

Further notes on *Parasolenoceras* (heteromorph ammonoid) from northern Hokkaido

(Studies of Cretaceous ammonites from Hokkaido-LIX)

Tatsuro MATSUMOTO* and Toshiya MIYAUCHI**

北海道北部産パラソレノセラス (異常型アンモナイト)
についての続報

松本達郎*・宮内敏哉**

標題の *Parasolenoceras* は COLLIGNON (1969) がマダガスカル島の白亜系カンパニアン階から産した *P. splendens* COLLIGNON を模式種として設立したが、その後の研究者はこれを無視又は軽視して正しく評価していない。私たちは 1984 年に北海道北部 (天塩山地と宗谷地域) のカンパニアン階から 2 種を記述した。しかし資料は断片的で不明確な点も残っていた。今回その後の資料 (宮内コレクション) により知見を補足することができた: (1) 成長初期のよい標本が得られ、本属では初期から晩期にわたって直線状に長い肢節が U 字型屈曲で連結して幾度か回っていることがわかった。これは初期に立体螺旋 (3₄) 状に巻いている *Solenoceras* とは異なる。(2) 本属の縫合線は ELUI の要素から成る。I は独立してよく発達する。I (3 分岐) 以外の要素は 2 分岐し鳩尾型である。概して *Neocrioceras* や *Pseudoxybeloceras* のに類似し、*Solenoceras* や *Schlueterella* (I が付属的) のとは異なる。(3) 本属の少なくともある種では、各肋の外側の肩にある突起は直立し、頂上に前後 2 本高さの異なる小鋸歯がある。この特異な形質は *P. tomitai* と新種の成長後期の突起について確認したが、本属の他の種でも同様か否かは、突起の頂上部が欠けていることが多く、まだ不明である。(4) 周期的の強い肋と強い突起の有無やこの強い突起で細肋が結ばれるか否かは、本属内で変異がある。(5) *P. tomitai* MATSUMOTO, 1984 と *P. periodicum* MATSUMOTO et MIYAUCHI, 1984 に加えて、*P. soyaense* sp. nov. を追加記述した。(6) この 3 種ともカンパニアン階上部の下部に該当する *Metaplacenticerias subtilistriatum* 帯に産し、既知の 2 種は同階下部の上部に該当する *Sphenoceras schmidti* 帯上部にも産する。

Problems and general results

The genus *Parasolenoceras* COLLIGNON, 1969 was defined in the original description of the type species, *P. splendens* COLLIGNON (1969, p. 44, pl. 530, figs. 2087, 2088), from the Lower Campanian (in tripartite scheme) of Madagascar. It has been however, inadequately understood or little evaluated by some subsequent authors. Recently examples of this genus have been described in a monograph of some Campanian ammonites from northern Hokkaido. They are *P. tomitai* MATSUMOTO (1984b, p. 32, pl. 8, figs. 1-2), from the Zone of *Metaplacenticerias subtilistriatum* (lower Upper Campanian in the bipartite scheme)

* 九州大学気付 c/o Department of Geology, Kyushu University 33, Fukuoka 812.

** 稚内市緑 6 丁目 Midori 6-chome, Wakkanai 097.

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of the Teshio Mountains, *P. periodicum* MATSUMOTO et MIYAUCHI (1984, p. 64, pl. 28, fig. 1), from the Subzone of *Schlueterella kawadai* (lower part of the Zone of *Metaplacenticeras subtilistriatum*), and *P. cf. P. periodicum* (*ditto*, p. 65, pl. 31, fig. 1), Fukiyose Member (upper part of the Zone of *Sphenoceras schmidti*) (upper Lower Campanian in the bipartite scheme), the last two in the western coastal area of Cape Soya.

As in many other cases of heteromorph ammonoids, the specimens on which species of *Parasolenoceras* have been established are more or less incomplete. Therefore, we should search for more material to know the specific and generic characters more distinctly. In this paper we show that the shell-form of *Parasolenoceras* is made up of long and nearly straight shafts connected by U-curves at several times throughout growth (i.e. from the early growth-stage onward). This shell-form is quite similar to that of *Diplomoceras* HYATT, 1900, whose shape in the early growth-stage has been recently made clear by some examples from northern Hokkaido (MATSUMOTO, 1984b, p. 31, pl. 8, fig. 3; MATSUMOTO and MIYAUCHI, 1984, p. 68, text-fig. 11; pl. 27, fig. 2).

