compositions, relative abundance, and diversity if the following number of specimens of each species is collected:

- *Tarjadia* AZ (replication 143): 77 specimens of *Massetognathus*, 14 *Chiniquodon*, 29 *Probainognathus*, 6 *Chanaresuchus*, 6 *Tropidosuchus*, 1 *Gualosuchus*, 3 *Gracilisuchus*, 2 *Lagerpeton*, 2 *Lewisuchus*, and 2 *Marasuchus*.
- *Massetognathus-Chanaresuchus* AZ (replication 143): 74 *Tarjadia*, 19 rhynchosaurs, 6 cf. *Aleodon*, 24 cf. *Scalenodon/Mandagomphodon*, 6 medium-sized long-necked paracrocodylomorphs, and 13 large paracrocodylomorphs.

It should be noted that these are the minimum number of collected specimens necessary in each AZ to generate very similar SQS diversities –and also including all the components of one AZ into the other– because the diversity curves of both AZs approach each other also along the subsequent 150 replications. After the replication 150, the SQS diversity of the *Massetognathus-Chanaresuchus* AZ reaches a plateau ranging between values of 6.5 and 7.4 and the SQS diversity of the *Tarjadia* AZ drops continuously up to values around 5.0.

SQS-based simulations including the most abundant taxon

The SQS diversity of the *Tarjadia* AZ is equal to 4.2 in the first replicate (replicate=143) in which the sampling intensity successfully recovers in this AZ the eleven currently valid species of the *Massetognathus-Chanaresuchus* AZ (Supplementary figure 18). The SQS diversity curve of the *Massetognathus-Chanaresuchus* AZ acquires values of 4.2 in replications 38 and 39. Under these sampling intensities, the following number of specimens of each species should be collected in each AZ:

- *Tarjadia* AZ (replication 143): 77 *Massetognathus*, 14 *Chiniquodon*, 29 *Probainognathus*, 6 *Chanaresuchus*, 6 *Tropidosuchus*, 1 *Gualosuchus*, 3 *Gracilisuchus*, 2 *Lagerpeton*, 2 *Lewisuchus*, and 2 *Marasuchus*.
- *Massetognathus-Chanaresuchus* AZ (replications 38 and 39): 20 *Tarjadia*, 5 rhynchosaurs, 2 cf. *Aleodon*, 6–7 cf. *Scalenodon/Mandagomphodon*, 2 medium long-necked paracrocodylomorphs, and 3–4 large paracrocodylomorphs.

After replication 143, the SQS diversity curve of the *Tarjadia* AZ drops continuously up to values that range 2.2 and 2.3. As a result, the SQS diversity of the *Tarjadia* AZ overlaps those of the *Massetognathus-Chanaresuchus* AZ up to the minimum values that can acquire the latter when all the missing species are sampled (i.e. 3.5, in replication 25 of the *Massetognathus-Chanaresuchus* AZ and replications 244–276 of the *Tarjadia* AZ). Under these intensity samplings both AZs would acquire the same SQS diversity if the following number of specimens of each species is sampled:

- *Tarjadia* AZ (replications 244–276): 132–149 *Massetognathus*, 24–28 *Chiniquodon*, 49–55 *Probainognathus*, 10–11 *Chanaresuchus*, 10–11 *Tropidosuchus*, 2 *Gualosuchus*, 5–6 *Gracilisuchus*, 4–5 *Lagerpeton*, 4–5 *Lewisuchus*, and 4–5 *Marasuchus*.
- *Massetognathus-Chanaresuchus* AZ (replication 25): 13 *Tarjadia*, 3 rhynchosaurs, 1 cf. *Aleodon*, 4 cf. *Scalenodon/Mandagomphodon*, 1 medium long-necked paracrocodylomorphs, and 2 large paracrocodylomorphs.

