

939. A RECORD OF *PSEUDOPHYLLITES INDRA* (LYTOCERATINA, TETRAGONITIDAE) FROM THE UPPER CRETACEOUS OF HOKKAIDO AND SAKHALIN*

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Abstract. A tetragonitid ammonite, *Pseudophyllites indra* (Forbes) is described based on material from the Orannai Formation in the Soya area of northern Hokkaido and from the Krasnoyarka Formation in the Naiba area of south Sakhalin. *P. indra*, occurring in the *Schlueterella kawadai* Subzone of the *Metaplacenticeras subtilistriatum* Zone, which corresponds to the upper Campanian, has a nearly circular initial chamber in median section, a subellipsoid caecum with weakly constricted base and a ventrally located siphuncle. In various areas of the North Pacific region, the present species first appeared almost synchronously in the upper Campanian. From Santonian to early Campanian times, *P. indra* was distributed in the Indian region. This evidence shows that this species extended its geographical distribution from the Indian region to the North Pacific region in late Campanian time.

Key words. *Pseudophyllites*, upper Campanian, Soya, Naiba, ontogeny, paleobiogeography.

Introduction

The genus *Pseudophyllites* Kossmat, 1895 of the family Tetragonitidae is considered to be one of the offshoots from *Tetragonites* (Kennedy and Klinger, 1977). Species of *Pseudophyllites* are known to occur from the Santonian to Maastrichtian worldwide (Collignon, 1956). In Hokkaido several fragmentary specimens of *Pseudophyllites* were described as *P. indra* (Forbes, 1846) and *P. cf. teres* (Van Hoepen, 1920) by Matsumoto and Miyauchi (1984) from the upper Campanian of the Soya area, but further work based on more sufficient material is required to discuss the taxonomy, biostratigraphy and paleobiogeography of this genus.

Recently, I have discovered many well preserved specimens referable to *P. indra*

from the upper Campanian of the Soya area of Hokkaido and from the Naiba (= Naibuti) area of Sakhalin, as described below.

Paleontological description

Order Ammonoidea Zittel, 1884
Suborder Lytoceratina Hyatt, 1889
Superfamily Tetragonitaceae Hyatt, 1900
Family Tetragonitidae Hyatt, 1900
Genus *Pseudophyllites* Kossmat, 1895

Type species.—*Ammonites indra* Forbes, 1846 by original designation.

Diagnosis.—Very involute tetragonitids with a high whorl expansion rate and a small umbilicus. Early whorls rounded in cross section, later whorls becoming elliptical, with a convex venter, somewhat flattened flanks and a steeply sloping umbilical wall. Shell surface ornamented by fine striae, inflected

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foward and passing radially across venter. Constriction absent. Suture very finely divided with asymmetrically trifid or asymmetrically bifid major saddles having subphyllid terminations.

Pseudophyllites indra (Forbes, 1846)

Figures 1-4

Ammonites indra Forbes, 1846, p. 105, pl. 11, fig. 7; Stoliczka, 1865, p. 112, pl. 58, fig. 2; Whiteaves, 1879, p. 105, pl. 13, fig. 2.

Pseudophyllites indra (Forbes); Kossmat, 1895, p. 137, pl. 16, figs. 6-9, pl. 17, figs. 6-7, pl. 18, fig. 3; Whiteaves, 1903, p. 331; Woods, 1906, p. 334, pl. 41, fig. 6; Spath, 1922, p. 119; Collignon, 1938, p. 24, text-fig. E; Usher, 1952, p. 57, pl. 3, figs. 2-13; pl. 31, figs. 15-17; Collignon, 1956, p. 90; Matsumoto, 1959, p. 134, Jones, 1963, p. 25, pl. 7, figs. 6-7, pl. 8, pl. 29, figs. 7-12, text-fig. 10; Collignon, 1969, p. 12, pl. 516, fig. 2032; Kennedy and Klinger, 1977, p. 182, text-figs. 19-22; Matsumoto and Miyauchi, 1984, p. 54, pl. 21, fig. 5; Henderson and McNamara 1985, p. 50, pl. 2, figs. 7, 8, pl. 3, figs. 4, 5, text-fig. 5a, d.

