Abstract: In the previous article**, data were given on the clockwise rotation of the Tarim Basin at a speed of 0.461° per million years around a virtual axis within the structure. Additional fieldwork and new evidence confirm earlier findings about the asymmetry of the Indo-Asian collision zone. These data are additional arguments in favor of the rotation of the Tarim Basin and lithospheric interactions along the Tarim boundaries. Conclusions are based on detailed geological and geo-physical data.

Keywords: Tarim Basin, block rotation, Indian plate, Eurasian plate, continental collision, paleoenvironment, westerly moisture pathway

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Вращение Таримского бассейна по часовой стрелке под влиянием движения Индийской плиты. Часть II*

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Резюме: В предыдущей статье** были приведены данные о вращении Таримского бассейна по часовой стрелке со скоростью 0.461° в миллион лет вокруг виртуальной оси внутри структуры. Дополнительные полевые исследования и новые фактические данные подтверждают сделанные ранее выводы об асимметрии зоны Индо-Азиатского столкновения. Эти данные являются дополнительными аргументами в пользу вращения Таримского бассейна и литосферных взаимодействий вдоль границ Тарима. Выводы базируются на детальных геолого-геофизических данных.

Ключевые слова: Таримский бассейн, вращающиеся блоки, Индийская плита, Евразийская плита, континентальная колллизия, палеогеография, западный водный канал

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** This is the continuation of the article: Zhao Junmeng, Zhang Peizhen, Yuan Xiaohui, Gan Weijun, Sun Jimin, Deng Tao, et al. Clockwise rotation of the Tarim basin driven by the Indian plate impact. Earth sciences and subsoil use. 2019;42(4):425–436. https://doi.org/10.21285/2686-9993-2019-4-4-425-436

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Four profiles crossing Tarim basin and its surrounding mountains

The outcome of the paper is based mainly on four seismic profiles traversing diverse parts of the boundary zones of the Tarim Basin, that is, the XB Line in the north, the KJ Line in the northeast, the BD Line in the east, and the ANTILOPE-I line in the south. The locations of the profiles are shown in Fig. S1 and Fig. 1**. Results of the XB, BD, and ANTILOPE-I lines are published in Zhao et al. [1–3]. The KJ line is the most recent profile. Compared with previous profiles, the new data from the KJ line revealed a complex lithospheric configuration of the Tarim Basin boundaries, which motivated further examination of the plate kinematics and the (clockwise) rotation of the basin. Here we briefly summarize the relevant results of the four profiles, which are closely related to the topic of the present paper.

Fig. S1. Map of profile locations

Black lines denote the profile locations. Red lines indicate faults. Stars along each profile stand for the shot points, with the red one showing the relation between the Tarim basin and its surrounding mountains by seismic records, traveling time fitting, amplitude fitting and ray tracing.

TP – Tibetan Plateau; TB – Tarim Basin; QB – Qaidam Basin; JB – Junggar Basin; AOB – Altai Orogenic Belt; CTS – Central Tien Shan; ETS – Eastern Tien Shan; AS – Altyrn Tagh Shan; KS – Kunlun Shan; KKS – Karakorum Shan

The authors invite to compare the illustrative material in this article with the figures from the previous article "Clockwise rotation of the Tarim basin driven by the Indian plate impact". The differentiation of the illustrative material of this article under figure numbering is performed using additional literals.

