

Original Article

Re-examination of type specimens, Miocene and Pliocene ostracods
from the Sendai Area (by Ishizaki, 1966)

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Abstract: Thirty ostracod type species from the Miocene and Pliocene deposits from Sendai area described by Ishizaki (1966) were re-examined by SEM using non-evaporation coating. On the basis of morphological features of the valve, these species were categorized into 23 genera under 9 families. The present review provide a checklist that will be useful in classifying Neogene ostracod fossils from Japan and its adjacent regions.

Key Words: Ishizaki, Miocene, non evaporation coating, Pliocene, Type specimen

Introduction

Miocene and Pliocene ostracods from Japan were first described by Professor Emeritus Kunihiko Ishizaki of Tohoku University in 1963 and 1966. There also exist pioneering investigations of Cenozoic ostracod assemblages from Japan. Many Japanese ostracodologists have cited Ishizaki's work in their investigation of fossil assemblage, as well as descriptions of new species, paleoenvironment, paleobiogeographic relationships, etc. (e.g., Irizuki *et al.*, 1998; Tanaka *et al.*, 2002). Tanaka *et al.* (2004) provided SEM photographs illustrating Middle Miocene ostracods from the Sunagozaka Formation exposed along the Aiodani valley, which is close to the type locality investigated by Ishizaki (1963). Ishizaki (1966) described 30 new species from the Sendai area of northern Japan using optical microphotographs. Although these microphotographs were considered as high-quality images during that time, SEM studies allowed comparison of the fine details of carapace characters with those of other ostracod specimens from Neogene localities. Puri and Hulings (1976) re-investigated Brady's (1880) specimen by using photographs and designed lectotype. Their study had a powerful influence on later generations of ostracodologists when many scientists make a comparison between their investigated ostracod specimens and the Brady's (1880) type specimens. Here I have re-examined Ishizaki's (1966) type specimens by SEM nonevaporation coating. I have also evaluated the systematic position of Ishizaki's (1966) type specimens on the bases of these SEM images and the information from previous studies such as Hanai *et al.* (1977) and Yamaguchi (2003), and I have provided a checklist of these species by adding references of the studies published since Ishizaki's work in 1966. This re-examination will be helpful in identifying Miocene ostracods from the Tomioka Group, which is widely distributed in the southwestern part of Gunma Prefecture and is now being explored by staff members of the Gunma Museum of Natural History.

Materials and Methods

Each type specimen was mounted on stubs, and viewed using a JEOL JSM-6100 scanning electron microscope at 1 kV at Kyoto University Museum. All type specimens have been deposited in Tohoku University Museum (IGPS-number).

Systematics

Order Podocopida Sars, 1866
Superfamily Cytheroidea Baird, 1850
Family Eucytheridae Puri, 1954
Genus *Kotoracythere* Ishizaki, 1966
Kotoracythere abnormalis Ishizaki, 1966
Pl. I, fig. 1 (Holotype, IGPS-87008)

Kotoracythere abnormalis Ishizaki, 1966: p. 152, pl. 18, figs. 10-12, text-fig. 1, fig. 9; Hanai *et al.*, 1977, p. 28; Irizuki *et al.*, 2001, fig. 18-1; Yamaguchi and Hayashi, 2001, fig. 6-4.

Non *Kotoracythere abnormalis* Ishizaki, 1966: Huh and Paik, 1992a, b, pl. 1, figs. 2, 3. Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation, Kubota Formation).

Kotoracythere tatsunokuchiensis Ishizaki, 1966
Pl. I, figs. 2, 3 (Holotype, IGPS-87014)

Kotoracythere tatsunokuchiensis Ishizaki, 1966: p. 152, 153, pl. 18, figs. 13, 14, text-fig. 1, fig. 8; Hanai *et al.*, 1977, p. 28.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation).

Genus *Munseyella* van den Bold, 1957
Munseyella hatatensis Ishizaki, 1966
Pl. I, figs. 4, 5 (Holotype, IGPS-87030)

Munseyella hatatensis Ishizaki, 1966: p. 153, pl. 19, fig. 12; Ishizaki, 1971, p. 92, pl. 4, figs. 5, 6; Hanai *et al.*, 1977, p. 28; Ishizaki and Matoba, 1985, pl. 5, fig. 3; Cronin and Ikeya, 1987, p. 76, pl. 3, fig. 16; Paik and Lee, pl. 1, fig. 6; Ikeya and Itoh, 1992, fig. 19A; Lee and Paik, 1992, pl. 2, fig. 2; Irizuki, 1994, p. 8, pl. 1, fig. 2; Kamiya *et al.*, 1996, pl. 2, fig. 3; Ozawa, 1996, pl. 7-2; Yamaguchi and Hayashi, 2001, fig. 6-7; Yamada *et al.*, 2002, pl. 1, fig. 7; Ozawa, 2006, fig. 1-13; Irizuki and Ishida, 2007, fig. 3-1; Irizuki *et al.*, 2007, fig. 7-1.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Fujikotogawa Formation, Hatatate Formation, Kubota Formation), Pliocene (Kuwa Formation, Sasaoka Formation), Plio-Pleistocene (Junicho Formation, Omma Formation, Setana Formation, Sogwipo Formation, Tomikawa Formation), Pleistocene (Anden Formation, Sasaoka Formation, Shibikawa Formation), Recent (Aomori Bay, Sendai Bay).

