

RHINOCEROTIDS IN CHINA - SYSTEMATICS AND MATERIAL ANALYSIS

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ABSTRACT - Under the family Rhinocerotidae, seventeen genera, sixty-two species (including four subspecies and two variants) were recognized or originally named in China. *Chilotherium* is the most diversified genus, which contains eighteen species and two variants. *Rhinoceros sinensis*, *Coelodonta antiquitatis* and *Dicerorhinus mercki* are the three most frequently appearing species in geologic records, but 61% of the species have only one single locality and horizon. In material, *Coelodonta antiquitatis* is the best represented species. In geologic horizon, Miocene and Quaternary are the most productive rhino-bearing strata. In taxonomy, the Quaternary rhinos, especially *Rhinoceros sinensis* and *Dicerorhinus mercki*, are still in question. © 2001 Éditions scientifiques et médicales Elsevier SAS

KEYWORDS: RHINOCEROTIDAE, INVENTORY, GEOLOGICAL RANGE, CHINA.

RÉSUMÉ - Dix-sept genres et soixante-deux espèces (y compris quatre sous-espèces et trois variants) appartenant à la famille des Rhinocerotidae ont été signalés en Chine; un bon nombre des espèces y ont leur gisement-type. *Chilotheridium*, avec 18 espèces et deux variants, est le genre le plus diversifié. *Rhinoceros sinensis*, *Coelodonta antiquitatis* et *Dicerorhinus mercki* sont les taxons les plus fréquemment rencontrés alors que 61 % des espèces signalées ne le sont que d'un seul gisement et d'un seul niveau. *Coelodonta antiquitatis* est le rhinocéros le mieux représenté. Du point de vue stratigraphique, ce sont les niveaux miocènes et quaternaires qui sont les plus riches. Enfin, sur le plan taxonomique, les espèces quaternaires et particulièrement *Rhinoceros sinensis* et *Dicerorhinus mercki* posent encore des problèmes. © 2001 Éditions scientifiques et médicales Elsevier SAS

MOTS-CLÉS: RHINOCEROTIDAE, INVENTAIRE, EXTENSION STRATIGRAPHIQUE, CHINE.

GENERA UNDER THE FAMILY RHINOCEROTIDAE FOUND IN CHINA

- Subfamily DICERATHERIINAE Dollo, 1885
 - Diceratherium* MARSH, 1875
- Subfamily ACERATHERINAE Dollo, 1885
 - * *Chilotherium* RINGSTRÖM, 1924
 - * *Plesiaceratherium* YOUNG, 1937
- Subfamily TELEOCERATINAE HAY, 1920
 - Brachypotherium* ROGER, 1904
 - Diaceratherium* DIETRICH, 1931
- Subfamily RHINOCEROTINAE Dollo, 1885
 - Gaindatherium* COLBERT, 1934
 - * *Guixia* YOU, 1977
 - Rhinoceros* LINNAEUS, 1758
- Subfamily DICERORHININAE Ringström, 1924
 - Coelodonta* BRONN, 1831
 - Dicerorhinus* GLOGER, 1841
- Subfamily ELASMOTHERIINAE Gill, 1872
 - Caementodon* HEISSIG, 1972
 - Elasmotherium* FISCHER, 1808
 - * *Huaqingtherium* HUANG & YAN, 1983
 - * *Shennongtherium* HUANG & YAN, 1983
 - * *Sinotherium* RINGSTRÖM, 1924
 - * *Tesselodon* YAN, 1979
- Subfamily IRANOTHERIINAE Kretzoi, 1942
 - * *Ninxiatherium* CHEN, 1977

Up to now seventeen genera under the family Rhinocerotidae were reported in China as listed above, eight of which were named originally in China (marked with *); six genera are known in China only; four genera, *Diceratherium*, *Brachypotherium*, *Diaceratherium* and *Gaindatherium* are not very well represented, because of the poor materials and limited locations. As to the genus *Guixia*, it's still open to question, because it is the earliest record of rhinocerotid in China, and its relationship with other rhinocerotines are not yet clear. The materials referred to the genus *Aceratherium* were included within *Acerorhinus*, and finally *Acerorhinus* was treated as a subgenus under *Chilotherium*; now *Chilotherium* is the largest genus which has two subgenera and twenty species and variants (see Fig. 1), this is also one of the most important genera both for paleontology and stratigraphy, other important genera being *Rhinoceros*, *Coelodonta*, *Dicerorhinus*. *Ninxiatherium* was originally put into Iranotheriinae, but subsequent scholars referred it to Elasmotheriinae (Guérin 1989; Heissig 1989). *Sinotherium* is a genus widely accepted, but some authors moved the species from under this genus to *Elasmotherium* without any comment, and didn't list the name of *Sinotherium* in the inventory of Elasmotheriines

