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浙赣地区上奥陶统砚瓦山组的牙形刺及其地层意义*

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提要 描述产自浙江常山 205 国道剖面上奥陶统砚瓦山组的牙形刺, 主要有 *Baltoniodus alobatus*, *B. variabilis*, *Periodon aculeatus*, *Dapsilodus viruensis*, *Scabbardella altipes* 和 *Panderodus gracilis* 等, 可归入 *Baltoniodus alobatus* 带。浙赣地区奥陶系砚瓦山组自建立以来都被归入瀚江期, 并与宝塔组对比。本文根据当前的发现并结合以前报道的砚瓦山组牙形刺化石, 认为砚瓦山组自下而上可识别出 *Pygodus anserinus*, *Baltoniodus alobatus* 和 *Hamarodus brevirameus*(＝*Hamarodus europaeus*)等带, 其时代应归为桑比早期至凯迪早期, 并可与华南扬子区的庙坡组大部(或大田坝组)至宝塔组对比。其中, *Pygodus anserinus* 带和 *Baltoniodus alobatus* 带见于浙江常山、江山地区, *Hamarodus brevirameus* 带则见于江西武宁。在常山黄泥塘金钉子剖面, 砚瓦山组底部为 *Pygodus anserinus* 带; 在常山 205 国道剖面则见 *Baltoniodus alobatus* 带; 但在江西武宁地区, 砚瓦山组从底部起, 几乎全都归为 *Hamarodus brevirameus* 带。因而, 砚瓦山组在江西武宁与浙江常山等地之底界并不一致, 有明显的穿时现象。本文牙形刺生物地层研究还表明, 晚奥陶世古滕贝格的 $\delta^{13}C$ 的正偏移事件(GICE)在常山地区的起始时间不会早于 *B. alobatus* 带。

关键词 牙形刺 地层对比 化学地层学 砚瓦山组 奥陶系 浙赣地区

UPPER ORDOVICIAN CONODONTS FROM THE YENWASHAN FORMATION IN THE ZHEJIANG-JIANGXI BORDER REGION, S. E. CHINA AND THEIR BIOSTRATIGRAPHIC SIGNIFICANCE

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Abstract A small conodont fauna from the Upper Ordovician Yenwashan Formation exposed at a road-cut along Highway 205 near Changshan, western Zhejiang includes *Baltoniodus alobatus*, *B. variabilis*, *Dapsilodus viruensis*, *Panderodus gracilis*, *Periodon aculeatus* and *Scabbardella altipes* and is referred to the Chinese *Baltoniodus alobatus* Zone. Based on the present study, and on the conodont faunas previously described from the unit, the Yenwashan

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Formation in its most complete stratigraphical range contains conodonts of the *Pygodus anserinus*, *Baltoniodus alobatus*, and *Hamarodus brevirameus* (formerly *Hamarodus europaeus*) zones and ranges from the early Sandbian to the early Katian. It can be correlated with most of the Miaopo Formation (or the equivalent Datianba Formation) and the Pagoda Formation. Both biostratigraphic and chemostratigraphic data indicate that the base of the Yenwashan Formation is diachronous and occupies a different stratigraphic level in different distribution areas of the formation. The present investigation is of special interest in showing that the beginning of the Guttenberg $\delta^{13}C$ excursion (GICE) is not older than the *B. alobatus* Zone in the study area.

Key words Conodonts, biostratigraphy, chemostratigraphy, Yenwashan Formation, Ordovician, Zhejiang-Jiangxi border region

The Upper Ordovician Yenwashan Formation is widely distributed in the Jiangnan Region of South China, and consists of a succession of purple-red, grayish green and gray nodular limestone with interbedded grayish green and gray calcareous shale, with a thickness varying in different areas. It was originally proposed as the "Yenwashan System" (Liu and Chao, 1927) based on the succession at its type locality at the village of Yanwashan, 15 km east of Changshan County Town in western Zhejiang Province. As originally defined, this unit comprised also stratigraphical intervals now included in the Hulo and Huangnekang formations. Hsü (1934) split the Hulo Formation from the original Yenwashan Formation. Lu *et al*. (1955) introduced the Huangnekang Formation and restricted the Yenwashan Formation to its current scope and regarded it to be of Caradocian (Early Katian) age. Based on the occurrence of the cephalopods *Orthoceras regulare*, *Michelinoceras huangnigangense* and *Sinoceras chinense*, Zhang (1964) correlated it with the Pagoda Formation. Subsequently, most geologists, such as Zhang *et al*. (1982) and Chen *et al*. (1985), accepted this correlation, which was confirmed by Chen and Zhang (1984) based on the discovery of the *Hamarodus brevirameus* Zone fauna in the formation at Wuning in Jiangxi Province. Recently, Zhen *et al*. (2009) reported the *Pygodus anserinus* Zone fauna from the most basal part of the Yenwashan Formation in the Huangnitang section at Changshan, western Zhejiang (cf. An, 1987) and referred this interval to the early Sandbian.