Tetragonites glabrus (Jimbo); Shigeta, 1989, p. 334, text-fig. 12(3).

Type.—The holotype is the specimen originally figured by Forbes (1846, pl. 11, fig. 7), BMNH C51068, from the Valudayur Group near Pondicherry, southern India.

Material.—In addition to the specimen (MNH. 231) described by Matsumoto and Miyauchi (1984, pl. 21, fig. 5) from the Soya Harbor, 14 specimens collected from the upper part of the Orannai Formation in the Soya area of northern Hokkaido and three specimens from the middle part of the Krasnoyarka Formation in the Naiba area of south Sakhalin are used in the following description: UMUT MM18991-18997 from fishery harbor of Soya (upper Campanian); UMUT MM18998 from fishery harbor of Kiyohama-I (upper Campanian); UMUT MM18999-19002 from new fishery harbor of Kiyohama-II (upper Campanian); UMUT MM19003 and MM19004 from old fishery harbor of Kiyohama-II (upper Campanian); UMUT MM19005 from locality NB3031 (=

N100 of Matsumoto's locality, upper Campanian); UMUT MM19006 and MM19007 from the middle course of the Krasnoyarka River (NB3023P) (upper Campanian). All the specimens from the Soya area and two specimens from the Naiba area were obtained from floated calcareous nodules. For details of their localities and ages see Matsumoto and Miyauchi (1984) and Matsumoto (1942).

All the specimens utilized herein are deposited at the University Museum, University of Tokyo (UMUT). The specimen (MNH. 231) described by Matsumoto and Miyauchi (1984) is now kept at UMUT (UMUT MM19008) by courtesy of Mr. T. Miyauchi.

Dimensions.—

	Shell diameter (D) (mm)	Breadth of umbilicus (U) (mm)	Whorl height (H) (mm)	Whorl breadth (B) (mm)	U/D	B/H
MNH. 231 (MM19008)	110.0	18.0	61.0	50.0	0.16	0.82
MM18991	185.0	30.0	100.0	75.0	0.16	0.75
MM18998	40.6	9.0	19.7	19.8	0.22	1.01
MM18999	33.0	7.5	14.7	15.7	0.23	1.07
MM18994	28.4	6.3	14.3	14.5	0.22	1.01
MM18995	23.8	5.7	11.7	12.0	0.23	1.03
MM19003	21.3	5.2	9.8	10.0	0.24	1.02
MM19001	17.2	4.4	8.1	8.5	0.25	1.05

Description.—

Early internal shell structure (Figure 1)

The initial chamber is nearly circular in median section. The caecum is subelliptical in lateral view with a weakly constricted base, and its adapical end connects with the initial chamber wall by a short, adorally concave prosiphon. The siphuncle occupies a central position near the prosepium and then immediately shifts toward the venter within the second chamber. Thereafter it keeps a ventral position. Initial chamber size, ammonitella size and its spiral length in the specimen UMUT MM18996 in median section are 712 μ m, 1,550 μ m, and 336° respectively.