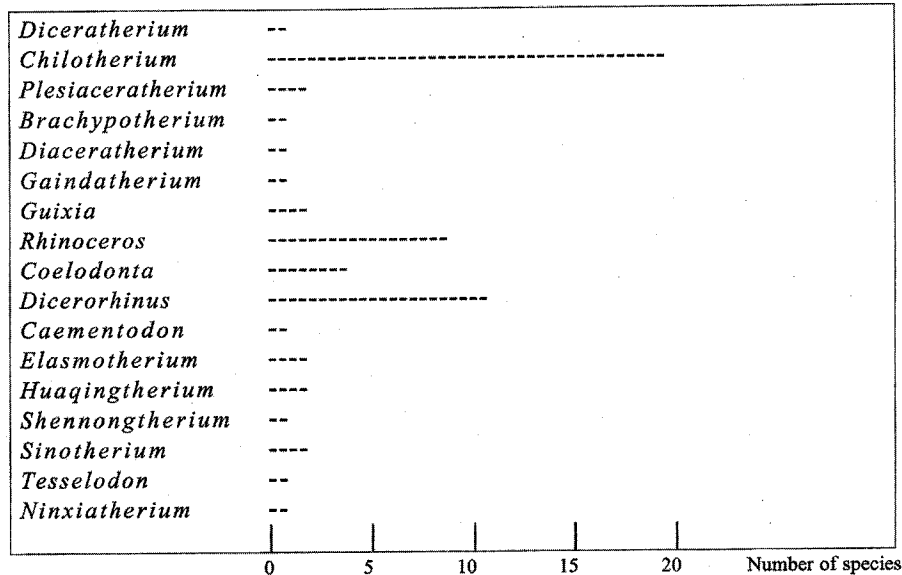


FIGURE 1 - Numbers of species (including subspecies and variants) named or recognized in each genus of rhinocerotids in China. *Nombre d'espèces (sous-espèces et variants inclus) définies ou reconnues en Chine dans chaque genre de Rhinocerotidae.*

(Huang & Yan, 1983); actually, there exists a large temporal gap between *Sinotherium* and *Elasmotherium*.

