

Short Article

Two new ostracod species from the Late Miocene formations of Japan

TANAKA Gengo¹, IWAI Yuka², UENO Yuki², KANBE Iren²,
FURUICHI Saki² and NOMURA Shin-ichi³

¹Gunma Museum of Natural History, 1674-1, Kamikuroiwa, Tomioka, Gunma 370-2345, Japan.
(tanaka@gmnh.pref.gunma.jp)

²Tomioka Higashi Highschool, 118-6, Tomioka, Gunma 370-2316, Japan.

³Amawa Highschool, 299, Kazuma, Tomitsu, Chiba 299-1606, Japan
(snom@biglobe.ne.jp)

Abstract: A new loxoconchid species *Loxoconcha tuberculatus* sp. nov. (Crustacea, Ostracoda) is described from the Late Miocene Maja Formation of Kume-jima Island, Okinawa Prefecture, Japan. The new species shows strong sexual dimorphism and characteristically develops big round tubercles at the posterior area in males. This new species has only been reported from the Late Miocene Maja Formation from Kume-jima Island. Also, a new hemicytherid species *Aurila joushuensis* sp. nov. is described from Late Miocene Itahana Formation of Yoshii Town, Takasaki City, Gunma Prefecture, Japan. This species denotes strong sexual dimorphism. *Aurila joushuensis* sp. nov. has only been found from the Late Miocene Itahana Formation.

Key Words: *Aurila*, Itahana Formation, Late Miocene, *Loxoconcha*, Maja Formation, Ostracoda

Introduction

The genus *Loxoconcha* was proposed by Sars (1866) with the type species *Cythere rhomboidea* Fischer (1855), based on a Recent specimen from Lervig (= Larvik), South Norway. Since then, about 690 species belonging to this genus have been identified from around the world (Kempf, 1986, 1995, 2008). The oldest fossil record is from the Eutaw Formation (Late Cretaceous) of northwest Selma, Dallas City, Alabama, North America (Crane, 1965). Today, it is widely distributed in littoral, sublittoral and brackish-water environments throughout the world except for the polar regions (Athensuch and Horne, 1984). The genus *Aurila* was proposed by Pokorný (1955) with the type species *Cythere convexa* Baird (1850), based on a Recent specimen from Secca di Benda near Naples (75 m depth). Since then, about 370 species of the genus have been reported from around the world (Kempf, 1986, 1995, 2008). The first appearance of the genus is from the Marianna Limestone (Early Oligocene) of Alabama, North America (Hazel, 1990). Here, we describe two new pedocopid species from the Late Miocene formations in Japan.

Materials

Six samples (S1-S6) were collected from the Maja Formation. One of these samples (sample 1 of figure 1 = S5 of Tanaka and Nomura, 2009) had been already used for study. In the study area, the lower part of the Maja Formation, which is 6 m in thickness, consists of massive light-gray very fine sandstone. The sandstone is dissected by poorly-sorted conglomerate (cobble to pebble) and shows normal grading from conglomerate to medium sandstone. Several calcareous nodular beds are developed in the coarse to medium sandstone. Nakamura et al. (1999) dated the

Maja Formation of our study point to 7.8-7.2 Ma by using strontium isotope stratigraphy.

In the Itahana Formation, one sample (sample 2 of figure 1) was collected and used for taxonomic study. The sample was semi-consolidated and contained many shell fragments. The lithological character of this sample shows light grey colored massive very fine sandstone. According to Takahashi and Hayashi (2004), the total thickness of the Itahana Formation is + 1200 m, also the lithology of the lower part of the formation is characterized by alternation of conglomeratic sandstone and sandy siltstone, and that of the upper part of the formation is characterized by conglomerate with sandstone and felsic tuff and conglomerate with thick lignite beds. Takahashi and Hayashi (2004) mentioned that the Baba Tuff which is the uppermost part of the Haraichi Formation dates 11.23±0.12 Ma (biotite and sanidine). From the geological and lithological view, sample 2 was thought to have been collected from the lower part of the Itahana Formation.

