上部白亜紀後期および古第三紀初期の三重要花粉グループの層位学的意義

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Stratigraphic significance of three important pollen groups in the Late Upper Cretaceous ane Early Palaeogene

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Introduction

Hitherto, the author (1964-1982) has studied on Upper Cretaceous palynology, especially on the triprojectate pollen group which is a main constituent of the Late Upper Cretaceous microflora. In this paper, he selects 72 species of the triprojectate, oculata, and *Callistopollenites* pollen groups which are distributed commonly in more than two provinces in the world and furthermore are considered usefully for stratigraphic correlation or age determination and examines on their palaeogeographic and stratigraphic distribution.

Geographic distribution

Zaklinskaja (1962, 1966, 1967) made a division of the geographic distribution based on the Upper Cretaceous and Early Tertiary spores and pollen grains. Samoilovich (1967) subdivided the *Aquilapollenites* province in Siberia into two subprovinces Khatanga-Lena and Yenisey-Amur. Srivastava (1967, 1975, 1978) summarized on the distribution of the Upper Cretaceous pollen assemblages in the world and further stated his opinion on the distribution of *Aquilapollenites*. Recently, he generalized all Cretaceous sporomorphs. Herngreen and Chlonova (1981) discriminated eight Cretaceous microfloral provinces in the world. Among these provinces the Upper Cretaceous *Aquilapollenites* province is only related to the present theme. They stated that *Aquilapollenites* appears at the end of the Turonian, *Orbiculapollis* somewhat later and the oculata pollen group in this time interval.

The author (1967, 1970, 1973, 1976) reported on change and distribution of the Late Cretaceous

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and Early Tertiary spores and pollen grains in the circum-Pacific regions and then tried their geographic division. Furthermore, he (1981) described in detail on the stratigraphic and geographic distribution of the triprojectate, oculata, and *Callistopollenites* pollen groups in the Late Upper Cretaceous and Early Palaeogene.

The Triprojectacites pollen grains are widely distributed in Siberia, Kazakhstan, China, Japan, Sarawak, S. India, the Rocky Mountains (Alberta, Montana, Wyoming, N. Dakota, S. Dakota, Colorado), Gulf Coast, Atlantic Coastal Plain, Arctic Canada, Alaska, West Greenland, Scotland (Mull Island), Central Europe, West Africa, and Brazil (see Takahashi, 1981).

The oculata pollen grains are distributed in narrower extent than that of the Triprojectacites pollen grains, that is, in Siberia, Kazakhstan, Japan, the Rocky Mountains, Gulf Coast, Arctic Canada, Alaska, and West Greenland (see Takahashi, 1981).

Unlike the distribution of the triprojectate and oculata pollen groups, the *Callistopollenites* pollen group occurs in the most restricted regions, that is, in Zeya-Bureya (Siberia), Hubei (China), Hida (Japan), Arctic Canada, and Western Canada (Alberta) (see Takahashi, 1981).

All oculata and *Callistopollenites* pollen grains occur trustily in the Triprojectacites pollen province.

Stratigraphic correlation and age determination

The triprojectate pollen group occurs during Santonian-Eocene time. Of the oculata pollen group, *Wodehousea* species appear restrictedly during Maestrichtian-Palaeocene time, *Azonia* during Santonian (?)-Maestrichtian time, and *Singularia* only in Maestrichtian time.

The *Callistopollenites* pollen group occurs restrictedly only in Maestrichtian time excepting the Campanian examples from the Jianghan basin in the Hubei Province, China.

The author selects 72 species of the triprojectate, oculata, and *Callistopollenites* pollen groups which are useful for stratigrbphic correlation or age determination. He shows these species in the tables 1-4.

These species and their time-range are as follows.