Family Cytheruridae G. W. Müller, 1894
Genus *Eucytherura* G. W. Müller, 1894
Eucytherura neoalae (Ishizaki, 1966)
Pl. I, figs. 6, 7 (Holotype, IGPS-85850)

Cytheropteron neoalae Ishizaki, 1966: p. 139, 140, pl. 17, figs. 6, 7.

Eucytherura neoalae (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 54, 55.

Non *Eucytherura neoalae* (Ishizaki, 1966) : Irizuki *et al.*, 2001, fig. 18-17; Yamaguchi and Hayashi, 2001, fig. 5-14.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Genus *Cytheropteron* Sars, 1866
Cytheropteron sendaiense Ishizaki, 1966
Pl. I, figs. 8, 9 (Holotype, IGPS-85854)

Cytheropteron sendaiense Ishizaki, 1966: p. 140, pl. 17, figs. 13, 14; Hanai *et al.*, 1977, 59.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Genus *Semicytherura* Wagner, 1957
Semicytherura neosubundata (Ishizaki, 1966)
Pl. I, figs. 10, 11 (Holotype, IGPS-85861)

Cytherura neosubundata Ishizaki, 1966: p. 138, 139, pl. 17, fig. 21, text-fig. 1, fig. 2.

Semicytherura neosubundata (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 57.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation).

Genus *Howeina* Hanai, 1957 (Hanai, 1957b in reference)
Howeina neoleptocytheroidea (Ishizaki, 1966)
Pl. I, figs. 12, 13 (Holotype, IGPS-85858)

Cytherura neoleptocytheroidea Ishizaki, 1966: p. 138, pl. 17, figs. 19, 20.

Howeina neoleptocytheroidea (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 56; Irizuki, 1994, p. 12, pl. 2, figs. 10, 11.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Miocene (Fujikotogawa Formation), Pliocene (Tatsunokuchi Formation).

Family Paracytherideidae Puri, 1957
Genus *Paracytheridea* G. W. Müller, 1894
Paracytheridea neolongicaudata Ishizaki, 1966
Pl. II, fig. 1 (Holotype, IGPS-87049)

Paracytheridea neolongicaudata Ishizaki, 1966: p. 141, pl. 19, figs. 20-22; Hanai *et al.*, 1977, p. 60.

Non *Paracytheridea neolongicaudata* Ishizaki, 1966; Ishizaki and Matoba, 1985, pl. 5, fig. 18; Kamiya and Nakagawa, 1993, pl. 5, fig. 4; Irizuki *et al.*, 2001, fig. 8-8; Kamiya *et al.*, 2001, fig. 18-5; Yamaguchi and Hayashi, 2001, fig. 6-9; Hu and Tao, 2008, p. 432, pl. 30, fig. 8, pl. 39, fig. 19, pl. 49, figs. 3, 6, pl. 71, fig. 19, pl. 121, fig. 5.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Family Loxoconchidae Sars, 1925
Genus *Loxoconcha* Sars, 1866
Loxoconcha kitoraformum (Ishizaki, 1966)
Pl. II, figs. 2, 3 (Holotype, IGPS-87024)

Loxocornuculum kitoraformum Ishizaki, 1966: p. 150, 151, pl. 18, figs. 15, 16; Hanai *et al.*, 1977, p. 65; Irizuki and Yamada, 2004 (in Irizuki *et al.*, 2004), p. 138, pl. 8, figs. 14, 15.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Akeyo Formation, Hatatate Formation, Toyama Formation).

Loxoconcha subkitoraforma Ishizaki, 1966
Pl. II, fig. 4 (Holotype, IGPS-87026)

Loxoconcha subkitoraforma Ishizaki, 1966: p. 150, pl. 19, fig. 5.

Loxoconcha (Loxoconcha) subkitoraforma Ishizaki, 1966: Hanai *et al.*, 1977, p. 63.

Non *Loxoconcha subkitoraforma* Ishizaki, 1966; Ishizaki and Matoba, 1985, pl. 4, fig. 19; Ikeya and Itoh, 1992, fig. 17D; Ishii *et al.*, 2005, fig. 1H; Irizuki and Ishida, 2007, fig. 3-30.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Genus *Palmoconcha* Swain and Gilby, 1974
Palmoconcha saboyamensis (Ishizaki, 1966)
Pl. II, figs. 5, 6 (Holotype, IGPS-87022)

Loxoconcha saboyamensis Ishizaki, 1966: p. 149, 150, pl. 18, figs. 19, 20.

Loxococoncha (Palmoconcha) saboyamensis (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 64.

Non *Loxococoncha (Palmoconcha) saboyamensis* (Ishizaki, 1966) : Cheong *et al.*, 1986, pl. 3, fig. 19.

Non *Palmoconcha saboyamensis* (Ishizaki, 1966) : Irizuki *et al.*, 2007, fig. 5-14.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Family Leptocytheridae Hanai, 1957 (Hanai, 1957a in reference)

Genus *Callistocythere* Ruggieri, 1953

Callistocythere gorokuensis Ishizaki, 1966

Pl. II, figs. 7, 8 (Holotype, IGPS-85827)

Callistocythere gorokuensis Ishizaki, 1966 : p. 145, 146, pl. 16, fig. 9; Hanai *et al.*, 1977, p. 30.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation).

