

# Two ephialtitid wasps (Insecta, Hymenoptera, Ephialtitoidea) from the Yixian Formation of western Liaoning, China



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Two wasps belonging to the family Ephialtitidae from the Yixian Formation of western Liaoning, China, are described and illustrated as *Crephanogaster rara* sp. nov. and *Tuphephialtites zherikhini* gen. et sp. nov. That ephialtitids occupy a very small proportion of the hymenopteran assemblage in western Liaoning suggests the age of the Yixian Formation to be Early Cretaceous or, possibly, as old as latest Jurassic. This is the first record of Ephialtitidae from the upper Mesozoic of China.

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KEY WORDS: Hymenoptera; Ephialtitidae; Ephialtitinae; new taxa; latest Jurassic; Early Cretaceous; Yixian Formation; China.

## 1. Introduction

The Ephialtitidae is an extinct family known from rocks ranging in age from Early Jurassic to Early Cretaceous (Meunier, 1903; Rasnitsyn, 1975b, 1977, 1990, 1999; Zessin, 1981, 1985; Zhang, 1986; Darling & Sharkey, 1990; Rasnitsyn & Ansoerge, 2000; Rasnitsyn & Martínez-Delclòs, 2000). This family is considered to be the second most primitive of the Hymenoptera suborder Apocrita, and it and the Karatavitidae, the most primitive apocritans, constitute the superfamily Ephialtitoidea (Rasnitsyn, 1988). The family Ephialtitidae is divided into two subfamilies: Ephialtitinae Handlirsch, 1906 and Symphytopterinae Rasnitsyn, 1980. It plays an extremely important role in the evolution of Hymenoptera, and all other apocritans except the Karatavitidae and Orussoidea are considered to have originated from this group (Rasnitsyn, 1980, 1988).

Although the earliest occurrence of this family is in the Lower Jurassic of Germany (Zessin, 1981, 1985), it was not until the Late Jurassic that the family reached its apex (Rasnitsyn, 1975b, 1977). During the Early Cretaceous, the Ephialtitidae declined markedly; only a few representatives have been reported (Meunier, 1903; Darling & Sharkey, 1990; Rasnitsyn, 1990; Rasnitsyn & Ansoerge, 2000;

Rasnitsyn & Martínez-Delclòs, 2000). They were doubtless parasitoids of other insects and initially of the larvae of powder post beetles (Lyctidae) or horn-tails (Siricidae) (Rasnitsyn, 1975a), and were widely distributed in China, Mongolia, Siberia, Kazakhstan, Germany, Spain and Brazil (Rasnitsyn & Martínez-Delclòs, 2000).

In China, only one species referred to Ephialtitidae, *Sinephialtites glyptus* Zhang, has been described from the Middle Jurassic Xiahuayuan Formation (Zhang, 1986). Recently, two ephialtitids have been recovered from the Jianshangou Bed of the Yixian Formation at Huangbanjigou Village, Beipiao, western Liaoning Province, the first records from the upper Mesozoic of China. These two specimens are now deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

## 2. Systematic palaeontology

Order: Hymenoptera Linnaeus, 1758  
Suborder: Apocrita Gerstaecker, 1867  
Superfamily: Ephialtitoidea Handlirsch, 1906  
Family: Ephialtitidae Handlirsch, 1906  
Subfamily: Ephialtitinae Handlirsch, 1906  
Genus *Crephanogaster* Rasnitsyn, 1990

*Type species.* *Crephanogaster femorata* Rasnitsyn, 1990; Lower Cretaceous, Turga Formation, Transbaikalia, Russia.

*Species included.* The type species and the new one described below.

*Diagnosis.* Antenna with 26 segments. Forewing venation complete; 1r-rs rudiment, 2A,  $a_1$ - $a_2$  present; basal section of Rs nearly perpendicular to R; cells 2rm and 3rm comparatively short; cu-a slightly post-furcal or interstitial. Hindwing with cell r closed.