Santonian-Maestrichtian : *Aquilapollenites formosus, Integricorpus trialatum.*

Campanian-Maestrichtian : *Aquilapollenites asper, A. rigidus, A. turbidus, Triprojectus magnus, Mancicorpus calvum, Integricorpus mtchedlishvilii, Azonia calvata, Az. fabacea.*

Campanian-Palaeocene (+Eocene) : *Aquilapollenites amplus, A. attenuatus, Hemicorpus delicatum, H. senonicum, Integricorpus catenireticulatum, I. reductum, Orbiculapollis globosus.*

Campanian : *Mancicorpus tripodiforme.*

Maestrichtian-Palaeocene or Eocene : *Aquilapollenites spinulosus, A. unicus, Triprojectus conatus, Hemicorpus polare, Integricorpus reticulum, Pseudointegricorpus clarireticulatum, Fibulapollis mirificus, Orbiculapollis lucidus, Pentapollenites rombicus, Wodehousea elegans, W. fimbriatus, W. spinata.*

Maestrichtian : *Aquilapollenites aucellatus, A. cruciformis, A. drumhellerensis, A. insignis, A. granulatus, A. latilobus, A. petasus, A. quadrinus, A. senegalensis, A. subtilis, Triprojectus dispositus, T. ovalis, Hemicorpus pulvinum, H. pulchrum, H. solidum, H. tenue, H. trapeziforme, Mancicorpus albertense, M. ancorforme, M. minimum, M. unicum, Integricorpus mirabile, I.*

Table 1. Occurrence and distribution of the selected triprojectate pollen in the Late Upper Cretaceous and Early Palaeogene (I).

ZB : Zeya-Bureya　HR : Horton River　ND : North Dakota　Fu-Bo : Fushun-Bohai
KL : Khatanga-Lena　WG : West Greenland　SD : South Dakota
WSL : Western Siberian lowland　WC : West Canada　Co : Colorado
AC : Arctic Canada　Mo : Montana　GC : Gulf Coast
Al : Alaska　Wy : Wyoming　ACP : Atlantic Coastal Plain
A : Aquilapollenites　*T : Triprojectus*　*H : Hemicorpus*

	SANTONIAN	CAMPANIAN	MAESTRICHTIAN	PALAEOCENE and/or EOCENE
A. formosus	WC		HR	
A. amplus		Mo	Mo, SD, WG	Mo, WG
A. attenuatus		AC, Mo, Wy, SD	AC, Mo, Wy, GC	GC
A. asper		HR	Hida, ZB, WSL, HR	
A. rigidus		Mo	Jiangsu	
A. turbidus		Mo, Wy, SD, Co	Co	
A. aucellatus			Hida, HR, WC	
A. cruciformis			ZB, WSL	
A. drumhellerensis			WC, Mull	
A. insignis			ZB, Yenisey, WSL	
A. granulatus			ZB, Yenisey,WSL	
A. latilobus			Yenisey, Kazakhstan, WSL	
A. petasus			WC, Mull	
A. quadrinus			Hida, Hokkaido	
A. senegalensis			Mo, Senegal	
A. subtilis			Hida, ZB, WSL, Mull	
A. spinulosus			ZB, AC	WSL, Fu-Bo, Wy, ND, Co, GC
A. unicus			Yenisey, WSL	Yenisey, WSL
T. magnus		HR	Yenisey, WSL, HR, AC	
T. dispositus			Yenisey, WSL, Yukon	
T. ovalis			Yenisey, WSL	
T. conatus			AC, Mo, Wy, GC	GC
H. delicatum		Mo, SD	Mo, SD, Co, GC	Mo, GC
H. senonicum		Mo, Wy, Co	WSL, Al, AC, HR, Yukon, WC, Mo, Wy, GC	GC
H. notabile			ZB, KL, WSL	
H. pulvinum			Mo, SD	
H. pulchrum			Yukon, Wy	
H. solidum			ZB, WSL, WC	
H. tenue			Hida, ZB, WSL, Yukon	
H. trapeziforme			Hida, WSL, HR	
H. polare			AC, Wy	AC

Table 2. Occurrence and distribution of the selected triprojectate pollen in the Late Upper Cretaceous and Early Palaeogene (II).

