

## Quaternary Rhinoceros of China

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### Abstract

Quaternary is one of the most productive periods for rhino fossils in China. *Rhinoceros sinensis*, *Coelodonta antiquitatis* and *Dicerorhinus mercki* are the most frequently appearing species during this period. In taxonomy, too many names (Totally more than 17 currently used) at the specific and subspecific level were given to the Quaternary rhinos; furthermore, the distinctions between the two very important species, *Rhinoceros sinensis* and *Dicerorhinus mercki*, are still open to question. Geologically, all the three genera mentioned have representatives throughout Pleistocene, however *Dicerorhinus* concentrated in middle Pleistocene, *Coelodonta* and *Rhinoceros* were encountered mainly in late Pleistocene. Another least known genus, *Elasmotherium*, has been found only in Early Pleistocene. Geographically, *Elasmotherium*, *Coelodonta* and most of *Dicerorhinus* occurred in north China, *Rhinoceros* mainly in south China. The compositions of the rhino fauna in France can be correlated with those in north China.

**Key words:** Rhinocerotids; Quaternary; China

## 1 Taxonomy of Quaternary rhinocerotids in China

### 1.1 Overview on the taxonomic work

Totally, four generic and seventeen specific names (including four subspecific names) were currently used for the Quaternary rhinos. At the level of genus, there exists no argument, only sometimes, the distinctions between *Dicerorhinus* and *Rhinoceros* is not so easy for isolated materials; some authors determined the materials mainly according to where the material comes from, the materials from north China usually were determined as *Dicerorhinus*, the materials from south China were identified as *Rhinoceros*, it seems a little inappropriate. As to the genera *Coelodonta* and *Elasmotherium*, they are very easy to recognize by tooth. At the rank of species, some disputes still exist inside *Dicerorhinus*. Normally speaking, *Dicerorhinus* from north China is big-sized, double-horned, with semi-hypsodont cheek teeth, but lacks incisors (At least at adult stage). *Rhinoceros* from south China is relatively smaller, single-horned, with brachyodont cheek teeth and developed incisors, the upper cheek teeth are simply built (crochet and crista not developed), conspicuous ribs on the ectoloph of upper cheek teeth.

In Quaternary, even for all the geologic epoch, *Rhinoceros sinensis*, *Coelodonta antiquitatis* and *Dicerorhinus mercki* are among the most frequently appearing species, but it doesn't mean that they are the best known species, especially for *Rhinoceros sinensis*, which has the highest frequency of occurrence, but whose skull is still not well known up to now (Maybe the recent discovery in Hubei Province will throw some new light on it); on the other hand, to a great extent, its high frequency of appearance can be attributed to the inappropriate taxonomic work, this species has almost become a "wastebasket", all of the Quaternary rhino fossils from south China were put into it.

As about the classification and origin of *Coelodonta*, there exist a huge controversy, up to now, 2 species and 3 subspecies names have been created. Actually *Coelodonta* reached it's golden time in Late Pleistocene, so the present authors propose that the Early and Middle Pleistocene elements can be treated independently of the typical ones of Late Pleistocene, and give a subspecific name for the early *Coelodonta* is enough, because of the poor materials; and the specific name *C. antiquitatis* is only valid for the typical woolly rhinos of Late Pleistocene.

