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The late Eocene hyracodontid perissodactyl *Ardynia* from Saint Jacques, Inner Mongolia, China and its implications for the potential Eocene–Oligocene boundary

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Abstract

Saint Jacques is a classic Oligocene fossil locality in China, which was first investigated by P. Teilhard de Chardin and E. Licent in 1923. All the fossil mammals previously reported from the area are Oligocene in age. Here we report some new material of the hyracodontid *Ardynia* from two lower horizons in the Saint Jacques area. These new specimens represent two species: *Ardynia praecox* Matthew and Granger, 1923 and *A. ordosensis* n. sp. A right lower jaw of *Ardynia praecox* with complete i1-c shows that i2 is the largest. The new species, *Ardynia ordosensis*, is characterized by a moderately hypsodont M1 with a pillar-like "crista" and the metaloph connecting the ectoloph distal to the metacone, characters that are more similar to those of *A. altidentata* than to any other species in *Ardynia*. The stratum bearing Ergilian *Ardynia* extends the deposits at Saint Jacques down to the upper Eocene. In combination with early Oligocene microfossils from the strata overlying the upper Eocene *Ardynia*-bearing layers, it is reasonable to conclude that the Saint Jacques section may bracket, or likely document, the Eocene–Oligocene transition.

Keywords: Saint Jacques; Inner Mongolia; Hyracodontid; *Ardynia*; Ergilian; Eocene–Oligocene boundary

1. Introduction

The classic Oligocene Saint Jacques locality (San-tao-ho) is located on the right bank of the Yellow River, near Dengkou County (Li and Ting, 1983; Russell and Zhai, 1987), and about 2 km east of Balagong of Hangjin Banner, Ordos, Inner Mongolia (Fig. 1). It was first investigated by Teilhard de Chardin and Licent in 1923 during their survey in Ordos (Teilhard de Chardin and Licent, 1924a, 1924b, 1924c). The deposits at Saint Jacques were preliminarily regarded as Pliocene at the beginning (Teilhard de Chardin and Licent, 1924b, 1924c), and were revised to the Oligocene based on the occurrence of *Paraceratherium* (=*Baluchitherium*) soon afterward (Teilhard de Chardin and Licent, 1924a; Qiu and Wang, 2007). Later, Teilhard de Chardin (1926) reported mammalian fossils from Saint Jacques, found in two layers of the section that were clearly shown in a sketch. However, he considered the mammalian fauna from the different beds at Saint Jacques to be homogeneous (Russell and Zhai, 1987). After the exploration by Teilhard de Chardin and Licent, this area was rarely investigated except for a short visit by the Sino-Soviet Paleontological Expedition in 1959 (Chow and Rozhdestvensky, 1960) and IVPP crews in 1977 and 1978 (Wang, 1987). The mammalian fossils from Saint Jacques were commonly considered to be of early Oligocene age, and the lithology was roughly equivalent to the lower member of the Wulanbulage Formation in Qianlishan district (Wang, 1987, 1997).

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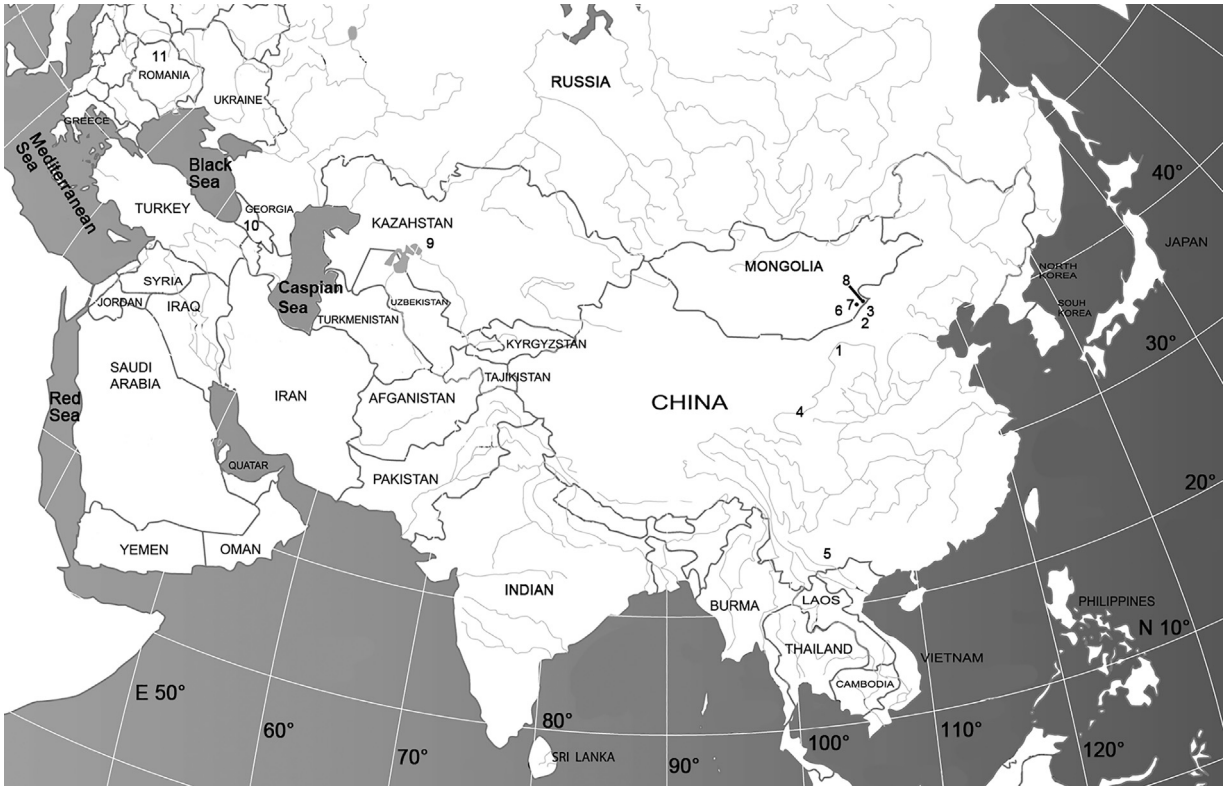