One of the first Chinese records of the global Guttenberg $\delta^{13}C$ excursion (GICE) was from the Yenwashan Formation in the Darriwilian GSSP section at Huangnitang near Changshan County Town, Zhejiang (Bergström *et al*., 2008). Their investigation did not include Member 2 of the Yenwashan Formation but a few years later, Munnecke *et al*. (2011) presented a $\delta^{13}C$ curve through the entire formation at this locality. Their carbon curve is virtually identical with that of the Bergström *et al*. (2008) curve through much of Member 1, but the curve of Munnecke *et al*. (2011) shows the continuation of the GICE through Member 2 of the Yenwashan Formation. Although the end of the GICE may not be present in the topmost portion of the Yenwashan Formation at this locality, most of the declining limb of the GICE occurs in Member 2.

Neither of these studies presented biostratigraphically useful conodont data from the Yenwashan Formation and previous investigations of this formation in the Changshan region (Zhen *et al*., 2009) have shown that conodonts are surprisingly scarce with many samples being barren, except near the base of the formation. Zhen *et al*. (2009) recorded a taxonomically diverse *Pygodus anserinus* Zone fauna from the most basal part of Member 1 at Huangnitang but biostratigraphically diagnostic conodonts have not previously been recorded from stratigraphically higher parts of the formation, including the GICE interval.

The goal of the present study was to explore whether a series of samples collected through a relatively new outcrop of the Yenwashan Formation along Highway 205 near Zhoutang Village about 0.5 km northeast of the Huangnitang section could provide needed conodont biostratigraphic information from the GICE interval. In the highway outcrop, the basal portion of Member 1 of the formation is not exposed but otherwise, the succession is quite similar to that in the nearby Huangnitang section, and we assume that the development of the two members of the Yenwashan Formation is closely similar, if not identical, in the two sections.

1　DESCRIPTION OF THE HIGHWAY 205 SECTION

At this locality, which was discovered by Mr. Yu Guohua in 2005 when highway 205 was under construction, the Yenwashan Formation is far more easily accessible and better exposed than in the Huangnitang section, especially Member 2. As shown in Figure 1, two sections (highway 205 and Huangnitang sections) are in the same distribution belt. A brief description of the Highway 205 section is as follows (cf. Zhang *et al.*, 2007).

The Yenwashan Formation is typified by gray-green and purple-red nodular and thin-bedded limestone and micritic limestone with a total exposed thickness of more than 44.1 m at this locality. Except for the lower part of Member 1, the entire Yenwashan Formation is well exposed and easily accessible along the Highway 205 road cut. The following lithological subdivisions can be distinguished:

Member 2: Purple-red and gray-green nodular micritic limestone and thin-bedded micritic limestone with a total thickness of 34.1 m.

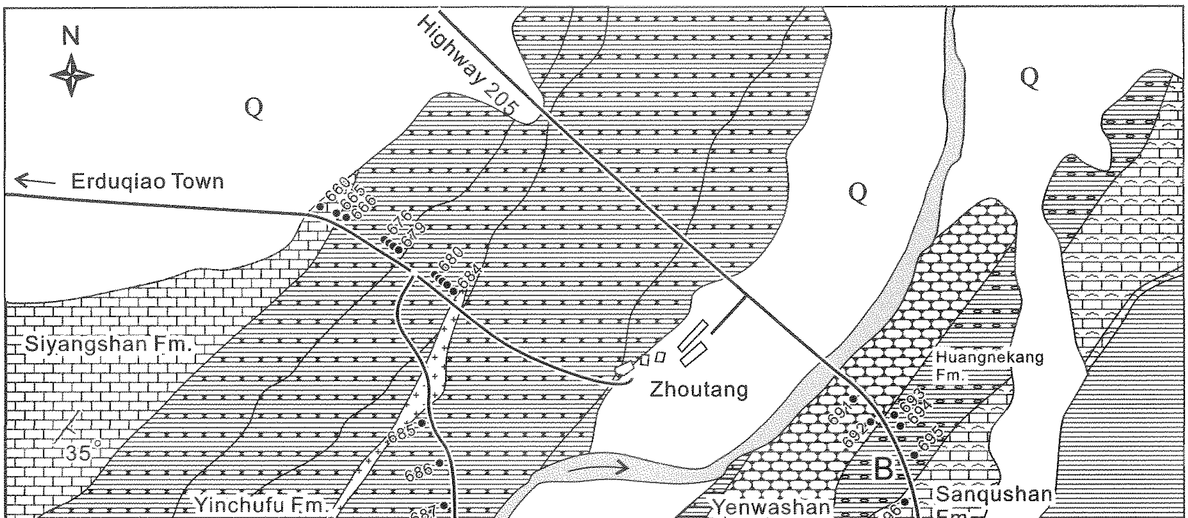

Figure 1　Map showing the location of the Huangnitang (A) and Highway 205 sections (B), Changshan, Western Zhejiang Province
Note the geographic range of the outcrop belt of the Yenwashan Formation.