Ge : Germany *M* : *Mancicorpus* *Ps* : *Pseudointegricorpus* *P* : *Pentapollenites*
Hu : Hungary *B* : *Bratzevaea* *F* : *Fibulapollis*
Be : Belgium *I* : *Integricorpus* *O* : *Orbiculapollis*

	SANTONIAN	CAMPANIAN	MAESTRICHTIAN	PALAEOCENE and/or EOCENE
M. tripodiforme		Mo, Wy, SD, Co		
M. calvum		Mo, Wy, SD	AC, Co	
M. albertense			Hida, WC	
M. ancoriforme			Yenisey, WSL	
M. minimum			Hida, Yenisey, WSL	
M. unicum			Yenisey, WSL	
B. amurensis			Hida, ZB	
I. trialatum	ZB, WC	AC, Mo, Wy, SD	Al, AC, WC	
I. catenireticulatum		Mo	WC, Mo, Wy	GC
I. mtchedlishvilii		Mo	WSL, Mo, Wy, Co	
I. reductum		Mo, Wy	Mo, Wy, SD, GC	GC
I. bertillonites			Mo, Wy	
I. dolium			ZB, KL	
I. mirabile			Hokkaido, WC	
I. reticulum			ZB, WSL, AC, Mo, SD, GC, ACP	GC
Ps. clarireticulatum			KL, HR, Al, WG	WG
F. psilatus			AC, WC	
F. mirificus			ZB, WSL	ZB, Yenisey, WSL
O. lucidus			ZB, WSL, Hida	WSL
O. globosus		HR	Hokkaido, ZB, KL, WSL, HR	Yenisey
P. rombicus			ZB, KL	ZB
P. laevigatus				Ge, Hu
P. pentangulus				Hubei, Ge, Hu, Be
P. regulatius				Ge, Hu, Be
P. striatus				Ge, Be
P. triangulus				Ge, Hu
P. verrucatoides				Ge, Be

bertillonites, I. dolium, Bratzevaea amurensis, Fibulapollis psilatus, Wodehousea aspera, W. gracilis, W. stanleyi, Azonia jactuense, Singularia aculeata, Callistopollenites striatus, C. comis, C. tumidoporus.

Eocene : *Pentapollenites laevigatus, P. pentangulus, P. striatus, P. triangulus, P. verrucatoides.*

Among 72 selected species of the triprojectate,

oculata, and *Callistopollenites* pollen groups, there are some species which are distributed restrictedly or widely. Accordingly, the author divides the Triprojectacites pollen province into three subprovinces, that is (A) subprovince (Siberia, Kazakhstan, China, and Japan), (B) subprovince (North America, West Greenland, Scotland (Mull), and West Africa), and (C) subprovince (Central Europe : Germany, Hungary, Belgium etc.) (see table 4). All selected species are arranged in each time-range in three above-mentioned subprovinces and besides in two combinative subprovinces (A)+(B) and (A)+(C).

In the (A), (B), and (A)+(B) subprovinces, many species appear only in Maestrichtian time. Accordingly, the sediments in which these species occur, are determined relatively easy to be Maestrichtian in age. On the other hand, however, only *Mancicorpus tripodiforme* occurs restrictedly in Campanian time in the (B) subprovince and there is no selected species appearing restrictedly in each Santonian, Palaeocene or Eocene time.In such a case, each age must be determined by combination of the species occurred. During the Eocene in Central Europe, 6 species of *Pentapollenites* are useful for correlation. *Aquilapollenites spinulosus* appears in Palaeocene time in Wyoming, N. Dakota, Colorado, and Gulf Coast and in Eocene time in Fushun and Bohai regions, in spite of occurring in Maestrichtian time in Zeya-Bureya (Siberia) and Arctic Canada. The author thinks that this species shows a marked trend to indicate Palaeocene or Eocene time in the restricted regions.