*Remarks.* The type species is represented by a poorly preserved specimen with antennae and metasomal distal half not preserved, legs mostly missing, and forewings and hindwings partly damaged. The generic characteristics are diagnosed on the basis of the type species and the new material.

*Crephanogaster rara* sp. nov.  
Figures 1A, B, 2A, B

*Etymology.* Latin, *rarus*, rare.

*Material.* Holotype LBSH98018/NIGP134559 (male), part and counterpart. Nearly complete.

*Diagnosis.* Unlike the type, the new species has a forewing with longer pterostigma and interstitial cu-a, a hindwing with basal section of Rs longer, a smooth propodeum and a metasoma with first tergum longer and not trans-striate.

*Description.* Male; female unknown. Body brown, antennae and legs (tibiae and tarsi) pale. No discernible surface sculpture. Head incomplete (?); eyes small, oval. Antennae composed of 26 segments, slightly longer than head and mesosoma combined; scape thin basally and gradually thickened apically, twice as long as wide; pedicel small, slightly thickened apically, and as long as wide; first flagellomere slightly thinner than apex of pedicel basally, gradually increasing in thickness apically, and 3.5 times as long as wide; second to fifth similar to first in shape, 2.5 times as long as wide; sixth to eighth similar to fifth but a little shorter; following flagellomeres similar to eighth in shape but slightly thinner and shorter; terminal short, rounded apically. Propleurae medium-sized; mesonotum large, mesosternum large and transversely rectangular; metanotum short. Propodeum broad, flat (with its dorsum straight in side view), and smooth. Fore- and midleg small. Hindleg with large coxa; trochanter small, trapezoid; femur thick; tibia slender, distinctly

longer than femur and gradually thickened apically; tarsus short with basal four tarsomeres preserved. Forewing with pterostigma elongate, nearly parallel-sided; basal section of Rs half length of that of M; vestigial 1r-rs short; 2r-rs meeting cell 2rm slightly basad of 2r-m; cell 3r elongate-triangular, pointed apically; cell 2rm hexagonal; cell 3rm nearly rectangular, about 1.5 times as long as 2rm; 1m-cu joining M slightly beyond bifurcation of Rs+M; 2m-cu meeting cell 3rm slightly beyond 2r-m; cu-a interstitial;  $a_1$ - $a_2$  complete. Hindwing with cell r narrow and elongate; basal section of Rs longer than r-m. Metasoma oval in side aspect, broadest at about its midlength, with eight segments distinguishable; first segment slightly narrowed basally with tergum longer; second to sixth equal in length, 0.7 times as long as first; seventh slightly shorter than sixth; terminal small. Body length 10.2 mm; antennal length 7.0 mm; forewing, as preserved, length 6.6 mm, width 2.7 mm.

Genus *Tuphephialtites* gen. nov.

*Etymology.* Greek, *tuphos*, vapour, and the generic name *Ephialtites*; gender masculine.