Callistocythere hatatensis Ishizaki, 1966

Pl. II, figs. 9, 10 (Holotype, IGPS-85828)

Callistocythere hatatensis Ishizaki, 1966 : p. 146, 147, pl. 16, figs. 8, 10, 11; Hanai *et al.*, 1977, p. 30; Irizuki *et al.*, 2001, fig. 18-2; Yamaguchi and Hayashi, 2001, fig. 5-2.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation, Kubota Formation).

Callistocythere kotorai Ishizaki, 1966

Pl. II, fig. 11 (Holotype, IGPS-85832)

Callistocythere kotorai Ishizaki, 1966 : p. 147, 148, pl. 16, figs. 14, 15; Hanai *et al.*, 1977, p. 30; Irizuki *et al.*, 2001, fig. 18-3; Yamaguchi and Hayashi, 2001, fig. 5-3.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation, Kubota Formation).

Callistocythere rugosoforma Ishizaki, 1966

Pl. II, figs. 12, 13 (Holotype, IGPS-85834)

Callistocythere rugosoforma Ishizaki, 1966 : p. 148, pl. 16, figs. 16, 17; Hanai *et al.*, 1977, p. 31.

Non *Callistocythere rugosoforma* Ishizaki, 1966 : Irizuki *et al.*, 2001, fig. 18-4.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation).

Callistocythere subsetanensis Ishizaki, 1966

Pl. II, fig. 14 (Holotype, IGPS-85837)

Callistocythere subsetanensis Ishizaki, 1966 : p. 149, pl. 16, figs. 18, 19; Hanai *et al.*, 1977, p. 31, 32; Irizuki *et al.*, 2001, fig. 18-5.

Remarks. This species was reported from the Miocene Hata-

tate Formation (type locality).

Occurrence. Miocene (Hatatate Formation, Kubota Formation).

Family Schizocytheridae Mandelstam, 1960

Genus *Paijenborchella* Kingma, 1948

Paijenborchella hatatensis Ishizaki, 1966

Pl. II, fig. 15 (Holotype, IGPS-87039)

Paijenborchella hatatensis Ishizaki, 1966 : p. 154, 155, pl. 19, figs. 16, 17.

Neomonoceratina hatatensis (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 39.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Genus *Neomonoceratina* Kingma, 1948

Neomonoceratina japonica (Ishizaki, 1966)

Pl. II, figs. 16, 17 (Holotype, IGPS-87041)

Paijenborchella japonica Ishizaki, 1966 : p. 155, 156, pl. 19, figs. 14, 15.

Neomonoceratina japonica (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 39.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Genus *Schizocythere* Triebel, 1950

Schizocythere hatatensis Ishizaki, 1966

Pl. II, fig. 18 (Holotype, IGPS-87053)

Schizocythere hatatensis Ishizaki, 1966 : p. 154, pl. 19, figs. 24, 25; Hanai *et al.*, 1977, 36, 37; Yamaguchi and Hayashi, 2001, fig. 6-13; Irizuki *et al.*, 2001, fig. 1-5.

Non *Schizocythere hatatensis* Ishizaki, 1966 : Paik and Lee, 1988, pl. 1, fig. 14.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation, Kubota Formation, Kobana Formation).

Family Krithidae Mandelstam, 1958

Genus *Krithe* Brady, Crosskey, and Robertson, 1874

Krithe antisawanensis Ishizaki, 1966

Pl. III, figs. 1, 2 (Holotype, IGPS-87016)

Krithe antisawanense [sic] Ishizaki, 1966 : p. 137, 138, pl. 18, figs. 17, 24, 25.

Krithe antisawanensis Ishizaki, 1966 : Hanai *et al.*, 1977, p. 26.

Non *Krithe antisawanensis* Ishizaki, 1966 : Lee and Paik, 1992, pl. 1, fig. 17; Ikeya and Suzuki, 1992, pl. 5, fig. 6; Zhou and Ikeya, 1992, p. 1111, 1112, figs. 9-4, 5, fig. 10-4, fig. 3; Irizuki *et al.*, 2007, fig. 5-2.

Remarks. This species was reported from the Miocene Hatatate Formation (type locality).

Occurrence. Miocene (Hatatate Formation).

Family Thaerocytheridae Hazel, 1967
 Genus *Bradleya* Hornibrook, 1952
Bradleya sendaiensis Ishizaki, 1966
 Pl. III, fig. 3 (Holotype, IGPS-85825)

Bradleya sendaiensis Ishizaki, 1966: p. 156, pl. 16, fig. 12.
Bradleya? sendaiensis Ishizaki, 1966: Hanai *et al.*, 1977, p. 47.

Remarks. This species was reported from the Miocene Hata-tate Formation (type locality).

Occurrence. Miocene (Hatata Formation).

Family Hemicytheridae Puri, 1953
 Genus *Aurila* Pokorný, 1955
Aurila pseudoamygdala Ishizaki, 1966
 Pl. III, figs. 4, 5 (Holotype, IGPS-85822)

Aurila pseudoamygdala Ishizaki, 1966: p. 143, pl. 16, figs. 5, 6; Hanai *et al.*, 1977, p. 43.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation).

Genus *Hemicythere* Sars, 1925
Hemicythere gorokuensis Ishizaki, 1966
 Pl. III, figs. 6, 7 (Holotype, IGPS-85862)

Hemicythere gorokuensis Ishizaki, 1966: p. 141, 142, pl. 17, figs. 22, 23; Schornikov, 1974, p. 168, 169, pl. 3, fig. 2, text-fig. 17; Hanai *et al.*, 1977, p. 40, 41.

