Original Article

Additional specimens of *Pravitoceras sigmoidale* Yabe from the upper Campanian (Upper Cretaceous) of Hokkaido, Japan

YASUNARI SHIGETA¹ and MASATAKA IZUKURA²

¹Department of Geology and Paleontology, National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba, Ibaraki, 305-0005, Japan (e-mail: shigeta@kahaku.go.jp)
²N28 E21-1-3 Higashi-ku, Sapporo, Hokkaido 065-0028, Japan (e-mail: masataka.izukura@apricot.ocn.ne.jp)

Abstract. *Pravitoceras sigmoidale* Yabe, a heteromorph ammonoid of late Campanian (Late Cretaceous) age, occurs abundantly in the Izumi Group of Southwest Japan, but until now only one specimen had been reported from the Yezo Group in the Hidaka area, Hokkaido, northern Japan. We herein report two newly discovered specimens referable to this species that were collected from float concretions in a small tributary of the Pankeushappu River in the Hidaka area. One specimen consists of a nearly complete phragmocone and the rear part of the body chamber, while the other consists of part of a phragmocone outer whorl and two-thirds of the S-shaped body chamber. The shells are 1.25 times larger than the original Hidaka specimen, but they fit well within the size variation for specimens documented from Southwest Japan.

Key words: ammonoid, Cretaceous, Hidaka, Hokkaido, late Campanian, *Pravitoceras sigmoidale* (Recieved 31 October 2017)

Introduction

*Pravitoceras sigmoidale* Yabe, 1902, a late Campanian nostoceratid ammonite, exhibits a unique shell morphology consisting of a nearly planispiral phragmocone and subsequent S-shaped body chamber that forms a retroversal hook. Because of the taxon’s abundance in the Izumi Group on Awaji Island and in the Naruto area, it had long been regarded as an endemic species restricted to Southwest Japan. But then Matsunaga et al. (2008)’s discovery of a specimen assignable to *P. sigmoidale* from the Yezo Group in the Hidaka area, Hokkaido, northern Japan demonstrated that this species was distributed in a relatively wide area of the northwestern Pacific realm during the late Campanian. As *P. sigmoidale* is a short-ranging species, its discovery played an important part in the precise biostratigraphic correlation between the Izumi and Yezo groups.

In 2005 and 2011, M. Izukura collected two specimens referable to *Pravitoceras sigmoidale* from float concretions in a small tributary of the Pankeushappu River in the Hidaka area, about 4.5 km northwest of outcrop locality (Sr60) on the right bank of the Saru River where Matsunaga et al. (2008) found the single *P. sigmoidale* specimen (MCM.A1040) (Figure 1). Because *P. sigmoidale* is rare in Hokkaido, we herein document these newly discovered specimens and discuss their biostratigraphic implications for the upper Campanian of Hokkaido.

Notes on stratigraphy

Even through the Upper Cretaceous strata in the Pankeushappu River area are complexly folded and faulted, Takahashi and Suzuki (1986) divided the rocks based on lithostratigraphy into the underlying Upper Yezo Group and overlying Hakobuchi Group. Their lithology correlates well with that in the Urakawa area, situated 80 km southeast of Hidaka, where the stratigraphy has been well studied by numerous workers (Matsumoto, 1942; Kanie, 1966; Sakai and Kanie, 1986; Kanie and Sakai, 2002; Shigeta et al., 2016). For the purpose of this paper, we prefer to use the Urakawa Formation rather than the Upper Yezo Group and the Chinomigawa Formation instead of the Hakobuchi Group.

The Urakawa Formation consists primarily of
Figure 1. Index map showing distribution of the Yezo Group (black areas) in Hokkaido (A), collection localities of *Pravitoceras sigmoidale* Yabe, 1902 specimens in the Hidaka area (B) and geological map along a small tributary of the Pankeushappu River in the Hidaka area (C). HD, Hidaka; UK, Urakawa.
Additional specimens of *Parvitoceras* from Hokkaido

**Figure 2.** Late Campanian ammonoids from float concretions found in a small tributary of the Pankeushappu River of the Hidaka area, Hokkaido (white circles in Figure 1C). A-D, *Patagiosites alaskensis* Jones, 1963; A, B, HMG-1825; C, D, HMG-1826.
mudstone while the overlying Chinomigawa Formation is composed mainly of sandy mudstone with sandstone. The early middle Campanian index inoceramid *Sphenoceramus schmidti* (Michael, 1899) is abundant in the Chinomigawa Formation in the upper reaches of the Pankeushappu River (Takahashi and Suzuki, 1986).