(31) Gray-green nodular micritic limestone with gray nodular limestone and thin-bedded micrite; containing the brachiopod *Dedzetina* ? sp. 19.5 m

(30) Purple-red and less commonly, gray-green nodular micritic limestone, nodular limestone, and thin-bedded micrite; containing the trilobite *Cyclopyge* sp. 14.6 m

Member 1: Gray-green nodular limestone and micrite.

(29) Gray-green nodular limestone and nodular micrite; containing the conodonts *Baltoniodus alobatus*, *B. variabilis*, *Dapsilodus viruensis*, *Panderodus gracilis*, *Periodon aculeatus*, and *Scabbardella altipes*. >10 m

Yenwashan strata below unit (29) are not exposed.

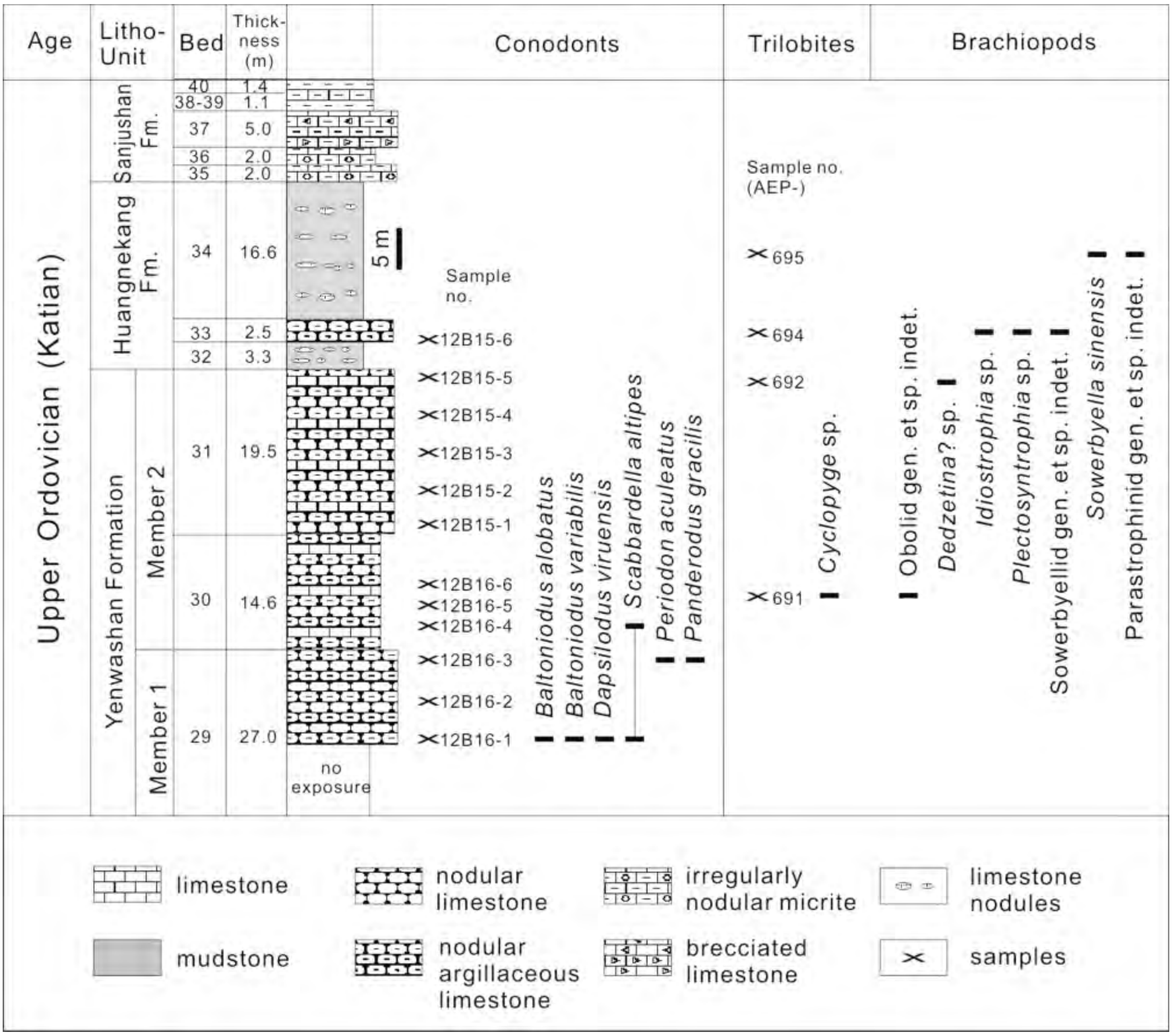

Figure 2 Chart showing the ranges of Late Ordovician conodonts, trilobites, and brachiopods recovered from the Yenwashan Formation exposed along the Highway 205 road-cut, Changshan, western Zhejiang