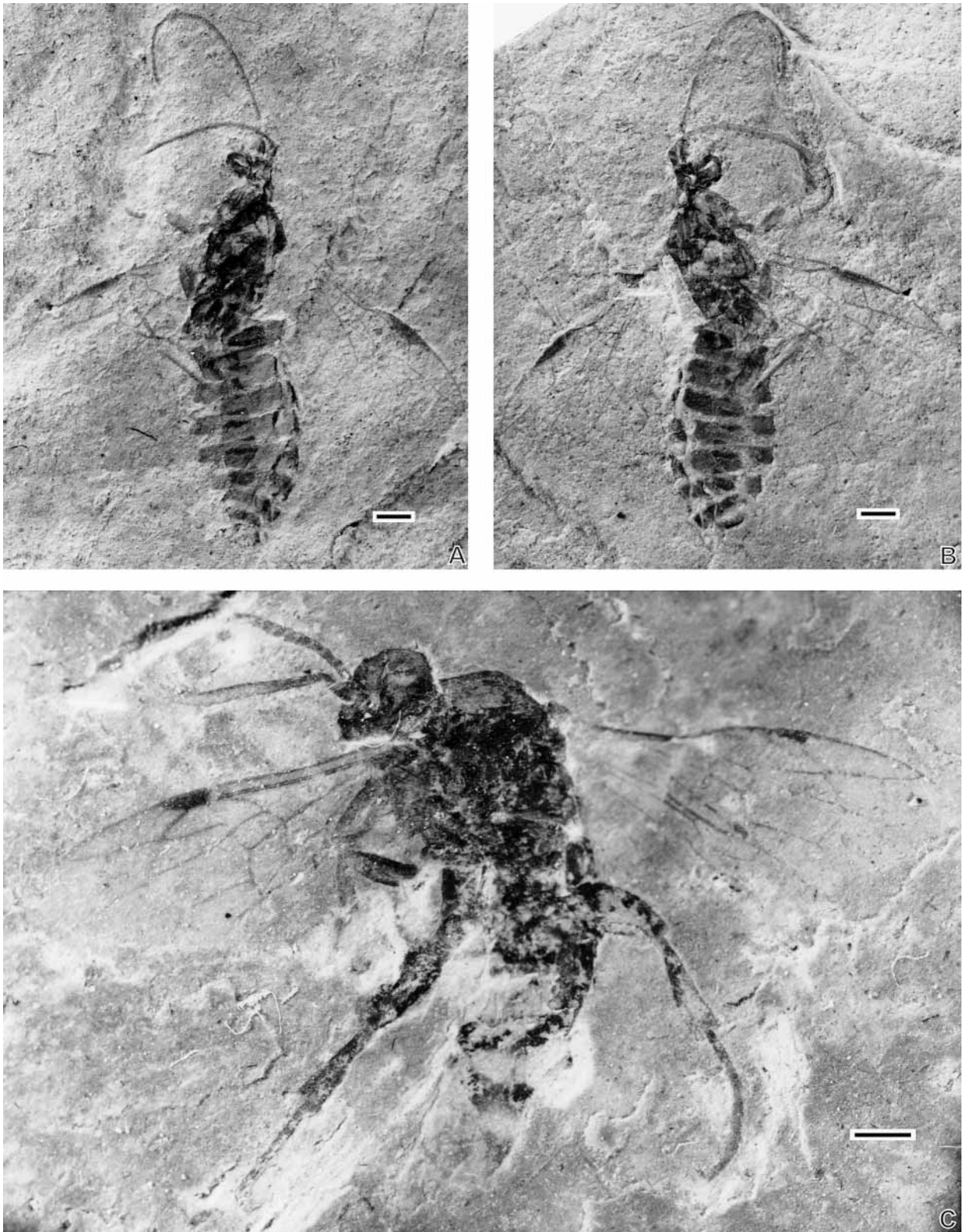
*Type species.* *Tuphephialtites zherikhini* sp. nov.; uppermost Jurassic or Lower Cretaceous, Yixian Formation, Liaoning, China.

*Species included.* One monotypical species described herein.

