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Nyana rooiwalensis: Near-Complete 210-Million-Year-Old Dinosaur Skull Restores Early Sauropodomorph Evolution in South Africa

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A newly described early-branching sauropodomorph dinosaur from South Africa's Eastern Cape Province provides the first near-complete, articulated skull from the Late Triassic lower Elliot Formation, filling a long-standing anatomical gap near the origin of giant long-necked dinosaurs. Named Nyana rooiwalensis by paleontologist Atashni Moopen and an international team in Royal Society Open Science , the roughly 210-to-220-million-year-old fossil preserves delicate cranial structures -- including the braincase, palate, hyoid apparatus, and scleral rings -- in three dimensions alongside associated postcranial bones from a juvenile individual estimated at approximately 400 kilograms in body mass.

Late Triassic sauropodomorph skulls are exceptionally scarce across the southern continents, where fluvial red beds frequently preserve isolated postcranial skeletons while crushing or scattering fragile cranial elements. Because early sauropodomorphs underwent rapid shifts in feeding mechanics, body size, and skull proportions before the Triassic-Jurassic boundary, the recovery of an intact, uncrushed cranium from the lower Elliot Formation offers direct comparative evidence for how early massopodans diverged from smaller, more basal Late Triassic ancestors.

An Articulated Juvenile Skull From the Lower Elliot Formation

The holotype specimen of Nyana rooiwalensis was unearthed in 2018 near Qhemegha village in the Eastern Cape Province, within strata of the lower Elliot Formation deposited during the Norian to Rhaetian stages of the Late Triassic. The genus name Nyana draws from isiXhosa, meaning "son" or "child," and Sesotho, meaning "small" or "little," acknowledging the juvenile ontogenetic stage of the specimen, while the specific epithet rooiwalensis honors the local Rooiwal tribal area where the fossil was recovered.

Unlike many lower Elliot Formation sauropodomorphs known primarily from limb bones and vertebrae -- such as large-bodied taxa including Eucnemesaurus and Plateosauravus -- the Nyana rooiwalensis holotype combines an articulated skull with partial postcranial material, including dorsal vertebrae and appendicular limb elements. That association allows researchers to tie cranial morphology directly to body-size and growth-stage data from the same individual, rather than relying on composite reconstructions across separate quarry sites. Consequently, Nyana rooiwalensis establishes a much-needed anatomical anchor for comparing early Gondwanan sauropodomorphs against coeval Laurasian lineages.

| Parameter | | Observed Specimen Record | | Paleobiological Significance |

| Taxon | | Nyana rooiwalensis (Moopen et al., 2026) | | Early-branching massopodan sauropodomorph |

| Stratigraphic Horizon | | Lower Elliot Formation, Eastern Cape, South Africa | | Late Triassic (Norian-Rhaetian, ~220-201 Ma) |

| Ontogenetic Stage | | Juvenile (<= 2 lines of arrested growth) | | Documents early post-hatching cranial and somatic growth |

| Estimated Body Mass | | ~400 kg | | Substantial juvenile mass foreshadowing sauropod gigantism |

| Imaging Modality | | Synchrotron X-ray micro-computed tomography | | Resolves internal braincase, palate, hyoid, and scleral ring |

Synchrotron Micro-Tomography Reveals Hidden Cranial Architecture

To examine internal cranial features without physically damaging the surrounding rock matrix or fragile bone contacts, the research team applied synchrotron X-ray micro-computed tomography. Traditional mechanical preparation in indurated Karoo mudstones and siltstones frequently risks fracturing millimeter-thin palatal bars, braincase sutures, or orbital bones, leaving internal cavities unstudied. High-resolution phase-contrast scanning at synchrotron facilities bypasses that constraint by resolving density boundaries between mineralized bone and iron -rich sedimentary matrix in three dimensions, revealing the braincase, palatal complex, hyoid elements, and bony scleral rings that supported the eye.

Preserving the palate, hyoid apparatus, and braincase in articulation is especially informative for reconstructing early sauropodomorph neurosensory and feeding evolution . Changes in braincase proportions, inner-ear geometry, hyoid leverage, and palatal bracing mark the transition from ancestral faunivorous or omnivorous bipeds toward increasingly specialized, high-fiber herbivores capable of bulk plant processing. Meanwhile, intact scleral rings offer rare anatomical evidence for orbital aperture proportions in a juvenile individual. Having a digitally segmented, three-dimensional juvenile cranium from the lower Elliot Formation establishes an empirical baseline for testing how cranial traits scaled through ontogeny in early massopodans.

Osteohistology and the Road to Sauropod Gigantism

Thin-section osteohistological analysis of the limb bones indicates that the holotype individual died while still actively growing, preserving at most two lines of arrested growth alongside a crenulated periosteal surface. Lines of arrested growth record periodic slowdowns in bone deposition during unfavorable seasonal intervals, allowing paleontologists to estimate minimum biological age at death independently of skeletal size. Despite its young biological age, the animal had already attained a body mass of roughly 400 kilograms -- comparable to or exceeding the adult body mass of many earlier Carnian and early Norian dinosauromorphs.

That combination of juvenile bone microstructure and high absolute mass reinforces a central pattern in sauropodomorph evolution: the shift toward giant body sizes began well before the appearance of obligate quadrupedal sauropods in the Jurassic. Earlier Late Triassic sauropodomorphs already experimented with elevated early-life growth trajectories and sustained fibrolamellar bone deposition, allowing juveniles to pass rapidly through vulnerable small-bodied size classes in seasonal semi-arid

floodplain ecosystems.

Reshaping Lower Elliot Formation Biostratigraphy and Phylogeny

In phylogenetic analyses, Nyana rooiwalensis recovers either as an early-branching massopodan or nested within Massospondylidae, forming a close sister relationship with taxa such as the North American Sarahsaurus or the southern African Ngwevu . Either placement narrows the morphological gap between basal Late Triassic plateosaurians and the diverse massospondylid radiation that flourished across the upper Elliot Formation following the end-Triassic extinction . It also underscores the biogeographic connectivity of Pangaean terrestrial faunas during the Late Triassic, when closely related massopodan lineages dispersed across both southern and northern hemispheres before continental rifting isolated Gondwanan basins.

Biostratigraphically, the lower Elliot Formation has historically been characterized by lower taxonomic resolution than the overlying Jurassic upper Elliot Formation, largely because articulated skulls were missing. Previous stratigraphic syntheses of the Karoo Basin's Elliot Formation documented a major faunal turnover across the Triassic-Jurassic boundary, with bulky, early-diverging Late Triassic forms giving way to more gracile, abundant Jurassic massospondylids. The addition of Nyana rooiwalensis demonstrates that smaller-to-medium-bodied, massopodan-grade lineages with well-ossified skulls were already established in southern Africa during the Late Triassic, indicating deeper evolutionary roots for Jurassic sauropodomorph diversity than postcranial fragments alone had previously revealed. Future fieldwork in the lower Elliot Formation will clarify how widely this lineage ranged across the Karoo Basin prior to the end-Triassic extinction.

References & Primary Sources

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