SPECIES (INCLUDING SUBSPECIES) OF RHINOCEROTIDS FOUND IN CHINA

- Diceratherium minus* (RINGSTRÖM, 1924) Bi et al., 1977 (M-L Mio.)
= *Diceratherium palaeosinense* var. *minus* RINGSTRÖM, 1924
- Chilotherium (Acerorhinus) blanfordi* LYDEKKER (1885) var. *hipparionum* (KOKEN, 1885)
= *Aceratherium blanfordi* var. *hipparionum* KOKEN, 1885 (?)
- Chilotherium (Acerorhinus) ceratorhinus* (SCHLOSSER, 1903) (?)
= *Aceratherium ceratorhinus* SCHLOSSER, 1903
- Chilotherium (Acerorhinus) cornutum* QIU & YAN, 1982 (E Pli.)
- Chilotherium (Acerorhinus) hezhengensis* (QIU & XIE, 1987) (L Mio.)
= *Acerorhinus hezhengensis* QIU & XIE, 1987
- Chilotherium (Acerorhinus) huadeensis* (QIU, 1979) (L Mio.)
= *Aceratherium huadeensis* QIU, 1979
- Chilotherium (Acerorhinus) palaeosinense* (RINGSTRÖM, 1924) Teilhard et al., 1942, Kretzoi, 1942 (L Mio.)
= *Diceratherium palaeosinense* RINGSTRÖM, 1924
- Chilotherium (Acerorhinus) tianzhuense* ZHENG, 1982 (L Mio.)
- Chilotherium (Acerorhinus) tsaidamense* (BOHLIN, 1937) Teilhard et al., 1942, Kretzoi, 1942 (L Mio.)
= *Diceratherium tsaidamense* BOHLIN, 1937
- Chilotherium (Chilotherium) anderssoni* RINGSTRÖM 1924 (L Mio.)
- Chilotherium (Chilotherium) gracile* RINGSTRÖM, 1924 (L Mio.)
- Chilotherium (Chilotherium) habereri* (SCHLOSSER, 1903) Teilhard et al., 1942 (L Mio-E Pli.)
= *Rhinoceros habereri* SCHLOSSER, 1903
- Chilotherium (Chilotherium) habereri* var. *laticeps* RINGSTRÖM, 1924 (L Mio.)
- Chilotherium (Chilotherium) planifrons* RINGSTRÖM, 1924 (L Mio.)
- Chilotherium (Chilotherium) wimani* RINGSTRÖM, 1924 (L Mio.)
- ? *Chilotherium brancoi* (SCHLOSSER, 1903) Teilhard et al., 1942 (L Mio-E Pli.)
= *Rhinoceros brancoi* SCHLOSSER, 1903
- Chilotherium fenhoensis* TUNG et al., 1975 (L Mio.)
- Chilotherium tanggulaense* ZHENG, 1980 (L Mio.)
- Chilotherium xizangensis* Ji et al., 1980 (L Mio.)
- Chilotherium yunnanensis* TANG et al., 1974 (L Pli.)
- Plesiaceratherium gracile* YOUNG, 1937 (M Mio.)
- Plesiaceratherium shanwangensis* WANG, 1965 (M Mio.)
- Diaceratherium* cf. *aurelianense* (NOUEL, 1866) (M Mio.)
- Brachypotherium pugnator* (MATSUMOTO, 1921) (E-M Mio.)
- Gaiindatherium* cf. *browni* COLBERT, 1934 (E Pli.)
- Guixia youjiangensis* YOU, 1977 (L Eoc.)
- Guixia simplex* YOU, 1977 (L Eoc.)
- † *Rhinoceros chaili* Li, 1979 (unpublished) (invalid name)
- o *Rhinoceros oweni* RINGSTRÖM, 1927 (Synonym of *Rhinoceros sinensis* by OSBORN; Synonym of *Dicerorhinus mercki* by Teilhard, 1942) (*nomen nudum*)
- o *Rhinoceros plicidens* KOKEN, 1885 (Synonym of *Rhinoceros sinensis*) (*nomen nudum*)
- o *Rhinoceros pygmaeus* RINGSTRÖM, 1927 (materials referred to *Chilotherium*) (*nomen nudum*)
- o *Rhinoceros simplicidens* KOKEN, 1885 (Synonym of *Rhinoceros sinensis*) (*nomen nudum*)
- Rhinoceros sinensis* OWEN, 1870 (E-L Ple.)
- Rhinoceros sivalensis* FALCONER & CAUTLEY, 1868 (M Ple.)
- Rhinoceros sondaicus* DESMAREST, 1822 (Hol.)
- Rhinoceros unicornis* LINNAEUS, 1758 (E Ple.)
- Coelodonta antiquitatis* (BLUMENBACH, 1799, 1807) (M-L Ple.)
= *Rhinoceros tichorhinus* CUVIER, 1812
= *Rhinoceros manchuricus* ISHIJIMA, 1939, Teilhard et al., 1942

Category	Frequency of occurrence	Species number	Ordinal numbers of species as in the text
category I	>60	2	33, 37
category II	40~60	0	
category III	20~39	1	47
category IV	5~19	0	
category V	2~4	18	1, 2, 7, 9, 10, 12, 15, 16, 21, 22, 24, 35, 40, 41, 48, 49, 50
category VI	1	33	3, 4, 5, 6, 8, 13, 14, 17, 18, 19, 20, 23, 25, 26, 27, 34, 36, 38, 39, 43, 44, 46, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62

TABLE 1 - Categories of species according to the frequency of occurrence. *Catégorisation des espèces en fonction de la fréquence de leur découverte.*

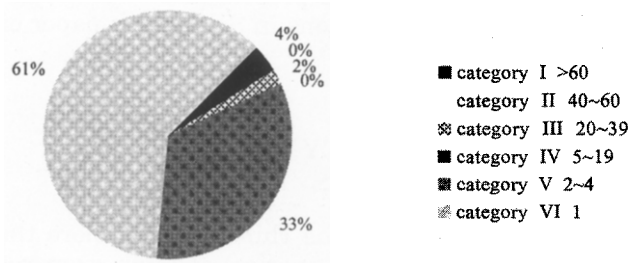


FIGURE 2 - Percentage of different categories of species according to the frequency of occurrence, the pattern shows the majority (61 %) of the species were reported only by once. *Pourcentage des différentes catégories d'espèces en fonction de la fréquence de leur découverte: 61 % n'ont été trouvées qu'une seule fois.*

