

An Introduction on the Paleoclimate Change Change Impacts on Primate Evolution

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The association between paleoclimate change and primate evolution is an ongoing topic of study. Readers should note that the following description is based on a search of current available literature and may not be the most accurate.

The first appearance of primates is around the boundary between Paleocene and Eocene. The earliest primate fossil found so far is from around 55 Mya. Studies have been conducted to estimate the appearance of the common ancestor of primates. Through methods of molecular phylogeny and relaxed clock analysis, the common ancestor of primates is speculated to be first appeared around 74.1 Mya, with an estimated range from 71.4 Mya to 77.5 Mya.

Studies based on purely fossil evidence have investigated the major events around 55 Mya and speculated how they are associated with primate evolution. Paleoclimate evidences collected from foraminifera shells shows that an extremely rapid environmental warming event occurred around 55 Mya, namely PETM (Paleocene–Eocene thermal maximum). PETM has been link to the volcanic activity associated with the NAIP (North Atlantic Igneous Province), which is considered a putative cause of a mass extinction event, the K-T (Cretaceous-Paleocene extinction event). During PETM, global temperature increased $5 - 8^{\circ}\text{C}$ in about 200,000 years. Some suggest that together with the EECO (Early Eocene Climatic Optimum), which is another warm period lasting from around 53 Mya to 50 Mya, warm weather has contributed to an ideal environment for the appearance and prosperity of early primates. The estimated appearance time 71.4 Mya of the primate common ancestor, however, is seldom associated to the major paleoclimate event around that time. From approximately 90 Mya to 66 Mya, there was a period of climatic warming named CTM (Cretaceous Thermal Maximum). During this time period, the estimated sea surface temperature is around $33 - 36^{\circ}\text{C}$ compared to $27 - 29^{\circ}\text{C}$ today.

Not only warm climate affects the evolution of primates. Around 48 Mya to 33.5 Mya, the latter half of Eocene has endured a long cooling trend, which was ended by a precipitous fall both in temperature and sea level. This event of the sudden climate shift is named TEE (Terminal Eocene Event) and has caused another mass extinction event, the Eocene–Oligocene extinction event. The rapid change in the environment not only not only forced the primates of the time to move to new habitats, but also changed the ecology of the habitats themselves, including the type of the forests.

Hominoids and Old World monkeys first appeared around 23 Mya at beginning of the Miocene, when the environment became rather drier and temperature returned to warmth, although not to Early Eocene levels. During this time, major orogenic events have result in a steeper latitudinal thermal gradient. Starting from 13 Mya, the temperature again began a consistent cooling, continuing to the present day, causing a Late Miocene "faunal turnover", together with the intensification of continental fragmentation from 10 Mya onwards. The even drier and seasonal environments only started becoming closer to the status of present around 9.2 Mya. Loss of evergreen forest both caused the extinction of several apes, referred to as the Vallesian Crisis, and the expansion of Old World monkeys during 6 – 7 Mya.