2 CONODONT ZONATION AND CORRELATION OF THE YENWASHAN FORMATION

As clearly shown from the previous study of the Huangnitang section, conodonts are surprisingly scarce in the Yenwashan Formation except in its most basal part, and the same applies to the Highway 205 outcrop, with most samples from Member 2 being barren. The reason for this poor yield remains uncertain. However, it is unlikely that the paucity of conodonts is somehow related to the GICE, because this excursion interval contains diverse and relatively abundant conodonts elsewhere, for instance in the Midcontinent of North America (e. g. Bergström and Sweet, 1966) and southeastern Norway (Bergström *et al.*, 2010b). The fact that the Yenwashan Formation was deposited in relatively deep water on the Jiangnan slope belt might have affected conodont diversity and abundance, because it appears that many Ordovician conodont species were adapted to shallow-water marine environments and are not present in deeper-water deposits.

The conodont species association recovered from the top 15 m of Member 1 (Figure 2) includes *Baltoniodus alobatus*, *B. variabilis*, *Dapsilodus viruensis*, *Panderodus gracilis*, *Periodon aculeatus*, and *Scabbardella altipes*. This species association is typical of the Chinese *Baltoniodus alobatus* Zone which is equivalent to the *Baltoniodus alobatus* Subzone of the *Amorphognathus tvaerensis* Zone in the Baltoscandian conodont zonation (Bergström, 1971). The *B. alobatus* Zone occurs just below the GICE interval in Baltoscandia, in some other areas in China, and in Malaysia. Of special interest is the GICE record from the Kaki Bukit Formation in Malaysia (Bergström *et al.*, 2010a, fig. 2) where the zone fossil *B. alobatus* ranges up to the middle portion of the rising limb of GICE, as is also the case at Huangnitang. Hence, the relations between conodont biostratigraphy and carbon chemostratigraphy in the Huangnitang area are the same as elsewhere. The fact that the beginning of the GICE in the Katian Stage GSSP section at Black Knob Ridge, Oklahoma is just above the base of the Katian Stage (Goldman *et al.*, 2007) indicates that the base of the Katian Stage is somewhere in the middle part of Member 1 of the Yenwashan Formation in the Huangnitang area.

Based on conodont biostratigraphy, the base of the Yenwashan Formation is diachronous regionally, ranging in age from the *Pygodus anserinus* Zone to the *Hamarodus brevirameus* Zone. At Huangnitang, the base of the Yenwashan Formation has the fauna of the *Pygodus anserinus* Zone according to Zhen *et al.* (2009). Whereas at the Highway 205 section the Yenwashan Formation contains the *Baltoniodus alobatus* Conodont Zone fauna in the top part of Member 1, and at Wuning in Jiangxi (Chen and Zhang, 1984) it contains a fauna of the *Hamarodus brevirameus* Zone ranging through the entire formation.

In the most complete successions, the Yenwashan Formation can be subdivided into, in descending order, the *Hamarodus brevirameus*, *Baltoniodus alobatus*, and *Pygodus anserinus* zones. Typical taxa of each of these conodont zones are as follows:

3. *Hamarodus brevirameus* Zone. This zone is characterized by the occurrence of *Cornuodus longibasis*, *Dapsilodus viruensis*, *Hamarodus brevirameus*, *Protopanderodus liripipus*, and *Scabbardella altipes*. This zone was documented from the Yenwashan Formation at Wuning, Jiangxi by Chen and Zhang (1984). The fact that this zone is well represented in the Pagoda Formation on the Yangtze Platform (Chen *et al.*, 2011) is the basis to correlate this unit with part of the Yenwashan Formation.

2. *Baltoniodus alobatus* Zone. This zone typically contains, among others, *Baltoniodus alobatus*, *Dapsilodus viruensis*, *Panderodus gracilis*, and *Scabbardella altipes*. The presence of this zone in the Highway 205 section has been described above. This zone has also been recorded from the upper part of the Miaopo Formation, the Datianba Formation, and the lowermost Pagoda Formation on the Yangtze Platform of South China.

1. *Pygodus anserinus* Zone. The species association of this zone includes, among others, *Dapsilodus viruensis*, *Periodon aculeatus*, *Pygodus anserinus*, *Protopanderodus cooperi*, *P. varicostatus*, and *Spinodus spinatus*. As noted above, this zone has been recorded from the most

basal portion of the Yenwashan Formation in the Huangnitang section by Zhen *et al.* (2009). It is also present in the lower and middle parts of the Miaopo Formation on the Yangtze Platform (Chen *et al.*, 2011) with an age ranging from the latest Darriwilian to earliest Sandbian.

