

Late Devonian longiconic nautiloids from the Tobigamori Formation, Iwate Prefecture, Northeast Japan

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Abstract: A geisonoceratid orthocerid, *Geisonocerina?* sp., and two pseudorthoceratid pseudorthocerids, *Spyroceras?* sp. and *Dolorthoceras* sp., are described from the Famennian (latest Devonian) shale of the Tobigamori Formation from an abandoned quarry (“Nendoyama”) in the Higashiyama area, Iwate Prefecture, Northeast Japan. They represent the first record of Late Devonian longiconic nautiloids in East Asia.

Introduction

Our knowledge concerning Devonian longiconic nautiloids in East Asia is very limited. Furthermore, previously described occurrences are exclusively from the Lower and Middle Devonian, including the Lochkovian parts of the Kamianama and Fukuji formations, Central Japan (Niko, 1991, 1993, 1996, 2017; Kamiya and Niko, 1997), the Emsian Daliancun and Liujing formations, Guangxi, South China (Lai and Zhang, 1988), the Eifelian rocks of Inner Mongolia, North China (Liang, 1981), the probably Eifelian part of the Nakazato Formation (Niko, 1989), and the Givetian Qiziqiao Formation, Hunan, South China (Lai and Zhang, 1988). The present Late Devonian specimens from the Tobigamori Formation in Northeast Japan are therefore noteworthy even though their preservation is not always satisfactory. The purpose of this paper is to describe three species, *Geisonocerina?* sp., *Spyroceras?* sp. and *Dolorthoceras* sp., based on the Tobigamori material for further taxonomic, biostratigraphic, and biogeographic studies.

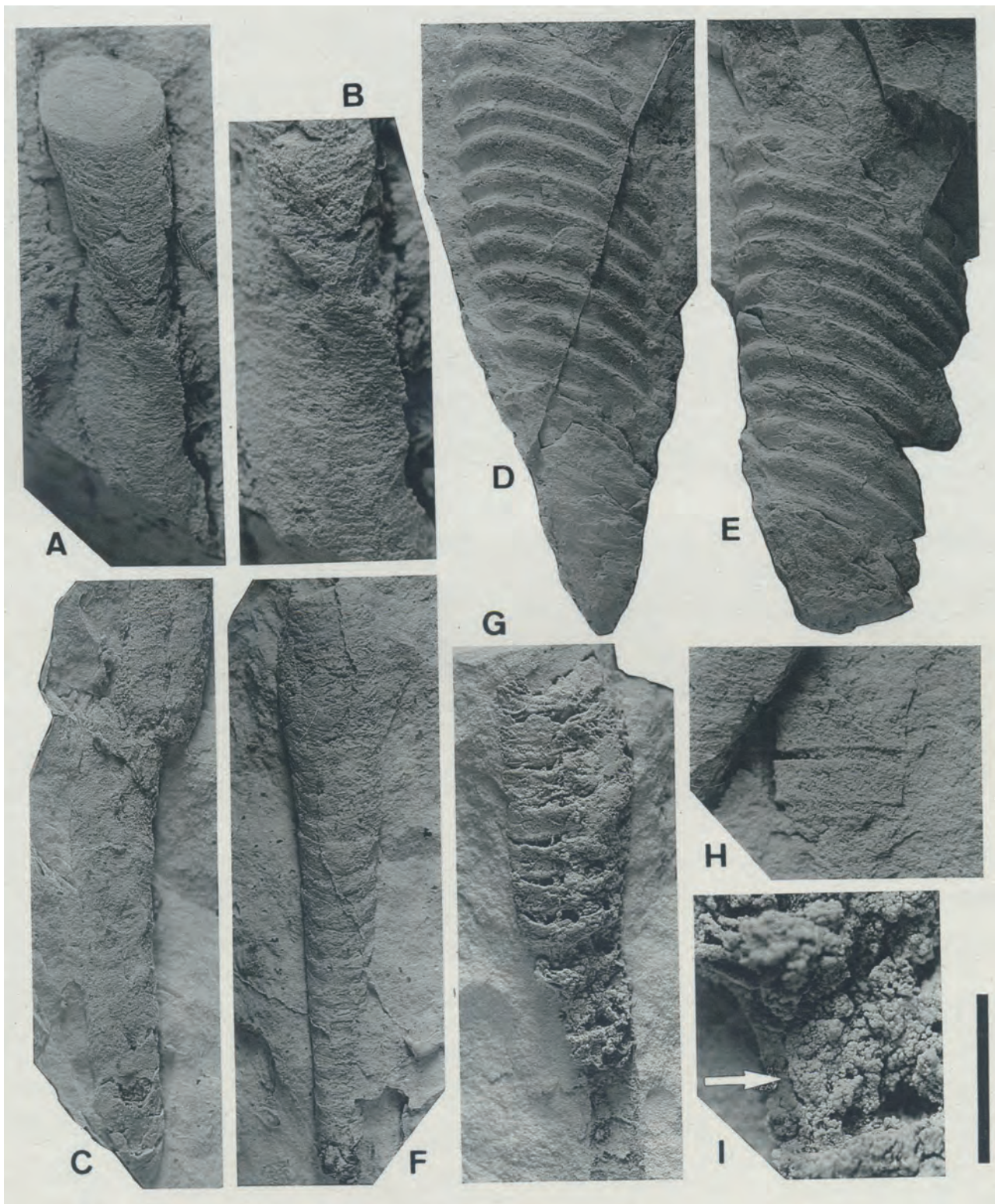
Abbreviations.—The following two abbreviations are used to indicate the repositories of nautiloid specimens. IGPS: Tohoku University Museum, Sendai, Miyagi Prefecture. MSK: Museum of Stones and Kenji Museum (Ishi to Kenji no Museum), Ichinoseki, Iwate Prefecture.