Table 3. Occurrence and distribution of the selected oculata pollen and *Callistopollenites* in the Late Upper Cretaceous and Early Palaeogene.
W : Wodehousea　Az : Azonia　S : Singularia　C : Callistopollenites

	CAMPANIAN	MAESTRICHTIAN	PALAEOCENE and/or EOCENE
W. aspera		Hida, WSL	
W. edmontonicola		Al, WC	
W. gracilis		Hida, WSL, Al, HR, WC	
W. stanleyi		Al, WC	
W. elegans		WSL, Al	WSL
W. fimbriatus		Al, HR, WC	Al, WC, Mo, SD
W. spinata		ZB, Yenisey, Kazakhstan, Al, AC, HR, WC, Mo, Wy, SD, GC	Mo, Wy, GC, Al, AC, WG
Az. calvata	Al	WSL, Yenisey, KL, Al	
Az. fabacea	Al, HR	Yenisey	
Az. jacutense		Yenisey, KL, HR, WC	
S. aculeata		Yenisey, Al, HR	
C. radiatostriatus	(Hubei)	Hubei, Hida, ZB, Kazakhstan, WC, Yukon	
C. comis	(Hubei)	Hubei, WC	
C. tumidoporus		Hida, AC, Yukon, WC	

Table 4. Diagram showing 72 selected species which occur in each time-range and province.

Time-range \ Province	(A) : Siberia, Kazakhstan, China, Japan	(B) : North America, West Greenland, Scotland (Mull), West Africa	(A) + (B)	(C) : Central Europe	(A) + (C)
Santonian-Maestrichtian		*A. formosus*	*I. trialatum*		
Campanian-Maestrichtian	*M. calvum*	*A. turbidus*	*A. asper, A. rigidus, T. magnus, I. mtchedlishvilii, Az. calvata, Az. fabacea*		
Campanian-Palaeocene (+ Eocene)		*A. amplus, A. attenuatus, H. delicatum, I. catenireticulatum, I. reductum*	*H. senonicum, O. globosus*		
Campanian		*M. tripodiforme*			
Maestrichtian-Palaeocene (or Eocene)	*A. unicus, F. mirificus, O. lucidus, P. rombicus*	*T. conatus, H. polare, W. fimbriatus*	*A. spinulosus, I. reticulum, Ps. clarireticulatum, W. elegans, W. spinata*		
Maestrichtian	*A. cruciformis, A. insignis, A. granulatus, A. latilobus, A. quadrinus, A. subtilis, T. ovalis, H. notabile, M. anconiforme, M. minimum, M. unicum, I. dolium, B. amurensis, W. aspera*	*A. drumhellerensis, A. petasus, A. senegalensis, H. pulvinum, H. pulchrum, I. bertillonites, F. psilatus, W. edmontonicola, W. stanleyi*	*A. aucellatus, T. dispositus, H. solidum, H. tenue, H. trapeziforme, M. albertense, I. mirabile, W. gracilis, Az. jacutense, S. aculeata, C. radiatostriatus, C. comis, C. tumidoporus*		
Eocene				*P. laevigatus* *P. regulatius* *P. striatus* *P. triangulus* *P. verrucatoides*	*P. pentangulus*

A : Aquilapollenites *M : Mancicorpus* *F : Fibulapollis* *PS : Pseudointegricorpus* *S : Singularia*
T : Triprojectus *I : Integricorpus* *O : Orbiculapollis* *W : Wodehousea* *C : Callistopollenites*
H : Hemicorpus *B : Bratzevaea* *P : Pentapolleniles* *Az : Azonia*

Abstract

The author (1981, 1982) has studied all genera and species of the triprojectate, oculata, and *Callistopollenites* pollen groups, added two new genera, and treated of their stratigraphic and geographic distribution in the world. In this paper, he selects and examines 72 species of these pollen groups which are distributed commonly in some provinces and moreover seem usefully for age determination. These species show relatively restricted occurrence and 36 species appear restrictedly only in Maestrichtian age. He explains that these species are useful for stratigraphic correlation.

要　約

筆者は、これまで triprojectate, oculata および *Callistopollenites* 花粉グループのすべての属・種を検討し、2つの新属を設立し、全世界におけるそれらの層位学的および地理学的分布について取り扱った。本論では、各地域に共通して分布し、時代決定に有用と思われる種類を72種選び出し、検討した。これらの種は比較的限られた産出を示し、36種はマーストリヒト階に限られて産出する。これらの種が地層対比に有用であることを説明した。

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