## 1.2 Taxonomy at subfamilial and generic level

Subfamily *Rhinocerotinae* Dollo, 1885

*Rhinoceros* Linnaeus, 1758

Subfamily *Dicerorhininae* Ringström, 1924

*Coelodonta* Bronn, 1831

*Dicerorhinus* Gloger, 1841

Subfamily *Elasmotheriinae* Gill, 1872

*Elasmotherium* Fischer, 1808

## 1.3 Taxonomy at specific and subspecific level

- *Rhinoceros chaii* Li, 1979 (E Ple.) (unpublished) (invalid name)
- *Rhinoceros oweni* Ringström, 1927 (Senior synonym of *Dicerorhinus mercki* by Teilhard, 1942) <sup>[1]</sup> (*nomen nudum*)
- *Rhinoceros plicidens* Koken, 1885 <sup>[2]</sup> (Synonym of *Rhinoceros sinensis* by Teilhard et al, 1942, Colbert et al. 1953) (*nomen nudum*)
- *Rhinoceros simplicidens* Koken, 1885 <sup>[2]</sup> (Synonym of *Rhinoceros sinensis* by Teilhard et al, 1942, Colbert et al. 1953) (*nomen nudum*)
- *Rhinoceros sinensis* Owen, 1870 <sup>[3]</sup> (E-L Ple.)
- *Rhinoceros sivalensis* Falconer & Cautley, 1868 <sup>[4]</sup> (M Ple.)
- *Rhinoceros sondaicus* Desmarest, 1822 <sup>[5]</sup> (Hol.)
- *Rhinoceros unicornis* Linnaeus, 1758 <sup>[6]</sup> (L Ple.)
- *Coelodonta antiquitatis* (Blumenbach, 1799, 1807) <sup>[7]</sup> (E-L Ple.)  
= *Rhinoceros tichorhinus* Cuvier, 1812  
= *Rhinoceros manchuricus* Ishijima, 1939, Teilhard et al., 1942 <sup>[8]</sup>
- *Coelodonta antiquitatis chilinensis* Jiang, 1977 <sup>[9]</sup> (L Ple.)
- *Coelodonta antiquitatis shansius* Chia & Wang, 1978 <sup>[10]</sup> (E Ple.)
- *Coelodonta antiquitatis yenshanensis* Chow, 1979 <sup>[7]</sup> (M Ple.)
- *Coelodonta nihowanensis* Chow, 1978 <sup>[7]</sup> (E Ple.)
- *Dicerorhinus choukoutienensis* (Wang, 1931) Teilhard et al., 1942, Chow, 1963, 1979 <sup>[11]</sup>  
(No conspicuous differences from *Dicerorhinus mercki* by Xu, 1986)  
= *Rhinoceros choukoutienensis* Wang, 1931 <sup>[13]</sup>  
= *Dicerorhinus mercki* (Jäger, 1839)
- *Dicerorhinus choukoutienensis eurymylus* Liu et al., 1982 <sup>[14]</sup> (M Ple.)
- *Dicerorhinus kirchbergensis* (Jäger, 1839) <sup>[15]</sup> (*nomen oblitum*)  
= *Dicerorhinus mercki* (Jäger, 1839)
- *Dicerorhinus lantianensis* Hu & Qi, 1978 <sup>[16]</sup> (E Ple.)
- *Dicerorhinus mercki* (Jäger, 1839) (E-L Ple.)
- *Dicerorhinus sumatrensis* (Fischer, 1814) <sup>[5]</sup> (Hol.)  
= *Didermocerus sumatrensis* Fischer, 1814
- *Dicerorhinus yunchuchenensis* Chow, 1963 <sup>[17]</sup> (E Ple.)
- *Elasmotherium inexpectatum* Chow, 1958 <sup>[18]</sup> (E Ple.)
- *Elasmotherium peii* Chow, 1958 <sup>[18]</sup> (E Ple.)

## 2 Geochronologic distributions of Quaternary rhinoceros

As many other groups, the Pliocene rhino 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 is a break of fossil record of this genus during Pliocene; on the contrary, in Europe, this genus kept on developing during this time span, whether the Chinese Quaternary *Dicerorhinus* is a relict of the

local Miocene *Dicerorhinus* or a newcomer from Europe is still open to question. Moreover, the phylogeny of the Quaternary rhinos is far from clear.