Non *Hemicythere gorokuensis* Ishizaki, 1966: Ishizaki and Matoba, 1985, pl. 4, fig. 1.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation), Recent (Kunashiri Is., Shikotan Is., Iturup Is. and Kuril Islands).

Genus *Hermanites* Puri, 1955
Hermanites? posterocostatus Ishizaki, 1966
 Pl. III, fig. 8 (Holotype, IGPS-85819)

Hermanites posterocostata [sic] Ishizaki, 1966: p. 159, pl. 18, figs. 4-6.

Hermanites? posterocostatus Ishizaki, 1966: Hanai *et al.*, 1977, p. 48; Irizuki and Yamada, 2004 (in Irizuki *et al.*, 2004), p. 136, pl. 8, fig. 1.

Hermanites posterocostatus Ishizaki, 1966: Yamaguchi and Hayashi, 2001, fig. 6-1.

Remarks. This species was reported from the Miocene Hata-tate Formation (type locality).

Occurrence. Miocene (Akeyo Formation, Hatata Formation, Kubota Formation, Toyama Formation).

Genus *Finmarchinella* Swain, 1963
Finmarchinella japonica (Ishizaki, 1966)
 Pl. III, figs. 9, 10 (Holotype, IGPS-87036)

Nereina japonica Ishizaki, 1966: p. 143, 144, pl. 19, figs. 1-4, text-fig. 1, figs. 3, 4.

Finmarchinella japonica (Ishizaki, 1966) : Irizuki, 1994, p. 10, pl. 1, fig. 15.

Finmarchinella (Barentsovia) japonica (Ishizaki, 1966) : Neale, 1974, p. 92, 93; Hanai *et al.*, 1977, p. 46; Ishizaki and Matoba, 1985, pl. 3, figs. 16, 17.

Non *Finmarchinella japonica* (Ishizaki, 1966) : Ikeya *et al.*, 1985, pl. 3, fig. 14; Yajima, 1988, pl. 2, fig. 5; Ikeya and Itoh, 1991, Fig. 15D; Huh and Paik, 1992a, b, pl. 1, fig. 16; Ozawa, 1996, pl. 4-9; Irizuki *et al.*, 2001, fig. 18-11; Kamiya *et al.*, 2001, fig. 15-13; Yamaguchi and Hayashi, 2001, fig. 5-15; Irizuki and Yamada, 2007, fig. 3-17; Irizuki *et al.*, 2007, fig. 7-5.

Non *Finmarchinella japonica* s. l. (Ishizaki, 1966) : Yamada *et al.*, 2002, pl. 1, fig. 4.

Remarks. This species was reported from the Pliocene Higashimeya Formation (type locality).

Occurrence. Pliocene (Fujikotogawa Formation, Higashimeya Formation), Pleistocene (Shibikawa Formation).

Genus *Cornucoquimba* Ohmert, 1968
Cornucoquimba moniwensis (Ishizaki, 1966)
 Pl. III, figs. 11, 12 (Holotype, IGPS-85868)

Hermanites moniwensis Ishizaki, 1966: p. 158, 159, pl. 18, figs. 1-3.

Cornucoquimba moniwensis (Ishizaki, 1966) : Hanai *et al.*, 1977, p. 47; Ishizaki and Matoba, 1985, pl. 2, fig. 13; Yajima, 1992, p. 262, pl. 32, fig. 6; Irizuki and Ishida, 2007, fig. 3-24.

Non *Cornucoquimba moniwensis* (Ishizaki, 1966) : Cai, 1982, pl. 1, figs. 13-18; Cheong *et al.*, 1986, pl. 2, fig. 13; Yajima, 1988, pl. 1, fig. 6; Ikeya and Itoh, 1991, fig. 13D; Huh and Paik, 1992b, pl. 2, figs. 2, 3; Ozawa *et al.*, 1995, pl. 1, fig. 7; Yamaguchi and Hayashi, 2001, fig. 5-9.

Remarks. This species was reported from the Miocene Moniwa Formation (type locality).

Occurrence. Miocene (Akeyo Formation, Mizunami Group, Moniwa Formation), Pliocene (Sasaoka Formation), Pleistocene (Jizodo Formation, Shibikawa Formation, Yabu Formation).

Genus *Acuticythereis* Edwards, 1944
Acuticythereis? sendaiensis Ishizaki, 1966
 Pl. III, figs. 13, 14 (Holotype, IGPS-87047)

Acuticythereis sendaiensis Ishizaki, 1966: p. 145, pl. 19, figs. 18, 19, text-fig. 1, fig. 6.

Acuticythereis? sendaiensis, 1966: Hanai *et al.*, 1977, p. 48; Ishizaki and Matoba, 1985, pl. 1, figs. 5, 6; Ozawa, 1996, pl. 1-4.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation), Plio-Pleistocene (Omama Formation), Pleistocene (Sasaoka Formation).

Genus *Urocythereis* Ruggieri, 1950
Urocythereis gorokuensis Ishizaki, 1966
 Pl. III, figs. 15, 16 (Holotype, IGPS-87061)

Urocythereis gorokuensis Ishizaki, 1966: p. 144, 145, pl. 19, figs. 9, 10, text-fig. 1, fig. 7; Ishizaki, 1971, p. 83, 84, pl. 3, figs. 4, 5; Ishizaki and Matoba, 1985, pl. 6, fig. 13.