*** Авторы предлагают сравнить иллюстративный материал в данной статье с рисунками из предыдущей статьи "Вращение Таримского бассейна по часовой стрелке под влиянием движения Индийской плиты". Для возможности разграничения иллюстративного материала при нумерации рисунков в этой статье были дополнительно использованы литеры.
XB line. From the northern margin of the Tarim Basin (TB) (82°52′28″E, 41°02′34″N) to the southern foot hills of the Altay Orogenic Belt (AOB) (86°46′19.2″E, 48°56′00″N), the XB Line is 995 km long and crosses northern part of the Tarim Basin, the Tien Shan Orogenic Belt, the Junggar Basin (JB), and the Altai Orogenic Belt (Fig. 1 and Fig. S1). During the original study, Zhao et al. [1] obtained a 2D velocity structure by seismic reflection/refraction profiling, a 2D density structure from modeling gravity data, the detailed structure of the crust-mantle transitional zone using wavelet transforms of the deep seismic sounding (DSS) data, and a 2D electrical resistivity structure using magnetotelluric (MT) sounding. They also studied focal mechanisms and tectonic processes. With this comprehensive set of geological and geophysical data, a geodynamic model was obtained for this region ([1], also shown in Fig. S2). The results suggest that the Tarim Basin subducts northward beneath the Tien Shan orogenic belt, while the Junggar Basin contacts the Tien Shan in a pattern of strike-slip mode (Fig. 2, a and Fig. S2).

Evidence for the northward subduction of the Tarim Basin beneath the Tien Shan orogenic belt can be seen in detail with an example of a shot gather (shot point SP Byblk, located at 218.217 km along the profile). Two Moho reflection phases can be clearly observed (Fig. S3, a) and modeled (Fig. S3, b–d). The upper one is the Moho of the Tien Shan Orogenic Belt, and the lower one is the Moho of the Tarim Basin.

KJ Line. Recently, we have conducted a comprehensive geophysical profile from Korla to Jimasar (KJ line). From the northern margin of the Tarim basin (82°52′28″E, 41°02′34″N) to the southern margin of the Junggar basin (86°46′19.2″E, 48°56′00″N), the profile is 600 km long and crosses the northern margin of the Tarim basin, the Tien Shan, and the southern margin of the Junggar basin (Fig. S1).

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**Fig. S2. Structure of the crust and mantle lithosphere along the XB line**

The upper panel shows the elevation (solid line) and Bouguer anomaly (dotted line). The lower panel shows the lithospheric structures. The box and the star mark the location of the seismic section and the shot point shown in Fig. S3. LVZs represent low velocity zones. The solid lines are interfaces determined by deep seismic sounding, MT sounding and gravitational inversion. The dashed lines are inferred interfaces. Lines of high angles are faults determined by seismic sounding, MT sounding and gravitational analyses. The complicated crust-mantle transitional zone beneath the Tien Shan orogenic belt is determined by using wavelet transform [1].

**Рис. S2. Строение земной коры и литосферной мантии по линии XB**

В верхней части рисунка представлено поднятие (сплошная линия) и аномалия Буге (пунктирная линия). Нижняя часть рисунка демонстрирует литосферные структуры. Рамкой и звездочкой отмечено местоположение сейсмического разреза и очага сейсмического взрыва, показанного на рис. S3. LVZ – это зоны низких скоростей. Сплошными линиями отмечены границы раздела, которые определены глубинным сейсмическим зондированием, магнитотеллурическим зондированием и гравитационной инверсией. Пунктирными линиями обозначены предполагаемые границы. Крутонаклонные линии обозначают разломы, определенные сейсмоморфологией, магнитотеллурическим зондированием и гравитационным анализом. Сложная переходная зона коры в мантию, расположенная под орогенным поясом Тянь-Шань, определена с помощью вейвлет-преобразования [1]
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Fig. S3. Data and modeling example for SP Byblk:

- **a** – Seismic records of SP Byblk: The shot point (at 0 km) is located in the southern part of the Tien Shan orogenic belt (see Fig. S2 for the SP location) and the receivers are set up in the northern margin of the Tarim basin, the Tien Shan orogenic belt and the southern margin of the Junggar basin. All recorded seismic signals came from the same shot point at the same moment. The horizontal axis indicates offset distance from the shot point. The vertical axis indicates travel time reduced by 6 km/s. A 1–20 Hz bandpass filter and automatic gain control with 2-s window were applied. The thick solid lines show the identified effective seismic phases. The thin horizontal straight line at time of 0 s is a reference line. Travel times of all observed phases constitute the input data for ray tracing and synthetic seismogram.

