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# Late Triassic ammonoid *Arcestes* from the Saragai Group in the South Kitakami Belt, Northeast Japan

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**Abstract: Late Triassic ammonoid *Arcestes* sp. is described from the Chonomori Formation (Saragai Group), crop out at Haizaka, Minamisanriku Town in the South Kitakami Belt, Northeast Japan. It was collected from the *Monotis scutiformis* Zone, which occupies the lower part of the formation. Although it is ill-preserved, based on the general shell morphologies, it can be compared with some *Arcestes* species described from the lower Norian of Austria, being the Norian age of the Chonomori Formation became more probable.**

## Introduction

Naumann (1881) reported the occurrence of Late Triassic bivalve *Monotis* at Saragaizaka, Utatsu area, Minamisanriku district in the South Kitakami Belt, Northeast Japan, which was the first discovery of the Triassic fossils from Japan. Subsequently, Mojsisovics (1888) described some Japanese ammonoids (Middle Triassic ammonoids) for the first time from Japan. Most of them were collected from Inai and its environs, to the south of Utatsu. Yokoyama (1904) described first Jurassic ammonoids of Japan from Hosoura, on the south of Utatsu. Through these works, the Minamisanriku district came to attract attention as a representative locality of shallow marine Mesozoic strata, especially Triassic and Jurassic ones.

The *Monotis*-bearing Saragai beds (Shimizu and Mabuti, 1932, 1941) were regarded as the type strata of the Upper Triassic Saragian Stage (Ichikawa, 1950). Onuki and Bando (1958) subdivided the beds (Saragai Group) into the lower Shindate and the upper Chonomori formations. Molluscan fossils from the Saragai Group are all from the Chonomori Formation. The Saragai Group has been considered to be correlated with the Carnian to Norian stages, but opinion is divided on the precise correlation of it. It is partly due to scarce number of age-diagnostic fossils, such as ammonoid. Recently an ammonoid specimen collected from the Chonomori Formation was brought to the present author. This paper describes this ammonoid and discusses its stratigraphic significance.

## On the geological age of the Saragai Group

The Saragai Group is mainly distributed in the Motoyoshi and Utatsu areas in the southern part of the Southern Kitakami Massif, Northeast Japan (Figure 1), overlying the Lower–Middle Triassic (Olenekian–Ladinian) Inai Group and while underlying the Lower Jurassic Shizugawa Group both with unconformity. Shimizu and Mabuti (1932, 1941) correlated the Saragai beds (the Chonomori Formation) with the Norian Stage based on the occurrence of two ammonoids, *Arcestes* aff. *oligosarcus* Mojsisovics and *Placites* aff. *oxyphyllus* Mojsisovics. Ichikawa (1951) also considered that his Saragian Stage is roughly correlated with the Norian. Onuki and Bando (1958) divided the Chonomori Formation into four *Monotis* zones: $C_1$ to $C_4$ in ascending order, and considered that two ammonoids reported by Shimizu and Mabuti (1932, 1941) were come from the $C_2$ zone (*Entomonotis densistriata* Zone = *Monotis ochotica densistriata* Zone of Ando, 1983). They placed the Carnian/Norian boundary between the $C_1$ (*Entomonotis scutiformis* Zone = *Monotis scutiformis* Zone of Ando, 1983) and $C_2$ zones, based on the *Monotis* fauna and the above-mentioned ammonoids. These ammonoids, however, have not yet been described and the whereabouts of them are unknown. Nakazawa (1964a) established six molluscan zones in the Chonomori Formation: the *Tosapecten* Zone, *Dictyoconites* Zone, *Monotis typica* Zone, *M. ochotica densistriata* Zone, *M. ochotica* Zone and *M. zabaikalica* Zone, in ascending order, and considered that the horizon of the above-mentioned ammonoids to be the *M. typica* Zone or *Dictyoconites* Zone. Ando (1983) renamed the *M. typica*