Methods

In the field, fossiliferous rock samples were collected for ostracod taxonomic studies. Each of the dried rock samples (80 g) were disaggregated, using 5 % hydrogen peroxide solution or naphtha and/or sodium sulphate solution for rock maceration (Maiya and Inoue, 1973), washed through a 235 mesh (63 μm) sieve, and dried again. This procedure was repeated till the whole sediment sample had disaggregated. Ostracod specimens were picked and were identified under a stereoscopic microscope (Nikon SMZ-U) at 70 × magnification. The male and female specimens were mounted on stubs, then viewed using HITACHI (Tokyo) Microscope TM-1000 scanning electron microscope under low vacuum with non-evaporation coating.

Systematic Palaeontology

The morphological terms follow the usage of Scott (1961) and Athersuch et al. (1989). All illustrated specimens are deposited in the Gunma Museum of Natural History (GMNH-PI-number).

PODOCOPIDA Müller, 1894
 PODOCOPINA Sars, 1866
 CYTHEROIDEA Baird, 1850
 LOXOCOCHIDAE Sars, 1925
Loxococoncha Sars, 1866

Loxococoncha tuberculatus sp. nov.

Plate 1, figs. 1-18

Loxococoncha sp. 1 of Tanaka and Nomura, 2009

Derivation of name. 'tuberculatus' shows the posterior tubercle which is a diagnosis of this species.

Holotype. GMNH-PI-3162

Allotype. GMNH-PI-3163

Paratype. GMNH-PI-3164

Description. Valve subquadrate in lateral view (Pl. 1, figs. 1, 2, 7, 8). Anterior margin evenly rounded with small curvature; dorsal margin straight in right valve, concave in left valve; posterior margin truncated and caudated dorsally; ventral margin straight in right valve, convex in left valve. Eye tubercle prominent. Fossae developed at behind of eye tubercle and central area of valve. Reticulation developed from mid-anterior to vent-posterior area. Two concentric muri occur in mid anterior area, convex ventrally in the mid-ventral area, end at mid posterior area. One tubercle developed at mid-posterior or dorso-posterior area. One murus surrounding posterior half of tubercle. Murus abuts against into four short muri in female. Two prominent muri occurring in antero-central area, radially running toward anterior margin. Ala developed at mid-ventral or antero-ventral area. In dorsal view, carapace fusiform-shaped (Pl. 1, figs. 4, 11, 12). In ventral view, reticulation well developed. Three pairs of muri developed: inner most murus is short and running from antero-marginal area to mid-ventral area, second murus long and sinuate at mid-ventral area, outer most murus short and running from mid-anterior area to middle area. Punctae develops along ventral margin (Pl. 1, figs. 5, 13, 14). In anterior and posterior views, carapace triangular or pentagonally-shaped (Pl. 1, figs. 3, 6, 9, 10, 15, 16).

Large sexual dimorphism; in lateral view, male forms more elongate; in dorsal and ventral views, valves of female forms more inflated prominent protruberance only developing in male (Pl. 1, figs. 4, 5, 11-14); in anterior and posterior views, triangular outline in female, pentagonally-shaped outline in male (Pl. 1, figs. 3, 6, 9, 10, 15, 16).

Duplicature not developed or not preserved all of specimens which we investigated (pl. 1, fig. 17). Ocular sinus prominent. Hinge gonylodont: in right valve, anterior hinge area a rounded smooth tooth in a large socket; interangular hinge area dentate socket; posterior hinge area horseshoe-shaped tooth (pl. 1 fig. 17). One elliptical-shaped frontal scar (pl. 1, fig. 18). Four elliptical adductor; uppermost one peanuts-shaped, second one elongated, third one rather triangular-shaped, fourth ones

heart-shaped (pl. 1, fig. 18).

Remarks. The present species somewhat resembles *Loxocorniculum mutsuense* Ishizaki, 1971 in that of radially diverged two prominent muri at anterior area and outline of carapace. However, *Loxococoncha tuberculatus* sp. nov. has one tubercle developed at mid-posterior or dorso-posterior area, one murus surrounds posterior half of the tubercle, and has more coarse reticulation from antero-ventral to ventral area.

HEMICYTHERIDAE Puri, 1953

Aurila Pokorný, 1955

Aurila joushuensis sp. nov.

Plate 2, figs. 1-16

Aurila sp. of Yamaguchi and Hayashi, 2001.

Derivation of name. Joushu is an old provincial name of Gunma Prefecture which is discovered type species.