**Table 1 Geologic distributions of rhino species during Quaternary in China**

Species	Quaternary			
	Early Pleistocene	Middle Pleistocene	Late Pleistocene	Holocene
<i>Rhinoceros sinensis</i>	*	*	*	
<i>Rhinoceros sivalensis</i>		*		
<i>Rhinoceros sondaicus</i>				*
<i>Rhinoceros unicornis</i>	*			
<i>Coelodonta antiquitatis</i>		*	*	
<i>Coelodonta antiquitatis chilinensis</i>			*	
<i>Coelodonta antiquitatis shansius</i>	*			
<i>Coelodonta antiquitatis yenshanensis</i>		*		
<i>Coelodonta nihowanensis</i>	*			
<i>Dicerorhinus choukoutienensis</i>		*		
<i>Dicerorhinus choukoutienensis eurymylus</i>		*		
<i>Dicerorhinus lantianensis</i>	*			
<i>Dicerorhinus mercki</i>	*	*	*	
<i>Dicerorhinus sumatrensis</i>				*
<i>Dicerorhinus yunchuchunensis</i>	*			
<i>Elasmotherium inexpectatum</i>	*			
<i>Elasmotherium peii</i>	*			

Regarding to the origin of *Coelodonta*, we have enough fossil evidence to show that the earliest *Coelodonta* record in China is not only limited to the type locality in Nihowan, but also from four localities in Shanxi Province and one locality in Qinghai Province.

As to the question if rhinos survive into Holocene, now the answer is definite, because some very good materials were found in the deposits of 7000 yr. B.P. in the Provinces of Zhejiang<sup>[5]</sup> and Henan<sup>[19]</sup>. About the report of the discovery of Holocene *Coelodonta*<sup>[20]</sup> is to be verified.

**Table 2 Generic and specific numbers through Quaternary in China**

Geologic time	Number of genus	Number of species
Holocene	2	2
Late Pleistocene	3	4
Middle Pleistocene	3	7
Early Pleistocene	4	9

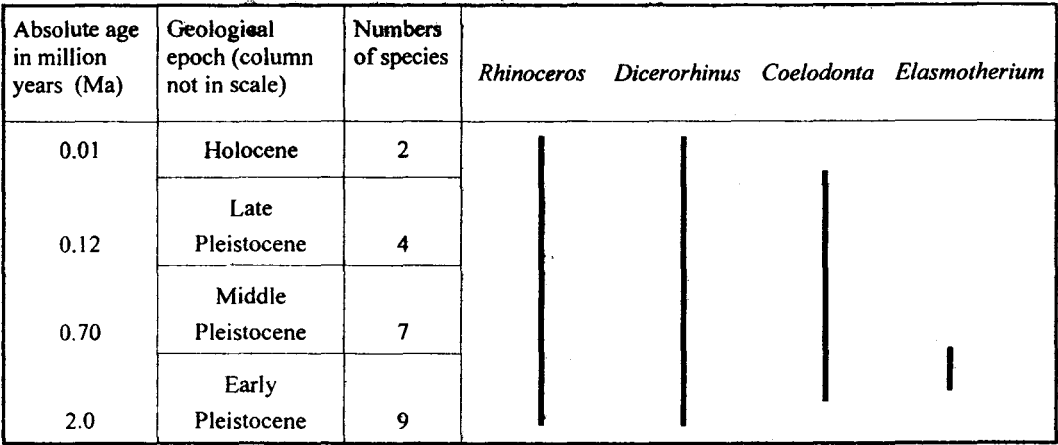


Figure 1 Temporal ranges of Quaternary rhinocerotid genera in China

3 Geographic distribution of Quaternary rhinoceros

About the geographic distributions of Quaternary rhinos in China, the patterns are clear for *Coelodonta* and *Elasmotherium*, they are mainly limited in north China, but for *Rhinoceros* and *Dicerorhinus*, the geographic pattern is a little artificial as mentioned above, the distinguishing of these two genera are mainly according to locality, but not exactly based on anatomical characters, the Quaternary rhino materials from south China were usually assigned to *Rhinoceros*, the materials from north China were referred to *Dicerorhinus*. The distributional areas of *Dicerorhinus* and *Coelodonta* are overlapped (see figure 3), these are some examples showing that *Dicerorhinus* and *Coelodonta* coexist even in the same locality as well as the same horizon, e.g. locality 1 and locality 13 in Zhoukoudian, Locality Dingcun in Shanxi Province, Locality Xiaogushan in Liaoning Province etc.

