

***Trematoceras hikichii* sp. nov., an Early Triassic orthocerid cephalopod from the Osawa Formation, Miyagi Prefecture, Northeast Japan**

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Abstract: A new Olenekian (late Early Triassic) species of orthocerid cephalopod, *Trematoceras hikichii*, is described from the Osawa Formation in the Utatsu area, Miyagi Prefecture, Northeast Japan. The new species more or less resembles *T. mangishlakense* Schastlivtceva, 1981, from Kazakhstan and *T. insperatum* Schastlivtceva, 1988, from Caucasus. Diagnostic characters of the species from these similar species are following; 4° in angle of conch expansion and very fine transverse lirae on the shell surface. This discovery represents the first record of the genus *Trematoceras* in Japan.

Introduction

So far only limited orthocerid cephalopods from the Mesozoic have been reported, namely Triassic *Paratrematoceras* Schastlivtceva, 1981, *Pseudotemperoceras* Schastlivtceva, 1986 and *Trematoceras* Eichwald, 1851, and Cretaceous *Zhuravlevia* Doguzhaeva, 1994. Among them *Trematoceras* is the most common and best-known genus whose records are recognized in the Olenekian (late Early Triassic) to Rhaetian (late Late Triassic) marine faunas of the Tethys, Boreal and Panthalassa regions. The present paper describes a new Olenekian species of *Trematoceras* from the Osawa Formation in Northeast Japan.

Abbreviations used for repositories are IGPS (Institute of Geology and Paleontology, Faculty of Science, Tohoku University, Sendai; kept in the Tohoku University Museum) and UIM (Utatsu Ichthyosaur Museum, Minamisanriku Town).

Systematic Paleontology

Order Orthocerida Kuhn, 1940

Superfamily Orthoceratoidea M'Coy, 1844

Family Orthoceratidae M'Coy, 1844

Subfamily Michelinoceratinae Flower, 1945

Genus *Trematoceras* Eichwald, 1851

Type species.—*Orthocera* [sic] *elegans* Münster, 1841; Carnian (lower Upper Triassic) in Carnic Alps.

Trematoceras hikichii sp. nov.

Figure 1

Diagnosis.—Species of *Trematoceras* with approximately 4° in angle of conch expansion and relatively short camerae with 1.6–2.3 in from ratios (maximum width per length); transverse lirae on shell surface are very fine.

Description.—Longiconic orthocones with circular cross sections; conch expansion is gradual for the family and moderate for the genus, indicating approximately 4° in angle; holotype is incomplete phragmocone with 68 mm in length; the largest specimen (paratype, IGPS coll. cat. no. 111571) attains 99 mm in length and 7 mm in approximate diameter (reconstructed), adoral 51 mm of which specimen represents body chamber; no apical part of conch and peristome preserved; shell surface ornamented by very fine transverse lirae; there are 12–16 ridges in 1 mm of conch length. Sutures are essentially straight and transverse; septa indicate moderate curvature; camerae are relatively short for the genus indicating from ratios (maximum width per length) of 1.6–2.3; siphuncle is nearly central (faintly ventral from center); position ratios of siphuncle (distance of central axis of septal foremen from ventral shell surface per corresponding conch diameter) are 0.45–0.47; siphuncular wall consists of orthochoanitic (to suborthochoanitic) septal necks and cylindrical connecting rings; length of necks is short, 0.19–0.23 mm. Endosiphuncular deposits absent; cameral deposits are well-developed, episeptal-mural, and thicker in venter than dorsum; in later stages, cameral deposits exhibit mammillary growth and extend to hyposeptal area.