Urocythereis? gorokuensis Ishizaki, 1966: Hanai *et al.*, 1977, p. 46; Tabuki, 1986, pl. 6, figs. 2-17; Ozawa and Kamiya, 2005, fig. 7-16.

Non *Urocythereis gorokuensis* (Ishizaki, 1966) : Ishizaki and Matoba, 1985, pl. 6, figs. 11, 12.

Non *Urocythereis? gorokuensis* (Ishizaki, 1966) : Irizuki, 1994, p. 10, pl. 2, fig. 2; Irizuki *et al.*, 2001, fig. 18-12

Non *Yezocythere gorokuensis* (Ishizaki, 1966) : Yamaguchi and Hayashi, 2001, fig. 5-17.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Pliocene (Tatsunokuchi Formation), Plio-Pleistocene (Daishaka Formation), Pleistocene (Omma Formation, Shibikawa Formation), Recent (Aomori Bay).

Genus *Robertsonites* Swain, 1963

Robertsonites japonicus (Ishizaki, 1966)

Pl. III, figs. 17, 18 (Holotype, IGPS-87046)

Buntonia japonica Ishizaki, 1966: p. 156, 157, pl. 19, figs. 6, 7, text-fig. 1, fig. 5; Huh and Paik, 1992a, b, pl. 2, figs. 12.

Buntonia? japonica Ishizaki, 1966: Hanai *et al.*, 1977, p. 52.

Robertsonites japonicus (Ishizaki, 1966) : Tanaka, 2002 (in Tanaka *et al.*, 2002), p. 13, fig. 8.6.

Remarks. This species was reported from the Pliocene Tatsunokuchi Formation (type locality).

Occurrence. Miocene (Fujina Formation, Yeonil Group), Pliocene (Tatsunokuchi Formation).

Robertsonites reticuliformis (Ishizaki, 1966)

Pl. III, figs. 19, 20 (Holotype, IGPS-85826)

Buntonia reticuliformis Ishizaki, 1966: p. 157, 158, pl. 16, fig. 7, text-fig. 1, fig. 1; Tabuki, 1986, p. 91-93, pl. 14, figs. 1-12, text-figs. 17-1, 2; Cronin and Ikeya, 1987, p. 84, pl. 2, fig. 15; Yajima and Lord, 1990, fig. 4-9; Huh and Paik, 1992a, b, pl. 2, fig. 13; Irizuki, 1996, figs. 7-3, 4; Ozawa, 1996, pl. 8, fig. 6.

Buntonia? reticuliformis Ishizaki, 1966: Hanai *et al.*, 1977, p. 53.

Remarks. This species was reported from the Miocene Hata-tate Formation (type locality).

Robertsonites? reticuliformis (Ishizaki, 1966) [sic]: Yajima, 1982, p. 205, pl. 12, fig. 13.

Robertsonites reticuliformis (Ishizaki, 1966) : Tanaka, 2002 (in Tanaka *et al.*, 2002), p. 13, 15, fig. 8.7.

Non *Robertsonites reticuliformis* (Ishizaki, 1966) : Tabuki, 1986, pl. 14, figs. 1-12; Ikeya and Suzuki, 1992, pl. 8, fig. 6; Irizuki, 1994, p. 10, pl. 2, figs. 4-6; Kamiya *et al.*, 1996, pl. 3, fig. 6; Ozawa, 1996, pl. 8-6.

Occurrence. Miocene (Fujina Formation, Hatatate Formation, Yeonil Group), Pliocene (Tentokuji Formation), Plio-Pleistocene (Daishaka Formation, Omma Formation), Pleistocene (Sasaoka Formation, Shimosa Group, Wakimoto Formation).

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仙台地域における中新統および鮮新統の介形虫群の模式標本 (Ishizaki, 1966) の再検討

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要旨： Ishizaki (1966) によって仙台地域の中新統および鮮新統の堆積物から記載された30種の介形虫種が無常着の走査型電子顕微鏡によって再調査された。殻の形態学的特徴から、これらの種は9科23属から構成されることが明らかになった。本チェックリストは、日本および周辺地域の新第三紀介形虫化石を分類する際にも重要なデータである。