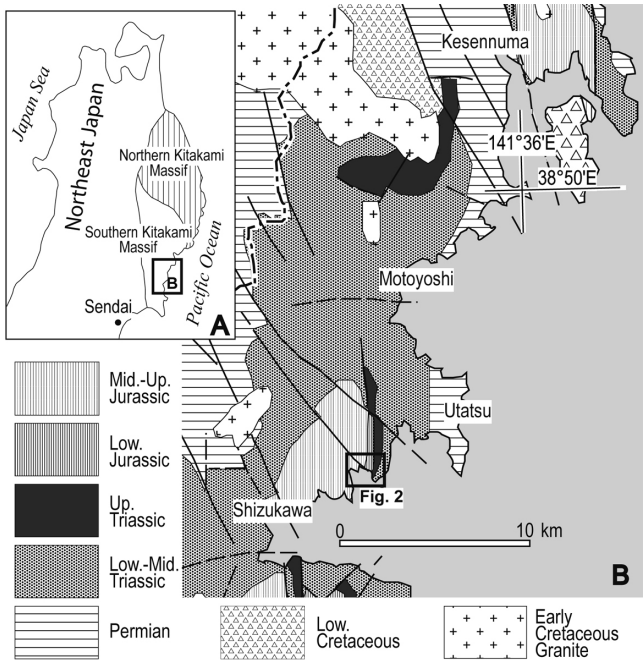


**Figure 1.** Index map (A) and generalized geologic map of the Utatsu area and its environs in the South Kitakami Belt, Northeast Japan (B).

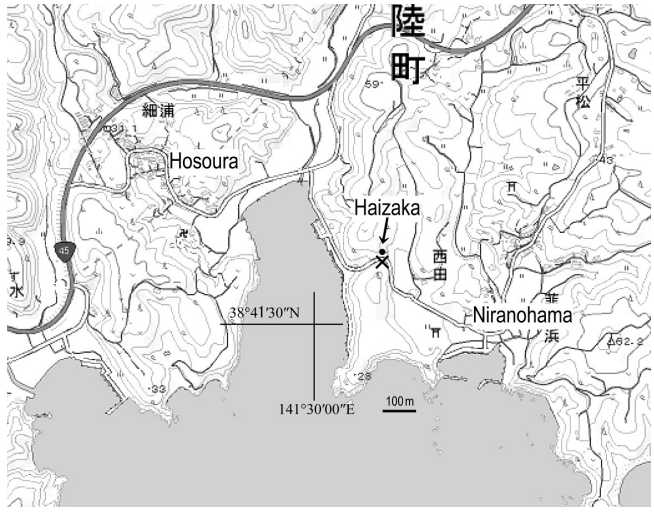


**Figure 2.** Locality map of Hosoura–Niranohama area showing the fossil locality (Haizaka). The base map is the Digital Map of Japan issued by Geospatial Information Authority of Japan.

Zone to the *M. scutiformis* Zone, but did not mention the precise position of the Carnian/Norian boundary.

Nakazawa (1964a) described newly discovered ammonoids, *Rhacophyllites* sp. (one specimen) and *Arcestes* sp. (two specimens), from the *M. typica* Zone at Haizaka, small pass between Hosoura and Niranohama (Figure 2). According to Nakazawa (1964a), *Rhacophyllites* from Haizaka somewhat resembles some Carnian species known from Kyushu, Japan and New Zealand, and his specimens of *Arcestes* are similar to. *A. oligosarcus* Mojsisovics, 1875 from the Norian of Austria and *A. trauthi* Diener, 1921 from Carnian-Norian mixed fauna of Austria. He also discussed the age of the *Dictyoconites* Zone and considered that it is probably Carnian in age, because the zonal fossil *Dictyoconites nipponicus* Shimizu and Mabuti, 1941 was considered to be similar to Carnian–Norian *D. multisulcatus* Bulow from Timor and *D.* aff. *haueri* Mojsisovics from the Carnian of Himalayas (Shimizu and Mabuti, 1941). Based on these fossils, Nakazawa (1964a) tentatively correlated the lower two zones (the *Tosapecten* and *Dictyoconites* zones) and upper four zones (above the *M. typica* zone) with the upper Carnian and lower Norian, respectively, but later, he (Nakazawa, 1964b) considered the age of the lower two zones to be lower Norian rather than late Carnian, based on the correlation of the *Monotis* fauna. Recently, new genus *Miyagiteuthis* was proposed (Niko and Ehiro, 2018) for *D. nipponicus*, and, therefore, the Carnian age of the *Dictyoconites* Zone needs to be reconsidered.

The present specimen of *Arcestes* was collected from the *Monotis scutiformis* Zone (*M. typica* zone of Nakazawa, 1964a) at Haizaka (Figure 2). It is ill-preserved and deformed by tectonic deformation, making it difficult to identify at the specific level. However, as discussed in the systematic section, based on the estimated shell form and its characteristic rostrum, the present species can be compared with some *Arcestes* species, such as *Arcestes oxycephalus* Mojsisovics and *A. dicerus* Mojsisovics both from the lower Norian of Austria. Therefore, the early Norian age of *M. scutiformis* Zone became more probable.