Material examined.—Holotype, IGPS coll. cat. no. 111572. Paratypes, IGPS coll. cat. nos. 111569–111571 and UIM

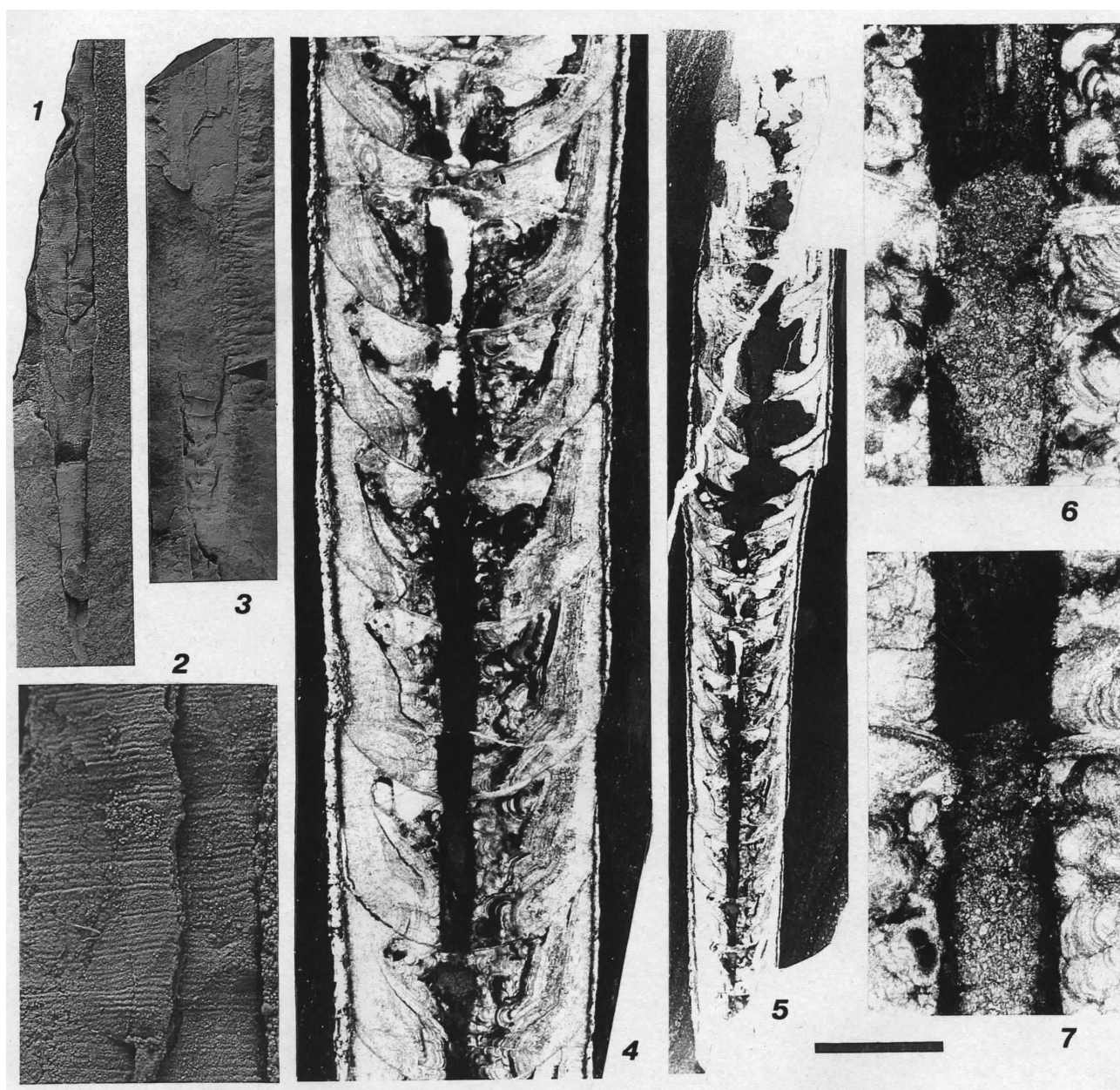


Figure 1. *Trematoceras hikichii* sp. nov. from the Early Triassic Osawa Formation in the Utatsu area, Minamisanriku Town, Miyagi Prefecture. **1, 2.** Paratype, IGPS coll. cat. no. 111569: **1**, side view of mold; **2**, partial enlargement of Figure 1.1 to show details of surface ornamentation, external mold. **3.** Paratype, IGPS coll. cat. no. 111571, side view of mold, arrow indicates the last septum. **4–7.** Holotype, IGPS coll. cat. no. 111572: **4**, partial enlargement of Figure 1.5, to show details of cameral deposits; **5**, dorsoventral thin section, venter on left; **6, 7**, partial enlargements of Figure 1.5 to show details of septal necks. Scale bar is 10 mm in Figure 1.1; 2 mm in Figure 1.2; 20 mm in Figure 1.3; 1.4 mm in Figure 1.4; 4 mm in Figure 1.5; 0.4 mm in Figures 1.6, 1.7.