A conodont-based correlation between the Yenwashan Formation and some other units is presented in Figure 3.

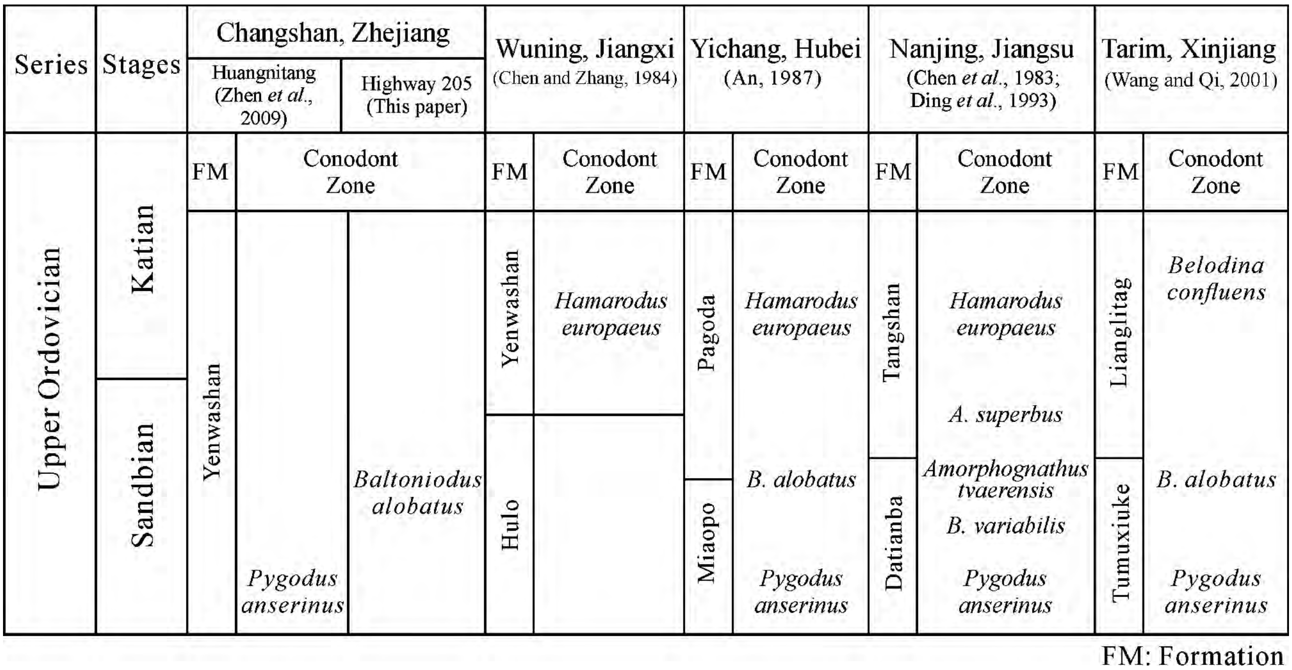

Figure 3 Chart showing a proposed conodont-based correlation between the Yenwashan Formation and coeval units of South China and the Tarim Basin

Note that *Hamarodus europaeus* is now referred to as *Hamarodus brevirameus*.

3 RELATIONS TO δ^{13}C CHEMOSTRATIGRAPHY

As indicated above, the initial goal of the present investigation was to clarify the previously poorly known conodont biostratigraphy in the GICE interval of the Yenwashan Formation. Our discovery of the *Baltoniodus alobatus* Zone in the rising limb of the GICE in Member 1 of the formation in the Highway 205 section provides important information about the maximum age of the GICE at this locality, but the end of the GICE still remains undated in the Changshan area. Our conodont-based dating at the beginning of the GICE is in full agreement with datings from the Pagoda Formation in parts of the Yangtze Platform, and supports the previously proposed correlation between the Pagoda Formation and at least part of the Yenwashan Formation.

The present study also confirms that the base of the Yenwashan Formation is of different age at different localities and ranges from the *Pygodus anserinus* Zone to the *Hamarodus brevirameus* Zone. Interestingly, this diachronism of the base of the formation is comparable with that of the largely coeval Pagoda Formation. For instance, whereas the lower limb of the GICE is slowly rising in the Pagoda Formation at Xiaotan, Hexian, Anhui Province, the GICE curve rises abruptly just above the base of the Pagoda Formation at Puxihe, north of Yichang in Hubei (Bergström *et al.*, 2009, fig. 6), and suggests a depositional gap in the latter succession. However, establishment of the local magnitude of a possible gap at the base of the Yenwashan and Pagoda formations requires further extensive regional studies that are far beyond the scope of the present investigation.

4 NOTES ON IMPORTANT CONODONT TAXA

The small conodont fauna obtained from the Highway 205 section includes well-known taxa that have been described adequately in the recent literature. Hence, we do not include detailed descriptions and present only some brief notes and lists of synonyms that mainly include previously published Chinese references.