## Systematic description

Order Ceratitida Hyatt, 1884
Superfamily Arcestoidea Mojsisovics 1875
Family Arcestidae Mojsisovics 1875
Genus *Arcestes* Suess 1865

***Arcestes*** sp.
Figures 3a–e

***Material:*** One specimen; IGPS coll. cat. no. 112167, collected by Yudai Torihata, 2018.

***Description:*** A small, partly squashed specimen is at hand. It is involute with completely closed umbilicus. The shell shape is looks like extremely discoidal, but this discoidal form is due in part to the tectonic deformation. It

is squashed, and the lateral sides are dented irregularly (Figure 3a) and the ventral part is collapsed in a narrow roof shape (Figure 3b). The living chamber is long and occupies about 1.25 volution. Near the apertural end the ventral part is projected forward as forming a prominent rostrum. The cross section of the rostrum is sub-rectangular, the ventral side of which is flattened and become concave near the nose, having sharp corners at both sides (Figures 3c, 3d). The shell surface is smooth without any ornamentation. The shell diameter (D) attains 42.3 mm, and its corresponding height (H) is ca. 27 mm. The maximum width of shell in the deformed state is near the peripheral end (frontal part of the rostrum) and measures 12.5 mm (WR/D = ca. 0.3; WR: width of the rostrum). Except for the rostrum, the apparent maximum width (Wa) is near the middle part of the sides and ca. 7.5 mm (Wa/D = 0.18).

The septa are partly destroyed and the suture lines are only partly observable. The first lateral to the fourth lateral saddles are preserved (Figure 3e). Although the second is crashed, it is *Arcestes*-type, and lateral saddles are high with sub-parallel, denticulate prongs.

***Discussion:*** The specimen described is deformed by severe tectonic deformation and lateral compaction, and its shell width and ratio of Wa/D above are not original values. It is estimated that the actual maximum width (W) is at the umbilicus and is equal or larger than that of the peripheral end (WR), and the original shell cross section is thought to be thinly discoidal with slightly converging sides and