30622. In addition, two poorly preserved specimens, IGPS coll. cat. no. 111573 and UIM 30623, were also examined.

Etymology.—The specific name honors Mr. Yasuhiro Hikichi, who discovered the holotype of the new species.

Occurrence.—All specimens of *Trematoceras hikichii* sp. nov. were collected from laminated mudstones of the Osawa Formation at the Tatezaki locality (38°42'50"N, 141°32'07"E) in the Utatsu area, Minamisanriku Town, Miyagi Prefecture,

Northeast Japan (see figures 1, 2 in Ehiro et al., 2015 for its geographic point). The specific components of the Osawa ammonoid fauna were revealed by Bando and Shimoyama (1974), Bando and Ehiro (1982), Ehiro (1993), Ehiro (2016), and Ehiro et al. (2016 in press). These results suggest that the formation is correlative with the upper Olenekian (= Spathian; upper Lower Triassic).

Discussion.—In examined specimens, only the apical shell of the holotype is undistorted. Thus, some important characters, such as profile of the conch, siphuncular structure and biotic deposits, in the above description are based on this specimen.

In its ratios of the cameral form and siphuncular position, *Trematoceras hikichii* sp. nov. resembles *T. mangishlakense* Schastlivtceva (1981, p. 79, 80, pl. 1, figs. 3a, b, 4a, b) from the Olenekian of Kazakhstan. The most important features to separate these two species are external morphologies. *Trematoceras mangishlakense* possesses slightly larger angle of conch expansion (6°–7°) and lacks evident surface ornamentation. Transverse surface lirae are developed also in *T. insperatum* Schastlivtceva (1988, p. 67, 68, pl. 2, figs. 12a, b, v) from the Anisian (lower Middle Triassic) of Caucasus, but its interspaces of the liare are much wider, 2–3 ridges in 1 mm, than those of the new species. The type species of the genus, *T. elegans* (Münster, 1841, p. 125, pl. 14, figs. 2a–c; Bizzarini and Gnoli, 1991, p. 112, pl. 1, figs. 1–4, pl. 2, figs. 1, 2) clearly differs from the new species in having strongly oblique surface liare and longer camerae.

This discovery from the upper Olenekian Osawa Formation is noteworthy because it represents the first record of *Trematoceras* in Japan. In addition, previous Early Triassic occurrences of the genus were restricted in Albania, Kazakhstan, northeastern Siberia, Primorye, and Vietnam (Kiparisova, 1961; Schastlivtceva, 1988; Shigeta and Nguyen, 2014).