Conclusion

The simulations clearly show quantitatively that it is extremely unlikely that the differences between the taxonomic composition and abundances of both AZs of the Chañares Formation could be the result of incomplete sampling. For example, it would require collecting more than 70 specimens of *Tarjadia* and *Massetognathus*, respectively, in levels that have not

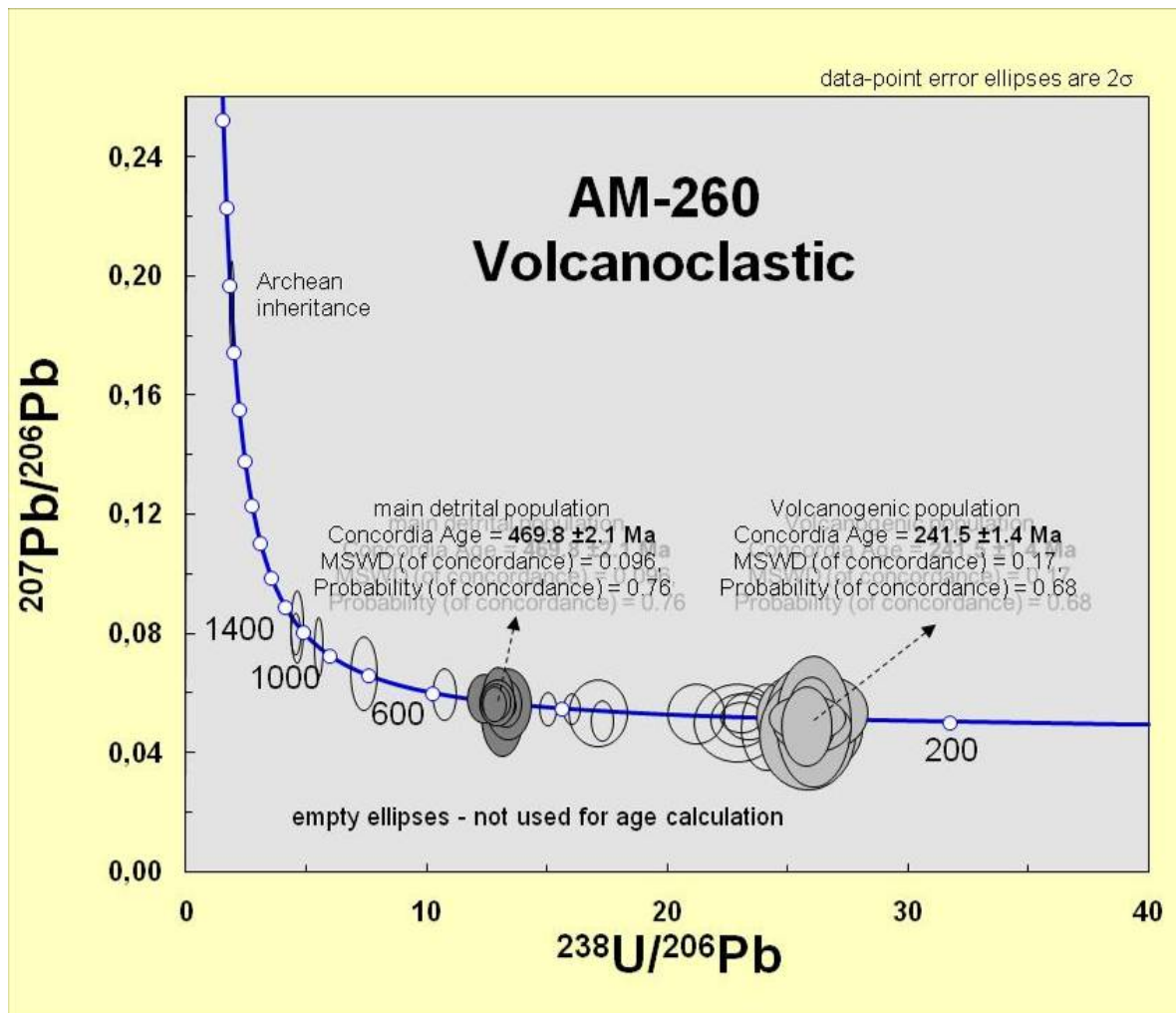
yielded any specimen of those taxa despite of an historic intensive sampling in the upper AZ and several field seasons in the lower AZ. Therefore, we reject the hypothesis that sampling bias could explain the faunistic differences reported in this manuscript.