Holotype. GMNH-PI-4001

Allotype. GMNH-PI-4002

Paratype. GMNH-PI-4003

Description. Valve subrhomboidal in lateral view (Pl. 2, figs. 1, 2, 7, 8). Anterior margin broadly rounded with infracurvature and protruded anteroventral direction; dorsal margin straight in right valve and sloping posteriorly, and convex in left valve and highest at middle; posterior margin truncated and caudated; ventral margin sinuated and concurved at one third from anterior end. Eye tubercle prominent. Reticulation developed from anterior area to ventromarginal area. Pit developed at median area, and punctate developed from dorsal to posterior area. Two prominent muri occurring at ventral area and running parallel to the ventral margin. In dorsal view, the carapace fusiform-shaped and widest at middle (Pl. 2, figs. 3, 9, 10). In ventral view, reticulation well developed. Three pairs of muri developed: inner most murus is longest and runs from antero-marginal area to postero-marginal area, second murus is shortest and running from antero-ventral area to mid-ventral area, outer most murus rather long and running from mid-ventral area to posterior area. In anterior and posterior views, carapace egg-shaped and widest slightly ventral from the middle (Pl. 2, figs. 5, 6, 13-16).

Large sexual dimorphism; in lateral view, male more elongate (Pl. 2, figs. 1, 2, 7, 8).

Remarks. The Present species somewhat resembles *Aurila togakushiensis* Ozawa, 2008 (in Ozawa et al., 2008) in that of all of the surface ornamented, large sexual dimorphism, and each outline in female and male. However, *A. joushuensis* sp. nov. has ornamentation on the valve outer surface, more triangular outline, and has a posterior ridge. *Aurila joushuensis* sp. nov. differs from *A. corniculata* Okubo, 1980, in that of lacks of two prominent radial ridges in anterior area.

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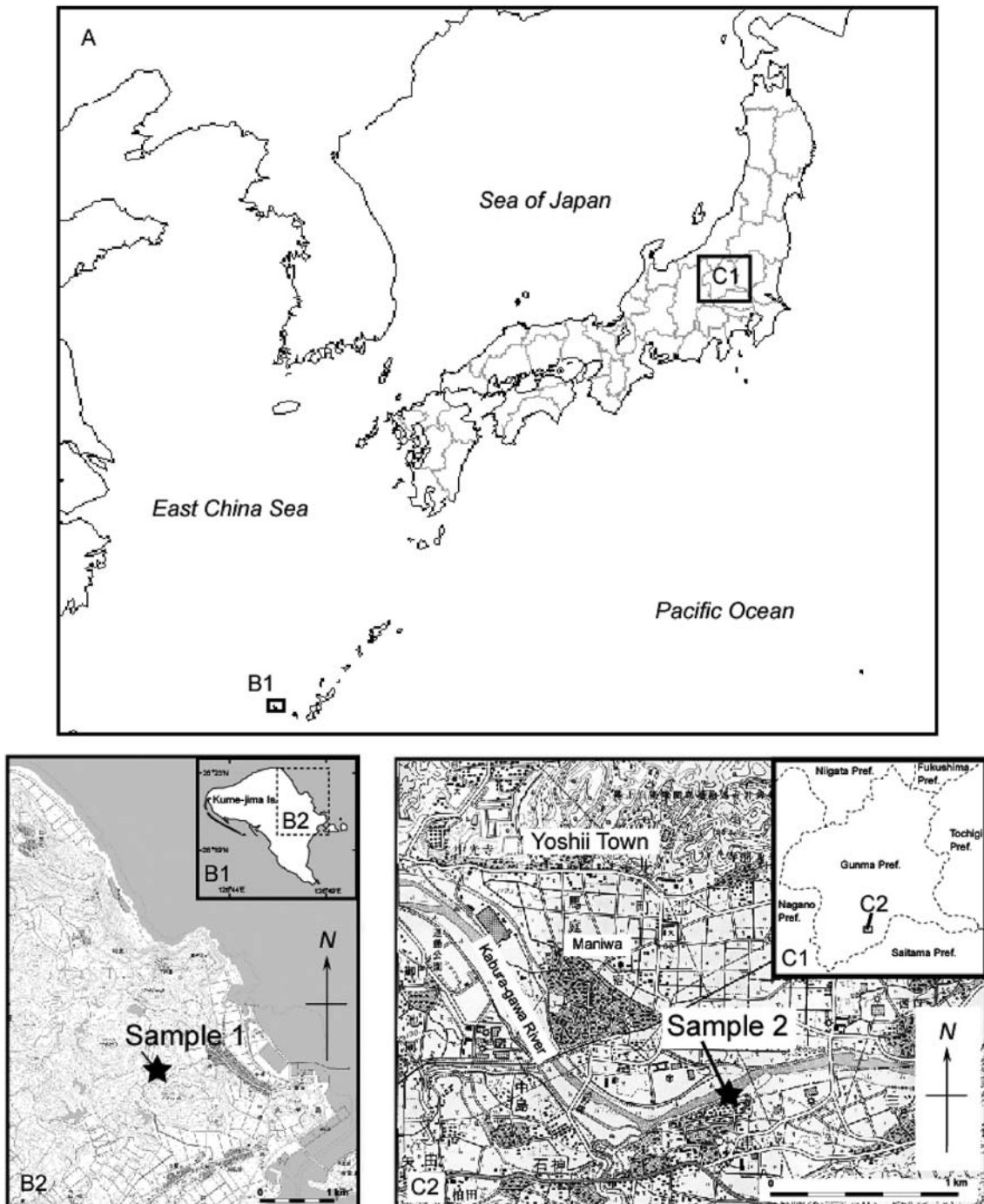