Baltoniodus **Lindström, 1955**

Type species *Prioniodus navis* Lindström, 1971

Baltoniodus alobatus **(Bergström, 1971)**

(Pl. I, figs. 1, 2)

1971 *Prioniodus alobatus* Bergström, p. 145, pl. 2, figs. 4, 5.

1987 *Prioniodus alobatus* Bergström, An, p. 169, 170, pl. 25, figs. 7-9.

1987 *Prioniodus lingulatus* An, p. 170, 171, pl. 25, figs. 10-17.

1998 *Prioniodus alobatus* Bergström, Wang and Zhou, pl. 1, figs. 11-13.

2000 *Baltoniodus alobatus* (Bergström), Zhao *et al.*, p. 189, pl. 34, figs. 11-13; pl. 39, figs. 16-20, 23.

2011 *Baltoniodus alobatus* (Bergström), Zhen *et al.*, p. 214-216, Figs. 5L, Q, 8M-N.

Remarks This species of *Baltoniodus* is characterized by the Pa element which has a wide and low platform-like posterior process that is widest in the middle part and narrows toward the anterior and posterior ends. Other elements in its apparatus are closely similar to corresponding elements in *B. gerdae* and *B. variabilis*. The former species is distinguished from *B. alobatus* by the presence of a prominent, denticulated, postero-lateral process in the Pa element. This lateral process is missing in *B. variabilis*, which may be separated from *B. alobatus* by the presence of a distinctive triangular expansion of the inner side of the posterior process in the Pa element.

The fragmentary type specimens of the species *Prioniodus lingulatus* An, 1987 are closely similar to corresponding elements of *B. alobatus* and the Chinese species is considered a junior synonym of *B. alobatus*.

Occurrence South China and Xinjiang, Upper Ordovician, Miaopo, Datianba, Yenwashan, Kanling, and Tumuxiuke formations.

Dapsilodus **Cooper, 1976**

Type species *Distacodus obliquicostatus* Branson and Mehl, 1933

Dapsilodus viruensis **(Fåhræus, 1966)**

(Pl. I, fig. 3)

1966 *Acodus viruensis* Fåhræus, p. 12, pl. 2, figs. 2a, b; text-fig. 2A.

1993 *Dapsilodus mutatus* (Branson and Mehl), Ding (in Wang), p. 170, pl. 15, figs. 22-24, 26.

2004 *Dapsilodus viruensis* (Fåhræus), Löfgren, figs. 12aa-ab.

2009 *Dapsilodus viruensis* (Fåhræus), Zhen *et al.*, p. 142, fig. 4.

2011 *Dapsilodus viruensis* (Fåhræus), Zhen *et al.*, p. 252, figs. 9D-O..

Remarks Fåhræus (1966) based the description of his new species only on the acodiform (M element). Its base is short and laterally compressed. The reclined cusp is notably large with anterior and posterior keel ridges. The P and S elements have a longer base and have striae on the lateral faces in addition to a sharp costa.

Occurrence South China and Xinjiang, Upper Ordovician, Miaopo, Datianba, Yenwashan, Kanling, and Tumuxiuke formations.

Hamarodus **Viira, 1974**

Type species *Distomodus europaeus* Serpagli, 1967= *Hamarodus brevirameus* (Walliser, 1964).

Hamarodus brevirameus **(Walliser, 1964)**

1964 *Neoprioniodus brevirameus* Walliser, p. 42, pl. 4, fig. 5; pl. 29, figs. 5-10.

1967 *Distomodus europaeus* Serpagli, p. 36, pl. 14, figs. 1-6.

1974 *Hamarodus europaeus* (Serpagli), Viira, p. 88, pl. 13, figs. 22-25.

1984 *Hamarodus europaeus* (Serpagli), Chen and Zhang, p. 127, pl. 1, figs. 21-25.

1987 *Hamarodus europaeus* (Serpagli), An, p. 153, 154, pl. 16, figs. 8-10, 15, 21-24, 26.

1993 *Hamarodus europaeus* (Serpagli), Ding (in Wang), p. 180, pl. 13, figs. 14, 15.

1994 *Hamarodus brevirameus* (Walliser, 1964), Dzik, p. 111, pl. 24, figs. 14-19, text-fig. 31a (*cum syn.*).

2007 *Hamarodus europaeus* (Serpagli), Agematsu *et al.*, p. 27, fig. 12.

Remarks Dzik's (1994, p. 111) proposal to consider Walliser's (1964) *Neoprioniodus brevirameus* as an element in the apparatus of *H. europaeus* Serpagli, 1967 was supported by additional material from the Upper Ordovician type strata of the Carnic Alps. Hence, *H. europaeus* is treated herein as a junior synonym of *Hamarodus brevirameus* by following Dzik (1994) and others (e.g. Ferretti *et al.*, 2014).

