Reports

Mid-Oligocene Extinction Event in North American Land Mammals

Abstract. *Interest in extraterrestrial causes for the apparent 26- to 32-million-year periodicity of mass extinctions has focused on the terminal Eocene event and older events, although there is now evidence of a mid-Oligocene event near the early/late Oligocene boundary, or about 32.4 million years ago. An abrupt (200,000 years or less) mid-Oligocene extinction event appears in the record of North American land mammals, which results in the selective disappearance of archaic members of the fauna and later diversification of other taxa. The selective nature of the extinctions suggests climatic and ecological causes rather than an extraterrestrial catastrophe. Increased mid-Oligocene glaciation, worldwide cooling, a major regression event, and abrupt changes in the flora are probably the immediate causes, and these may have resulted from changes in global oceanic circulation.*

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The changes in the North American mammal fauna at the boundary between the Chadronian and Orellan land mammal ages (*1*) have attracted relatively little attention, although the extinction of the titanotheres at this time has provoked speculation (*2*) about causes of the changes. Paleomagnetic data (*3–5*) now make it possible to correlate the Oligocene land mammal record with the worldwide climatic record.

The correlation of terrestrial magnetostratigraphy with the magnetic polarity time scale (*4*) suggests that the Chadronian-Orellan boundary occurs about 32.4 million years ago. Correlation of the planktonic zonation (*6*) with the polarity time scale suggests that the Chadronian-Orellan boundary occurs at the top of planktonic foraminiferal zone P20 and near the middle of calcareous nannofossil zones CP18 and NP23. Terrestrial magnetobiostratigraphic studies (*3*) have established temporal ranges of mid-Oligocene North American land mammals indicating that a number of mammalian families (Fig. 1) last appeared within a short span of stratigraphic section near the end of the Chadronian. These families included not only the titanotheres, but also the primitive camel-like oromerycids, the mole-like epoicotheres, the pantolestids, and the primitive paramyid and cylindrodont rodents. In the early Orellan, most of these taxa were not replaced. However, there was some diversification of eumyine cricetid rodents, and the high-crowned leptauchenine oreodonts made their first appearance at this time. The oreodont *Miniochoerus* (*3, 7*) shows rapid dwarfing across the Chadronian-Orellan boundary, resulting in a 36 percent reduction in size. Speciation in the deer-like *Leptomeryx* and the camel *Poebrotherium* also occurred near this boundary. In most other respects, however, the typical Orellan fauna was quite similar to the late Chadronian fauna.

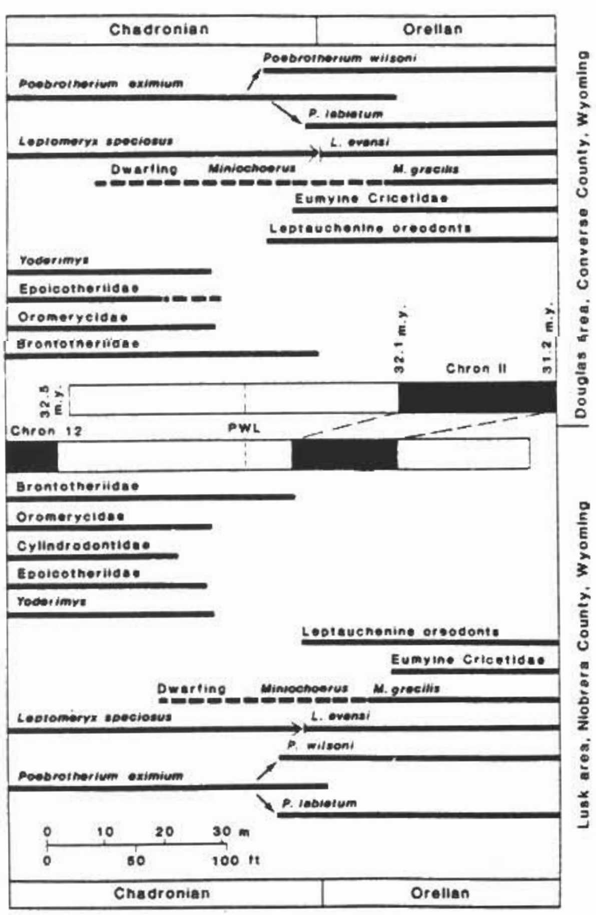

Fig. 1. Stratigraphic ranges of mammals most strongly affected by the mid-Oligocene event in two areas in Wyoming: Douglas, Converse County, and Lusk, Niobrara County. Biostratigraphy and magnetostratigraphy are taken from (*3*). Age of magnetic polarity event boundaries in millions of years are based on (*6*).

Magnetostratigraphy has also made it possible to estimate the rate of these changes. Correlation of the late Chadronian normal polarity event with chron C12 of the magnetic polarity time scale (*6*), and the early Orellan normal event with chron C11 (*4, 5*) indicates that the Chadronian-Orellan boundary is contained within chron C11R. Calculation of average sedimentation rate between paleomagnetic time planes (Fig. 1) suggests a span of no more than 200,000 years for the Chadronian-Orellan extinction event. This event might be even shorter in duration if normal range extensions due to improved sampling are taken into account. Such an abrupt transition has not been suspected, since a complete, thick sequence spanning this time interval is not preserved in the classic sections of the Big Badlands of South Dakota (*2*) or equivalent rocks of Nebraska (*8*). Much higher resolution of this event can be seen in sections near Lusk (*3, 9*) and Douglas (*3*), Wyoming (Fig. 1).

Although this faunal transition is relatively rapid, it is not catastrophic. Extinction at the Chadronian-Orellan boundary was selective, occurring in archaic groups that were primarily relicts from the Eocene. Most of the other changes (dwarfing and speciation) are drawn out over the entire transition and do not suggest geologically instantaneous, catastrophic causes. The lack of change in the bulk of the fauna also argues against indiscriminate, periodic extraterrestrial extinction events (*10*). The Chadronian-Orellan transition strongly suggests that there was a major ecological and climatic change, since similar changes in the reptilian fauna (*11*), the vegetation (*12*), and the soil horizons (*13*) have been reported at this time.

A major mid-Oligocene cooling event, as suggested by the benthic foraminiferal $\delta^{18}O$ record (*14–16*), and circulation event, as suggested by the planktonic foraminiferal $\delta^{13}C$ record (*14*), are known to have occurred. The largest regression in the Tertiary is reported (*15, 17*) from the mid-Oligocene and apparently was caused by a glacio-eustatic fall in sea level (*15*). Evidence from planktonic microfossils (*15*) suggests that this regression began at the top of planktonic foraminiferal zone P20 or the base of zone P21a. Cooler water forms of planktonic foraminifera (*18*) increasingly dominate in the mid-Oligocene. *Braarudosphaera*, a coccolithophorid that is associated with crises, is common in the mid-Oligocene (*19*).

The combined faunal and isotopic evidence together have been interpreted as indicating an increase in Antarctic ice volume and concomitant global cooling in the mid-Oligocene (*15, 20*). This might have been caused by increased development of the circum-Antarctic current and resulting refrigeration of the Antarctic continent due to circumpolar deepwater circulation between Tasmania and Antarctica (*20*). Better knowledge of the precise sequence and timing of these events worldwide will allow a more definite chain of cause and effect to be reconstructed.

References and Notes

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