

= LACM 149371 =

LACM 149371 (Natural History Museum of Los Angeles County specimen 149371) is an enigmatic fossil mammalian tooth from the Paleogene (66 to 23 million years ago , mya) of Peru . It is from the Santa Rosa fossil site , which is of uncertain age but possibly late Eocene (55 to 34 mya) or Oligocene (34 to 23 mya) . The tooth is poorly preserved and may have been degraded by acidic water or because it passed through a predator 's digestive tract . Its largest dimension is 2 @. @ 65 mm . It is triangular in shape and bears six cusps that surround the middle of the tooth , where there are three basins (fossae) . Crests connects the cusps and separate the fossae . The microscopic structure of the enamel is poorly preserved .

LACM 149371 was described in 2004 by Francisco Goin and colleagues , who tentatively interpreted the tooth as a left last upper molar . Although they saw similarities with South American ungulates , some early rodents , and multituberculates , they believed the tooth was most likely of a gondwanatheres . Among gondwanatheres ? a small and poorly known group otherwise known from the Cretaceous through Eocene of some of the southern continents (Gondwana) ? they thought the Cretaceous Argentinian Ferugliotherium to be the most similar .

= = Discovery and context = =

LACM 149371 was discovered in 1998 at the Santa Rosa fossil site in the Ucayali Region of Peru . The Santa Rosa fauna also contains fossils of various unique species of marsupials and hystricognath rodents , a possible bat , and some notoungulates . The fauna was published in a volume of the Science Series of the Natural History Museum of Los Angeles County in 2004 , which included a paper by Francisco Goin and colleagues that described and discussed LACM 149371 .

The age of the Santa Rosa fauna remains highly uncertain , as the outcrop where the fossils were found cannot easily be placed in a known stratigraphical unit , and the fossils are so distinct from other known fossil faunas that biostratigraphy cannot provide a precise estimate . In a summary of the 2004 volume , Kenneth Campbell tentatively referred Santa Rosa to the Mustersan South American Land Mammal Age (SALMA) , which he placed near the Eocene ? Oligocene boundary , around 35 million years ago . However , Mario Vucetich and colleagues suggested in 2010 that the Santa Rosa fauna may be substantially later ? perhaps as young as the Deseadan SALMA (late Oligocene , around 25 million years ago) . According to Campbell , the Santa Rosa mammals likely lived in a savanna habitat that contained rivers .

= = Description = =

LACM 149371 is a poorly preserved molar @-@ like tooth that largely lacks a recognizable enamel surface and shows many small grooves and holes on the crown surface . This suggests the tooth may have been chemically degraded , perhaps by acidic water or because it passed through the digestive tract of a predator . The roots are broken off , but remaining pulp cavities suggest the presence of four main roots , which are partially joined into two pairs . A smaller pulp cavity between those roots suggests the likely presence of a fifth root and a slight depression in the tooth may represent another root .

The crown of the tooth is triangular and contains six cusps , connected by low crests , that surround two prominent , low @-@ lying fossae (basins) and a third , smaller fossa . Because of the complexity of the crown , Goin and colleagues interpreted it as a molar ; because of the number of roots , the arrangement of the cusps , and the shape of the tooth , as an upper molar ; and because it tapers towards the end , as a last molar . One side , the longest , is flat and low compared to the others , suggesting it is the labial (outer) face . This would imply that the tooth is from the left jaw . Under this interpretation , the length of the tooth is 2 @. @ 65 mm , width is 2 @. @ 20 mm , height at the labial side is 1 @. @ 05 mm , and height at the lingual side is 1 @. @ 30 mm .

For convenience , Goin and colleagues designated the six cusps as A through F : A on the front labial corner of the tooth ; B on the labial face ; C on the back corner ; D on the lingual (inner) face

; E on the front lingual corner ; and F on the front face . The large front fossa is located between cusps A , B , D , E , and F ; the smaller intermediate fossa is between cusps B and D ; and the much smaller back fossa is just in front of cusp C. All three are nearly round . Cusp A , the largest cusp , is triangular in shape and is separated from the smaller , rounded B by a deep valley ; a low crest connects the two cusps further lingually , separating the valley from the front fossa . At its back , B connects to a long crest that reaches the back fossa and behind it the small cusp C , which has a groove on its labial side . A valley separates it from cusp D. D itself is crest @-@ shaped and forms the lingual wall of the intermediate fossa ; it is described as " very odd " , and may in fact consist of two fused , triangular cusps . A crest issuing from D separates the back from the intermediate fossa , and another , larger crest separates the front from the back fossa and nearly reaches cusp B. Cusp E is triangular and separated from cusps F and D by valleys , which are bordered internally by crests connecting the cusps . F is rounded . The microstructure of the tooth enamel is not clearly recognizable , evidently because the tooth is degraded , though structures resembling enamel prisms (bundles of hydroxyapatite crystals) and Hunter @-@ Schreger bands are recognizable .

= = Identity = =

Because of the complexity of the crown , Goin and colleagues identified the tooth as a mammal ; although some non @-@ mammalian groups , like crocodylians , may have complex teeth , none approach the level of complexity seen in LACM 149371 . They could find no resemblance to australosphenidans including monotremes , metatherians including marsupials , xenarthrans , and some related groups . They did see some general resemblances to the upper premolars of the early South American ungulates , but the cusp arrangement is different from that of any ungulate . There are also some resemblances to the early rodents Ivanantonia from Asia and Nonomys from North America , but Ivanantonia has a central groove and lacks fossae , and Nonomys has a prominent cingulum (shelf) at the edges of the tooth and also lacks the fossae of LACM 149371 .

The tooth resembles multituberculates ? a large group of extinct mammals with many @-@ cusped teeth ? in the shapes of the valleys and crests , but multituberculates lack fossae and usually have quadrangular teeth with two longitudinal rows of cusps separated by a central valley . In the same features , LACM 149371 resembles gondwanatheres , a small and enigmatic group of mammals from the Cretaceous through Eocene of the southern (Gondwanan) continents that may be related to multituberculates . In particular , Ferugliotherium from the late Cretaceous of Argentina has similarly formed cusps and also has crests that connect the cusps to the center of the tooth . However , the upper molars are unknown , and the low @-@ crowned teeth of Ferugliotherium lack deep fossae . Members of the higher @-@ crowned gondwanathere family Sudamericidae do have fossae . Goin and colleagues conclude that LACM 149371 most likely represents a member of the gondwanathere family Ferugliotheriidae ; if so , it would be among the youngest known gondwanatheres .