Mid-Oligocene Extinction Event in North American Land Mammals

Abstract. Interest in extraterrestrial causes for the apparent 26- to 22-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 arbovic 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, world-wide cooling, a major regression event, and abrupt changes in the flora are possibly 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 titanothere 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 (6) 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 foraminifera zone P30 and near the middle of calcareous nanofossil zones CP18 and NP22. Terrestrial magnetostratigraphic studies (7) have established tempestite ranges of mid-Oligocene North American land mammals indicating 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 titanothere, but also the primitive camel-like oreomerycids, the pantoestids, and the primitive pantodonts and cylindroodont rodents. In the early Orellan, most of these taxa were not replaced. However, there was some diversification of eumyeine eucrotalid rodents, and the high-crowned leptoamerican oreodonts made their first appearance at this time. The oreodont Meniscotherium (7, 8) shows rapid dwarfing across the Chadronian-Orellan boundary, resulting in a 36 percent reduction in size. Speciation in the diceratherine Lepomemys and the camel Protheroitherium also occurred near this boundary. In most cases, however, the typical Chadronian-Orellan fauna is quite similar to the late Chadronian fauna.

Magnetostriatigraphy 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 C14 (6, 7) indicates that the Chadron-Orellan boundary is contained within chron C11R. Calculation of average sedimentation rate between paleomagnetic polarity zones (Fig. 1) suggests a span of no more than 200,000 years for the Chadronian-Orellian extinction event. This event might be even shorter in duration if normal range extinctions 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 Bluffs of South Dakota (2) or equivalent rocks of Nebraska (8). Much higher resolution of this event can be seen in sections near Lusk (2, 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 arctic groups that were primarily restricted from the Eocene. Most of the other changes (dwarving and speciation) are
drawn out over the entire transition and do not suggest geocentrically
instantaneous, catastrophic causes. The lack of change in the bulk of the fauna
also argues against indiscriminate, periodic, extrepamrestrial extinction events
(10). The Cretaceous-Tertiary 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
δ¹⁸O record (14-16), and circulation event, as suggested by the planktonic
foraminiferal δ¹³C record (14), have been observed to have occurred. The
largest regression in the Tertiary is reported (15, 17) from the mid-Oligocene and appear-
ently was caused by a glacio-eustatic fall in sea level (15). Evidence from plank-
tonic 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 plank-
tonic foraminifera (18) increasingly dominate in the mid-Oligocene. Braunscho-
phiina, a coccolithophorid that is associated with crises, is common in the mid-
Oligocene (19). The combined fossil 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 develop-
ment of the circum-Antarctic current and resulting refrigeration of the Antarctic
continent due to circumpolar deepwater circulation between Tasmania and Aus-
ttralia (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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