- **b** – Calculated theoretical amplitude: The vertical axis indicates travel time reduced by 6 km/s.

- **c** – Travel time fitting: The vertical axis indicates travel time measured (marked with ⋄) and calculated (crosses), reduced by 6 km/s.

- **d** – Ray tracing: The vertical axis indicates depth in km. The thick lines are interfaces determined by modeling of the seismic phases. The distance axis is referenced to the shot point in (a) and to the entire XB line in (b–d).

Рис. S3. Данные и пример моделирования очага сейсмического взрыва Byblk:

- **a** – сейсмограммы очага сейсмического взрыва Byblk. Точка взрыва (0 км) расположена в южной части орогенного пояса Тянь-Шаня (местоположение очага сейсмического взрыва см. на рис. S2), сейсмоприемники расположены по северному краю Таримского бассейна, орогенного пояса Тянь-Шаня и южной окраине Джунгарского бассейна. Все зарегистрированные сейсмические сигналы пришли из одного и того же очага сейсмического взрыва в один и тот же момент. Горизонтальная ось показывает расстояние между очагом сейсмического взрыва и приемником. Вертикальная ось показывает скорость распространения, уменьшенную на 6 км/с. Были применены пропускающий полосовой фильтр 1–20 Гц и автоматическая регулировка усиления амплитуд с двухсекундным окном. Жирные сплошные линии обозначают выявленные действующие сейсмические фазы. Тонкая прямая горизонтальная линия в момент 0 с является исходной линией отсчета. Время пробега всех наблюдаемых фаз является исходными данными для трассировки лучей и синтетической сейсмограммы.

- **b** – построение вре‌монов пробега. Вертикальная ось показывает время пробега, уменьшенное на 6 км/с.

- **c** – построение кривых времени пробега. Вертикальная ось показывает измеренное время пробега (⋄) и расчетное время пробега (отмечено крестиками), уменьшенное на 6 км/с.

- **d** – трассировка лучей. Вертикальная ось показывает глубину в километрах. Жирные линии обозначают границы, определенные моделированием сейсмических фаз. Ось расстояния привязана к очагу взрыва на графике (a) и ко всей линии XB на графиках (b–d).
We obtained a 2D velocity structure from seismic reflection/refraction profiling, a 2D density structure and 2D geomagnetic intensity structure from joint inversion of the gravity anomaly with the geomagnetic anomaly. In contrast with the XB line, no evidence of crustal underthrusting can be found along the KJ line beneath the northern margin of the Tarim basin. In contrast, the results suggest that the Tarim Basin moves away from the Tien Shan Orogenic belt, and the Junggar Basin subducts southward beneath the Tien Shan orogenic belt, as shown in Fig. 2, b and Fig. S4.

The spatial separation of Tarim Basin and the Tien Shan orogenic belt can be seen in detail in Fig. S5. The shot point SP Hoxud is located at 177 km. Modeling seismic records shows that there exists a gap and dislocation between the Tarim Moho and Tien Shan Moho, implying that the Tarim Basin is moving from the Tien Shan, leaving a lateral gap between the two Mohos.

**BD Line.** Here we present the results of a 1420-km-long seismic refraction/wide-angle-reflection profile (BD Line) that crosses from NW to SE the northern margin of the Tarim basin, the east central Tarim basin, the Altyn Tagh Range, and the northern Qaidam basin (Fig. 1). The 2D velocity structure along the BD Line as shown in Fig. S6 was obtained from the modeling of the seismic data as mentioned above. The results indicate that the Tarim Basin has subducted beneath the Altyn Tagh Range, as shown in Fig. 2, c and Fig. S7 for detail.