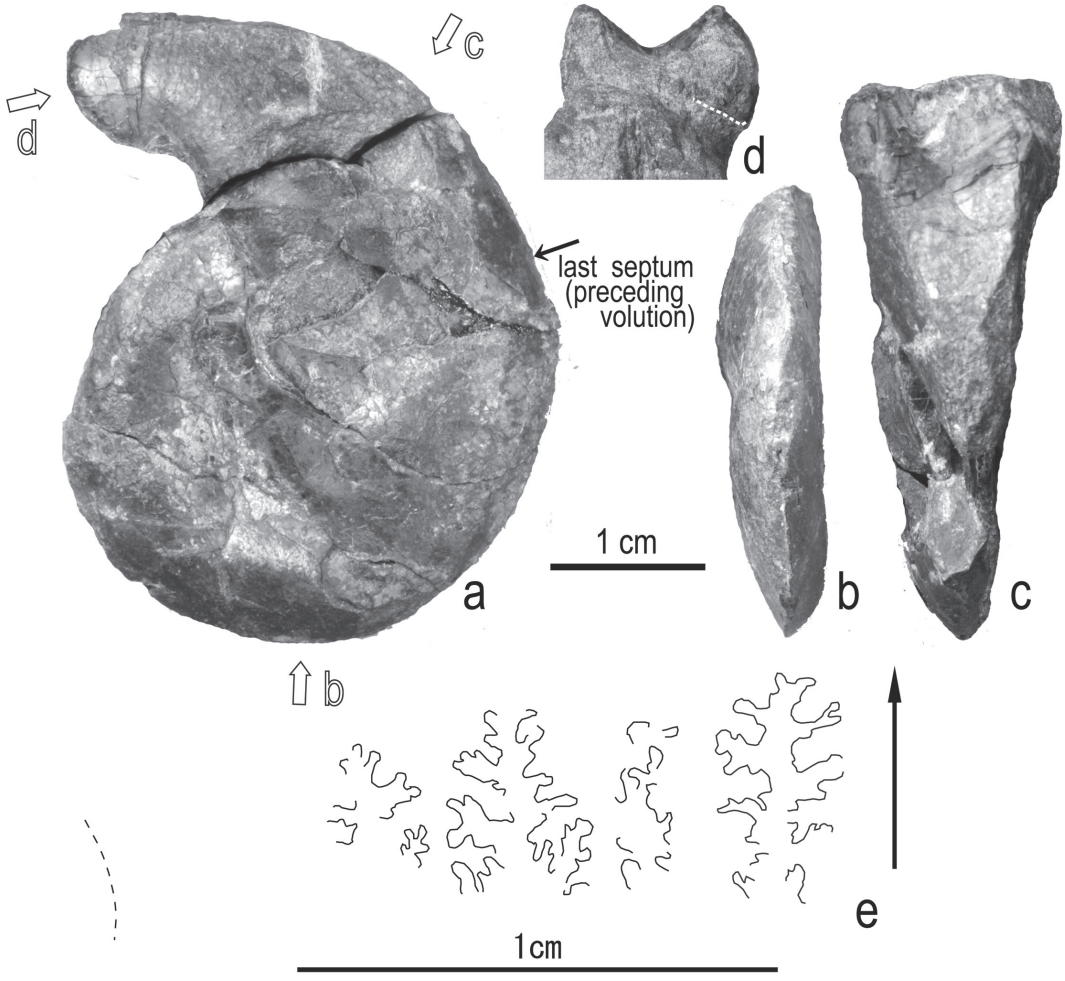


**Figure 3.** *Arcestes* sp. collected from the *Monotis scutiformis* Zone of the Chonomori Formation at Haizaka (IGPS coll. cat. no. 112167). **a.** lateral view; **b.** ventral view; **c.** ventral view including the peripheral end (rostrum); **d.** frontal view of the rostrum, white dotted line shows the lower margin of the rostrum; **e.** external suture line of the last septum. Open allows show view line directions of figure b, c and d.

narrowly rounded venter.

In having discoidal shell, the genus *Arcestes* somewhat resembles the genus *Proarcestes* Mojsisovics, 1893. These two genera, however, easily distinguished by there shell morphology: The periodic constrictions of the genus *Arcestes* are confined to the phragmocone and the living chamber shows some mature modifications, while the living chamber of the genus *Proarcestes* possesses constrictions and shows no modification (Diener, 1921; Spath, 1951). Because it has a prominent rostrum at the peripheral end, the present species is considered to belong to the genus *Arcestes*.

The shell widths (W) of already-known species of *Arcestes*, having flattened to concave venter at the peripheral end of the living chamber, described by Mojsisovics (1875) and Diener (1921), are nearly the same as those of flattened venter (WR) to ca. 1.3 times larger than WR. Because the WR of the present specimen is very narrow, with WR/D value of ca. 0.3, it original ratio of W/D is estimated to be about or less than 0.4 (thinly discoidal). Although the precise comparison with the known species of *Arcestes* is difficult, I attempt to compare the present species with known ones based on the estimated shell form and a characteristic rostrum with sub-rectangular cross section and concave ventral side.

In the shell shape having extremely discoidal to discoidal shell cross section, closed umbilicus and narrow (WR/D = 0.4 or smaller) flattened venter at the apertural end with sharp corners, it resembles *Arcestes oxycephalus* (Mojsisovics, 1875, P. 141, pl. 38, figs. 2a–c) and *A. dicerus* (Mojsisovics, 1875, p. 122, pl. 47, figs. 1a–c, pl. 53, fig. 20) from the lower Norian of Austria. The apertural ends of latter two species, however, do not form a rostrum and slightly wider than the present species (WR/D = 0.37–0.40).

*A. oxystomus* (Mojsisovics, 1875, p. 130, pl. 48, figs. 2a–c) from the lower Norian of Austria has a rostrum-shaped peripheral end, but the rostrum has a tapered end. *A. piae* (Diener, 1921, p. 352, pl. 1, figs. 4–6) from the mixed Carnian-Norian fauna of Austria has a thinly discoidal shell with prominent rostrum comparable to the present species, but the living chamber of the former has a hook-shaped bend. *A.* aff. *frechi* (Diener, 1921, p. 359, pl. 1, figs. 8a–c) from the Carnian of Austria has a discoidal shell with a strong rostrum, but differs from the present species by having a small but distinct umbilicus. *Arcestes* sp. described from the same locality and horizon at Haizaka (Nakazawa, 1964a) is distinguished from the present species by having rather wide shell.

***Occurrence:*** From the *Monotis scutiformis* Zone (*M. typica* Zone) of the Chonomori Formation (Saragai Group), distributed at Haizaka, Minamisanriku-cho, Miyagi Prefecture.

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