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Million-year scale astronomical cycles and mammal turnover

J. van Dam (1), H. Abdul Aziz (2), M. Álvarez Sierra (3), F. Hilgen (1), L. van den Hoek Ostende (4), L. Lourens (1), P. Mein (5), A. van der Meulen (1), P. Pelaez Campomanes (6)

(1) Dept. of Earth Sciences, Utrecht University, the Netherlands (jdam@geo.uu.nl), (2) Dr. Hayfaa Abdul Aziz, Dept. of Earth and Environmental Sciences, Geophysics LMU, Munich, Germany, (3) Dept. of Paleontology, Complutense University, Madrid, Spain, (4) National Museum of Natural History, Naturalis, Leiden, the Netherlands, (5) Fac. of Earth Sciences, University of Lyon I, Lyon, France, (6) Dept. of Paleobiology, National Museum of Natural History, Madrid, Spain.

The mechanisms underlying regular species origination, extinction and turnover are still poorly understood. Various studies have invoked climate change to explain species turnover, but other studies have challenged this view and point to the dominance of biotic factors such a competition. Here we use an exceptionally long (24.5 - 2.5 million years ago), dense, and well dated terrestrial record of rodent lineages from central Spain, and show the existence of periodically occurring turnover “pulses” with mean periods of 2.4-2.5 and 1.0 million years. We link these cycles to low-frequency modulations of Milankovitch oscillations, and show that the pulses of turnover occur at minima of the 2.37 million-year eccentricity cycle and nodes in the 1.2 million-year obliquity cycle. Because long-period obliquity nodes and eccentricity minima are associated with a lack of extreme summers, they trigger ice sheet expansion and cooling, as evidenced by the timing of Oligocene (Oi), Miocene (Mi) and related marine stable oxygen isotope events. In addition, a change in the regional precipitation regime is to be expected because either strong 21-Kyr precession or 41-Kyr obliquity cycles are lacking. Both the ecological structure and the general lithology of the studied basins suggest drier conditions during 1.2-Myr spaced obliquity nodes, but wetter (summer) conditions during 2.37-Myr spaced eccentricity minima.