キーワード： 石崎, 中新統, 無常着, 鮮新統, 模式標本

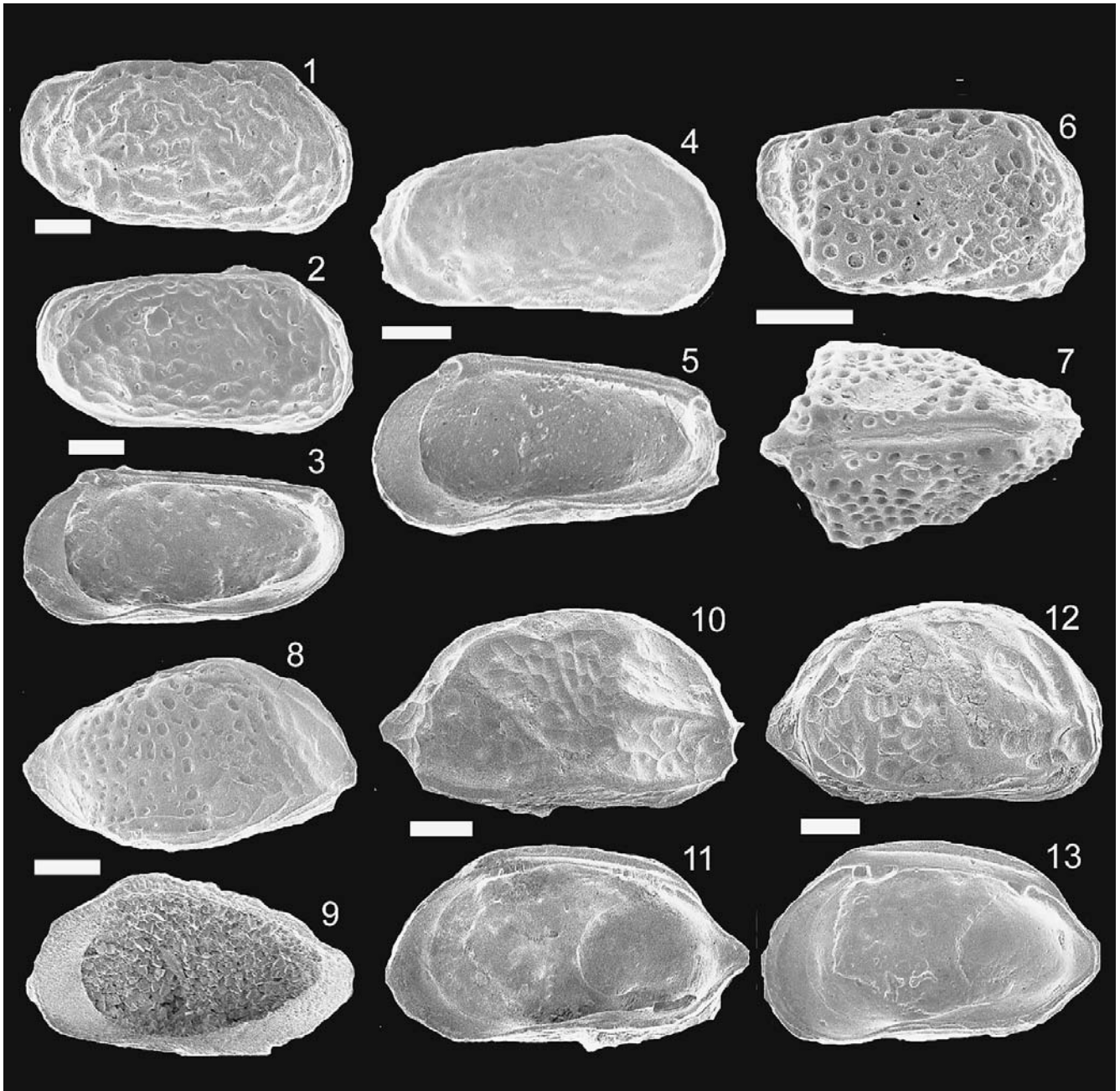


Plate I

Plate I

SEM images of eucytherid and cytherurid holotype specimens described by Ishizaki (1966).

Fig.1. *Kotoracythere abnormalis* Ishizaki, 1966 (IGPS-87008); outer lateral view of the right valve.

Figs.2, 3. *Kotoracythere tatsunokuchiensis* Ishizaki, 1966 (IGPS-87014); outer lateral view (Fig.2) and inner lateral view (Fig.3) of the right valve.

Figs.4, 5. *Munseyella hatatensis* Ishizaki, 1966 (IGPS-87030); outer lateral view (Fig.4) and inner lateral view (Fig.5) of the right valve.

Figs.6, 7. *Eucytherura neolae* (Ishizaki, 1966) (IGPS-85850); outer right lateral view (Fig.6) and outer dorsal view (Fig.7) of the carapace.

Figs.8, 9. *Cytheropteron sendaiense* Ishizaki, 1966 (IGPS-85854); outer lateral view (Fig.8) and inner lateral view (Fig.9) of the right valve.

Figs.10, 11. *Semicytherura neosubundata* (Ishizaki, 1966) (IGPS-85861); outer lateral view (Fig.10) and inner lateral view (Fig.11) of the right valve.

Figs.12, 13. *Howeina neoleptocytheroidea* (Ishizaki, 1966) (IGPS-85858); outer lateral view (Fig.12) and inner lateral view (Fig.13) of the right valve. Scale bar represents 100 μ m.

Plate II

SEM images of paracytherideid, loxoconchid, leptocytherid and schizocytherid holotype specimens described by Ishizaki (1966) .

Fig.1. *Paracytheridea neolongicaudata* Ishizaki, 1966 (IGPS-87049) ; outer lateral view of the left valve.

Figs.2, 3. *Loxoconcha kotoriformum* Ishizaki, 1966 (IGPS-87024) ; outer lateral view (Fig.2) and inner lateral view (Fig.3) of the left valve.

Fig.4. *Loxoconcha subkotoriforma* Ishizaki, 1966 (IGPS-87026) ; outer lateral view of the left valve.

Figs.5, 6. *Palmoconcha saboyamensis* (Ishizaki, 1966) (IGPS-87022) ; outer right lateral view (Fig.5) and outer dorsal view (Fig.6) of the carapace.

Figs.7, 8. *Callistocythere gorokuensis* Ishizaki, 1966 (IGPS-85827) ; outer lateral view (Fig.7) and inner lateral view (Fig.8) of the left valve.

Figs.9, 10. *Callistocythere hatatensis* Ishizaki, 1966 (IGPS-85828) ; outer lateral view (Fig.9) and inner lateral view (Fig.10) of the right valve.

Fig.11. *Callistocythere kotorai* Ishizaki, 1966 (IGPS-85832) ; outer lateral view of right valve.

