Bulletin of the Mizunami Fossil Museum, no. 34 (2008), p. 23–30, 3 figs.

Decapoda and Isopoda (Crustacea) from the Pliocene Shimajiri Group in the Miyako-jima island, Ryukyus, Japan

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Abstract

Eight species of decapods and *Bathynomus* sp. (Isopoda: Cirolanidae) are described and figured from the Pliocene Shimajiri Group in the Miyako-jima island, southwestern Ryukyus, Japan. *Portunus* (*Monomia*) *miyaku* sp. nov. represents the first record for the genus *Portunus* from the Japanese Neogene. *Bathynomus* sp. belongs to the "supergiant group" (Lowry and Dempsey, 2006) which has not yet known from the present seas of Japan.

Key words: Crustacea, Decapoda, Brachyura, Isopoda, Shimajiri Group, Pliocene, Japan.

Introduction

During the course of paleontological studies of the Shimajiri Group in the Miyako-jima island, southwestern Ryukyus, Japan, junior author collected decapod and isopod fossils from the Onogoshi and Yonahama formations. After that, the senior author has obtained additional materials from the Oura and Onogoshi formations. Eight species including one new species in eight genera of decapods and one isopod species are represented in our collections. The purpose of this work is to describe and figure these crustaceans from the Shimajiri Group.

The described specimens are housed in the Mizunami Fossil Museum (MFM).

Locality and Geology

The Geologic sketch map and fossil localities are shown in Fig. 1. The Mio–Pliocene Shimajiri Gorup in the Miyako-jima island mainly crops out along the coast of the island and is unconformably covered by the Pleistocene Ryukyu Group (the "Ryukyu Limestone"). The Shimajiri Group is divided into the Oura, Onogoshi, Yonahama, and Minebari formations, in ascending order (Nakamori, 1982). The Oura Formation mainly consists of sandstone in its lower part and alternating beds of sandstone and siltstone in its upper part. The lower part intercalates *Crassostrea gigas* beds and the upper part yields abundant shallow-marine molluscan fossils (Nakamori, 1982; Ogasawara and Masuda, 1983; Sato et al., 1986). The geologic age is assigned to latest Miocene to early Pliocene: N17 (Yazaki and Oyama, 1980), N18 and N19 (Nakamori, 1982), lower and upper PL1 (Ujiié, 1994) on the planktonic foraminiferal biostratigraphy. The Onogoshi Formation is mainly composed of massive siltstone yielding lower sublittoral molluscan fossils (Nakamori, 1982; Ogasawara and Masuda, 1983; Sato et al., 1986), and its age is assigned to early Pliocene: N18 (Yazaki and Oyama, 1980), N18–20 (Nakamori, 1982), and upper PL1 to lower PL2 (Ujiié, 1994). The Yonahama Formation is also composed of massive siltstone as the Onogoshi Formation, but yields bathyal molluscan fossils (Nakamori, 1982; Ogasawara and Masuda, 1983). Its age is assigned to N18–20 (Yazaki and Oyama, 1980), N20–N21 (Nakamori, 1982), and upper PL2 to PL5/6 (Ujiié, 1994). The Minebari Formation consists of rhythmical alternating beds of sandstone and siltstone in the southwestern coast area, but massive siltstone in the southern coast area. The age is late Pliocene to Pleistocene: N21–22 (Yazaki and Oyama, 1980), N21 (Nakamori, 1982), and PL5/6 to N22 (Ujiié, 1994). The massive siltstone in the southern coast intercalates silty sandstone rich in bathyal molluscan fossils such as *Malletia shinzatoensis*, *Limopsis* sp., and *Fulgoraria* sp.

We collected decapod and isopod fossils from the three localities: Loc. SMJ-1 (Yonahama Formation), Loc. SMJ-2 (Onogoshi Formatio), and Loc. SMH-3 (Oura Formation). Lithology and associated molluscan fossils at each locality are described below.

Locality SMJ-1 (Yonahama Formation): 24° 46′ 43″ N, 125° 23′ 24″ E (JDG). A small coast-cliff (5 to 6 m high, about 10 m wide), about 1 km northwest from the Urasoko beach. Grey massive sandy siltstone, over 7 m in thickness, intercalating a white fine-grained tuff, 3 cm thick. Molluscan fossils are rare. A conjoined valve of "*Parathyasira*" sp. and several pteropod shells were obtained.