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References

- Bando, Y., and Ehiro, M., 1982, On some Lower Triassic ammonites from the Osawa Formation at Asadanuki, Towa-cho, Tome-gun, Miyagi Prefecture, Northeast Japan. *Transactions and Proceedings of the Palaeontological Society of Japan, New Series*, no. 127, p. 375–385, pl. 60.
- Bando Y., and Shimoyama, S., 1974, Late Scythian ammonoids from the Kitakami Massif. *Transactions and Proceedings of the Palaeontological Society of Japan, New Series*, no. 94, p. 293–312, pls. 40–42.
- Bizzarini, F., and Gnoli, M., 1991, *Trematoceras elegans* (Münster) and other Late Triassic cephalopods from the San Cassino Formation, Eastern Dolomites (Italy). *Bollettino della Società Paleontologica Italiana*, vol. 30, p. 109–116.
- Doguzhaeva, L. A., 1994, An Early Cretaceous orthocerid cephalopod from north-western Caucasus. *Paleontology*, vol. 37, p. 889–899.
- Ehiro, M., 1993, Spathian ammonoids *Metadagnoceras* and *Keyserlingites* from the Osawa Formation in the Southern Kitakami Massif, Northeast Japan. *Transactions and Proceedings of the Palaeontological Society of Japan, New Series*, no. 171, p. 229–236.
- Ehiro, M., 2016, Additional Early Triassic (late Olenekian) ammonoids from the Osawa Formation at Yamaya, Motoyoshi area, South Kitakami Belt, Northeast Japan. *Paleontological Research*, vol. 20, no. 1, p. 1–6.
- Ehiro, M., Sasaki, O., and Kano, H., 2016 in press, Ammonoid fauna of the late Olenekian Osawa Formation in the Utatsu area, South Kitakami Belt, Northeast Japan. *Paleontological Research*, vol. 20.
- Ehiro, M., Sasaki, O., Kano, H., Nemoto, J., and Kato, H., 2015, Thylacocephala (Arthropoda) from Lower Triassic of the South Kitakami Belt, Northeast Japan. *Paleontological Research*, vol. 19, p. 269–282.
- Eichwald, E. von, 1851, Naturhistorische Bemerkungen, als Beitrag zur vergleichenden Geognosie, auf einer Reise durch die Eifel, Tyrol, Italien, Sizilien und Alger. *Nouveaux Mémoires de la Société Impériale de Naturalistes d'Histoire de Moscou*, vol. 9, p. 1–464.
- Flower, R. H., 1945, Classification of Devonian nautiloids. *The American Midland Naturalist*, vol. 33, p. 675–724, pls. 1–5.
- Kiparisova, L. D., 1961, Paleontologicheskoe obosnovanie stratigrafii triasovykh otlozhenii primorskogo kraya. Chast 1. Golovonogie mollyuski [Paleontological fundamentals for the stratigraphy of Triassic deposits of Primorye region. Part 1. Cephalopod Mollusca]. *Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Geologicheskogo Instituta (BSEGI)*, vol. 48, p. 1–278. (in Russian)
- Kuhn, O., 1940, *Paläozoologie in Tabellen*, 50 p. Fischer, Jena.
- M'Coy, F., 1844, *A Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland*, 274 p. Privately published. (reissued by Williams and Norgate, London, 1862)
- Münster, G. zu, 1841, II. Beschreibung und Abbildung der in den Kalkmergelschichten von St. Cassian gefunden Versteinerungen. In, Wissmann, H. L., and Münster, G. zu, *Beiträge zur Geognosie und Petrefacten-Kunde des Südbösterreichs Tirol's Vorzüglich der Schichten von St. Cassian*, p. 25–152, pls. 1–16, Bayreuth.
- Schastlivtceva, N. P., 1981, O sistemicheskom polozenii triasovykh ortotseratoidei yuga SSSR [On systematic position of Triassic orthoceratids of the southern USSR]. *Byulleten Moskovskogo Obschestva Ispytatelei Prirody, Otdel Geologicheskii*, vol. 56, p. 76–82. (in Russian)
- Schastlivtceva, N. P., 1986, Nekotorye triasovye ortotseratidy i nautilidy Severo-Vostoka SSSR [Some Triassic orthoceratids and nautilids of the Far East of the USSR]. *Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Geologicheskogo Instituta (BSEGI)*, vol. 56, p. 1–12. (in Russian)

- and nautilids from North-East USSR]. *Byulleten Moskovskogo Obschestva Ispytatelei Prirody, Otdel Geologicheskii*, vol. 61, p. 122–129. (in Russian)
- Schastlivtceva, N. P., 1988, Triasovye ortotseratidy i nautilidy SSSR [Triassic orthoceratids and nautilids of the USSR]. *Akademii Nauk SSSR, Trudy Paleontologicheskogo Instituta*, vol. 229, p. 1–104, pls. 1–8. (in Russian)
- Shigeta, Y., and Nguyen, H. D., 2014, Cephalopods. In, Shigeta, Y., Komatsu, T., Maekawa, T., and Dang, H. T., eds., *Olenekian (Early Triassic) Stratigraphy and Fossil Assemblages in Northeastern Vietnam*. National Museum of Nature and Science Monographs, no. 45, p. 65–167, Kokusai Bunkensha Co. Ltd., Tokyo.