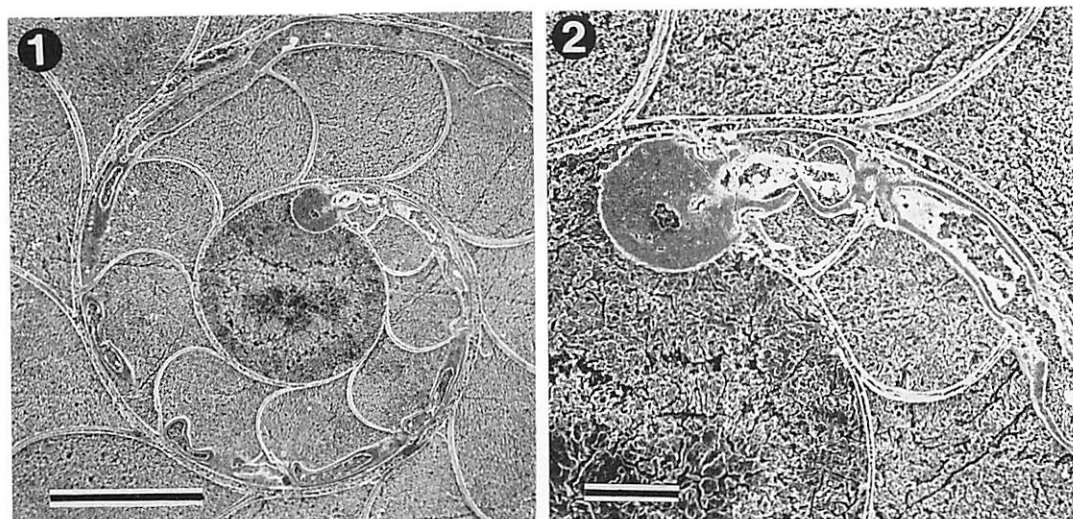


Figure 1. Scanning electron micrographs of the early internal shell structure of *Pseudophyllites indra* (Forbes) in median section. Scale bar