Category	Materials found for each group	Total numbers in each category	Species numbered as in previous text
Category I	Species represented by complete skeletons	2	37, 38
Category II	Species with complete skull and some limb bones	8	6, 7, 9, 10, 11, 17, 33, 47
Category III	Species with complete or almost complete skull	15	4, 5, 12, 13, 14, 19, 35, 39, 44, 46, 48, 50, 52, 56, 62
Category IV	Species represented by complete or partial maxilla or/and mandible	18	3, 8, 15, 16, 18, 20, 21, 22, 26, 27, 34(?), 40, 41, 43, 55, 58, 60, 61
Category V	Species represented by isolated teeth only	7	1, 2, 23, 24, 49, 53, 57
Category VI	Species represented by one single tooth only	4	25, 36, 54, 59

TABLE 2 - Category of species according to fossil materials. *Catégorisation des espèces en fonction de leurs restes.*

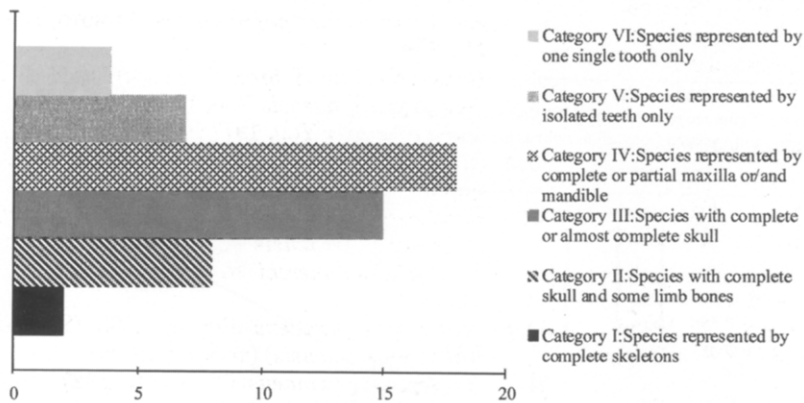


FIGURE 3 - Species numbers of each group according to fossil materials ever found, the bar plot shows that the majority of the species were represented either by skulls, or by mandibles and/or maxilla; and quite a lot only by teeth. *Nombre des espèces de chaque groupe selon le matériel découvert.*

- | | |
|---|---|
| 38. <i>Coelodonta antiquitatis chilinensis</i> JIANG, 1977 (L Ple.) | = <i>Rhinoceros choukoutienensis</i> WANG, 1931 |
| 39. <i>Coelodonta antiquitatis shansius</i> CHIA & WANG, 1978 (E Ple.) | = <i>Dicerorhinus mercki</i> (JÄGER, 1839) |
| 40. <i>Coelodonta antiquitatis yenshanensis</i> CHOW, 1979 (M Ple.) | 43. <i>Dicerorhinus choukoutienensis eurymylus</i> LIU et al., 1982 (M Ple.) |
| 41. <i>Coelodonta nihowanensis</i> CHOW, 1978 (E Ple.) | 44. <i>Dicerorhinus cixianensis</i> CHEN & WU, 1976 (M Mio.) |
| 42. Δ <i>Dicerorhinus choukoutienensis</i> (WANG, 1931) Teilhard et al., 1942 (No conspicuous differences from <i>Dicerorhinus mercki</i>) (<i>nomen dubium</i>) | 45. # <i>Dicerorhinus kirchbergensis</i> (JÄGER, 1839) (<i>nomen oblitum</i>)
= <i>Dicerorhinus mercki</i> (JÄGER, 1839) |
| | 46. <i>Dicerorhinus lantianensis</i> HU & QI, 1978 (E Ple.) |