Table 3 Numbers of locality published for each rhino genus in Quaternary

Genera	Numbers of locality for each rhino genus in Quaternary			
	E. Pleistocene	M. Pleistocene	L. Pleistocene	Holocene
<i>Coelodonta</i>	13	11	48	1( ?)
<i>Dicerorhinus</i>	8	19	9	3
<i>Elasmotherium</i>	6	0	0	0
<i>Rhinoceros</i>	15	19	38	3

It worth mentioning that rhino fossils are usually associated with human fossils in China, rhino fossils were encountered at most of the human sites (80%) (Tong , in press)<sup>[21]</sup>. In south China, *Rhinoceros* existed throughout the whole Pleistocene, but in the north, the fauna of rhinos had an overturn from Middle to Late Pleistocene; In Early and Middle Pleistocene , the north was dominated by *Dicerorhinus mercki*, in Late Pleistocene it's *Coelodonta* which occupied the whole area (see table 3 and figure 2 ).

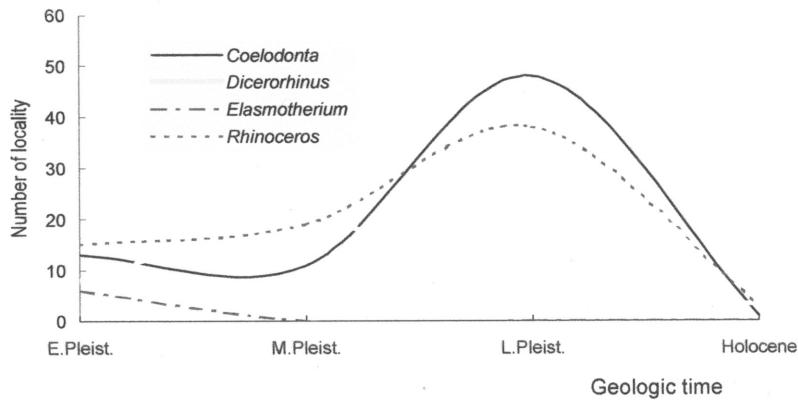


Figure 2 Locality numbers for each rhino genus through Quaternary in China

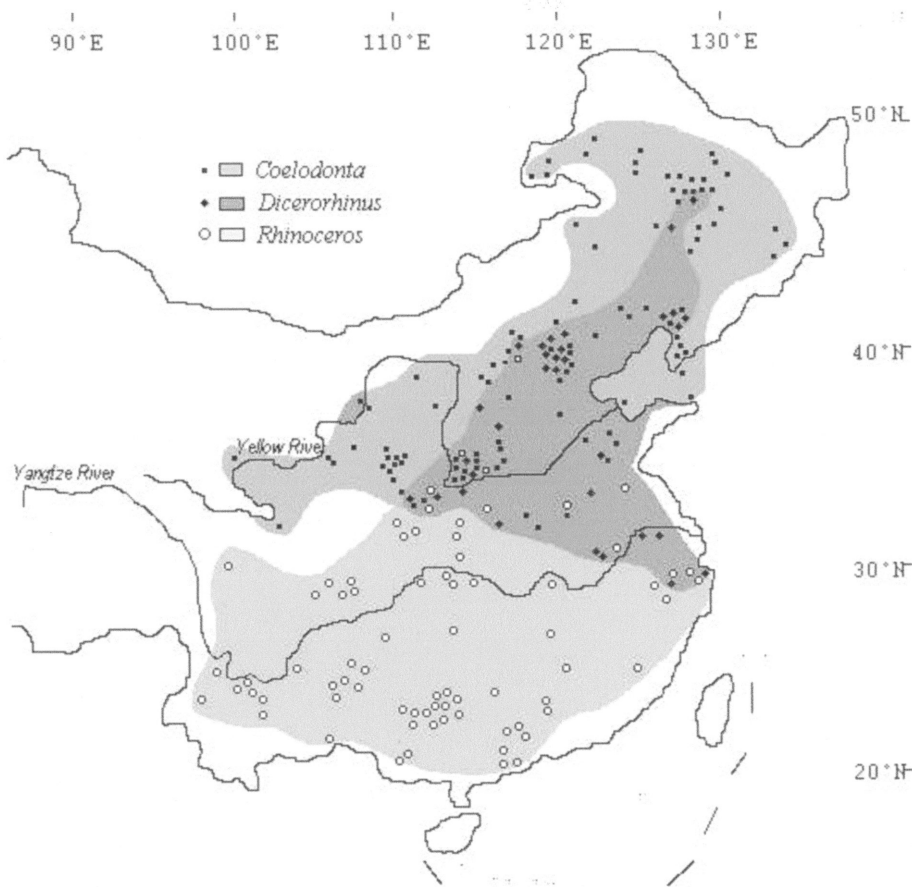


Figure 3 Sketch map showing geologic distributions of Quaternary rhinos in China

#### 4 Correlations of rhino faunas between China and France

China and France share most of the genera and some species of rhinos during Quaternary, such as *Dicerorhinus mercki*, *Coelodonta antiquitatis*. But the difference is also very prominent, which can be seen in the following aspects:

Firstly, the *Rhinoceros* is only limited to Aisa.

Secondly, during the Early Quaternary there is no such a counterpart rhino fauna in China as in France, neither in taxonomy nor in quantity. In France, the early Quaternary rhino fauna is very unique, almost completely composed of *D. etruscus*, this is a relatively smaller and brachydonty rhino, but in China there was no report on this species; on the other hand, the Early Pleistocene rhino fauna in China is not so rich as in France.

