frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 20 October 2023
DOI 10.3389/feart.2023.1305471

OPEN ACCESS

EDITED AND REVIEWED BY
Timothy Ian Eglinton,
ETH Zürich, Switzerland

*CORRESPONDENCE
Łucja Fostowicz-Frelik,
lfost@twarda.pan.pl

RECEIVED 01 October 2023
ACCEPTED 11 October 2023
PUBLISHED 20 October 2023

CITATION
Fostowicz-Frelik Ł, Li Q and Métais G (2023), Editorial: Biotic changes in terrestrial environments around the Eocene–Oligocene transition. *Front. Earth Sci.* 11:1305471. doi: 10.3389/feart.2023.1305471

Editorial: Biotic changes in terrestrial environments around the Eocene–Oligocene transition

Łucja Fostowicz-Frelik[1]*, Qian Li[2] and Grégoire Métais[3]

[1]Institute of Paleobiology, Polish Academy of Sciences, Warsaw, Poland, [2]Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China, [3]Centre de Recherche en Paléontologie—Paris, UMR 7207 (CNRS, MNHN, Sorbonne Université), Muséum National d'Histoire Naturelle, Paris, France

KEYWORDS

mammals, Eocene-Oligocene transition, paleoenvironments, stratigraphy, Asia

Editorial on the Research Topic
Biotic changes in terrestrial environments around the Eocene–Oligocene transition

The biotic event associated with the Eocene-Oligocene transition (EOT) is arguably one of the most significant in the Cenozoic history of life. At the planetary scale, the EOT is marked by a climatic shift from "greenhouse" to "icehouse" world (e.g., Zachos et al., 2001) caused by multiple factors including the final isolation of the Antarctic initiating development of permanent ice sheets on this continent and setting of the circum-Antarctic current, which had global consequences in the Earth-wide cooling and climate drying. These changes in temperature and air circulation facilitated the appearance of the first large-scale open habitats and substantially changed biotas across the globe. In Asia, the enhanced aridification across the EOT, coupled with the India–Asia collision and remarkable global sea-level drop profoundly changed the geography of Central Asia, creating land bridges that allowed biogeographic re-organization of terrestrial biotas.

In Western Europe, the EOT is concomitant with a major turnover in terrestrial vertebrate fauna, the so-called *Grande Coupure*, first identified by Stehlin (1909) in the Paris Basin, which marked the demise of endemic Eocene assemblages (Hooker et al., 2009), and the influx of multiple clades of Asian mammals. Likewise, the "Mongolian remodeling" (Meng and McKenna, 1998) shows a significant biotic reorganization reflecting an aridification of the Mongolian Plateau. These pulses in faunal migration, generally radiating from Asia to other continents, are thought to be the result from a complex interplay between the orogenic evolution of Asia (mostly India–Asia collision) and the global cooling and aridification of Asia induced by the combined partial pressure of CO_2 (pCO_2) drawdown and the westward retreat of the Paratethys Sea initiated at ~40 Ma (Bosboom et al., 2014). This profound biotic reorganization eventually led to shaping of modern aspect ecosystems with the faunal content we know today.

The base of the Oligocene (Global Boundary Stratotype Section for the base of the Ruppelian stage) was formally established on the open marine sediment series of the Massignano section (Italy; see Premoli Silva and Jenkins, 1993), close to the top of chron C13r, which gives a numerical age ~34.0 Ma (Speijer et al., 2020). In order to reconstruct the changes in the terrestrial environments we need to refer to other Eocene-Oligocene sediment series documenting EOT. Some of the exceptionally preserved strata displaying the

Eocene–Oligocene boundary can be found in Asian (e.g., Wasiljeff et al., 2020) or North American deposits (see e.g., Fostowicz-Frelik, 2013 and references therein).

In recent years, the interest in the EOT and pre-EOT faunal research has been centered on continental China (e.g., Wang et al., 2010; Wang et al., 2012; Li et al., 2016a; Li et al., 2016b), southeastern Europe and Western Asia (Balkanatolia; Licht et al., 2022; Métais et al. in press), and tropical-equatorial area of South America (Antoine et al., 2021). According to the currently available biostratigraphic data, the Eocene-Oligocene boundary in China is probably located in the upper part of the Xianaogangdai Formation at the Erden Obo Section, Siziwang Qi, Nei Mongol, which is a set of reddish muddy siltstone or silty mudstone. The rodent assemblage, consisting of the most abundant and diverse small mammal taxa, displays a significant change across the boundary (Li et al., 2016a; Li et al., 2017). The preliminary paleomagnetic results also support the placement of the Eocene–Oligocene boundary in the upper part of the Xianaogangdai Formation. Another area with a documented Eocene–Oligocene boundary is Ulantatal, Alax Zuoqi and Balagong, in Hangjin Qi, Nei Mongol (Zhang et al., 2016; Wang et al. this volume). Based on the paleomagnetic reversal stratigraphy and faunal correlation in Ulantatal, the deposition time of this sediment series was established at between 35 and 27 Ma, thus exposing a long sedimentary succession ranging from the latest Eocene to the late Oligocene (Wasiljeff et al., 2020). Moreover, the assemblage of small mammals from the Kekeamu Section of this area, including the Eocene-Oligocene boundary (Wasiljeff and Zhang, 2022), displays an array of primitive and derived morphologies that resemble faunal elements known from the late Eocene and early Oligocene of China and Mongolia (Xu et al., 2023), and pointing to gradual faunal changes that started before the EOT.