Geologic setting and occurrence

The Tobigamori Formation is a thick sedimentary unit (800–1800 m) composed of black shales with intercalations of tuff, sandstone and conglomerate (Noda, 1934; Tachibana, 1952; Onuki, 1956). It unconformably overlies ultramafic rocks probably associated with the Motai

metamorphic rocks (Sasaki *et al.*, 1997). The relationship between the formation and the overlying Karaumedate Formation is inferred to be conformably (Okami *et al.*, 1973; Osawa *et al.*, 1981; Kawamura and Kawamura, 1989). Since the first discovery of the Late Devonian brachiopod *Spirifer verneulli* by Yabe and Nada (1933), the diverse fauna and flora ranging in age from the Famennian to the Tournaisian (latest Devonian to earliest Carboniferous) have been recorded from the Tobigamori Formation as stated below. The main Famennian part is characterized by abundant occurrences of the index brachiopods *Cyrtospirifer* and *Sinospirifer* (Hayasaka and Minato, 1954; Noda and Tachibana, 1959; Minato and Kato, 1979) and the vascular terrestrial plants *Leptophloeum* and *Cyclostigma* (Tachibana, 1950, 1966). The exact age determinations of the upper to uppermost parts were done by Ehiro and Takaizumi (1992). They confirm that the Devonian–Carboniferous boundary situates within the Tobigamori Formation by findings of the Famennian ammonoids, *Costaclymenia* sp. and *Platyclymenia* (*Platyclymenia*) sp., from the 25–35 m below of the top of the Tobigamori Formation and the Tournaisian ammonoid *Protocanites* sp. from a float block derived from the 5–10 m below of ditto.

The examined specimens of longiconic nautiloids come from shale exposures of an abandoned quarry, which is called “Nendoyama”, at Minamiwairi, Nagasaka in the Higashiyama area, Ichinoseki City, Iwate Prefecture (see fig. 1 in Ehiro and Takaizumi, 1992, for its geographic position). Among them, a specimen of *Geisonocerina?* sp. (IGPS coll. cat. no. 112841) was collected from talus deposits, whose original horizon is situated approximately 35 m below the top of the formation. Although the exact stratigraphic origin of the other specimens MSK19921211, 19950501, 20230801-1, 2 (*Geisonocerina?* sp.), MSK19950501 (*Spyroceras?* sp.) and MSK19950501



(*Dolorthoceras* sp.) are unknown, the lithologic characters of their matrixes indicate that they derive from the upper part indicating Famennian age.

Systematic paleontology

Subclass Orthoceratoidea Teichert, 1967

Order Orthocerida Kuhn, 1940

Family Geisonoceratidae Zhuravleva, 1959

Genus *Geisonocerina* Foerste, 1935

Type species.—*Orthoceras wauwatosense* Whitfield, 1882.