in 1, 500 μm . Scale bar in 2, 100 μm . UMUT MM18996, the upper Campanian, fishery harbor of Soya.

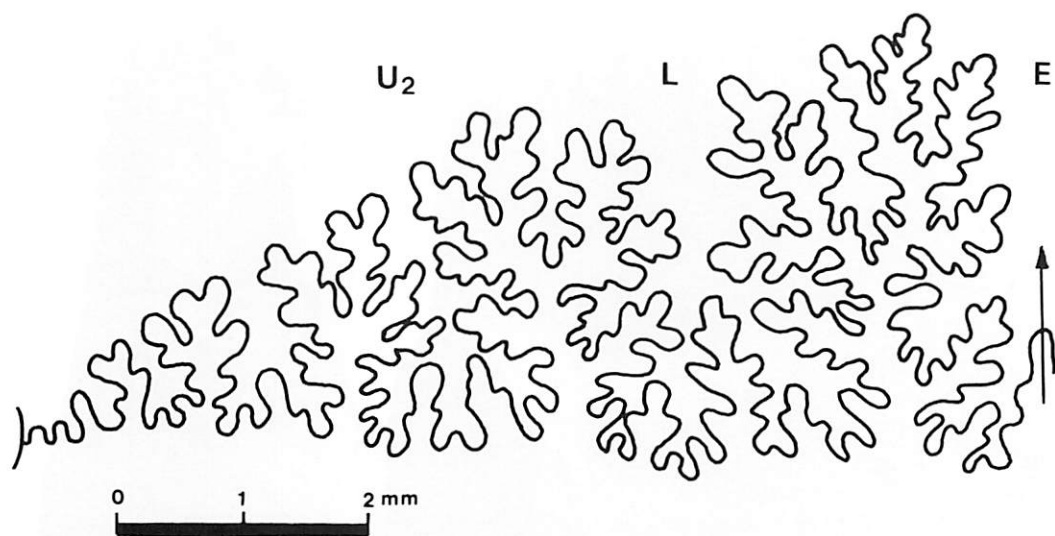
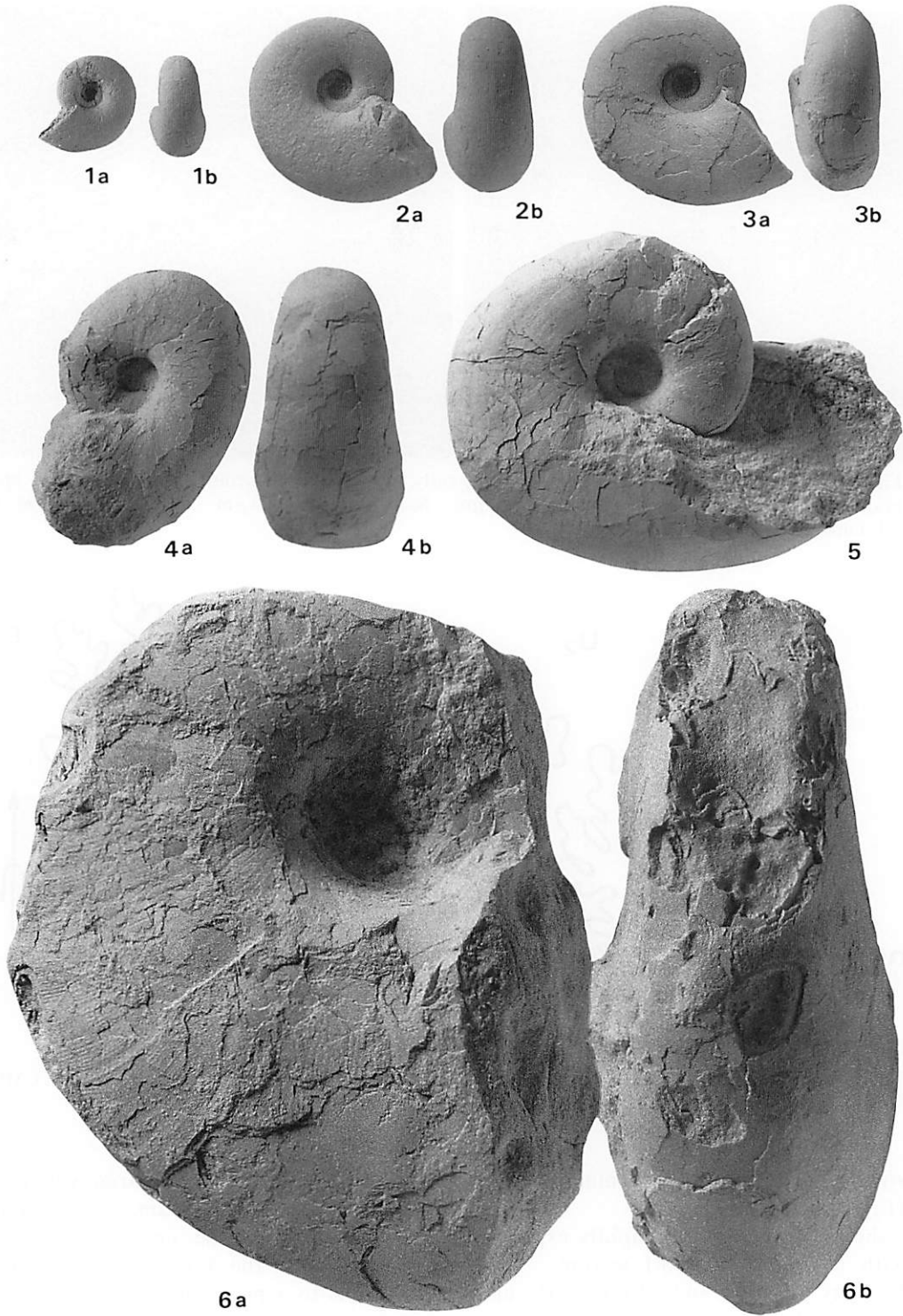