In South China, the lower part of the Chaijiachong Formation was established as late Eocene on the basis of mammal fauna, although some recent discoveries show the possibility of lower Oligocene taxa admixture in strata bearing the Chaijiachong fauna in Qujing, Yunnan (Maridet and Ni, 2013). Further paleontological survey in the Youganwo Formation in Maoming, Guangdong, or in the Shinao Formation (Southwestern Guizhou and Eastern Yunnan, China) would improve our knowledge of the late Eocene faunas of Southeast Asia, so far only documented by the Krabi fauna of southern Thailand (Ducrocq et al., 1995).

The aim of the current volume was to bring our readers up to speed on recent discoveries in the field of mammal biostratigraphy, faunal diversity, and biotic changes in Asian terrestrial environments during the EOT and pre-EOT. This volume focuses on the continental Asian fossil record of the mammalian fauna and mammal paleocommunities, showing gradual changes in fauna as it transforms from the mid-Eocene climatic optimum (MECO) all the way through the Eocene–Oligocene biotic crisis. This Frontiers Research Topic presents studies depicting these events in different regions of China from Tibetan Plateau (see Ni et al.), Xinjiang (Li et al.) and Inner Mongolia (Bai et al.; Wang et al.; Zhang et al.) to south Chinese Guangdong Province (Averianov et al.), showing the response to changing environment in different mammalian groups. We do not focus on any particular group of mammals, although studies on rodents, the world's most numerous and diverse group dominate in taxonomical (see Ni et al.; Li et al.) and stratigraphic and paleogeographic aspects (Li et al.; Wang et al.). Further contributions feature also new taxa of artiodactyls (Bai et al.), and carnivores (Averianov et al.; Zhang et al.), complementing the picture of the paleo-trophic chains active during the late Eocene and early Oligocene in Asia.

Author contributions

ŁF-F: Writing–original draft, Writing–review and editing. QL: Writing–original draft, Writing–review and editing. GM: Writing–original draft, Writing–review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Antoine, P.-O., Yans, J., Castillo, A. A., Stutz, N., Abello, M. A., Adnet, S., et al. (2021). Biotic community and landscape changes around the Eocene–Oligocene transition at Shapaja, Peruvian Amazonia: regional or global drivers? *Glob. Planet. Change* 202, 103512. doi:10.1016/j.gloplacha.2021.103512

Bosboom, R., Dupont-Nivet, G., Grothe, A., Brinkhuis, H., Villa, G., Mandic, O., et al. (2014). Timing, cause and impact of the late Eocene stepwise sea retreat from the Tarim Basin (west China). *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 403, 101–118. doi:10.1016/j.palaeo.2014.03.035

Ducrocq, S., Chaimanee, Y., Suteethorn, V., and Jaeger, J. J. (1995). Mammalian faunas and the ages of the continental Tertiary fossiliferous localities from Thailand. *J. Southeast Asian Earth Sci.* 12, 65–78. doi:10.1016/0743-9547(95)00021-6

Fostowicz-Frelik, Ł. (2013). Reassessment of *Chadrolagus* and *Litolagus* (Mammalia: Lagomorpha) and a new genus of North American Eocene lagomorph from Wyoming. *Am. Mus. Novit.* 3773, 1–76. doi:10.1206/3773.2

Hooker, J. J., Grimes, S. T., Mattey, D. P., Collinson, M. E., and Sheldon, N. D. (2009). "Refined correlation of the late Eocene-early Oligocene Solent Group and timing of its climate history,". *Late Eocene Earth: Hothouse, Icehouse, and Impacts*. Editors C. Koeberl, and A. Montanari (Geological Society of America Special Paper), 452, 179–195.