**Fig. S4. Crustal structure along KJ line:**
- **a** – Elevation (black solid line) and Bouguer anomaly (blue dotted line) along the KJ line
- **b** – Lithospheric structure and geodynamic model. Solid lines are interfaces determined by deep seismic sounding and joint inversion of gravity and geomagnetism. Vertical triangles at surface denote shots. Arrows below the Moho indicate Moho movement direction. The thin dotted lines are velocity contours
  - TB – Tarim Basin; TOB – Tien Shan Orogenic Belt; JB – Junggar Basin

The box and the star mark the location of the seismic section and the shot point, respectively, shown in Fig. S5

Рис. S4. Строение земной коры по линии Корла-Джимсар (КЖ):
- **a** – поднятие (черная сплошная линия) и аномалия Буге (синяя пунктирная линия) по линии КЖ
- **b** – строение литосферы и геодинамическая модель. Сплошные линии обозначают границы, определенные глубинным сейсмическим зондированием и совместной инверсией силы тяжести и геомагнетизма. Вертикальные треугольники на поверхности обозначают очаги сейсмических взрывов. Стрелки под Мохо (Moho) указывают направление движения Мохо. Тонкими пунктирными линиями обозначены изолинии скорости
  - TB – Таримский бассейн; TOB – орогенный пояс Тянь-Шань; JB – Джунгарский бассейн

Рамочка и звездочка обозначают соответственно местоположение сейсмического профиля и очага взрыва, показанных на рис. S5

Результаты полевых исследований
On-Site Research Results
Fig. S5. Data and modeling example for SP Hoxud
The shot point (at 0 km) is located in the southern part of the Tien Shan orogenic belt and the receivers are set up in the northern margin of the Tarim basin, the Tien Shan orogenic belt and the southern margin of the Junggar basin. Locations of the shot and the seismic section are indicated in Fig. S4. The horizontal axis indicates offset distance from the shot point. Presentation (panels a–d) is the same as described in Fig. S3

ANTILOPE-I. The ANTILOPE-I profile is a broadband passive-source seismic array traversing western Tibet and southern Tarim Basin. It consisted of about 80 stations, operated from October 2006 to November 2007. During one year operation time, 478 teleseismic earthquakes of high signal / noise ratio were recorded and used for receiver function analysis [3]. A total number of 3476 S receiver functions (including SKS receiver functions from 249 events at epicentral distances of 60–115°).
Fig. S6. Crustal and upper-mantle cross-section along the BD line across the east-central Tarim basin, Altn Tagh Range and Qaidam basin [2]:

a – Tectonic setting and topography;
b – Crustal structure derived from the seismic velocity structure using laboratory measurements of seismic velocities for a wide suite of rock types.

The box marks the location of the seismic section shown in Fig. S5. The respective shot point is highlighted.

In the S receiver function image (Fig. S8), the Moho can be identified along the profile A Moho step can be observed beneath the border from the Tibetan plateau to the Tarim Basin. No evidence of crustal underthrusting can be identified.

GPS Data and strategy

The main part (~55%) of GPS velocities are from the published solutions of two Chinese national scientific projects, Crustal Movement Observation Network of China (CMONOC-I) and Tectonic and Environmental Observation Network of Mainland China (CMONOC-II) [4]. The detailed GPS observation methods and data processing strategies were introduced by Li et al. [4]. In addition to the GPS velocity data set of 240 stations from CMONOC (around the Tarim Basin but within the territory of China), we merged another published GPS velocity data set of 202 stations (around the western Tarim Basin) from Zubovich et al. [5] to enhance the density and coverage of GPS stations.