Figure 2. External suture at a whorl height of 6.2 mm of *Pseudophyllites indra* (Forbes). UMUT MM18994, the upper Campanian, fishery harbor of Soya.

Early to middle whorls (10–60 mm in diameter) (Figures 2 and 3)

The shell is very involute, rapidly expanding, with a depressed whorl section. The umbilicus is narrow and deep, with an abruptly rounded shoulder. The shell sur-

face is ornamented by fine striae which arise across the umbilical seam, sweep slightly backwards across the umbilical wall, flex backwards over the shoulder, and pass across the flanks in a prorsiradiate direction. The striae sweep backwards across the ventrolater-



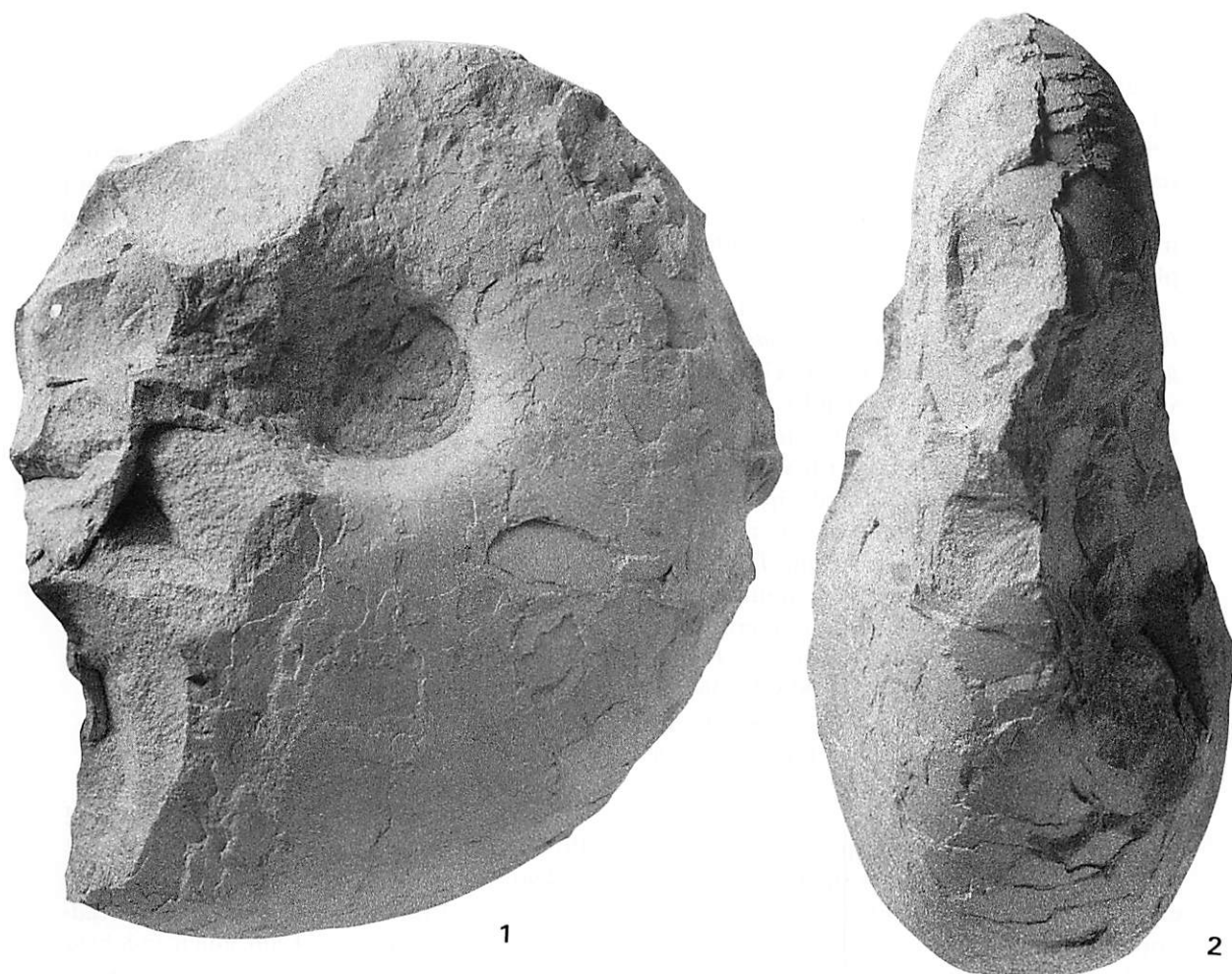


Figure 4. *Pseudophyllites indra* (Forbes), $\times 0.7$. UMUT MM18991, the upper Campanian, fishery harbor of Soya. 1: lateral view, 2: ventral view.

al shoulder and cross the venter with a broad, faint, concave ventral sinus.

The suture (Figure 2) is highly subdivided, with a large irregularly trifold first lateral saddle (E/L), a smaller bifid second lateral saddle (L/U₂), a deeply incised bifid lateral lobe (L), and a suspensive lobe with a large bifid

first auxiliary saddle.