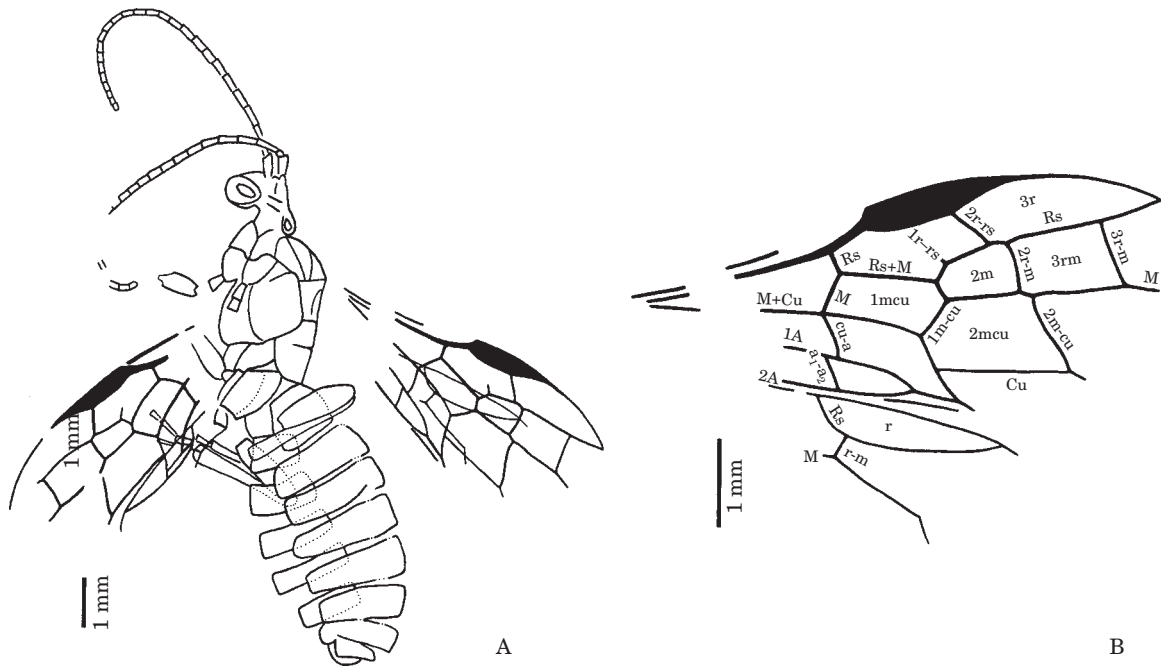
*Diagnosis.* Antenna with more than 29 segments. Forewing venation complete; 2r-m and 3r-m oblique, sinuate; 2m-cu meeting M distad of 2r-m; cu-a interstitial; 2A present;  $a_1$ - $a_2$  complete, cell 2a closed. Hindwing with cell r closed; r-m shorter than basal section of Rs; origin of M basad of that of Rs. Metasoma with first segment thick, slightly narrowed basally and nearly as broad as second.

*Comparison and remarks.* Although very similar to *Cretephialtites* Rasnitsyn & Ansoerge, 2000 in the forewing, the new genus can be distinguished by the 2m-cu received by cell 3rm, and the presence of 2A and  $a_1$ - $a_2$ . *Cretephialtites* Rasnitsyn & Ansoerge was erected on the basis of a complete forewing (Rasnitsyn & Ansoerge, 2000) in which vein 2A and crossvein  $a_1$ - $a_2$  have completely disappeared, indicating this genus to be more advanced to some degree than the new one.

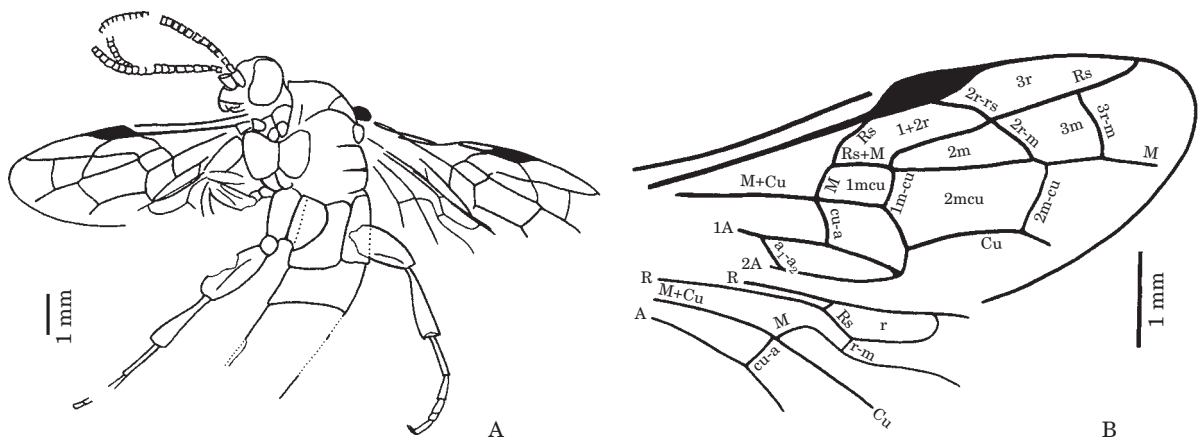
*Tuphephialtites zherikhini* sp. nov.  
Figures 1C, 3A, B



**Figure 1.** A, B, *Crephanogaster rara* sp. nov., holotype. A, part, NIGP134559a; B, counterpart, NIGP134559b. C, *Tuphephialtites zherikhini* gen. et sp. nov., holotype, NIGP134560. Scale bars represent 1 mm.