Although the CMONOC velocities and those of another data set are given in Eurasia-fixed reference frames, their frames may differ slightly from each other. As these two data sets shared some stations with the CMONOC data set, we used stations common to the CMONOC data set as “links” to transform all the other velocities into the same reference frame as that for CMONOC by using rigid-body rotations with appropriate angular velocity (Euler vector). After the reference frame transformations, the maximum differences of north and east components of the velocities for the same stations in different data sets are 2.6 and 2.2 mm/yr, respectively; these values are within 2 standard deviations of the velocity components. The final velocities of the common stations are the weighted average of the values from all the data sets in the same Eurasia-fixed
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The shot point (at 0 km) is located south of the Altyn Tagh fault in the Qaidam basin (see Fig. S8 for the SP location). The receivers were located in the Tarim basin, Altyn Tagh Range, and Qaidam basin. The horizontal axis indicates offset distance from the shot point: ATR – Altyn Tagh Range; QB – Qaidam Basin [2]

Reference frame. The combined velocities of 442 GPS stations in a Eurasia-fixed reference frame demonstrate the western Tarim regions are dominated by N-S direction while eastern Tarim moves toward the NE (Fig. 3, a).

In order to highlight the relative motion of Tarim Basin with respect of its surroundings, we used the following strategy to transform the GPS velocity field into a special “Tarim surrounding vicinity fixed reference frame”. Firstly, we solved for the angular velocity of rigid-body rotation on Earth sphere that minimized the RMS velocity of all these surrounding stations. Then, by reversely rotating the whole GPS velocity field of the Tarim basin with the above angular velocity, we removed the overall rigid rotation of the surrounding vicinity of the Tarim Basin. This is equivalent to converting the original GPS velocity field relative to the Eurasia-fixed reference frame to the “Tarim surrounding vicinity fixed reference frame”.

The geodynamic source of the rotation of the Tarim plate
Tibetan plateau is made up of three plates: the rigid Indian plate in the south, the rigid Asia plate in the north and a giant crush zone – Tibet "plate" sandwiched between the two. The giant crush zone with a horn-like shape facing east is featured high temperature (temperature is higher by ~300° K than both the India plate and Eurasian plate) and low velocity (S wave velocity is lower by 5% than the two plates on its both sides), and high Sn wave attenuation (on top of the upper mantle the Sn wave almost disappears) and strong seismic anisotropy, hence it must be softer. It can be seen from Fig. S9 that the collision...
between The Indian plate and the Asian plate occurred mainly at the southwest corner of the Tarim Basin, and a torque was generated in the Tarim plate, making the Tarim plate rotate clockwise. To the east, the Tibetan “plate”, which is soft between the Indian plate and the Asian plate, has strong internal deformation under the stress background of the south-north compression, transmitting the stress to the west. Therefore, under the impact of the Indian plate, the Tarim plate would rotate clockwise on the one hand and translate from south to north on the other hand.

**Eocene and Oligocene mammalian faunas from the Junggar basin and the Mongolian plateau**

Changes in faunal compositions reveal distinct differences in biological evolution of the Junggar basin nearby the Tarim basin, and the Mongolian plateau, more than 1000 km farther east, but with the same latitude (Fig. S10).

The above arguments in favor of the character of rotation of the Tarim Basin are confirmed by the analysis of the distribution of the Eocene-Oligocene Mammalian fauna. There are data from various sources.

Late Eocene, Junggar basin [7] includes the Keziletuogayi A3 Fauna Insectivora, Fam. et gen. indet., Lagomorpha, Ochotonidae, Desmatolagus sp. Rodentia, Cylindrodontidae, Ardynomys vinogradovi Ardynomys sp., Dipodidae Allosminthus sp., Perissodactyla, Brontotheriidae Gen. et sp. indet., Paraceratheiinae Gen. et sp. indet., Amynodotinae Gen. et sp. indet., Cadurcodon cf. ardynensis, Gigantamynodon giganteus, Rhinocerotidae Gen. et sp. indet.