8. New U–Pb ages from detrital zircons of the Chañares Formation

U–Pb detrital zircon data from AM-260

This sample is a volcanoclastic quartz-rich sandstone that was collected 12 metres above the base of the Chañares Formation at the Brazo del Puma locality (Supplementary figure 4). A total of 52 zircon grains were dated and values are reported in Extended Data 4. The analyzed zircons have the following morphologies sorted in decrease order by their relative abundance in the sample: i) euhedral and subhedral prismatic, ii) prismatic fragmented, and iii) rounded grains.

The Concordia diagrams indicate that most of the analyzed zircons lie close to the Concordia line, bracketing the interval in 1259–236 Ma (Supplementary figure 19). The detrital zircon distribution pattern shows isolated data of Mesoproterozoic ($n=2$) and Neoproterozoic ($n=2$) ages. The largest group is formed by Middle Ordovician (Dapingian) ages with a peak at 469.8 ± 2.1 Ma ($n = 14$). Four grains are included in the Early to Middle Devonian in a wide range of ages. Permian ages are represented by a considerable number of zircons ($n=6$), forming a peak of 270 Ma. Triassic zircons are the most abundant ($n=13$) and can be broadly assigned to a peak of 241.5 ± 1.4 Ma (Supplementary figure 19). However, when this group of data is analyzed in detail, smaller groupings are observed. Among them, the three youngest values represent a peak of 236.2 ± 1.1 Ma and the youngest zircon of the entire sample was dated in 236 ± 0.3 Ma (Supplementary figure 21).