Occurrence South China, Upper Ordovician Pagoda Formation.

Periodon Hadding, 1913

Type species *Periodon aculeatus* Hadding, 1913

Periodon aculeatus Hadding, 1913

(Pl. I, figs. 7-10)

1913 *Periodon aculeatus* Hadding, p. 33, pl. 1, fig. 14.

1984 *Periodon aculeatus* Hadding, Wang and Luo, p. 271, 272, pl. 6, figs. 10-16.

1987 *Periodon aculeatus* Hadding, An, p. 167, pl. 24, figs. 7-17.

1998 *Periodon aculeatus* Hadding, Wang and Zhou, pl. 4, figs. 2-4.

2000 *Periodon aculeatus* Hadding, Zhao *et al.*, p. 212, pl. 40, figs. 5, 6, 8-13.

2009 *Periodon aculeatus* Hadding, Zhen *et al.*, p. 148, 149, figs. 6A-R, 8N, 10L.

2011 *Periodon aculeatus* Hadding, Zhen *et al.*, p. 231, 232, figs. 16A-P.

Occurrence South China and Xinjiang, Upper Ordovician, Miaopo, Datianba, Yenwashan, Kanling, and Tumuxiuke formations.

Pygodus Lamont and Lindström, 1957

Type species *Pygodus anserinus* Lamont and Lindström, 1957

Pygodus anserinus Lamont and Lindström, 1957

(Pl. I, figs. 4-6)

1957 *Pygodus anserinus* Lamont and Lindström, p. 68, pl. 5, figs. 12, 13.

1984 *Pygodus anserinus* Lamont and Lindström, Wang and Luo, p. 297, pl. 11, figs. 10, 19; pl. 12, fig. 14.

1987 *Pygodus anserinus* Lamont and Lindström, An, p. 176, 177, pl. 26, figs. 9-12, 14.

2001 *Pygodus anserinus* Lamont and Lindström, Wang, p. 357, pl. 2, figs. 5, 6, 10, 13-15, 17, 18, 20-26.

2009 *Pygodus anserinus* Lamont and Lindström, Zhen *et al.*, p. 152-157, Figs. 8N, 9A-I, 10A-L.

2011 *Pygodus anserinus* Lamont and Lindström, Zhen *et al.*, p. 237-250, Figs. 24A-P.

Remarks Pa element has four denticle ridges on oral face of the triangular platform.

Occurrence South China and Xinjiang, Upper Ordovician, Miaopo, Datianba, Yenwashan, Kanling, and Tumuxiuke formations.

Scabbardella Orchard, 1980

Type species *Drepanodus altipes* Henningsmoen, 1948

Scabbardella altipes (Henningsmoen, 1948)

(Pl. I, fig. 11)

1948 *Drepanodus altipes* Henningsmoen, p. 420, pl. 25, fig. 14.

1984 *Drepanodus*? *altipes* Henningsmoen, Wang and Luo, p. 257, pl. 2, figs. 3, 4, 15, 17.

1987 *Scabbardella similaris* (Rhodes), An, p. 179, 180, pl. 5, figs. 14-17, 19-24, 26, 27.

2000 *Scabbardella altipes* (Henningsmoen), Zhao *et al.*, p. 221, 222, pl. 23, figs. 10-12.

2007 *Scabbardella altipes* (Henningsmoen), Agematsu *et al.*, p. 29, 30, Figs. 11.4, 11.8, 11.10, 11.13.

2011 *Scabbardella altipes* (Henningsmoen), Zhen *et al.*, p. 252, Figs. 9D-O.

Remarks The P and S elements have long and compressed bases with keeled anterior and posterior edges. The lateral faces of the cusp are smooth or have one costa. The basal cavity is very deep, extending almost to the tip of the cusp.

Occurrence South China and Xinjiang, Upper Ordovician, Miaopo, Datianba, Yenwashan, Kanling, and Tumuxiuke formations.

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Explanation of Plate

All of the conodonts are from the Upper Ordovician Yenwashan Formation of Changshan，W. Zhejiang. Most of them are deposited in Nanjing Institute of Geology and Palaeontology，Chinese Academy of Sciences except a few specimens，which are stored at the Australian Museum. The magnifications are shown by the scale bars，which represent 100 μm.

Plate Ⅰ

1，2. *Baltoniodus alobatus*(Bergström，1971)

Oral views of Pa elements，Highway 205 road-cut，Coll. n. 12B16-1，Cat. nos. 161378，161379.

3. *Dapsilodus viruensis*(Fåhræus，1966)

Lateral view of acodiform element，Highway 205 road-cut，Coll. n. 12B16-1，Cat. no. 161380.