In *Parasolenoceras* every rib has two tubercles, i.e. ventrolateral (that may be called "ventral" in some cases) tubercles on either side of the nearly flat, main part of the venter or "the siphonal zone." Ribs are nearly of equal intensity in some species and major ribs with larger tubercles may occur periodically in some other species. In the latter minor ribs may or may not be looped at the major tubercle, being variable between species or even within an individual. The situation is similar to the case of *Pseudoxybeloceras* WRIGHT et MATSUMOTO, 1954, in which every rib is quadrituberculate and major ribs with stronger tubercles may occur periodically with more or less distinctness and the looping of ribs at major tubercles may or may not occur (see MATSUMOTO in MATSUMOTO et al., 1986). In other words, in *Parasolenoceras* and also *Pseudoxybeloceras* the looping is not so firmly stabilized as in *Neocrioceras* SPATH, 1921 (see MATSUMOTO et al., 1986), *Kawashitaceras* MATSUMOTO, 1984, *Schlueterella* WIEDMANN, 1960 (emend, MATSUMOTO and MIYAUCHI, 1984) and *Lewyites* MATSUMOTO et MIYAUCHI, 1984, in all of which ribs are characteristically looped at major tubercles and the intervening ribs have no minor tubercle.

We are going to illustrate an interesting feature that certain species of *Parasolenoceras* have minutely dentate ventrolateral tubercles. This is a miniature of the typical character shown by *Kawashitaceras*. Its function is probably similar to that mentioned on that genus (MATSUMOTO, 1984a).

Another point of the diagnosis of *Parasolenoceras* is the distinctness of the antisiphonal lobe (I). In other words, I is independently well developed. This was mentioned clearly by COLLIGNON (1969, p. 44), who showed the sutures in the photograph of a specimen in lateral and ventral views but omitted that of *dorum*. In this paper we illustrate the sutures of two species from northern

Hokkaido. In the well developed I and other features, the sutural pattern of *Parasolenoceras* is similar to that of *Neocrioceras*, essentially similar to that of *Pseudoxybeloceras* and quite distinct from that of *Schlueterella* and *Solenoceras* CONRAD, 1860. This does not necessarily conform with their similarity or difference in the shell-form and ornamentation, showing diversity in evolution. Should the suture be evaluated as suggestive of phylogenetic relationships, *Schlueterella* and *Solenoceras* could be assigned to the Anisoceratidae, whereas *Neocrioceras*, *Pseudoxybeloceras* and *Parasolenoceras* are members of the Turrititidae.

In the palaeontological description below, we present more concretely the above generalized results of our study. The prefix MNH. of the numbered specimens indicates the Natural History Collection of Northern Hokkaido, now kept by T. MIYAUCHI, Wakkanai. The holotype is to be transferred to the Geological Collection of Kyushu University (GK.).

As to the geographic location, stratigraphy and correlation, readers may refer to MATSUMOTO and MIYAUCHI, 1984 and MATSUMOTO, 1984b, c in a recently published monograph.

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Palaeontological descriptions

Parasolenoceras soyaense sp. nov.

Pl. 1, figs. 1-4; text-figs. 1-2

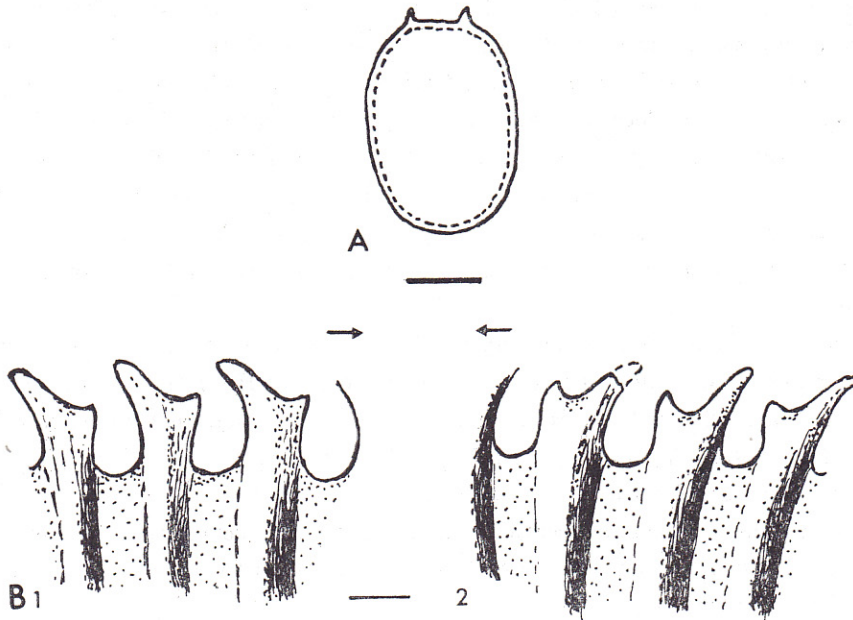
Holotype: GK. H 8120 [= MNH. 324], from loc W 7A, an excavated block (large calcareous nodule) from the bed of silty-fine grained sandstone containing *Schlueterella kawadai* MATSUMOTO et MIYAUCHI.