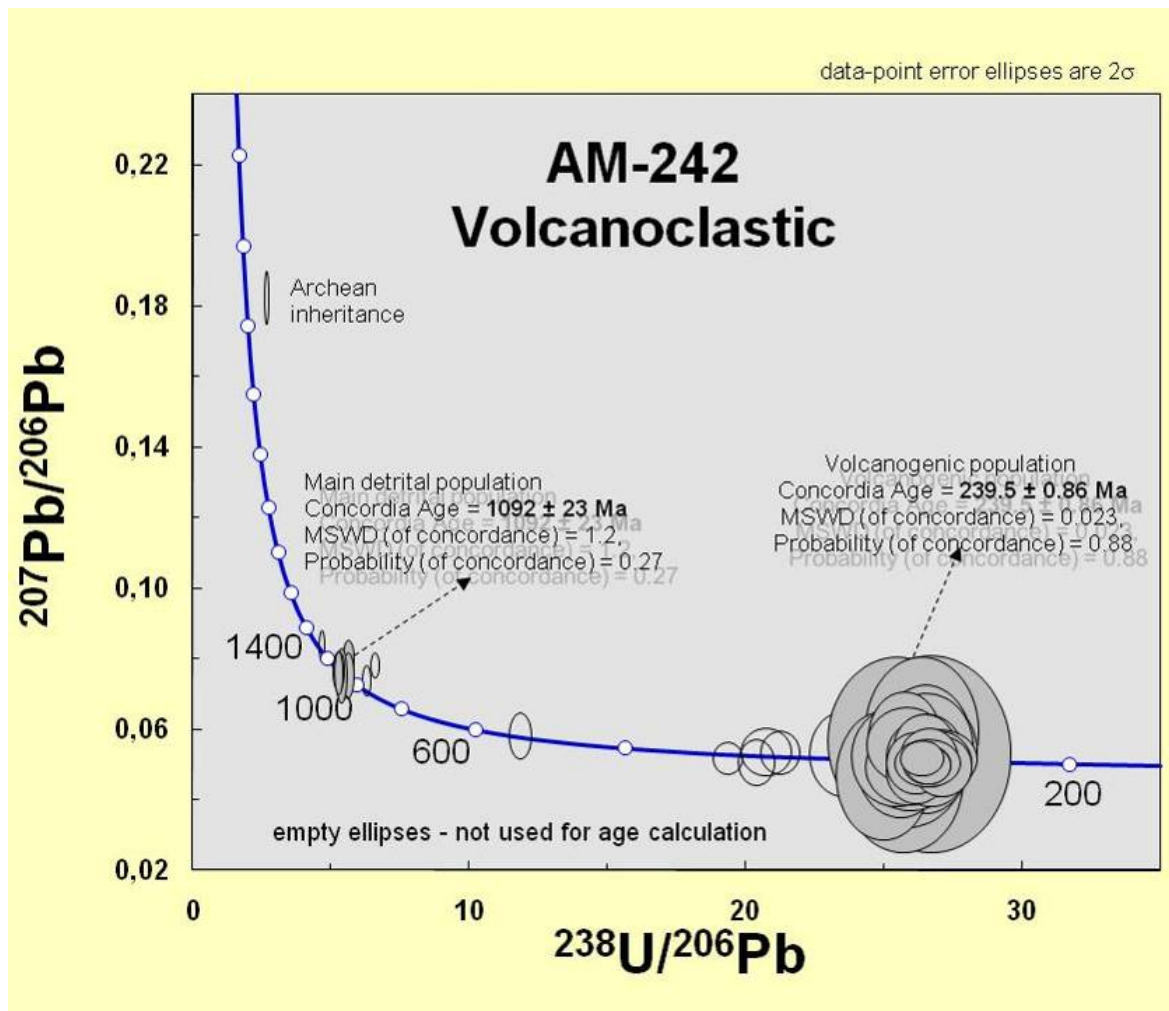


Supplementary figure 19. Concordia plot of sample AM-260. The youngest aged shown here does not represent the maximum depositional age calculated for the sample (see text and Supplementary figure 21).