Figs.12, 13. *Callistocythere rugosoforma* Ishizaki, 1966 (IGPS-85834) ; outer lateral view (Fig.12) and outer dorsal view (Fig.13) of carapace.

Fig.14. *Callistocythere subsetanensis* Ishizaki, 1966 (IGPS-85837) ; outer lateral view of right valve.

Fig.15. *Paijenborchella hatatensis* Ishizaki, 1966 (IGPS-87039) ; outer lateral view of left valve.

Figs.16, 17. *Neomonoceratina japonica* (Ishizaki, 1966) (IGPS-87041) ; outer lateral view (Fig.16) and inner lateral view (Fig.17) of the left valve.

Fig.18. *Schizocythere hatatensis* Ishizaki, 1966 (IGPS-87053) ; outer lateral view of the left valve. Scale bar represents 100 μ m.

Plate III

SEM images of krithid, thaerocytherid, and hemicytherid holotype specimens described by Ishizaki (1966) .

Figs.1, 2. *Kritha antisawanensis* Ishizaki, 1966 (IGPS-87016) ; outer lateral view (Fig.1) and inner lateral view (Fig.2) of the right valve.

Fig.3. *Bradleya sendaiensis* Ishizaki, 1966 (IGPS-85825) ; outer lateral view of the right valve.

Figs.4, 5. *Aurila pseudoamygdala* Ishizaki, 1966 (IGPS-85822) ; outer right lateral view (Fig.4) and outer dorsal view (Fig.5) of the carapace.

Figs.6, 7. *Hemicythere gorokuensis* Ishizaki, 1966 (IGPS-85862) ; outer lateral view (Fig.6) and inner lateral view (Fig.7) of the right valve.

Fig. 8. *Hermanites? posterocostatus* Ishizaki, 1966 (IGPS-85819) ; outer lateral view of the right valve.

Figs.9, 10. *Finmarchinella japonica* (Ishizaki, 1966) (IGPS-87036) ; outer lateral view (Fig.9) and inner lateral view (Fig.10) of the left valve.

Figs.11, 12. *Cornucoquimba moniwensis* (Ishizaki, 1966) (IGPS-85868) ; outer right lateral view (Fig.11) and outer dorsal view (Fig.12) of the carapace.

Figs.13, 14. *Acuticythereis? sendaiensis* Ishizaki, 1966 (IGPS-87047) ; outer lateral view (Fig.13) and inner lateral view (Fig.14) of the right valve.

Figs.15, 16. *Urocythereis gorokuensis* Ishizaki, 1966 (IGPS-87061) ; outer lateral view (Fig.15) and inner lateral view (Fig.16) of the right valve.

Figs.17, 18. *Robertsonites japonicus* (Ishizaki, 1966) (IGPS-87046) ; outer lateral view (Fig.17) and inner lateral view (Fig.18) of the right valve.

Figs.19, 20. *Robertsonites reticuliformus* (Ishizaki, 1966) (IGPS-85826) ; outer lateral view (Fig.19) and inner lateral view (Fig.20) of the right valve. Scale bar represents 100 μ m.