Geisonocerina? sp.

Figures 1.A–1.C, 1.H

Description.—Three fragmentary specimens were examined; they are longiconic orthocones with very gradual expansion and circular transverse sections; the largest specimen is a phragmocone (IGPS coll. cat. no. 112841), which measures 81 mm in length and approximately 9 mm in reconstructed diameter; conch surface ornamented by fine transverse lirae. Camerae relatively long with approximately 1.7 in form ratio (maximum reconstructed width per length). Sutures directly transverse. No siphuncular structure preserved.

Material examined.—MSK20230801-1, 2. IGPS coll. cat. no. 112841.

Discussion.—Accurate generic identification of the specimens is difficult because of their poor preservation, but they are tentatively included in the geisonoceratid genus, *Geisonocerina*, on the basis of the possessions of the very gradually expanding conchs, the fine surface lirae, and the relatively long camerae.

Order Pseudorthocerida Barskov, 1963

Family Pseudorthoceratidae Flower and Caster, 1935

Subfamily Spyroceratinae Shimizu and Obata, 1935

Genus *Spyroceras* Hyatt, 1884

Type species.—*Orthoceras crotalum* Hall, 1861.

Spyroceras? sp.

Figures 1.D, 1.E

Description.—A single fragment of deformed body chamber was examined; it is an annulated orthocone with gradual expansion and 69 mm in length; on the premise that this body chamber is conical, the reconstructed conch diameter is approximately 25 mm near the adoral end; peristome not preserved; annulations oblique at the present (by post mortem deformation) with rounded crests; no distinct surface ornamentation detected both on and between annulations.

Material examined.—MSK19950501.

Discussion.—This poorly preserved specimen is tentatively placed in the pseudorthoceratid genus, *Spyroceras*, because it is comparable in external morphology with the body chamber of *S. melolineatum* Niko, 1996, described from the Lower Devonian Takaharagawa Member, the Fukuj Formation in Gifu Prefecture. Similar annulations also occur in *Cycloceras* M'Coy, 1844, but its type species, *Orthoceras laevigatum* M'Coy, 1844, has the much slenderer conch and occurs exclusively in the Carboniferous.

Genus *Dolorthoceras* Miller, 1931

Type species.—*Dolorthoceras circulare* Miller, 1931.

Dolorthoceras sp.

Figures 1.F, 1.G, 1.I

Description.—A single specimen of imperfect phragmocone was examined; it is a longiconic orthocone with moderate expansion and 75 mm in length; assuming that the conch shape is conical, the reconstructed diameter is approximately 11 mm near adoral end; conch surface smooth lacking distinct ornamentation. Camerae short indicating 3.2–3.7 in form ratio (maximum reconstructed width per length). Septa relatively shallow. Sutures oblique because of post mortem deformation. Siphuncle nearly central in position and consists of suborthochoanitic(?) septal necks and weakly inflated connecting rings.

Material examined.—MSK19921211.

Discussion.—Although the specimen is poorly preserved, its gross conch shape, short camerae and connecting ring shape warrant the generic assignment to *Dolorthoceras*. This species may resemble some Late Devonian species, such as *D. elegans* Flower, 1939, *D. palmerae* (Flower and Caster, 1935) and *D. solitarium* Flower, 1939, but it is not

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Figure 1. A–C, H. *Geisonocerina?* sp. A, B, SKM20230801-1: A, side view of conch; B, partial enlargement of A to show details of surface ornamentation; C, IGPS coll. cat. no. 112841, side view of phragmocone, silicone rubber cast; H, SKM20230801-2, side view of phragmocone, internal mold. **D, E.** *Spyroceras?* sp., body chamber, SKM19950501. D, side view, silicone rubber cast; E, side view, internal mold. **F, G, I.** *Dolorthoceras* sp., phragmocone, SKM19921211. F, side view, silicone rubber cast; G, side view, internal mold; I, partial enlargement of G to show siphuncular structure, arrow indicates connecting ring. Scale bar is 10 mm in A; 6 mm in B, H; 15 mm in C, G; 20 mm in D–F; 4.3 mm in I.

complete enough for confident comparisons.

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