Drastic environmental change in the Kenya Rift and mammalian faunal interchange between Africa and West Eurasia around 10 Ma

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Environmental change may have an important effect on the evolution of life. The Kenya Rift is a treasure house for understanding the evolution from great apes to humans, because many Miocene to Pliocene hominoids fossils have been discovered in the area. We here report the geology, 40Ar-39Ar ages, magnetostratigraphy, and palaeontology of the early Late Miocene hominoids-bearing successions at Nakali and Samburu Hills in central to northern Kenya Rift. We also discuss their palaeoenvironments and mammalian faunal interchanges between East Africa and West Eurasia.

The Nakali Formation (Fm) consists mainly of lake and fluvial deposits, along with tuff and lapilli tuff beds, lahar and pyroclastic flow deposits. Primate and mammalian fossils were recovered from the lahar deposits.

Combined with the 40Ar-39Ar ages (10.10+-0.12 to 9.82+-0.09Ma) and magnetostratigrapy, the age of the Nakali Fm ranges from 10.1 to 9.8 Ma (within Chron C5n.2n to C5n.1n; Cande & Kent, 1995).

Based on K-Ar ages and magnetostratigrapy, age of the uppermost part of the Aka Aitheputh and the Namurugle Fms ranges from 10.2 Ma to 9.3 Ma (Sawada et al., 2006). Samburupithecus is slightly younger than the Nakali hominoids.

Environmental conditions in the northern Kenya Rift changed drastically at around 10 Ma. Thick red palaeosols intercalated with siliceous and calcareous beds are characteristic of the uppermost part of the Aka Aitheputh Fm. These sedimentary facies do not occur in underlying parts of the Samburu Hills succession. These features indicate that climate became seasonal, with alternation of warm and humid conditions with arid periods during which extreme evaporation occurred. The Aka Aiteputh Fm passes upward into alternating sand and silt beds of the Namurungule Fm, which record repeated inundation and drying-up of a flood plain. This facies change indicates that rainfall increased overall, probably due to the beginning of the monsoon around the Himalaya. This time period also corresponds to a tectonically active phase, as shown by presence of numerous growth faults in the uppermost part of the Aka Aitheputh Fm and subsequent deposition of fluvio-lacustrine sediments in the Namurungule Fm. These observations suggest that the main northern Kenya Rift graben formed between ca 10 Ma and 9.3 Ma. The abrupt environmental change recorded may be related to regional doming prior to rift graben formation and also to global climate change. The regional tectonic events and global climate change (e.g. Haq et al., 1987) thus combined to cause drastic environmental change, with shift from relatively uniform conditions throughout the area to pockets of differing local environments along the Rift.

The mammalian assemblages of the Nakali fauna closely resemble the Namrungule and Ngeringerwa faunas in Kenya. These faunas were designated as Faunal Set VI of East African biostratigraphy (ca 10 Ma). Early Late Miocene East African faunas contain components similar to the Pikermian Biome that was established on seasonal sclerophyllous evergreen woodlands covering Greece, Turkey, Iran, and the Sahara (Solounias et al., 1999). Isotopic studies of tooth enamel of proboscideans and equids from both sites indicate C3 diets, but the Samburu Hills herbivores show a greater tendency for transition toward the C4 diet (Cerling et al. 1997, 1999, Cerling, pers. comm.) than do those at Nakali. The combination of active tectonism and higher rainfall led to ongoing deterioration of the environment in this region after 10 Ma. This may account for the relatively open environment indicated by the younger Namurungule fauna compared to the Nakali fauna. The mammalian faunal interchange between East Africa and the Pikermian Biome in the early Late Miocene might have been facilitated by this environmental change.