The two specimens of *Pravitoceras sigmoidale* reported herein were collected from float concretions found in a small tributary of the Pankeushappu River, where the Chinomigawa Formation is widely distributed (Figure 1). Although float concretions with late Campanian ammonoids (Figures 2–4) are numerous, *in-situ* concretions containing age-diagnostic ammonoids or inoceramids are extremely rare. We collected only one *in-situ* concretion from the area, and it contained a late Campanian ammonoid *Patagiosites alaskensis* Jones, 1963 and an inoceramid bivalve *Inoceramus shikotanensis* Nagao and Matsumoto, 1940 (Figure 4).
Additional specimens of *Parvitoceras* from Hokkaido

**Figure 4.** Late Campanian ammonoids and inoceramid bivalves from an in-situ concretion found in bank along a small tributary of the Pankeushappu River in the Hidaka area, Hokkaido (solid black circle in Figure 1C). A–H, *Patagiosites alaskensis* Jones, 1963; A–D, HMG-1818; E–H, HMG-1819; I, J, *Inoceramus shikotanensis* Nagao and Matsumoto, 1940; I, HMG-1820; J, HMG-1821.

**Paleontological description**

Systematic descriptions follow the classification established by Wright et al. (1996). Morphological terms are those in Arkell (1957).

*Institution abbreviations.*—HMG = Hobetsu Museum, Mukawa; MCM = Mikasa City Museum; UUMT = University Museum, University of Tokyo.

Suborder Ancyloceratina Wiedmann, 1966
Superfamily Turrilitoidea Gill, 1871
Family Nostoceratidae Hyatt, 1894
Genus *Pravitoceras* Yabe, 1902

**Type species.**—*Pravitoceras sigmoidale* Yabe, 1902.

*Pravitoceras sigmoidale* Yabe, 1902

Figures 5, 6

*Pravitoceras sigmoidale* Yabe, 1902, p. 3, pl. 1, figs. 2–4; Yabe, 1915, p. 19, pl. 2, figs. 1–4, pl. 3, fig. 1; Matsumoto et al., 1981, p. 169, pl. 22, fig. 1, pl. 23, figs. 1, 2, pl. 24, figs. 1–3, pl. 25, figs. 1, 2, pl. 26, fig. 1, text-figs. 1, 3; Morozumi, 1985, p. 42, pl. 18, figs. 1, 2; Matsunaga et al., 2008, p. 313, figs. 2, 4, 5; Misaki et al., 2014, figs. 2, 6, 9, 10; Yoshino and Matsuoka, 2016, figs. 5A–H, 7A–C, 8.

*Lectotype.*—UMUT MM7479, figured by Yabe (1902, p. 3, pl. 1, fig. 3), from the Izumi Group near Minato along the western coast of Awaji Island, here designated as a lectotype. Specimen is an internal mold of a planispiral phragmocone.

*Material.*—HMG-1816 (42°54′36.66″N, 142°25′20.44″E) and HMG-1817 (42°54′35.29″N, 142°24′57.12″E) were extracted from float concretions found in a small tributary of the Pankeushappu River in the Hidaka area, Hokkaido (Figure 1).

*Description.*—HMG-1816 consists of a nearly complete phragmocone and rear part of the body chamber. The longer diameter (vertical length in Figure 5A) is about 175 mm. Early whorls are partly preserved and show tight, helical and dextral coiling with a nearly circular whorl section (Figure 6A). Succeeding phragmocone is nearly planispiral and very evolute with circular whorl section. Whorl is slightly in contact with previous whorl, but there is no overlap. Body chamber initially follows the coiling of the phragmocone for a half whorl, then separates tangentially from the coiling part. Shell surface is ornamented with numerous rectiradiate ribs with ventrolateral tubercles which appear on every third to fifth rib.

HMG-1816 consists of a part of the outer whorl of a phragmocone and two-thirds of the S-shaped...
Figure 5. Pravitoceras sigmoidale Yabe, 1902 from float concretions found in a small tributary of the Pankeushappu River in the Hidaka area, Hokkaido (white stars in Figure 1C). A, B, HMG-1817; A, lateral view; B, back view; C, D, HMG-1816; C, lateral view; D, frontal view. Arrow indicates position of last septum.
Additional specimens of *Parvitoceras* from Hokkaido

*Figure 6. Pravitoceras sigmoidale* Yabe, 1902 from float concretions found in a small tributary of the Pankeushappu River in the Hidaka area, Hokkaido. (white stars in Figure 1C). **A**, early whorls of HMG-1817; **B–D**, HMG-1816; **B**, upper view; **C**, lateral view; **D**, back view.
body chamber. Coiling is dextral, but twisted and apparently sinistral. Longer diameter (vertical length in Figure 5C) is about 185 mm. Body chamber lacks the rear part, but it twists in a reverse direction to form a retroversal hook with a U-shape. Rectiradiate ribs become rursiradiate on retroversal hook. Two rows of ventrolateral tubercles shift in accordance with twisting of the shell. Apertural margin thickens.