4—6. *Pygodus anserinus* Lamont and Lindström，1957

4. Lateral view of Pb element，copied from Zhen *et al*. (2009)，Huangnitang，Coll. n. CHY9，Cat. n. AMF134475，stored in Australian Museum；

5. Oral view of Pa element，copied from Zhen *et al*. (2009)，Coll. n. CHY9，Huangnitang，Cat. n. AMF134473，stored in Australian Museum；

6. Lateral view of Sa element copied from Zhen *et al*. (2009)，Coll. n. CHY9，Huangnitang，Cat. n. AMF134481，stored in Australian Museum.

7—10. *Periodon aculeatus* Hadding，1913

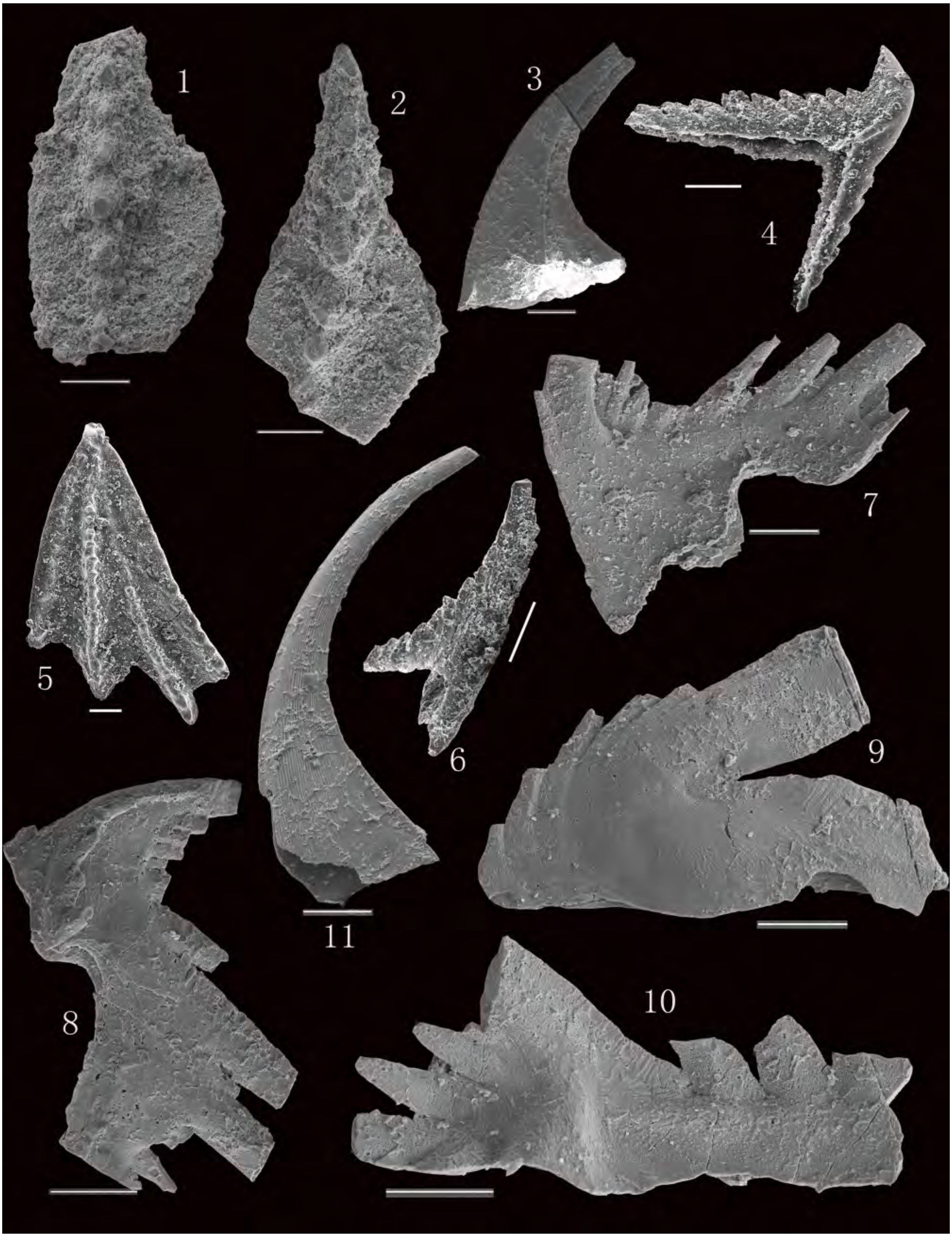
7，8. Lateral views of S elements，Highway 205 road-cut，Coll. n. 12B16-1，Cat. nos. 161382，161383；

9. Lateral view of M element，Highway 205 road-cut，Coll. n. 12B16-1，Cat. no. 161384；

10. Lateral view of Pa element，Highway 205 road-cut，Coll. n. 12B16-1，Cat. no. 161385.

11. *Scabbardella altipes*(Henningsmoen，1948)

Lateral view，Highway 205 road-cut，Coll. n. 12B16-1，Cat. no. 161381.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