Figure 1. Geographic occurrence of the *Loxoconcha tuberculatus*, sp. nov. *Aurila joushuensis* sp. nov. described in this paper. A. map showing Far East Asia. B. index map showing the type locality of *Loxoconcha tuberculatus* sp. nov. (Kume-jima Island, Okinawa Prefecture, Japan). C. index map showing the type locality of *Aurila joushuensis* sp. nov. (Yoshii Town, Takasaki City, Gunma Prefecture, Japan).

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上部中新統からの日本産介形虫の2新種

田中源吾¹・岩井結香²・上野優貴²・神戸以恋²・古市早紀²・野村真一³

¹〒370-2345 群馬県富岡市上黒岩1674-1 群馬県立自然史博物館
(tanaka@gmnh.pref.gunma.jp)

²〒370-2316 群馬県富岡市富岡118-6 群馬県立富岡東高等学校

³〒299-1606 千葉県富津市数馬229 千葉県立天羽高等学校
(snom@biglobe.ne.jp)

要旨：ロクソコンカ科の1新種 *Loxoconcha tuberculatus* が沖縄県久米島の上部中新統真謝層から記載された。本新種は顕著な性的二形を示し、雄の背甲後部に大きな丸い瘤が特徴的に発達する。本種はこれまでのところ、久米島の上部中新統真謝層のみから報告されている。ヘミシレ科の1新種 *Aurila joushuensis* が群馬県高崎市吉井町の上部中新統板鼻層から記載された。本種は顕著な性的二形を示す。*Aurila joushuensis* はこれまでのところ上部中新統板鼻層からのみ知られている。