Paratype: MNH. 325, from loc. W 7A.

Diagnosis: Shell of moderate size, consisting of nearly straight, long and subparallel shafts connected by U-curved parts at several times; subelliptical in section and higher than broad.

Numerous, fairly crowded, annular ribs, each of which provided with ventral tubercles on either side of the siphonal zone. Periodic major ribs not particularly seen. The tubercles on the adult body-chamber clavate at their base, erected and provided with two minor denticles of unequal heights, with the posterior one higher than the anterior.

Sutures E, L, U, I, of which I stands independently and is well developed.



Text-fig. 1. *Parasolenoceras soyaense* sp. nov. Holotype.

- A. Whorl-section at the preserved end of the body-chamber which may be somewhat deformed. Scale bar=10 mm.
- B. Tubercles in lateral view (sketch under a binocular microscope) on the right side in the middle of the last shaft (B1) and on the left side at the last portion (B2). Arrow indicates to the anterior. Scale bar is about 1 mm.
- (T. MATSUMOTO *delin.*)

All the lobes and saddles bipartite, except tripartite I, forming dove-tail; florid in late growth-stages, being finely and deeply incised.

Observation: The holotype consists of two long, subparallel shafts connected by a U-curve. The body-chamber occupies its main part, 130 mm long in the earlier shaft and 120 mm in the later one, with a curved part in between. Only a fraction of the phragmocone is preserved in the earlier 40 mm of the early shaft and the rest main part is missing. The specimen is secondarily compressed, with height = 28 mm and breadth = 19 mm at the end of the body-chamber and height = 14.5 mm and breadth = 9.2 mm at the beginning of the preserved early shaft. The interspace between the two shafts is 30 mm at the end of the last shaft. These measurements are in the deformed state and not on the restored form.

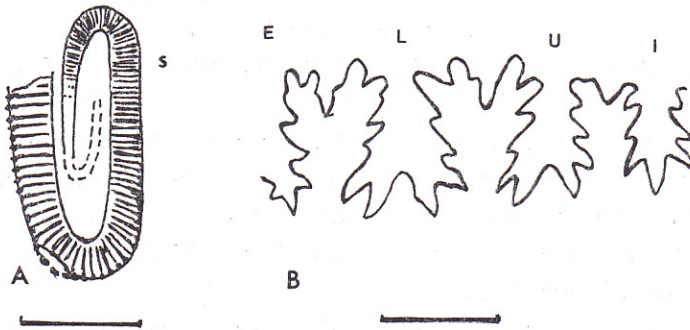
The shelly material remains in part but irregularly. This may give apparent irregularity in ribbing, but actually ribs are generally uniform in their fairly crowded disposition. Exceptionally a few finer ribs occur singly or in a diverged or intercalated state in a curved part. Also a finer rib occurs along with the normal one, forming an apparent and exceptional looping at the ventral tubercle

in the posterior part of the last shaft. Normally every rib has two ventrolateral tubercles. The siphonal zone between the two rows of tubercles is rather flat and narrow (see text-fig. 1A), but this may have been at least partly affected by the secondary compression.

The shelly material on the higher part of a tubercle is often cut off and un-preserved. When the entire tubercle is preserved, it is fairly high, standing upright on its clavate base and has two minor denticles on its summit; normally the posterior denticle is taller and sharper than the anterior one, resulting in a forward inclined summit of the tubercle (text-fig. 1B). This inclination is opposite to that of the dentate tubercles in *Kawashitaceras* (see MATSUMOTO, 1984a).

The suture is discernible through a semi-transparent inner shell layer in a part of the preserved phragmocone.

The paratype (MNH. 325) is much smaller than the holotype, but it is regarded as representing the early immature shell of the same species, because of the similarity in shell-form, numerous, dense and fine ribs and ventrolateral tubercles. As is shown in the plate (pl. 1, fig. 4) and text-fig. 2A, it consists of 4 subparallel shafts connected by U-curves. Regrettably the first shaft was destroyed away. The second shaft is at first nearly smooth and soon begins to be ornamented with numerous, fine and weak, annular ribs without tubercles. From the middle of the third shaft onward the ribs are provided with ventrolateral tubercles, which are at first tiny nodes. The ribs and tubercles are gradually strengthened with growth. Exceptionnally, at the beginning of the U-curve from the third to the fourth shaft, a nodeless finer rib is intercalated. Fig. 2B shows the suture at the beginning of the third shaft (where whorl-height is 2.5 mm). The diagnostic features, including the independence of the antisiphonal lobe [I], are already well shown.