Thirdly, strictly speaking, the Quaternary French rhino faunas can be correlated only with those in north China at the generic level, but not south China. In south China, only *Rhinoceros* has been found, but in the north the rhino fauna is composed of *Dicerorhinus*, *Coelodonta* and *Elasmotherium*, which is almost the same as that of in France at generic level.

Fourthly, the French Quaternary rhino localities far outnumbered that of in China, in China the proximal number of officially published rhino localities is 193, but in France it's 290<sup>[22]</sup>.

#### 5 Conclusion

1. Taxonomically, 4 genera of rhinos have been found in the Quaternary deposits in China, they are *Rhinoceros*, *Dicerorhinus*, *Coelodonta* and *Elasmotherium*; at the level of genus, the identification of isolated materials for *Rhinoceros* and *Dicerorhinus* is not satisfied; at specific rank, many identification works should be reconsidered.
2. In material, *Coelodonta* was the best represented, quite a lot of complete skeletons have been found; *Dicerorhinus* also was represented by many materials, but without complete skeleton; the material of *Rhinoceros* is rich, but mainly teeth, the skull is rare; *Elasmotherium* was known only by teeth, but very typical and easily recognized.
3. Totally, more than 190 Quaternary localities have been found bearing rhino fossils in China, which cover almost all the period of Pleistocene.
4. Phylogenetically, all the Quaternary rhino groups are open to questions, the relationship with the local Tertiary rhinos and the relationship with other Quaternary rhino groups outside China are really not quite clear. Anyway, one thing is definite, that's the earliest *Coelodonta* is from China, more attention should be paid to this genus.
5. The compositions of the rhino fauna in France can be correlated with those in north China. China and France share the most important common rhino genera of Quaternary.

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