キーワード：アウリラ, 板鼻層, 上部中新統, ロクソコンカ, 真謝層, 介形虫

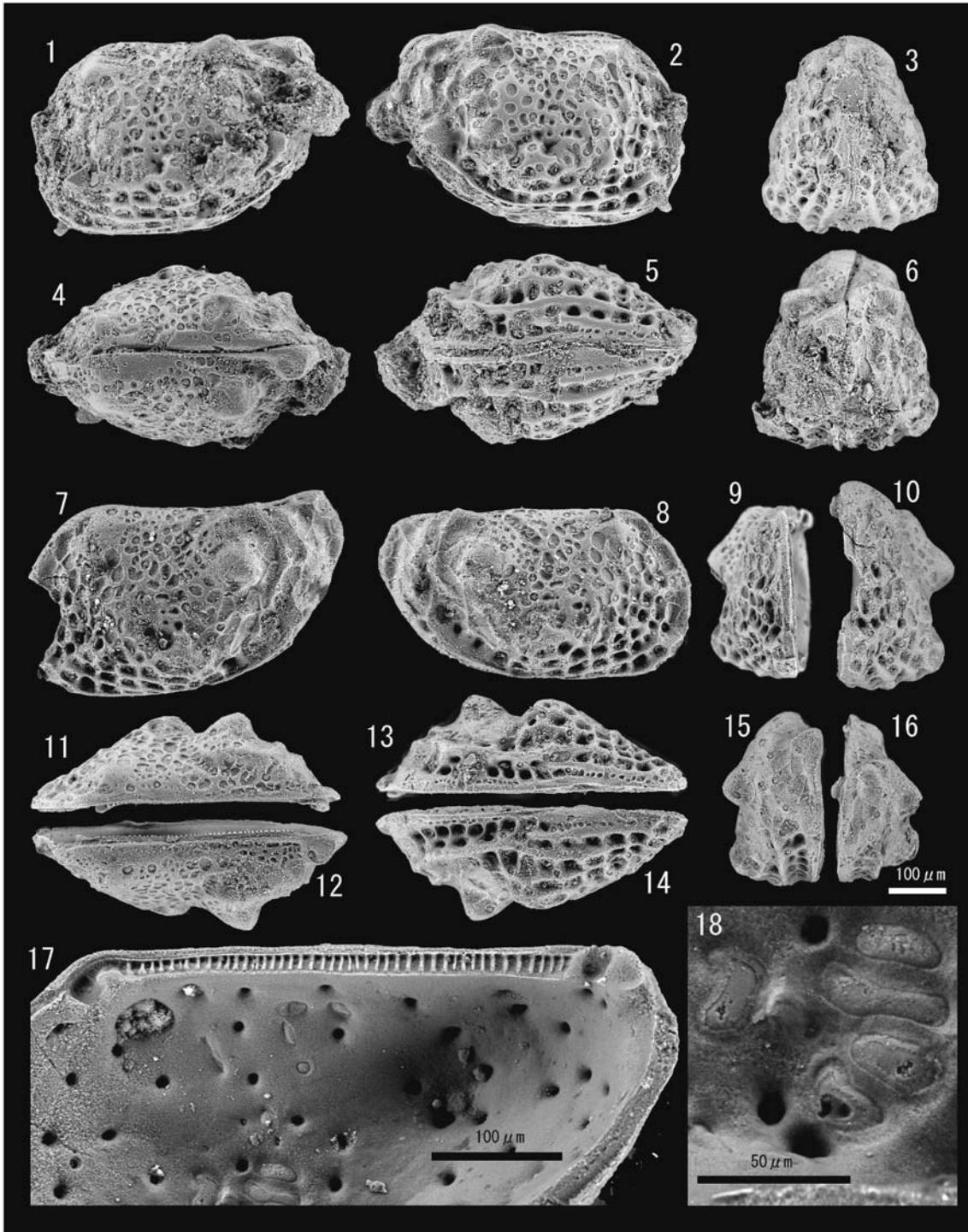


Plate 1. *Loxoconcha tuberculatus* sp. nov. from the Late Miocene Maja Formation, Kume-jima Island, Okinawa Prefecture, Japan. 1-6: carapace of female, (holotype: GMNH-PI-3162); 1, left lateral view; 2, right lateral view; 3, anterior view; 4, dorsal view; 5, ventral view; 6, posterior view. 7-18: valves of male, (8, 9, 11, 13, 16, 17, 18: allotype: GMNH-PI-3163; 7, 10, 12, 14, 15. paratype: GMNH-PI-3164); 7, left lateral view; 8, right lateral view; 9, anterior view of right valve; 10, anterior view of left valve; 11, dorsal view of right valve; 12, dorsal view of left valve; 13, ventral view of right valve; 14, ventral view of left valve; 15, posterior view of left valve; 16, posterior view of right valve; 17, inner view of right valve; 18, adductor muscle and mandibular scars of right valve.