Remarks.—Shell size of the planispiral part of HMG-1817 and retroversal hook of HMG-1816 are 1.25 times larger than MCM-A1040 from the Saru River (Matsunaga et al., 2008), but they fit well within the size variation of Pravitoceras sigmoidale documented by Matsumoto et al. (1981) from Southwest Japan. Misaki et al. (2014) reported that specimens of Pravitoceras sigmoidale from Awaji Island are frequently encrusted by sessile anomid bivalves, which are found on both sides and ventral peripheries of the ammonoid shells and then become predominant on the body chamber. No such bivalve encrustation is present on the shells of the Hidaka specimens.

Occurrence.—Pravitoceras sigmoidale occurs in the upper Campanian on Awaji Island, the Naruto area in Shikoku, and the Hidaka area in Hokkaido.

Discussion

Various horizons of the Izumi Group of Southwest Japan are well known for their rich late Campanian ammonoid faunas. Indeed, the following four ammonoid zones are recognized, in ascending order: Didymoceras sp., D. awajiense, Pravitoceras sigmoidale and Pachydiscus awajiensis (Morozumi, 1985). Although the discovery of P. sigmoidale in Hokkaido has resulted in a much more precise biostratigraphic correlation between the Izumi and Yezo groups (Matsunaga et al., 2008), other zonal-index ammonoids, i.e., D. awajiensis (Yabe, 1901) and P. awajiensis Morozumi, 1985, have not yet been found in the Yezo Group.

The Yezo Group exhibits a lateral change of litho- and biofacies, which infers an eastward-deepening setting for the “Yezo Basin” (Matsumoto and Okada, 1971; Tanaka, 1977). Because regressive deltaic facies become predominant in the uppermost part of the Yezo Group, a complete succession of marine fossil assemblages spanning the Campanian–Maastrichtian is not recorded in the western part of the Yezo Basin (Matsumoto, 1954; Maeda, 1986). In contrast, fossiliferous mudstone and sandy mudstone facies are dominant in the uppermost part of the Cretaceous in the eastern part of the Yezo Basin, and faunal successions are observable toward the top of the sequence (Shigeta et al., 1999; Maeda et al., 2005; Shigeta et al., 2016). Therefore, it is possible that the late Campanian zonal-index ammonoids, Didymoceras awajiense and Pachydiscus awajiensis will eventually be found in the eastern part of the Yezo Basin.

Recently, Shigeta et al. (2016) discovered a continuous succession yielding middle Campanian Metaplacenticeras subtilistriatum (Jimbo, 1894) and early late Campanian Baculites subanceps Haughton, 1925 together with Didymoceras hidakense Shigeta (in Shigeta et al., 2016) in the Chinomigawa Formation in the Urakawa area of Hokkaido. Because D. hidakense closely resembles Didymoceras sp. of the Izumi Group, the zone containing D. hidakense is probably a correlative of the Didymoceras sp. Zone (Shigeta et al., 2016). Since upper Campanian strata overlying the D. hidakense-containing beds are not known to occur in the area near Urakawa where Shigeta et al. (2016) worked because of a synclinal structure, it would be highly unlikely to find a complete succession of late Campanian fossil assemblages in the area.

The discovery of additional specimens of Pravitoceras sigmoidale strongly suggests that upper Campanian strata crop out along the Pankeushappu River in the Hidaka area. Although a detailed stratigraphic study of the Yezo Group has not been conducted in this immediate area, it is anticipated that further geological and paleontological work may therefore provide an important key for the establishment a precise biostratigraphic framework for the upper Campanian of Hokkaido.

Acknowledgments

We are very grateful to Tomohiro Nishimura (Hobetsu Museum, Mukawa) for his co-operation in the field. We thank Jim Jenks (West Jordan, Utah) for his helpful suggestions and improvement of the English text.
Additional specimens of *Parvitoceras* from Hokkaido

References


(要 旨)

カンパニアン期後期（白亜紀後期）の異常巻きアンモナイト Pravitoceras sigmoidale Yabe は，西南日本に分布する和泉層群から多産し，北海道・日高地域に分布する蝦夷層群からも1標本の産出が報告されている。本論文では、新たに日高地域のパンケウシャップ川支流から転石として採集された2標本を報告する。1つ目の標本は気房部と住房の後方部よりなり，2つ目の標本は気房部の一部と後方部を欠くがS字状の住房部の2／3部分よりなる。これらの殻サイズは，日高地域から見つかった第一標本よりも1．25倍大きいが，西南日本で報告されている本種の標本の変異幅の中に入る。