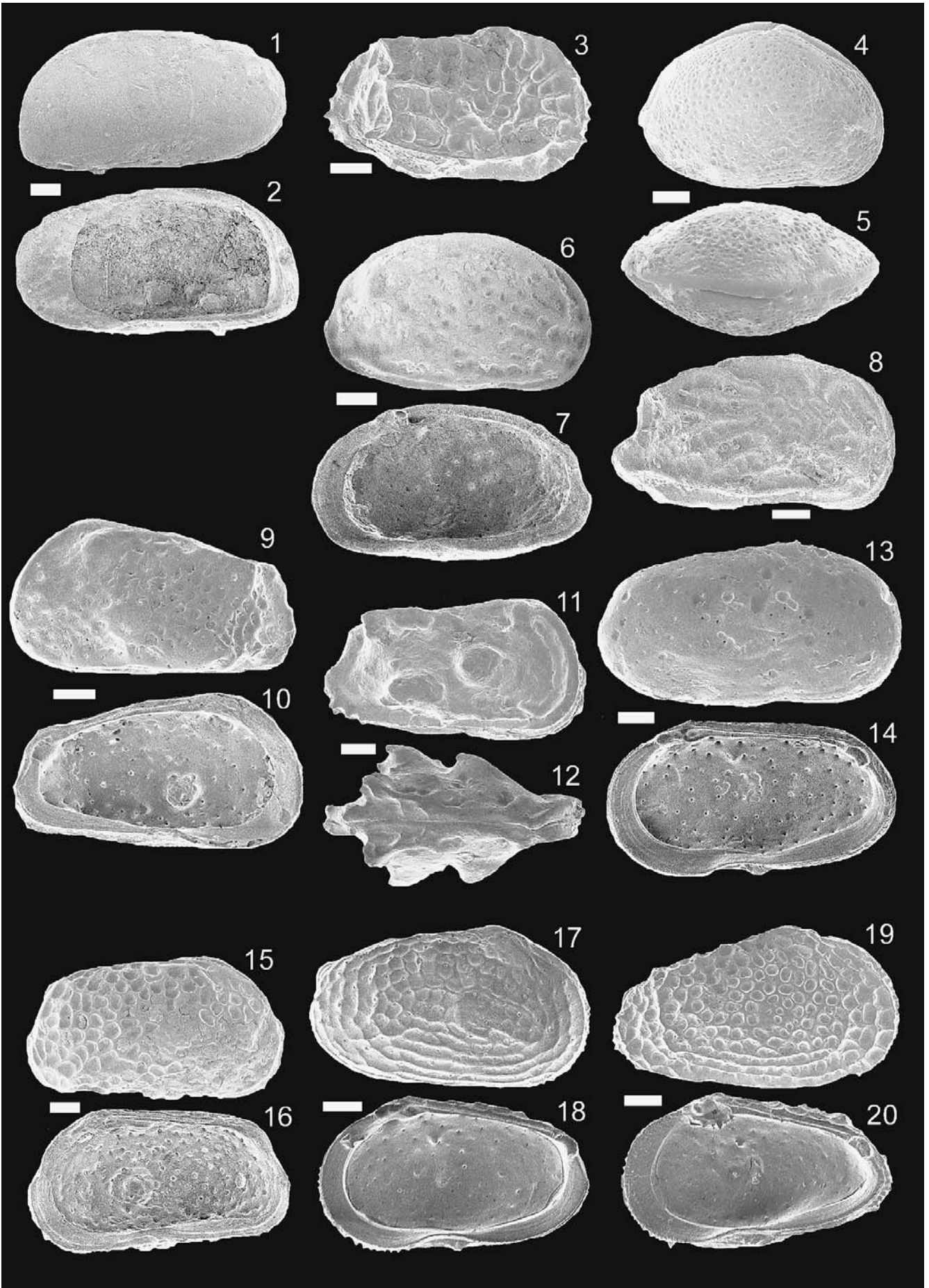


Plate II

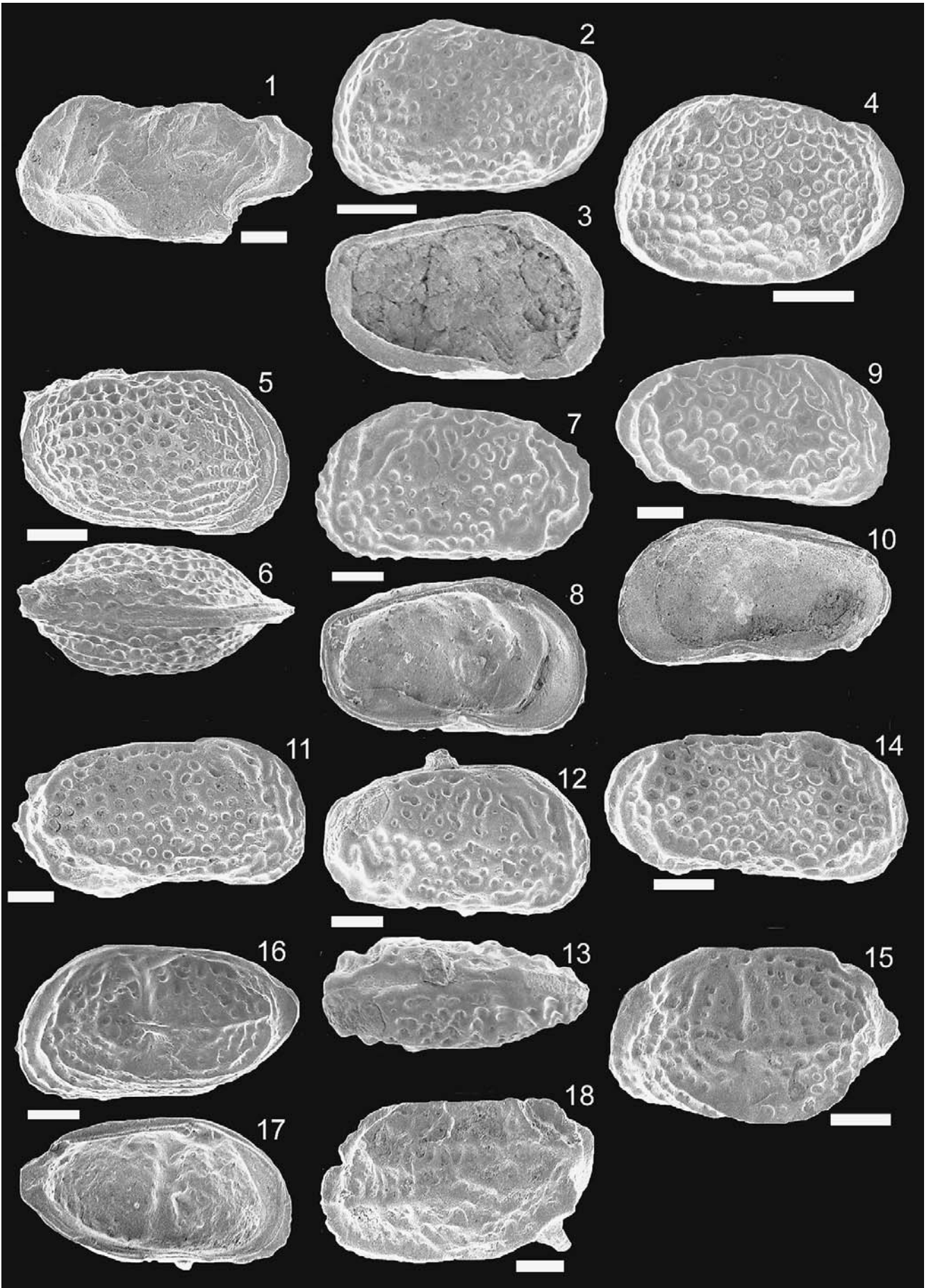


Plate III