**Figure 2.** *Crephanogaster rara* sp. nov., holotype. A, male, lateral-ventral aspect, camera lucida drawing of NIGP134559a. B, forewing and hindwing, based on camera lucida drawing of NIGP134559a.



**Figure 3.** *Tuphephialtites zherikhini* gen. et sp. nov., holotype. A, sex unknown, lateral-ventral aspect, camera lucida drawing of NIGP134560. B, forewing and hindwing, based on camera lucida drawing of NIGP134560.

**Etymology.** In memory of Dr Vladimir Zherikhin, the late Russian palaeoentomologist.

**Material.** Holotype LBSH98019/NIGP134560. Antennae and legs incomplete, distal half of metasoma not preserved, otherwise nearly complete.

**Description.** Sex unknown. Body brown, antennae and legs (tibiae and tarsi) pale. Head medium-sized; eyes large, kidney-like. Mandibles small. Antennae incomplete with 29 segments preserved; scape thin basally and gradually increasing in thickness apically, 1.5

times as long as wide; pedicel small and slightly thickened apically, slightly longer than wide; flagellum thin basally and apically, and gradually increasing in thickness towards its midlength, with each flagellomere inversely trapezoid; first to fifth flagellomeres slightly longer than wide, others as long as or slightly shorter than wide. Mesothorax large; metanotum and propodeum of subequal length, transversely broad, flat (with dorsum straight in side view). Fore- and midleg small; hindleg large with coxa thick, slightly shorter than width of head; trochanter small, nearly oval; femur slightly longer than coxa, swollen

Table 1. Geological distribution of the known taxa of Ephialtitidae.

Age	Genus	NS	Location and horizon	References
Cretaceous	<i>Crephanogaster</i> Rasnitsyn, 1990	1	Turga, Transbaikalia, Russia; Turga Fm	Rasnitsyn, 1990
	Ephialtitidae <i>incertae sedis</i>	1	Turga, Transbaikalia, Russia; Turga Fm	Rasnitsyn, 1990
	<i>Ephialtitis</i> Meunier, 1903	1	La Pedrera de Rúbies, Lleida, Spain; Lithographic limestones	Meunier, 1903
	<i>Moniscephialtitis</i> Rasnitsyn & Martínez-Delclós, 2000	1	La Cabrúa, Lleida, Spain; Lithographic limestones	Rasnitsyn & Martínez-Delclós, 2000
	K <sub>1</sub> <i>Cretephialtitis</i> Rasnitsyn & Ansoerge, 2000	1	La Pedrera de Rúbies, Lleida, Spain; Lithographic limestones	Rasnitsyn & Ansoerge, 2000
	<i>Karataus</i> Rasnitsyn, 1977	1	La Cabrúa, Lleida, Spain; Lithographic limestones	Rasnitsyn & Martínez-Delclós, 2000
	<i>Cratephialtitis</i> Rasnitsyn, 1999	1	Ceará, Brazil; Santana Formation	Darling & Sharkey, 1990; Rasnitsyn, 1999
	K <sub>1</sub> <i>Crephanogaster</i> Rasnitsyn, 1990	1	Beipiao, western Liaoning, China; Yixian Fm	this study
	or J <sub>3</sub> <i>Tuphephialtitis</i> gen. nov.	1	Beipiao, western Liaoning, China; Yixian Fm	this study
	Jurassic	<i>Stephanogaster</i> Rasnitsyn, 1975	5	
<i>Asiephialtitis</i> Rasnitsyn, 1975		4(?)		
<i>Parephialtitis</i> Rasnitsyn, 1975		1		
<i>Mesephialtitis</i> Rasnitsyn, 1975		1		
<i>Leptephialtitis</i> Rasnitsyn, 1975		10		
<i>Sessiventer</i> Rasnitsyn, 1975		5		
<i>Symphlyopterius</i> Rasnitsyn, 1975		14	Karatau, South Kazakhstan; Karabastau Fm	Rasnitsyn, 1975b, 1977, 1990
<i>Microphialtitis</i> Rasnitsyn, 1975		1		
<i>Symphogaster</i> Rasnitsyn, 1975		1		
<i>Karatawiola</i> Rasnitsyn, 1975		2		
<i>Trigonalopterius</i> Rasnitsyn, 1975		1		
<i>Karataus</i> Rasnitsyn, 1977		1		
J <sub>2</sub> <i>Sinephialtitis</i> Zhang, 1986		1	Luanping, Hebei Province, China; Xiahuayuan Fm	Zhang, 1986
J <sub>1</sub> <i>Sippelipterus</i> Zessin, 1985		1	Schandelah near Braunschweig, Germany; Upper Lias (Toarcian)	Zessin, 1985
<i>Liadobracona</i> Zessin, 1981		1	Dobbertin near Schwerin, Germany; Upper Lias (Toarcian)	Zessin, 1981, 1985

