



## Recalibrating the Great American Faunal Interchange

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A late Miocene gomphothere from southeastern Peru documents the earliest occurrence of a North American mammal in South America as a result of the Great American Faunal Interchange (GAFI). The gomphothere came from the Ipururo Formation, which underlies the Madre de Dios Formation and is separated from it by the Pan- Amazonian Ucayali Unconformity. The Madre de Dios Formation is dated to 9.5-3.0 Ma using  $^{40}\text{Ar}/^{39}\text{Ar}$  dates on two volcanic ashes, in combination with magnetostratigraphy. The basal horizon of the Madre de Dios Formation is often fossiliferous, containing many fossil vertebrates typical of the Chasicoan (12-9 Ma) and Huayquerian (9-6 Ma) SALMAs. Also occurring in this horizon are other North American mammals, including other gomphotheres, tapirs, and two genera of extinct peccaries. The presence of this suite of North American mammals in South America in the late Miocene is recognized as the first pulse of the GAFI. Although the well-known swimming ability of elephantoids might have facilitated their very early (~10+ Ma) dispersal to South America, geologic data are now available that indicate the presence of a terrestrial pathway connecting North and South America in the late Miocene. This pathway led from central Panama, where North American mammals are found in early Miocene deposits, through mountainous terrain of the Panama-Costa Rica arc prior to this allochthonous terrain being completely sutured onto western Colombia. Late Miocene ground sloths found in North America probably traveled this route as well. Sea level fluctuations might have served to pulse interchange events until a permanent terrestrial link was established at ~5.0 Ma. That the GAFI began in earnest via terrestrial links in the late Miocene is supported by new data derived from paleontological discoveries, paleoceanographic research, and molecular divergence time estimates. The presence of such a terrestrial link has implications for many fields of scientific endeavor.

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