Li, Q., Meng, J., and Wang, Y.-Q. (2016a). New cricetid rodents from strata near the Eocene-Oligocene boundary in Erden Obo section (Nei Mongol, China). *PLoS ONE* 11, e0156233. doi:10.1371/journal.pone.0156233

Li, Q., Wang, Y.-Q., and Fostowicz-Frelik, Ł. (2016b). Small mammal fauna from Wulanhuxiu (Nei Mongol, China) implies the Irdinmanhan–Sharamurunian (Eocene) faunal turnover. *Acta Palaeontol. Pol.* 61, 759–776. doi:10.4202/app.00292.2016

Li, Q., Gong, Y.-X., and Wang, Y.-Q. (2017). New dipodid rodents from the late Eocene of Erden Obo (Nei Mongol, China). *Hist. Biol.* 29, 692–703. doi:10.1080/08912963.2016.1232406

Licht, A., Métais, G., Coster, P., İbilioğlu, D., Ocakoğlu, F., Westerweel, J., et al. (2022). Balkanatolia: the insular mammalian biogeographic province that partly paved the way to the Grande Coupure. *Earth Sci. Rev.* 226, 103929. doi:10.1016/j.earscirev.2022.103929

Maridet, O., and Ni, X. (2013). A new cricetid rodent from the early Oligocene of Yunnan, China, and its evolutionary implications for early Eurasian cricetids. *J. Vert. Paleontol.* 33, 185–194. doi:10.1080/02724634.2012.710283

Meng, J., and McKenna, M. C. (1998). Faunal turnovers of Palaeogene mammals from the Mongolian Plateau. *Nature* 394 (6691), 364–367. doi:10.1038/28603

Métais, G., Coster, P., Licht, A., Ocakoğlu, F., and Beard, K. C. 1993. Additions to the late Eocene Süngülü mammal fauna in Easternmost Anatolia and the Eocene-Oligocene transition at the periphery of Balkanatolia. *C. R. Palevol.* (In press).

Premoli Silva, I., and Jenkins, D. G. (1993). Decision on the Eocene-Oligocene boundary stratotype. *Episodes* 16 (3), 379–382. doi:10.18814/epiiugs/1993/v16i3/002

Speijer, R. P., Pälike, H., Hollis, C. J., Hooker, J. J., and Ogg, J. G. (2020). "The Paleogene Period," in *The Geologic Time Scale 2020*. Editors F. M. Gradstein, J. G. Ogg, M. D. Schmitz, and G. M. Ogg (Amsterdam: Elsevier BV), 1087–1140. doi:10.1016/B978-0-12-824360-2.00028-0

Stehlin, H. G. (1909). Remarques sur les faunules de mammifères de l'Eocène et de l'Oligocène du Bassin de Paris. *Bull. Soc. Géol. Fr.* 4 (9), 488–520.

Wang, Y.-Q., Meng, J., Beard, K. C., Li, Q., Ni, X., Gebo, D. L., et al. (2010). Early Paleogene stratigraphic sequences, mammalian evolution and its response to environmental changes in Erlian Basin, Inner Mongolia, China. *Sci. China Earth Sci.* 53, 1918–1926. doi:10.1007/s11430-010-4095-8

Wang, Y.-Q., Meng, J., and Jin, X. (2012). Comments on Paleogene localities and stratigraphy in the Erlian Basin, Nei Mongol, China. *Vert. Palasiat.* 50, 181–203.

Wasiljeff, J., and Zhang, Z.-Q. (2022). Stratigraphical significance of Ulantatal sequence (Nei Mongol, China) in refining the latest Eocene and Oligocene terrestrial regional stages. *Vert. Palasiat.* 60, 42–53. doi:10.19615/j.cnki.2096-9899.210716

Wasiljeff, J., Kaakinen, A., Salminen, J. M., and Zhang, Z.-Q. (2020). Magnetostratigraphic constraints on the fossiliferous Ulantatal sequence in Inner Mongolia, China: implications for Asian aridification and faunal turnover before the Eocene–Oligocene boundary. *Earth Planet. Sci. Lett.* 535, 116125. doi:10.1016/j.epsl.2020.116125

Xu, R., Zhang, Z., Li, Q., and Wang, B. (2023). New material of *Karakoromys* (Ctenodactylidae, Rodentia) from Late Eocene-Early Oligocene of Ulantatal (Nei Mongol): taxonomy, diversity, and response to climatic change. *Diversity* 15, 744. doi:10.3390/d15060744

Zachos, J. C., Sloan, L., Thomas, E., and Billups, K. (2001). Trends, rhythms, and aberrations in global climate 65 Ma to present. *Science* 292, 686–693. doi:10.1126/science.1059412

Zhang, Z.-Q., Liu, Y., Wang, L.-H., Kaakinen, A., Wang, J., Mao, F.-Y., et al. (2016). Lithostratigraphic context of Oligocene mammalian faunas from Ulantatal, Nei Mongol, China. *C. R. Palevol.* 15, 903–910. doi:10.1016/j.crpv.2015.05.012