47. *Dicerorhinus mercki* (JÄGER, 1839) (E-L Ple.)
48. *Dicerorhinus orientalis* (SCHLOSSER, 1921) Ringström, 1924, 1927 (L Mio.)
49. *Dicerorhinus ringstroemi* (ARAMBOURG, 1959) (L Mio.)
50. *Dicerorhinus sumatrensis* (FISCHER, 1814) (Hol.)
= *Didermocerus sumatrensis* FISCHER, 1814
51. † *Dicerorhinus tianshuiensis* XIE, 1984 (unpublished)
(Invalid name)
52. *Dicerorhinus yunchuchenensis* CHOW, 1963 (E Ple.)
53. *Caementodon tongxinensis* GUAN, 1988, 1993 (M Mio.)
54. *Elasmotherium inexpectatum* CHOW, 1958 (E Ple.)
55. *Elasmotherium peii* CHOW, 1958 (M Ple.)
56. *Huaqingtherium lintungensis* (ZHAI, 1978) Huang & Yan, 1983 (M Mio.)
= *Hispanotherium lintungensis* ZHAI, 1978
57. *Huaqingtherium qiu* GUAN & ZHANG, 1993 (M Mio.)
58. *Shennongtherium hyposodontus* HUANG & YAN, 1983 (M Mio.)
59. *Sinotherium simplum* CHOW, 1958 (L Mio.)
60. *Sinotherium lagrelii* RINGSTRÖM, 1923 (L Mio.)
61. *Tesselodon fangxianensis* YAN, 1979 (M Mio.)
62. *Ninxiatherium longirhinus* CHEN, 1977 (E Pli.)

Totally, sixty-two species (including four subspecies and two variants) under the family Rhinocerotidae have been named or reported in China, fifty-two of which were originally defined on materials from China; one is regarded as forgotten name (*nomen oblitum*, marked with #); two are invalid names (marked with †), because of unpublication; one was considered as a *nomen dubium* (marked with Δ), because there is no conspicuous difference from a previously established form; four were regarded as *nomen nudum* (marked with o), because the materials under them were transferred to other species. *Chilotherium brancoi* is a species in question, because this species was originally erected under the genus *Rhinoceros*; most of the materials once

included in it was referred to *Chilotherium* (Teilhard et al. 1942), but the species name was not rejected; actually, both in morphology and geological occurrence, this species is more related to *Chilotherium* than to *Rhinoceros*. As to the species *Dicerorhinus ringstroemi*, in the papers by Hooijer (1966) and Heissig (1989), it seems that this species was erected by Arambourg in 1959, but up to now, the author did not find the original descriptions in Arambourg's paper of 1959; on the other hand, in Yan's paper of 1978, it looks like *D. ringstroemi* was erected by Schlosser in 1921, and the present author didn't find the original descriptions in Schlosser's paper either.

FREQUENCY OF OCCURRENCE OF SPECIES

Among all the rhino species, more than the half (thirty-three species) of them were reported only once, that means that most of the species were from one single locality and one single horizon. Too many species have only one single locality and occurrence, it seems necessary to have a good check on the taxonomic work. The most frequently appearing are *Rhinoceros sinensis*, *Coelodonta antiquitatis* and *Dicerorhinus mercki*, so these three are the most popular species, but it doesn't mean that they are the best known, especially for *Rhinoceros sinensis*, which has the highest frequency of occurrence, but whose skull is still imperfectly known up to now; on the other hand, to a great extent, its high frequency of appearance can be attributed to taxonomic work, this species has become a 'wastebasket', almost all the Quaternary rhino fossils from south China being put into it.

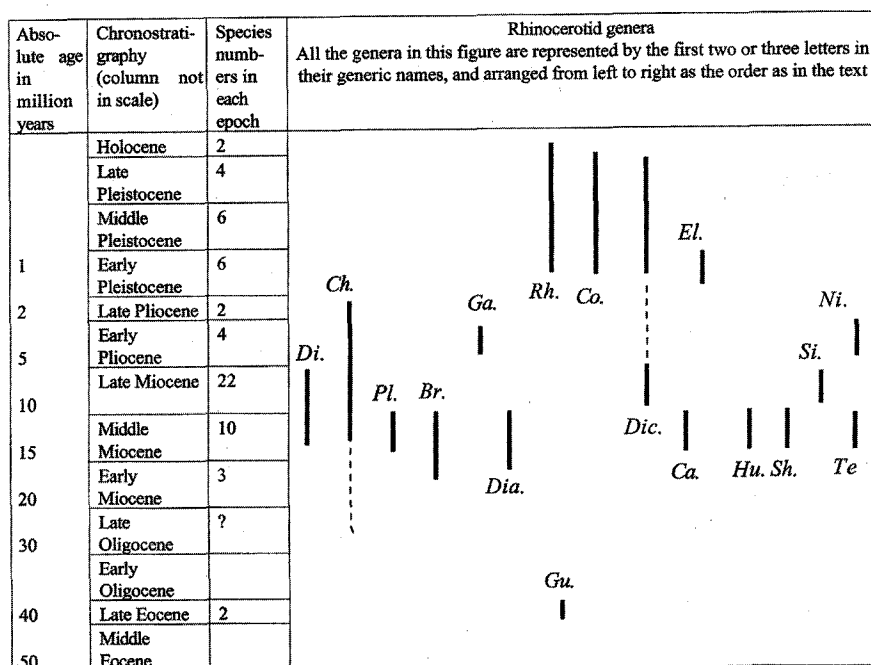


FIGURE 4 - Temporal ranges of Rhinocerotid genera in China. Extension temporelle des genres de Rhinocerotidae en Chine.