midway; tibia as long as femur, gradually thickened apically; tarsus 1.6 times as long as tibia with two claws apically, and length ratio of tarsomeres 6.0:3.0:2.0:1.0:3.0. Forewing with broad pterostigma, nearly a parallelogram, issuing 2r-rs slightly beyond its midlength; 2r-m meeting Rs at the point where 2r-rs meets Rs, and meeting M close to 2m-cu; 3r-m meeting Rs slightly closer to apex of 3r than to 2r-m; 3r slightly obtuse apically; cell 2rm slightly shorter than cells 1+2r and 2mcu, and distinctly longer than 3rm and 1mcu. Hindwing with cell r short, rounded apically; basal section of Rs 2.5 times as long as r-m; cu-a meeting M+Cu just before divergence of M+Cu into M and Cu; M, Cu and A long. First metasomal segment nearly as long as wide, trapezoid in side view; second slightly shorter than first, transversely rectangular; third and fourth poorly preserved and indistinct. Body length, as preserved, 10.6 mm; antennal length, as preserved, 5.7 mm; forewing length 6.4 mm, width 2.6 mm; hindwing, as preserved, length 3.8 mm, width 1.5 mm.

### 3. Stratigraphical implications

Although present from the Early Jurassic to the Early Cretaceous, Ephialtitidae only flourished in the Late Jurassic and were only moderately successful at other times (Meunier, 1903; Rasnitsyn, 1975b, 1977, 1990, 1999; Zessin, 1981, 1985; Zhang, 1986; Darling & Sharkey, 1990; Rasnitsyn & Ansoerge, 2000; Rasnitsyn & Martínez-Delclòs, 2000) (Table 1). With respect to the Late Jurassic, the ephialtitids are known only from the Karabastau Formation of Karatau, southern Kazakhstan (Rasnitsyn, 1975b, 1977, 1990), the age of which is generally considered to be pre-Tithonian Late Jurassic although a latest Middle Jurassic age cannot be excluded (Rasnitsyn *et al.*, 1998). Very few Tithonian wasps are known, all from the Solnhöfen insect assemblage, and no ephialtitids have been reported. Therefore during the latest Jurassic the record of the family Ephialtitidae is not yet clear.

Abundant hymenopterans have been found in the Yixian Formation of western Liaoning, of which 40 wasp species have been described (Zhang & Zhang, 2000a–d, 2001; Zhang *et al.*, 2001; Zhang *et al.*, 2002a, b). The two ephialtitids described above form a very small proportion of the western Liaoning assemblage. They suggest the age of this assemblage to be Early Cretaceous or, possibly, as old as latest Jurassic.

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