Text-fig. 2. *Parasolenoceras soyaense* sp. nov. Paratype.

A. Diagrammatic sketch, showing early growth-stages. Scale bar=10 mm.

B. Suture at the early part of the third shaft (height=2.5 mm). Scale bar=1 mm.

(T. MATSUMOTO *delin.*)

Comparison and discussion: The holotype of this species is distinct from that of *P. splendens* COLLIGNON, 1969 (p. 44, pl. 530, fig. 2087) in its somewhat coarser ribs, narrower siphonal zone, where ribs run between the two tubercles without weakening and especially the presence of denticles on the summit of the tubercles.

The paratype is probably the first well preserved record of immature shell of this genus. A poorly preserved immature shell and magnificent shells of late growth-stages were described in *P. nanaimoense* (WARD et MALLORY) (1977, p. 615, pl. 2, figs. 1-3; pl. 3, figs. 1-4). This is characterized by much elongated shafts and has numerous, dense ribs like those of *P. soyaense*, but it has periodic major ventrolateral tubercles where ribs are looped. Such periodic major tubercles do not occur in *P. soyaense*. That species was originally assigned to *Pseudoxybeloceras* (*Cyphoceras*), but we refer it to *Parasolenoceras* (see MATSUMOTO and MIYAUCHI, 1984, p. 66). Anyhow, WARD and MALLORY presumed that *Solenoceras* was derived from their *Cyphoceras*.

LEWY (1967) has shown a gyroconic spiral form of a young shell in an example of *Solenoceras* from Israel. This is different from the young shell of *Parasolenoceras* which we have shown in this paper. Therefore, we doubt that *Solenoceras* may not be directly related with *Parasolenoceras* phylogenetically. We have seen no paper in which a suture of *Solenoceras* has been illustrated clearly. STEPHENSON (1951, p. 400) mentioned that the antisiphonal lobe is small in *S. texanum* (SHUMARD). This suggests also that *Parasolenoceras* is not intimately related to *Solenoceras* phylogenetically.

Occurrence: Rarely found in the greenish, silty fine-grained sandstone belonging to the Subzone of *Schlueterella kawadai*, lower part of the Zone of *Metaplacenticerias subtilistriatum* (i.e. lower part of Upper Campanian) in the Soya area.

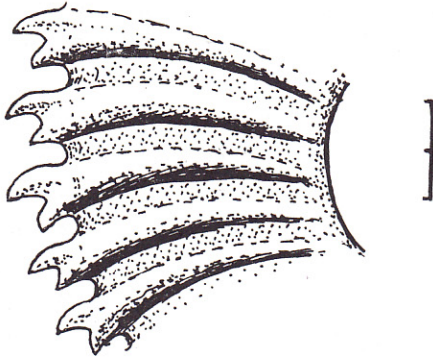
Parasolenoceras tomitai MATSUMOTO

Pl. 1, fig. 5; text-figs. 3, 4

1984. *Parasolenoceras tomitai* MATSUMOTO, *Palaeont. Soc. Japan, Spec. Pap.* no. 27, p. 32, pl. 8, figs. 1-2.

Material: In addition to the holotype from the Zone of *Metaplacenticerias subtilistriatum* in the Teshio Mountains, one of us (T. MIYAUCHI) obtained three fragmentary specimens, MNH. 328 from W 7C (Kiyohama-I), MNH. 329 from W 7A (Soya harbour) and MNH. 395 from W 7E (Kiyohama-II), all on the west coast of Cape Soya.

Descriptive remarks: The entire shell-form of this species is yet incompletely known. Compared with *P. splendens* and *P. soyaense* (established above), this species has a more open U-curve and the straight shafts are not parallel and seem to show V-shape at least near the U-curved part. This is shown in

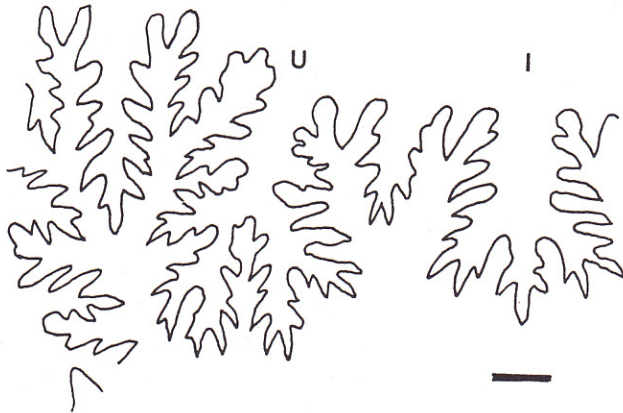


Text-fig. 3. *Parasolenoceras tomitai* MATSUMOTO.