Locality SMJ-2 (Onogoshi Formation): 24° 49′ 1″ N, 125° 19′ 42″ E (JDG). A ground surface of vacant land, about 10 m (NE–SW) and 3 m (NW–SE) in area, about 880 m southwest from the

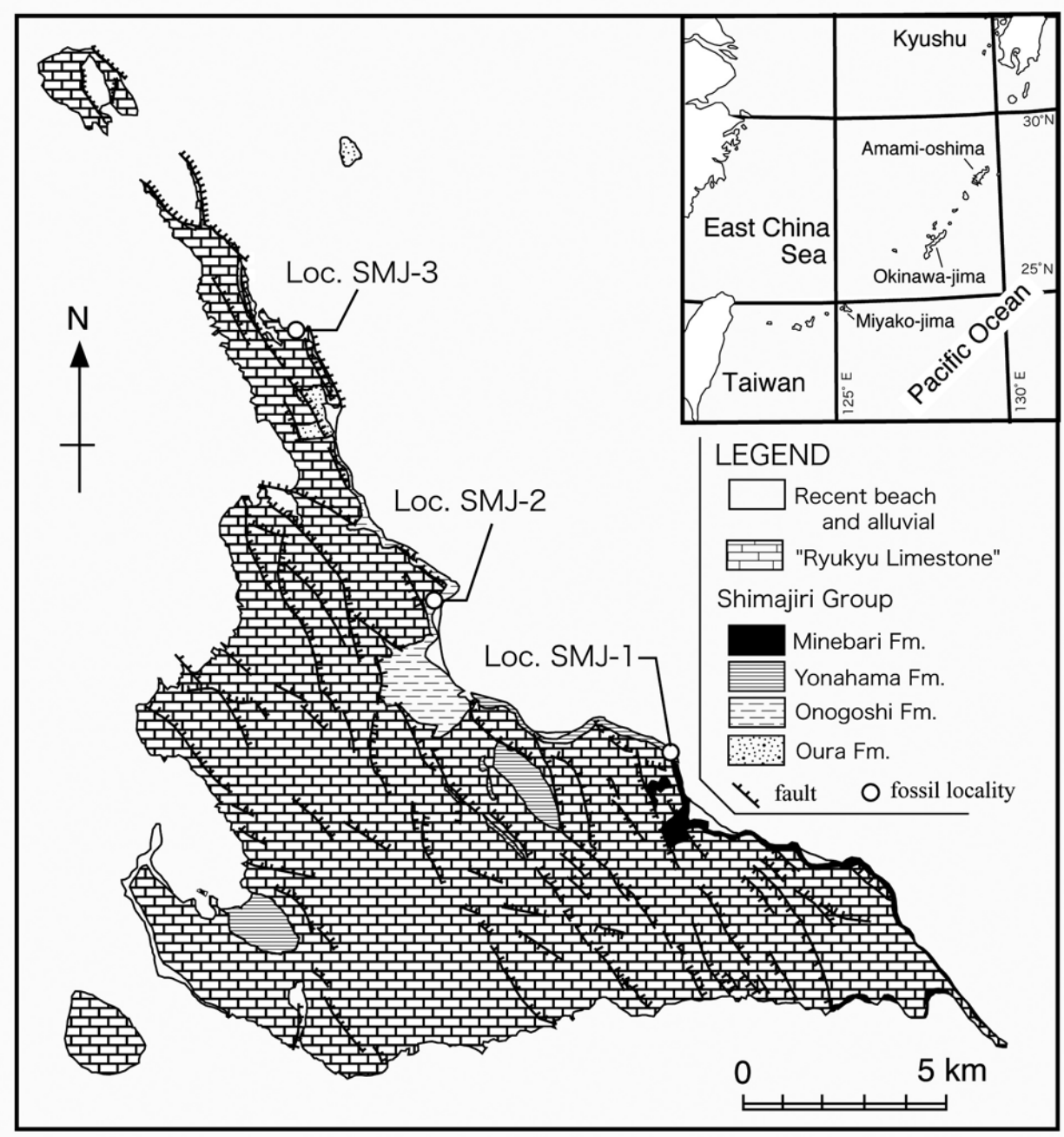


Fig. 1. Geologic sketch map (compiled after Nakamori, 1982) with fossil localities in this study.

cape Pisseoganzaki. A fine to medium-grained sandstone bed is exposed on the surface and covers grey massive clayey siltstone. The sandstone is poorly sorted and contains abundant rip-up clasts of siltstone. The sandstone yields abundant flat-elliptical nodules, about 4 cm in oval short diameter and 8 cm in maximum oval length diameter, which frequently contains decapod fossils. The surface of nodules is densely sculptured by abundant meandering borings. Molluscan fossils are also abundant in the sandstone beds. Outer shelf dwellers are common, such as *Acesta goliath*, *Paphia exilis*, and *Lischkeia alwinae*.

