

= TNM 02067 =

TNM 02067 (Tanzanian National Museums specimen 02067) is a fragmentary fossil dentary (lower jaw) from the Cretaceous (between 146 and 66 million years ago) of Tanzania . The short , deep bone is about 19 @. @ 5 mm (0 @. @ 77 in) long , but the back part is broken off . It contains a large , forward @-@ inclined incisor with a root that extends deep into the jaw , separated by a diastema (gap) from five cheekteeth . Very little remains of the teeth , but enough to determine that they are hypsodont (high @-@ crowned) . The third cheektooth is the largest and the roots of the teeth are curved . First described in 2003 , TNM 02067 has been tentatively identified as a sudamericid ? an extinct family of high @-@ crowned gondwanatherian mammals otherwise known from South America , Madagascar , India , and Antarctica . If truly a gondwanatherian , it would be the only African member of the group and may be the oldest . The describers could not exclude other possibilities , such as that the jaw represents some mammalian group known only from younger , Cenozoic times (less than 66 million years ago) .

= = Discovery and context = =

TNM 02067 was discovered in 2002 in the locality TZ @-@ 07 in the Mbeya Region of southwestern Tanzania , which has also yielded remains of various other vertebrates , including birds and other saurischian dinosaurs . The discovery was reported in a 2003 paper by David Krause and colleagues . TZ @-@ 07 lies in the " Red Sandstone Unit " (RSU) , an informal , poorly defined rock unit . Age estimates for the RSU have ranged from middle Jurassic to Miocene , but according to Krause and colleagues , part of this discrepancy is the result of confusion between two superficially similar rock units that outcrop nearby ; the older one , where TZ @-@ 07 is located , is undoubtedly Mesozoic and the younger is Cenozoic . Based on the presence of non @-@ avian dinosaurs and osteoglossomorph fishes , Krause and colleagues assigned TZ @-@ 07 to the Cretaceous (146 ? 66 million years ago) . In 2007 , Nancy Stevens and colleagues identified the unit that produced TNM 02067 as likely belonging to the middle part of the Cretaceous (around Aptian to Cenomanian) . TNM 02067 is significant as one of the very few mammals from the Cretaceous of the southern continents (Gondwana) .

= = Description = =

TNM 02067 is a damaged , partial left dentary (lower jaw bone) . It preserves much of the body of the bone , which is short and deep , but is broken along a vertical fracture behind the toothrow . There is another fracture in the front part of the jaw . The bone is 19 @. @ 5 mm (0 @. @ 77 in) long and 11 @. @ 4 mm (0 @. @ 45 in) deep . All the teeth are incomplete or absent , and lack both enamel and cementum , but what remains indicates that there was a large incisor at the front and five cheekteeth further back , separated by a diastema (gap) of about 2 @. @ 5 mm (0 @. @ 098 in) . On the labial (outer) surface of the dentary , there is one large mental foramen (opening) . The mandibular symphysis , where the two halves of the lower jaw meet , is poorly preserved , but there is nothing to suggest that the left and right dentaries were fused . The lower margin of the bone is convex at the front , but concave further back , so that the depth of the dentary is 8 @. @ 3 mm (0 @. @ 33 in) below the diastema , but only 7 @. @ 0 mm (0 @. @ 28 in) below the third cheektooth . The origin of the coronoid process , a projection at the back of the dentary , lies far to the front .

The large incisor is inclined forward , and its root ? the only part of the tooth that is preserved ? forms an angle of about 55 ° with the horizontal . At the tip of the alveolus , where the tooth projects out of the bone , it is 3 @. @ 0 mm (0 @. @ 12 in) high and 2 @. @ 1 mm broad . The root extends through the dentary to a position below the third cheektooth . Only the roots of the first and second cheekteeth are preserved . Both are about 1 @. @ 5 mm in diameter , but the first tooth may have been slightly smaller than the second . The third tooth , the largest of the cheekteeth , has the root slightly curved backward . This root is deeply anchored in the dentary , extending down through about three @-@ fourths of the bone . The crown is preserved in the form of a stump of dentine , 2

@. @ 3 mm (0 @. @ 091 in) long and 1 @. @ 9 mm (0 @. @ 075 in) broad , that extends high above the dentary , indicating that the tooth was hypsodont (high @-@ crowned) . High dentine stumps also remain of the fourth and fifth cheekteeth . The fourth is about as large as the first and second and the fifth is smaller , with a diameter of about 1 @. @ 0 mm (0 @. @ 039 in) . The fourth cheektooth also has a long , curved root , which extends more than halfway through the dentary , and that of the fifth tooth is even smaller and shorter . The orientation of the roots and teeth indicates that all the teeth were single @-@ rooted .

= = Identity = =

The dentary superficially resembles that of various other mammalian groups with enlarged incisors , such as rodents , lagomorphs , hyraxes , wombats , the aye @-@ aye , and the extinct apatemyids , tillodonts , and taeniodonts ? all of which are known only from the Cenozoic , less than 66 million years ago . Krause and colleagues could not exclude the possibility that TNM 02067 represents an early member of such a group or an otherwise unknown major group of mammals . However , only two groups of Mesozoic mammals resemble TNM 02067 : gondwanatheres ; and multituberculates in the superfamilies Djadochtatherioidea and Taeniolabidoidea . Djadochtatherioids and taeniolabidoids occur in the late Cretaceous through Paleogene of the northern continents (Laurasia) , and gondwanatheres , an enigmatic group of uncertain evolutionary affinities , are known from the late Cretaceous through Paleogene of Gondwana , with forms such as Gondwanatherium , Sudamerica (both from Argentina) , Lavanify (Madagascar) , and Bharattherium (India) .

No multituberculates are known to have had hypsodont teeth , none has more than two molariform (molar @-@ like) teeth in a single toothrow , and most have large , blade @-@ like teeth . However , the form of the remains of TNM 02067 's third cheektooth suggests it was not such a blade @-@ like tooth and that at least the last three cheekteeth were likely molariform . In these respects , TNM 02067 does resemble gondwanatheres in the family Sudamericidae , and Krause and colleagues tentatively identified it as representing that family , primarily on the basis of its hypsodont teeth . Krause and colleagues compared the dentary in detail to that of Sudamerica , the only other gondwanathere for which a substantial fragment of the jaw was known . Sudamerica has only four , not five , cheekteeth (all of which are molariform) , a higher , narrower incisor with a root that extends further through the dentary , and a shorter diastema ; in all these respects , TNM 02067 is more primitive . In addition , the mental foramen of the TNM 02067 is located lower and the cheekteeth vary more in size .

If truly a gondwanathere , TNM 02067 extends the known geographic range of the group to another part of Gondwana , the African mainland . The uncertain age of locality TZ @-@ 07 renders a precise assessment of the significance of TNM 02067 difficult . It may well be older than the oldest previously known gondwanathere , the Campanian Gondwanatherium . It also has implications for the hypothesis that Africa was isolated from the rest of Gondwana from an early date ? as early as the early Cretaceous ? and consequently had a fauna distinct from the rest of Gondwana for much of the Cretaceous , as it may be closely related to the sudamericids of South America , India , Madagascar , and Antarctica , a highly derived group .