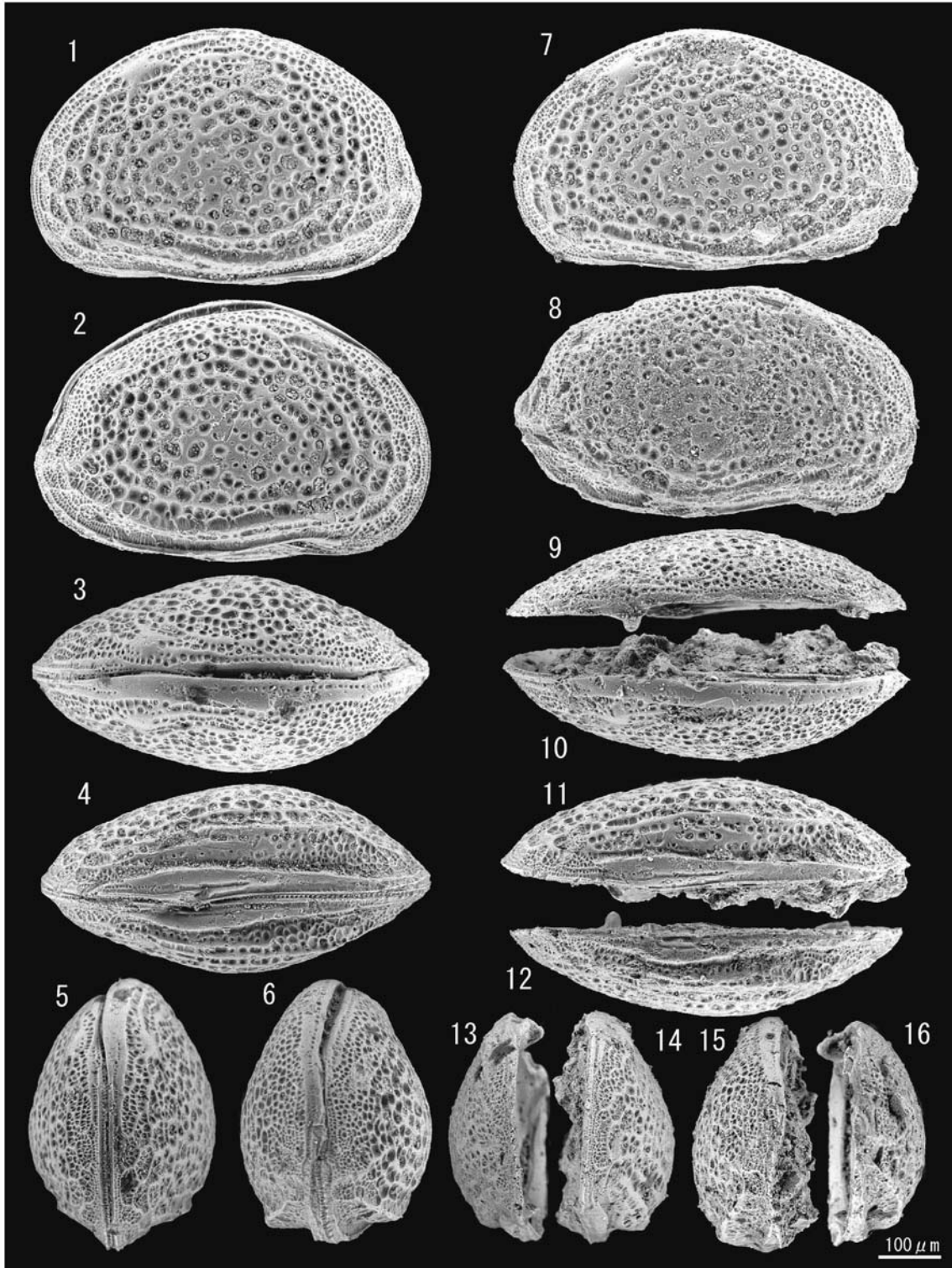


Plate 2. *Aurila joushuensis* sp. nov. from the Late Miocene Itahana Formation, Yoshii Town, Kanra County, Gunma Prefecture, Japan. 1-6: carapace of female, (holotype: GMNH-PI-4001) ; 1, left lateral view; 2, right lateral view; 3, dorsal view; 4, ventral view; 5, anterior view; 6, posterior view. 7-16: valves of male, (8, 9, 11, 13, 16: allotype: GMNH-PI-4002; 7, 10, 12, 14, 15: paratype: GMNH-PI-4003) ; 7, left lateral view; 8, right lateral view; 9, dorsal view of right valve; 10, dorsal view of left valve; 11, ventral view of left valve; 12, ventral view of right valve; 13, anterior view of right valve; 14, anterior view of left valve; 15, posterior view of left valve; 16, posterior view of right valve.