Locality SMJ-3 (Oura Formation): 24° 52′ 38″ N, 125° 17′ 38″ E (JDG). A small road-cut cliff, about 5 m high, along the Shimajiri fishery harbor. Fine-grained sandstone, about 3.5 m thick, is exposed and covered by massive siltstone, over 2 m thick. The fine-grained sandstone intercalates many thin siltstone layers, which are intensely bioturbated and laterally pinches out. The uppermost part of the sandstone bed is fossiliferous. Shells are well-preserved and conjoined bivalves are common. *Turritella filiorarta* is dominant and forms a shell-concentrated bed. *Amussium pleuronectes* and *Onustus exutus* are commonly associated. All the consititute mollusks are upper sublittoral elements.

Systematics

Order Decapoda Latreille, 1802
Suborder Reptantia Boas, 1880
Infraorder Brachyura Latreille, 1802
Section Eubrachyura de Saint Laurent, 1980
Superfamily Dorippoidea MacLeay, 1838
Family Dorippidae MacLeay, 1838
Subfamily Dorippinae MacLeay, 1838
Genus *Paradorippe* Serène and Romimohtaro, 1969

***Paradorippe* sp.**

(Figs. 2-12, 13)

Material examined: MFM142439, 142440 from Loc. SMJ-2.

Remarks: The specimens are represented by a broken carapace, male thoracic sternum, and male abdomen. The specific identification of this species awaits the discovery of a well preserved carapace. The genus is known from the Pleistocene Shimosa Group (Kato and Karasawa, 1998).

Superfamily Calappoidea de Haan, 1833
Family Calappidae de Haan, 1833
Genus *Calappa* Weber, 1795

***Calappa pustulosa* Alcock, 1896**

(Figs. 2-10, 11, 14)

Material examined: MFM142441–142443 from Loc. SMJ-2.

Remarks: The present range of this species extends from Japan to China, Philippines, and India, at depths of between 40–165 m (Galil, 1997). In the carapace characters *C. pustulosa* is quite similar to two fossil species, *Calappa sanguranensis* Van Straelen, 1938, from the Miocene–Pliocene of Java and *Calappa chungi* Hu and Tao, 1984, from the upper Miocene of Taiwan.

Genus *Mursia* Desmarest, 1823

***Mursia* sp. aff. *M. australiensis* Campbell, 1971**

(Figs. 2-7, 9)

Material examined: MFM142444, 142445 from Loc. SMJ-2.

Remarks: This species is recorded from the upper Pliocene Kakegawa Group and Masuda Formation (Karasawa, 1997).

Superfamily Majoidea Samouelle, 1819
Family Pisidae Dana, 1851
Genus *Chorilia* Dana, 1851

***Chorilia? yui* Hu, 1984**

(Figs. 2-8, 15–17)

Material examined: MFM142446–142449 from Loc. SMJ-2.

Description: Carapace pyriform, strongly convex transversely and longitudinally. Rostrum wanting. Anterolateral margins sinuous, with anterolaterally directed small, triangular hepatic spine and 3 small anterolateral spines. Posterolateral margins sinuous. Posterior margin narrow, weakly convex. Protogastric regions inflated, ornamented with tubercles which varying in size. Mesogastric region rhombic, tumid, with 2 median tubercles and 2 lateral tubercles. Urogastric region transversely ridged with median tubercle. Cardiac region more convex with 2 median tubercles longitudinally arranged; small submedian tubercles close to anterior one. Intestinal region strongly tumid with posteriorly directed median tubercle. Hepatic regions inflated with small spine. Epibranchial regions convex, ornamented with irregular tubercles. Mesobranchial regions swollen, with 4 tubercles; 2 closed tubercles near cardiac region, lateral one largest. Metabranchial regions slightly convex.

Discussion: The present species originally placed within *Chorilia*, but the generic status of the species is uncertain because of lacking the anterior part of the carapace. A well-preserved carapace needs to confirm a further generic discussion.