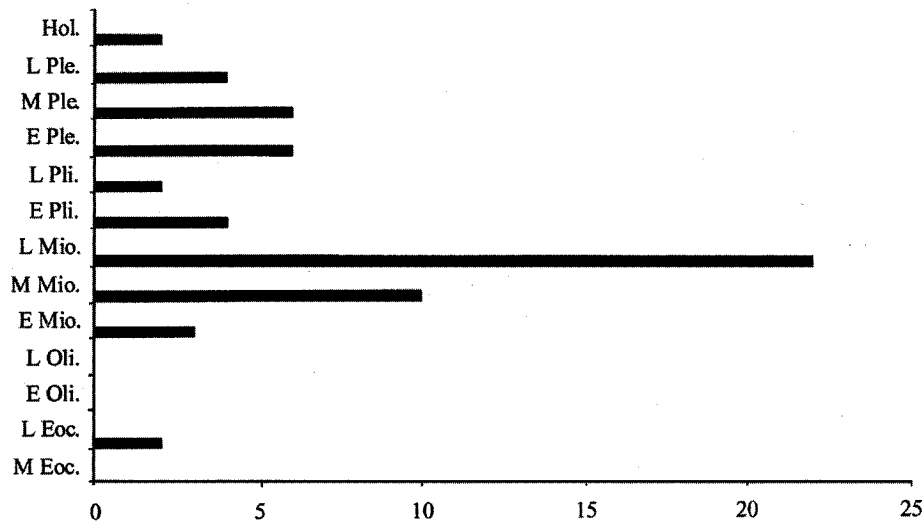


FIGURE 5 - Rhinocerotid species numbers through geologic time in China. *Nombre des espèces de Rhinocerotidae en Chine, selon le niveau stratigraphique.*

MATERIAL ANALYSIS

Among all the rhino species, only one was represented by complete skeletons, that's *Ceolodonta antiquitatis* and its subspecies, this species not only has a popular occurrence, but also has very well preserved materials; but most of the rhino species represented by partial skulls, mandibles and maxillae as well as partial tooth rows. It is necessary to indicate that seven of the species were known only by isolated teeth, and another four, *E. inexpectatum*, *S. simplum*, *G. browni* and *R. unicornis*, were all originally defined on one single tooth only, and without new finds ever since.

CHRONOLOGICAL DISTRIBUTION

Regarding to the geological distributions of rhinocerotids in China, firstly it should be indicated that the geological ages have been recalibrated and revised for each species by subsequent researchers, maybe they are completely different from the original publications; in this paper, the ages were determined according to the papers by Li et al. (1984), Qiu & Qiu (1990) and Tong et al. (1995). Unfortunately the sequence of fossil rhinoceros is not very clear, so few people use them as zone fossils. Concerning the earliest record of *Chilotherium*, according Qiu & Qiu (1990), this genus appeared in Tunggurian (middle Miocene), but in Huang's paper of 1982, the earliest *Chilotherium* record is from late Oligocene in Nei Mengol; from the latest stratigraphic data, most of the rhinocerotid genera and species were from middle and late Miocene in China, and most of the rhinocerotid localities are concentrated in Miocene and Quaternary. What should be stressed hereby is that the Pliocene genera didn't survive into Quaternary, all the Quaternary genera, except *Dicerorhinus*, appeared in China at the beginning of Quaternary period; as to the relationships between Miocene and Quaternary *Dicerorhinus*, is still not clear; there exist a very large gap between the Miocene *Dicerorhinus* and the Quaternary ones, there were no records of this

genus for a long time between late Miocene and early Pleistocene; on the contrary, it was very frequent in Europe during this time span; so whether the Chinese Quaternary *Dicerorhinus* is a relict of Miocene *Dicerorhinus* or a newcomer from Europe is still open to question.

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