

Global warming and the beginning of the “Age of Mammals”

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The catastrophic events of the Cretaceous-Tertiary boundary (~65 million years ago) swept aside the dinosaurs and paved the way for mammalian hegemony on Earth. Following this dramatic mass extinction event, a span of nearly ten million years elapsed before mammalian faunas began to resemble those of the modern world. Early and middle Paleocene faunas on the northern continents were dominated by anatomically archaic, ecologically peculiar mammalian taxa that are only distantly related to the lineages prevailing today. Tiny insectivorous mammals were abundant and diverse, but these animals were only distantly related to living shrews, moles, and hedgehogs. Likewise, the small to medium-sized herbivorous mammals of the early and middle Paleocene would be unfamiliar to us, because they did not resemble living horses, rhinos, deer, pigs, or other modern ungulates. Yet by the beginning of the Eocene, roughly 55 million years ago, mammalian faunas across the northern half of the globe had been utterly transformed. These Eocene faunas prominently included early relatives of the same major lineages that populate modern ecosystems. What caused this dramatic transformation, and why did it happen so quickly?

Beginning in the late Paleocene, the Earth's climate became increasingly warmer. Global warming reached a crescendo at the Paleocene-Eocene boundary, when the rate and magnitude of climate change approximated that of today. Paleogeographic differences from modern conditions were caused by higher eustatic sea level and slightly different continental plate configurations. The most significant geographic differences included: (1) the presence of an epicontinental sea (variously called the Obik Sea or the Turgai Straits) running north-south across central Eurasia, which effectively segregated western Europe from eastern Asia; (2) the presence of a consistently emergent Bering land bridge connecting northeastern Asia with northwestern North America; and (3) the presence of a North Atlantic land bridge connecting Greenland and northeastern North America with Scotland and northwestern Europe. The net effect of these geographic differences was that dispersal of early mammals from one continent to another could only occur across land bridges that were located at high latitudes. Because of the high northern latitude of these land bridges, global warming during the late Paleocene and early Eocene facilitated faunal exchange between Asia and North America, and between North America and Europe.

This lecture reviews recent discoveries of fossil mammals from Asia, North America, and Europe within the context of the rapidly changing climate of the early Cenozoic. Three successive waves of mammalian dispersal from Asia to North America can now be documented at a high level of resolution. The fossil record of western Europe is less complete, but it generally resembles that of North America. As a result of this repeating pattern of dispersal of new types of mammals from Asia to North America to Europe, mammalian ecosystems across the northern half of the globe became modernized and cosmopolitan by the earliest Eocene. These relatively modern and nearly cosmopolitan mammalian faunas included early rodents, primates, and modern hooved mammals (including the ancestors of horses, deer, and many others). The episode of

global warming at the Paleocene-Eocene boundary profoundly altered the course of evolution, and set the stage for the evolution of modern global ecosystems.