MNH. 395. U-curved piece in lateral view, showing denticles on each tubercle.

Scale bar=2 mm.

(T. MATSUMOTO *delin.*)



Text-fig. 4. *Parasolenoceras tomitai* MATSUMOTO. Holotype.

Suture at the middle of the curved part, when whorl-height=10.5 mm and breadth=7.0 mm.

L and E are omitted, for they are concealed by the shelly substance. Scale bar =1 mm.

(T. MATSUMOTO *delin.*)

MNH. 328 which is somewhat larger than the holotype and has the body-chamber. Its whorl is higher than broad as in the holotype.

The ribs are somewhat, but not much, coarser than those of *P. soyaense* and they are prorsiradiate on the straight shaft and subradial on the U-curved part. The siphonal zone between the rows of ventrolateral tubercles are rather narrow and flat but crossed vertically by the ribs.

The ventrolateral tubercles are somewhat clavate at their base. When the specimen is isolated as in the holotype, the shelly material on the summit of the tubercles are more or less broken. In both of the two fragmentary specimens of dissimilar sizes, each tubercle stands upright and its summit has two

denticles, of which posterior one is taller than the anterior. This can be seen when a specimen rests on (but is not covered with) the rock matrix (see pl. 1, fig. 5; text-fig. 3).

The sutures in the late growth-stage are well exposed in the holotype but were not illustrated in the original paper. One of them is shown in text-fig. 4 of this paper, although the outer part is omitted because of the covering by shelly material. The antisiphonal lobe [I] is well developed and independent.

Occurrence: MNH. 328 was obtained from the Fukiyose Member (upper part of the Zone of *Sphenoceras schmidti*) of Kiyohama-I; MNH. 329 and MNH. 395 from the greenish silty sandstone of the Subzone of *Schlueterella kawadai* at W 7A (Soya) and W 7E (Kiyohama-II) respectively. Thus the vertical range of this species has extended somewhat downward than the original record.

Parasolenoceras periodicum MATSUMOTO et MIYAUCHI

1984. *Parasolenoceras periodicum* MATSUMOTO et MIYAUCHI, *Palaeont. Soc. Japan, Spec. Pap.*, no. 27, p. 64, pl. 28, fig. 1; pl. 31, figs. 1-2.

Material: MNH. 327, from loc. W 7A, T. MIYAUCHI Coll.

Descriptive remarks: The holotype and paratypes of this species are fragmentary pieces of dissimilar growth-stages. The above specimen is a fragmentary piece of a straight shaft, about 60 mm in length, but is of intermediate growth-stage, with 24.6 mm in height (H) and 16.2 mm in breadth (B). Although B/H (0.66) is somewhat smaller than that of the holotype (0.75), this may be due to the secondary compression. Its whorl-section is subrectangular with a flat and broad venter between the rows of ventrolateral tubercles. Major tubercles occur periodically where ribs are loped. The rib density is similar to that of the types.

The existence or absence of minor denticles on the summit of tubercles has not yet been determined for the unfavourable preservation of the available specimens.

Occurrence: This additional specimen was obtained at W 7A and probably came from the Subzone of *Schlueterella kawadai*.

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Kiyohama (清浜)

Soya (宗谷)

Teshio (天塩)

Explanation of plate 1

Figs. 1-3. *Parasolenoceras soyaense* sp. nov.

Holotype, GK. H 8120 [=MNH. 324], from loc. W 7A, excavated from the bed with *Schlueteria kawadai* for the reconstruction of Soya harbour. Lateral view (1) and a view from the venter of the earlier shaft (2), $\times 1$; part of the last shaft in lateral view (3), $\times 1.25$.

Fig. 4. *Parasolenoceras soyaense* sp. nov.

Paratype, MNH. 325, from loc. W 7A (same as above). Lateral view of an immature shell, $\times 2$.

Fig. 5. *Parasolenoceras tomitai* MATSUMOTO.

MNH. 395, from loc. W 7E, excavated from the bed with *Schlueteria kawadai* for the reconstruction of fishery harbour Kiyohama-II. Lateral view of a U-curved piece, showing denticles on each tubercle, $\times 1.5$.

Photos by courtesy of Dr. M. NODA, without whitening.