Early Oligocene, Junggar basin [7] includes the Keziletuogayi A1-2 Fauna Marsupia, Peradectidae, Junggaroperadectes buriqinensis, Insectivora, Changlelestidae, Tupaiodon cf. morrisi, Erinaceidae, Palaeoscaptor cf. acridens, Lagomorpha, Ochotonidae, Desmatolagus sp., Rodentia,
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Fig. S9. Plate tectonics of western China
The solid line represents the location of the seismic section. The shaded region highlights the locations of the rigid Tarim plate, the Indian plate, and the giant crush zone (the Tibetan "plate") (the lithospheric mantle) as determined by the seismic wide-angle reflection/refraction profile [1, 2], the receiver function [3], and seismic tomography [6].

The thick red line at the edge of the Tarim basin represents the lithosphere outer margin of the Tarim plate along four sections. Blue and red arrow pairs represent compression or extension stress environments.
The red star indicates the position of the Euler pole, around which the Tarim plate rotates regularly.

TB – Tarim Basin; JB – Junggar Basin; CTS – Central Tianshan; ETS – East Tianshan; P – Pamirs;
AS – Altyn Tagh mountain; KS – Kunlun Mountains; KKS – Karakoram mountains;
QB – Qaidam Basin; TP – Tibetan Plateau

Ctenodactylidae, Karakoromys decessus, Tsganomysidea, Cycloomylus lohensis, Muridae, Cricetop dormitory, Dipodidae, Parasmithinus tanglingoli, Parasmithinus aff. Asiaecentrali, Tatalsminthus sp., Sciuridae, Gen. et sp. Indet, Aplodontidae, Prosciurus sp., Cricetidae, Gen. et sp. Indet, Eucricetodon sp., Eucricetodon caducus, Eucricetodon asiaticus, Ulaancricotodon cf. badamae, Castoridae, Propalaeocastor irtyshensis, Creodonta, Hyenodontidae, Hyenodon sp.

Late Oligocene, Junggar basin [8, 9] includes the Tieersihabahe Fauna Insectivora, Erinaceidae, Amphichinus kansuensis, Amphichinus minimus, Amphichinus cf. rectus, Talpidae, Gen. et sp. indet., Soricidae, Heterosoricinae, Gen. et sp. indet., Crocidosoricinae, Gen. et sp. indet., Didymoconidae, Didymoconus sp., Chiroptera, Fam. et gen. indet, Lagomorpha, Ochotonidae, Desmatolagus gobiensis, Desmatolagus sp. 1, Desmatolagus sp. 2, Sinolagomys major, Sinolagomys kansuensis, Rodentia, Ctenodactylidae,
Ardynomys et sp. indet.

olagus andrewsi
daedidae

the Ulan Gochu Fauna

Gen. et sp. indet.

nivora

somyinae

Litodonomys parvulus

cetodon

cricetidae

Yindirtemys

Cricetops dormitory

Desmotolagus gobiensis

Eomeryx

Zaisanamynodon

Gliruloides

Plesiosminthus

Rodentia

Hulgana ertinia

Desmotolagus

Bovidae

Paraceratherium
decessus

Tataromys sigmodon

Early Oligocene, Mongolian plateau [10, 11] includes the Wulanbulage Fauna Insectivora, Fam. et gen. indet., Lagomorpha, Ochotonidae, Desmotolagus gobiensis, Leoporidae indet., Gen. et sp. indet., Rodentia, Ctenodactyliidae, Karakorumys decessus, Tataromys sigmodon, Dipodidae, Plesiosminthus tangingoli, Tsaganomyidae, Tsaganomys sp., Cyclomylus lohensis, Muridae, Crocutops dormitory, Creodonta, Hyaeodontidae, Hyaeodon sp., Carnivora, Miocidae, Gen. et sp. indet., Fam. et gen. indet., Hulgana ertinia, Cylindrodonidae, Ardynomys sp., Anagalida, Anagalidae, Anagale gobiensis, Condylarthra, Mesonychidae, Mongo
estes hadrodens, Perissodactyla, Brontotheridae, Metalitan primus, Metalitan progressus, Embolotherium granger, Embolotherium loucksii, Embolotherium andrewsi, Amynodontidae, Gen. et sp. indet., Amynodontopsis sp., Cadurcodon sp., Zaisanamynodon? sp.

