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Lithostratigraphic context of Oligocene mammalian faunas from Ulantatal, Nei Mongol, China

Contexte lithostratigraphique des faunes mammaliennes oligocènes d'Ulantatal, Nei Mongol, Chine

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ABSTRACT

The Ulantatal area is well-known for its extraordinarily rich Oligocene mammalian fossils. The Ulantatal fauna was originally considered to be the representative fauna for the Chinese Land mammalian Age, Ulantatalian. However, the abundant fossils collected in the 1980s lack coordinates and/or detailed stratigraphic levels, and have been lumped together as either single, coeval fauna or grouped into three units. This lack of stratigraphic information hampers more precise biostratigraphic division and correlation of the faunas. Here we present a complete lithostratigraphic profile of the Ulantatal Formation with new fossil localities calibrated into the profile. Lithologically, the sequence shows a rather uniform pattern characterized by interbedded reddish to yellowish brown claystones and siltstones, with minor fine-grained sandstones. Preliminary biostratigraphic analysis shows that the Ulantatal Formation covers most of the Oligocene, and offers a long sequence and successive fossil records for understanding the evolution of mammal faunas after the critical Eocene/Oligocene transition.

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RÉSUMÉ

La région d'Ulantatal est bien connue pour sa richesse extraordinaire en fossiles mammaliens oligocènes. La faune d'Ulantatal a été considérée à l'origine comme étant la faune mammalienne représentative du continent chinois, d'âge Ulantatalien. Cependant, les nombreux fossiles récoltés manquent de coordonnées précises et/ou de niveaux stratigraphiques détaillés et ont été réunis en unités, soit uniques, soit contemporaines, soit encore en trois unités. Le manque de renseignements stratigraphiques empêche une division biostratigraphique et des corrélations plus précises des faunes. Ici est présenté un profil lithostratigraphique complet de la formation Ulantata, avec de nouveaux sites fossilifères répertoriés dans le profil. Lithologiquement, la séquence présente une disposition plutôt

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uniforme, caractérisée par une alternance de lits de claystones et de siltstones bruns, rougeâtres à jaunâtres, avec quelques couches de grès à grain fin. Une analyse biostratigraphique préliminaire montre que la formation Ulantatal recouvre en grande partie l'Oligocène et offre une longue séquence et des registres fossiles successifs pour comprendre l'évolution des faunes mammaliennes après la transition critique Éocène/Oligocène.

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1. Introduction

The Oligocene is a critical transitional period in the evolutionary history of Cenozoic mammals, and it also witnessed severe climatic changes (Dupont-Nivet et al., 2007; Hren et al., 2013; Liu et al., 2009; Zachos et al., 2001). However, the response of faunal turnover in different areas (Europe, Asia and North America) to the global scale temperature drop across the Eocene-Oligocene transition shows divergent patterns. The Grande Coupure at the start of the Oligocene marks a sudden change from the endemic European faunas to ones with major components of Asian origin in Europe (Hooker et al., 2004; Stehlin, 1910). The Mongolian remodeling pattern suggests that the Eocene perissodactyl-dominant faunas were replaced by the Oligocene rodent-lagomorph-dominant faunas in the Mongolian Plateau (Meng and McKenna, 1998). In sharp contrast, mammalian faunas in North America show minimal turnover across the boundary (Prothero and Heaton, 1996). To further explore the interaction of faunal turnovers and climatic changes, long and fossiliferous continental successions are required.

The Ulantatal Formation, named after the Ulantatal gulley in Alxa Zuoqi, western Nei Mongol (Inner Mongolia) (Wang and Wang, 1992) (Fig. 1) is well-known for producing extraordinarily rich Oligocene mammalian fossils. The first mammal fossils were discovered by a geological team from the Ningxia Geological Survey in 1977. In 1978, Huang Xueshi and his colleagues from the IVPP (Institute of Vertebrate Paleontology and Paleoanthropology) made a short survey in this area and found over a thousand specimens (Huang, 1982). Supported by the Academia Sinica and the Max Planck Gesellschaft, Germany, a Chinese-German expedition returned to this area in 1985. An extensive geological survey and screen washing of eight localities in a month produced thousands of isolated teeth of small mammals (Vianey-Liaud et al., 2006). In 1988 and 1989, Wang Banyue and her colleagues found the Kekeamu locality in the eastern part of the main locality area (Wang, 2010; Wang and Wang, 1991), and some Early Miocene fossils from the Wuertu area west from the main localities (Wang and Wang, 1990), adding new faunal horizons to the sequence. Extensive studies on fossils from these collections have been published (Huang, 1984, 1985a,b, 1986, 1992, 1993a,b, 1998; Huang and Zhu, 2002; Rodrigues et al., 2012, 2014; Vianey-Liaud et al., 2006, 2010, 2013; Wang, 1997a,b,c, 2010; Wang and Wang, 1991).

Huang (1982) compared the Ulantatal fauna with the Hsanda Gol fauna from Mongolia, and suggested its Middle Oligocene age. Based on fossils from Ulantatal, Tong and Huang (in: Tertiary Research Group of Chinese National Petroleum Corporation, 1991) named the Ulantatalian mammalian Age. Tong et al. (1995) followed this nomenclature, and included the Kekeamuan fauna (Wang and Wang, 1991) in the Ulantatalian Age. With the updated understanding of the Eocene-Oligocene boundary, the Ulantatalian fauna was later revised to be late Early Oligocene (Wang, 1997b,c). Daxner-Höck et al. (2010) compared the three units from Ulantatal with the biozones from the Valley of Lakes in central Mongolia, and correlated units I–III of Ulantatal roughly with Valley of Lakes biozones B–C1. The stratigraphical scheme was recently refined by Rodrigues et al. (2014), who further included Kekeamu fauna in the Earliest Oligocene and correlated it with biozone A of the Valley of Lakes.

Nevertheless, publications on fossils from the Ulantatal area have neither detailed geographical coordinates nor stratigraphy for localities. Huang (1982) measured a section of 18.6 m with simple description of sediments, but estimated in a later paper (1992) that the Ulantatal Formation might exceed one hundred meters in thickness. Based on lithofacies and distinctive sediment colours, Vianey-Liaud et al. (2006) divided the sequence into three lithological units, with an estimate of 60 meters for the total thickness of the sequence. Wang and Wang (1991) provided a detailed description of the Kekeamu locality, but did not correlate it with the main section.

The lumping of fossils from different horizons into one fauna has undoubtedly hampered more precise biostratigraphical division and correlation with other faunas, and further confused the understanding of the evolution history of taxa and faunal changes during a long geological time interval. From 2009 on, we have made extensive field surveys, excavations and stratigraphical investigations in this area over six field seasons. Our surface collection and excavation have produced over five thousand mammalian specimens (mostly upper and lower jaws) and dozens of well-preserved skulls. All fossil localities have been calibrated with GPS and measured using a Jacob's Staff and Abney level to the lithostratigraphical profile. Detailed study of these fossils is still ongoing.

In this paper, we present the four sections investigated, plot our new localities in them and synthesize the Ulantatal formation into one composite profile. A tentative correlation of previous localities into our profile is also given.

2. Stratigraphy of the sections

Oligocene sediments are well-exposed along the southern bank of the Ulantatal gulley, from the easternmost Kekeamu locality to the westernmost Shaozengtu area,

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