

An Introduction on the Paleoclimatology 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 earliest primate fossil record found so far is between 65 to 55 Mya, around the boundary between Paleocene and Eocene. Due to the scarcity of fossils for certain areas and extincted species, some studies dedicated on inferring the divergence time of the common ancestor of primates, using molecular clock and phylogeny methods. Through these methods, the first appearance of the primate common ancestor is speculated to be around 74 Mya, with an estimated range from 71 to 77 Mya.

Although the two types of approaches give two different divergence times, studies associated with paleoclimate conditions have been based mainly on the one supported by fossil evidence, which is around 65 to 55 Mya. At that time, an extremely rapid environmental warming event occurred around 56 Mya, namely PETM (Paleocene–Eocene thermal maximum). PETM has been linked to a mass extinction event around 66 Mya, namely the K-T (Cretaceous–Paleocene extinction event). During PETM, global temperature increased $5 - 8^{\circ}\text{C}$ in about 200,000 years. The warmer temperature on Earth caused by PETM, together with another warm period EECO (Early Eocene Climatic Optimum) from around 52 to 50 Mya, is suggested to contributed to an ideal environment for the appearance and prosperity of early primates.

Not only warm climate affects the evolution of primates. Around 48 to 33.5 Mya, the latter half of Eocene has endured a long cooling trend. This gradual cooling trend was ended by a precipitous fall both in temperature and sea level, namely TEE (Terminal Eocene Event) around 34 Mya. TEE is suggested to be associated with another mass extinction event, namely the Eocene–Oligocene extinction event. The rapid change in temperature 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. At that time, the environmental conditions became rather drier and the temperature returned to warmth, although not to Early Eocene levels. A steeper latitudinal thermal gradient has also been formed. Miocene Climatic Optimum, another warm period from about 18 to 14 Mya, precedes the Middle Miocene extinction event. After that, starting from 13 to 12 Mya, the temperature again began a consistent cooling continuing to the present day. This cooling trend is associated to the Late Miocene “faunal turnover”, which refers to simultaneous appearance and disappearance of species from a community. The even drier and seasonal environments only started becoming closer to present around 9.2 Mya. Loss of evergreen forests both caused the extinction of several taxa of primates in Europe, referred to as Vallesian Crisis, and the expansion of Old World monkeys during 6 to 7 Mya.