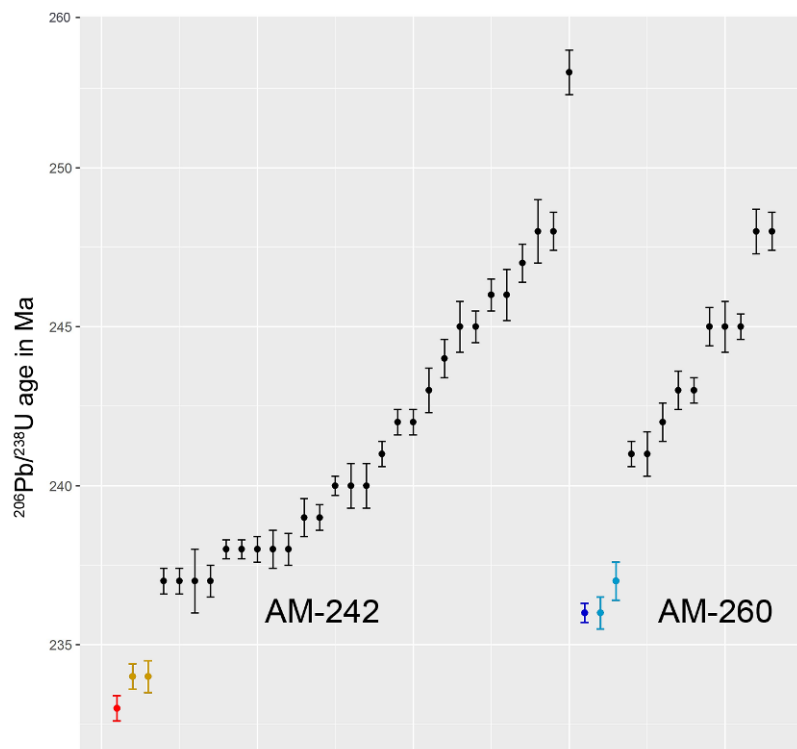
U–Pb detrital zircon data from AM-242

This sample is a tuff with a very low participation of detrititic grains (fine sand) collected 30 metres from the base of the Chañares Formation and 5 metres below the base of the Los Rastros Formation in the El Torcido locality (Supplementary figure 4). A total of 50 zircon grains were dated and values are reported in Extended Data 5. The analyzed zircons have variable morphology, but contrary to those of sample AM-260, there is a greater participation of prismatic and fragmented morphologies. Euhedral and subhedral prismatic, or rounded grains are subordinated.

The zircon ages of this sample show a practically exclusive Triassic peak with a mean age at 239.5 ± 0.86 Ma ($n = 21$) (Supplementary figure 20). However, smaller populations that are statistically separable are present in the Triassic data (Supplementary figure 21). The youngest peak is represented by three zircons and is of 233.6 ± 1.1 Ma, but the youngest zircon is dated in 233 ± 0.4 Ma (Fig. 1, Supplementary figure 21). Although the primacy of the Triassic ages is clear, it is important to emphasize the presence of Mesoproterozoic ages that form a peak of 1092 Ma ($n = 6$) and isolated Neopaleozoic ages. All these data plot in the Concordia line and, therefore, are reliable.



Supplementary figure 20. Concordia plot of sample AM-242. The youngest aged shown here does not represent the maximum depositional age calculated for the sample (see text and Supplementary figure 21).



Supplementary figure 21. Age-ranked representation of the latest Permian–Triassic zircons dated in the two samples of the Chañares Formation. The coloured data points represent the youngest zircons ($n=3$) used to calculate maximum depositional age of the samples and the red and blue data points represent the youngest dated zircon of each sample, respectively. The vertical bars represent 2σ uncertainties.

Maximum depositional age of the samples

The combined detrital zircon age spectra appear to be representative of the Proto-Andean margin basement of the Sierras Pampeanas. Mesoproterozoic and Neoproterozoic detrital zircon ages are largely present in the Pampean basement of the Sierras de Córdoba, Sierra Brava, and Ancasti (Rapela et al. 2007). A zircon peak of 470 Ma is a typical age for the Famatinian magmatism, which have conspicuous outcrops in the Sierras Pampeanas [e.g. Dahlquist et al. (2013) and references therein]. The Devonian ages could represent the batholiths of the eastern Sierras Pampeanas, such as the Achala batholiths (Dahlquist et al. 2014) or an hypothetical Devonian magmatic arc. Permian ages could represent the Pre-Choiyoi batholiths in the Chilean-Argentinean boundary (Mpodozis and Kay 1990).

The absence of zircon ages in the range of 2.02–2.26 Ga (Río de La Plata Craton; Rapela et al. 2007) and 540–515 Ma (Pampean magmatism; Iannizzotto et al. 2013; Gosen et al. 2014; and references therein) is notable. The absence of materials from the Pampean magmatism and the Río de La Plata Craton suggests that they were not outcropping or that different mountain ranges avoid the eroded material to arrive to these basins.

The Early-Middle Triassic peaks represent ages compatible with extension-related post-Choiyoi magmatism that characterize the Triassic rift basins of western Argentina (Sato et al. 2015). This set of values can be separated into smaller groupings, representing different pulses or volcanic episodes. The youngest statistically separable population of zircons forms a peak of 236.2 ± 1.1 Ma in AM-260 and a peak of 233.1 ± 1.1 Ma in AM-242 (Supplementary figure 21), indicating the maximum depositional age for these volcanoclastic deposits, respectively. Taking into account the syneruptive character of the sequence, it is possible to infer that the youngest ages indicate the moment of deposition of these samples of the Chañares Formation.

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