Later whorls (over 60 mm in diameter) (Figure 4)

The largest specimen in the present material, 185 mm in diameter, lacks a majority (5/6) of the body chamber. The shell is very involute, with compressed whorls and a high

← **Figure 3.** *Pseudophyllites indra* (Forbes), $\times 1.0$. 1a-b. UMUT MM19001, the upper Campanian, new fishery harbor of Kiyohama-II. 2a-b. UMUT MM18994, the upper Campanian, fishery harbor of Soya. 3a-b. UMUT MM18995, the upper Campanian, fishery harbor of Soya. 4a-b. UMUT MM19007, the upper Campanian, the middle course of the Krasnoyarka River, Naiba area. 5. UMUT MM19005, the upper Campanian, NB3031 (N100), Naiba area. 6a-b. UMUT MM19008 (MNH. 231), the upper Campanian, fishery harbor of Soya.

whorl expansion rate. The umbilicus is small and deep, with a sloping wall and abruptly rounded shoulder. It is ornamented by fine and dense striae which show a gently backward curve on the ventrolateral part.

The suture is poorly visible, but consists of numerous deeply incised elements, with subphylloid terminals of folioles.

Comparison.—In the juvenile stage *P. indra* most closely resembles *Tetragonites glabrus*, a Turonian to lower Campanian species known from Hokkaido, Sakhalin, Alaska, California and South Africa in having a subellipsoid caecum with weakly constricted base, ventrally located siphuncle, a high whorl expansion rate and a small umbilicus, but is distinguished from *T. glabrus* in having a rounded umbilical shoulder and weakly adorally concave sinuous aperture on venter. The specimens illustrated as *T. glabrus* by Shigeta (1989, UMUT MM18636–16, 29, 35, 37, 47, 51, 58) from the upper Campanian of the Soya area are regarded as a juvenile specimen of *P. indra*.

Occurrence.—*P. indra* is a cosmopolitan species known from the upper Santonian to lower Maastrichtian in South Africa, southern India and western Australia, and from the upper Campanian to lower Maastrichtian in southern Alaska and Vancouver Island. In Hokkaido and Sakhalin, this species occurs in the *Schlueterella kawadai* Subzone of the *Metaplacenticerias subtilistriatum* Zone, which is equivalent to the upper Campanian.

Stratigraphical significance of the occurrence

P. indra occurs in the *Metaplacenticerias pacificum* Zone and the *Pachydiscus suciaensis* Zone in British Columbia (Usher, 1952), in the *M. pacificum* Zone in California (Matsumoto, 1960), in the *Pachydiscus kamishakensis* Zone in Alaska (Jones, 1963), and the *M. subtilistriatum* Zone in Hokkaido and Sakhalin (Matsumoto, 1984; this study).

According to the zonal correlation of megafossils in the Northern Pacific region, this species is restricted to an interval from the upper Campanian to the lowest Maastrichtian (Muller and Jeletzky, 1970; Ward, 1978; Matsumoto, 1984). The upper limit of the occurrence of this species in Hokkaido and Sakhalin has not yet been sufficiently elucidated because in many areas megafossils are rather rare in the uppermost Campanian to the lowest Maastrichtian. However, the first appearance of this species in Hokkaido and Sakhalin is nearly synchronous with that in the Pacific coast of North America.

From Santonian to early Campanian times, *P. indra* was distributed in the Indian region (South Africa, Madagascar, and southern India) (Kossmat, 1895; Kennedy and Klinger, 1977). This evidence shows that this species extended its geographical distribution from the Indian region to the North Pacific region in late Campanian time.

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Hokkaido 北海道, Kiyohama 清浜, Naibuti 内淵, Soya 宗谷.

北海道及びサハリンの上部白亜系産テトラゴニテス科アンモナイト *Pseudophyllites indra* について: 北海道・宗谷地域のオランナイ層及びサハリン・ナイバ地域のクラスノヤルカ層より産出した *Pseudophyllites indra* について, 初期殻体内部構造および殻形の個体発生を記載した。標本はカンパニアン階上部の *Metaplacenticeras subtilistriatum* 帯の *Schlueterella kawadai* 亜帯からのみ産出したが, 両地域での本種の産出時期は他の北太平洋地域での初産出時期とほぼ一致する。本種はサントニアン後期からカンパニアン前期には南アフリカや南インドに分布していたことから, カンパニアン後期に北太平洋地域へ分布域を拡大したものと考えられる。

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