Early Oligocene, Mongolian plateau [10, 11] includes the Ulan Gochu Fauna Insectivora, Fam. et gen. indet., Lagomorpha, Ochotonidae, Desmotolagus gobiensis, Leoporidae indet., Gen. et sp. indet., Rodentia, Ctenodactyliidae, Karakorumys decessus, Tataromys sigmodon, Dipodidae, Plesiosminthus tangingoli, Tsaganomyidae, Tsaganomys sp., Cyclomylus lohensis, Muridae, Crocutops dormitory, Creodonta, Hyaeodontidae, Hyaeodon sp., Carnivora, Miocidae, Gen. et sp. indet., Fam. et gen. indet., Amphicyonidae, Amphicyon sp., Perissodactyla, Tapiroidea, Fam. et gen. indet., Chalicothereidae, Schizotherium sp., Paraceratherium, Paraceratherium lepidum, Amynodontidae, Cadurcodon

Yindirtemys cf. deflexus, Yindirtemys ambiguous, Cricetidae, Tachyoryctoides obrutschewi, Eucri
cetodon sp., Dipodidae Parasminthus asiecen
tralis, Parasminthus tangingoli, Bohlinosminthus parvulus, Plesiosminthus sp., Litodonomys sp. 1,
Litodonomys sp. 2, Litodonomys sp. 3, Litodonomys sp. 4, Litodonomys sp. 5, Aplodontidae, An
somyinae, Gen. et sp. indet., Sciuridae, Eutamias sp., Gen. et sp. indet., Eomyidae, Pseudotherido
mys asiaticus, Gliridae, Gliruloides zhoui, Car
nivora, Gen. et sp. indet. 1, Gen. et sp. indet. 2, Gen. et sp. indet. 3, Perissodactyla, Paracerac
theriidae, Aralotherium sui, Artiodactyla, Cer
voidea, Eumeryx sp. 1, Eumeryx sp. 2, Bovidae, Gen. et sp. indet.

Late Eocene, Mongolian plateau [9] includes the Ulan Gochu Fauna Insectivora, Didymoc
nidae, Gen. et sp. indet., Lagomorpha, Ochoton
idae, Desmotolagus velutus, Leoporidae, Gobi
olagus andrewsi, Rodentia, Ischyromyidae, Gen. et sp. indet., Hulgana ertinia, Cylindrodonidae, Ardynomys sp., Anagalida, Anagalidae, Anagale
ardynensis, Rhinocerotidae, Aprotodon sp., Gen. et sp. indet., Artiodactyla, Cervidae, Eumeryx sp., Lophiomyericyidae, Lophiomyericyx sp., Lophiomyercy gabiae, Bovidae, Gen. et sp. indet.

Late Oligocene, Mongolian plateau [9, 10] includes the Yikebulage Fauna Insectivora, Erinaceidae, Ampechechinus cf. rectus, Ampechechinus minimus, Ampechechinus sp., Lagormorpha, Ochotonidae, Desmatolagus sp., Sinolagomys gracilis, Sinolagomys kansuensis, Sinolagomys major, Sinolagomys sp., Rodentia, Ctenodactyli- dae, Distylomys qianlishanensis, Tataromys parvus, Yindiremynem ambiguuous, Yindirtemynem deflexus, Yindiremynem granger, Yindiremynem suni, Yindiremynem sp., Dipodidae, Plesiosminthus parvus, Plesiosminthus tanglingoli, Muridae, Tachyryoides kokonorensis, Tachyryoides obrutschewi, Tsaganomyidae, Tsaganomyidae sp., Castoridae, Gen. et sp. indet.

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The author performed the research, made a generalization on the basis of the results obtained and prepared the copyright for publication.

Автор выполнил исследовательскую работу, на основании полученных результатов провел обобщение, подготовил рукопись к печати.

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