Fig. 1. Distribution of *Ardynia* and *Prohyracodon* in Eurasia. 1, Saint Jacques, Inner Mongolia; 2, Erden Obo, Inner Mongolia; 3, Nom Khong, Inner Mongolia; 4, Linxia Basin, Gansu Province; 5, Lunan Basin, Yunnan Province; 6, Ergilin Dzo, Mongolia; 7, Khoer Dzan, Mongolia; 8, Dzamyn Ude, Mongolia; 9, Chelkar Teniz, Kazakhstan; 10, Benara, Georgia; 11, Transylvania, Romania.

In the past several years, IVPP crews have organized extensive, continuous explorations in Saint Jacques, and collected a large number of fossil mammals from different levels and sites. Unlike the previous interpretation of an early Oligocene age for the strata in the Saint Jacques section, preliminary analyses now suggest that the lithological sequence of Saint Jacques contains deposits of late Eocene through late Oligocene age. Some new specimens of the carnivore *Palaeogale sectoria* have been reported recently (Wang and Zhang, 2015), and studies on other groups are still underway.

Here we report new material of the hyracodontid *Ardynia* from two lower horizons in the Saint Jacques area, which confirms the presence of upper Eocene deposits there. The hyracodontid *Ardynia*, characterized by high crowned teeth and cursorial adaptation of the postcrania, was usually restricted to late Eocene Ergilian. Together with the unequivocal early Oligocene mammals from the higher stratigraphic levels, it can be hypothesized that the Saint Jacques section may bracket, or likely document, the Eocene–Oligocene transition.

2. Materials and methods

The new material includes a left M1 associated with a juvenile left mandible with dp3-dp4, m1 (IVPP V 23860), a nearly complete right mandible with left i1-2, right i1-3, c, and p2-m3 (IVPP V 23858), and a fragmentary right mandible with p4-m1 (IVPP V 23859).

During the recent fieldwork, relatively numerous faults have been recognized in the Saint Jacques area, which cut the Paleogene sediments into a number of blocks of various sizes. To avoid mixture of fossils collected from different horizons due to miscorrelation between different blocks, and for the sake of convenience, we labeled these blocks from A-block to W-block, and subdivided the strata of each block in its own sequence. IVPP V 23858 and V 23859 were collected from the layer L2 of L-block, and V 23860 was from the middle part of the layer D1 of D-block. The L-block and D-block consist of four layers (L1-L4) and eight layers (D1-D8), respectively, in ascending order. The strata of L-block are predominately brownish red beds of silty mudstone and gray/yellow siltstone. The strata of D-block are predominately brownish red beds of silty mudstone. The topmost horizon of L-block is considered to be correlated with or slightly lower than the basal part of D-block based on our field observation and correlation.

Micro-CT was utilized in order to acquire horizontal sections of the tooth crown in different levels. Scanning was carried out using 225 kV micro-computerized tomography (developed by the Institute of High Energy Physics, Chinese Academy of Sciences (CAS)) at the Key Laboratory of Vertebrate Evolution and Human Origins, CAS. IVPP V 23860 with M1 and dp3-m1

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