Superfamily Xanthoidea MacLeay, 1838
Family Pilumnidae Samouelle, 1819
Genus *Pilumnus* Leach, 1815

***Pilmunus* sp.**

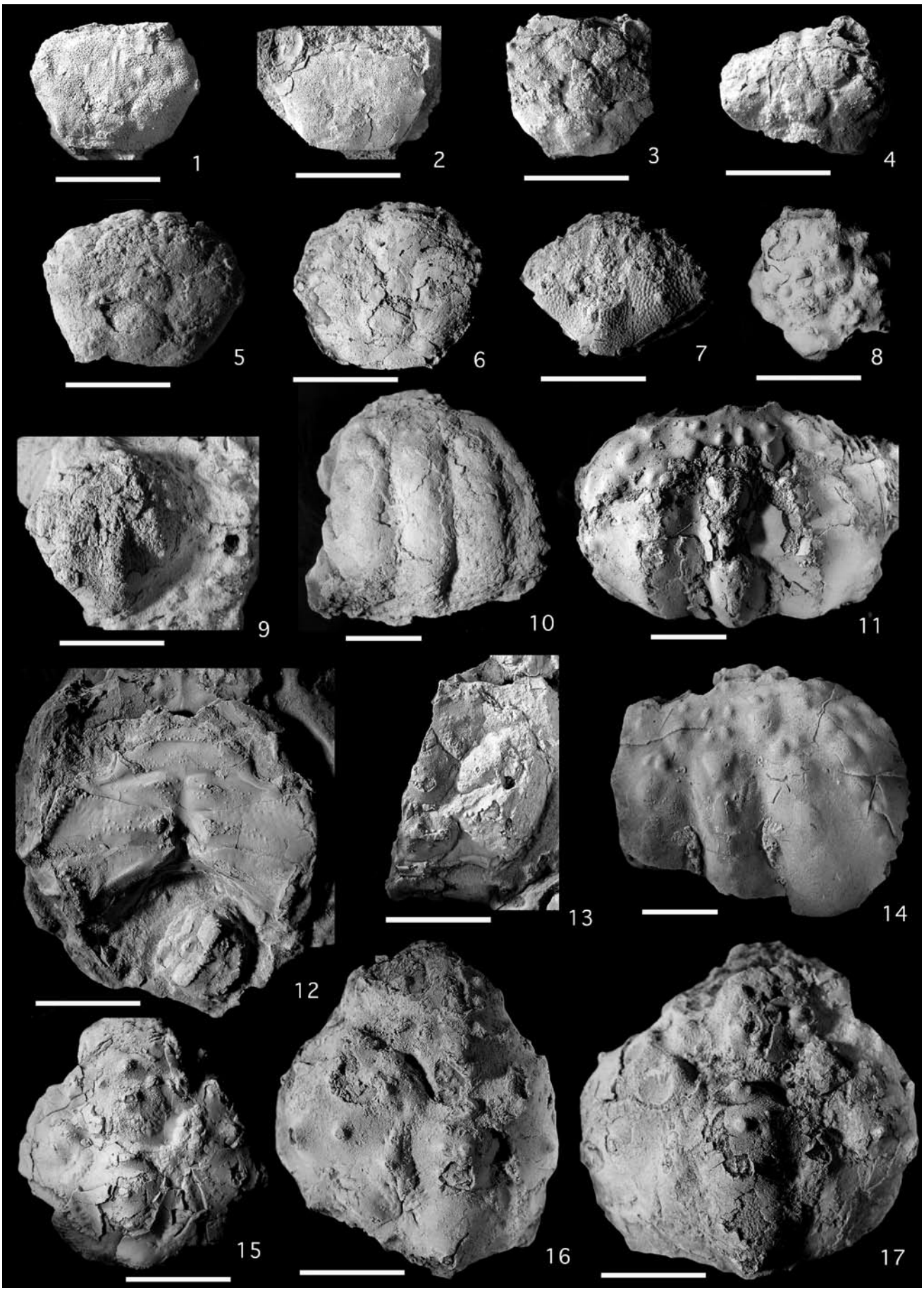
(Figs. 2-3–6)

Material examined: MFM142450–142453 from Loc. SMJ-2.

Description: Carapace small-sized for *Pilumnus*; carapace slightly wider than long, widest at position of last anterolateral spine; carapace weakly vaulted transversely and longitudinally. Front about 38 % carapace width, composed of 2 rounded lobes, axially notched, separated from small inner orbital angle by shallow V-shaped notch. Front-orbital margin about 90 % carapace width, orbit wide. Anterolateral margins short, slightly, convex, bearing 4 small spines including outer orbital spine. Posterolateral margins sinuous, longer than anterolateral margins. Posterior margin weakly convex, rimmed, about 50% carapace width. Dorsal regions moderately defined; epigastric regions transversely ridged; protogastric regions tumid; anterior mesogastric process well defined; mesogastric region with shallow median depression; cardiac region with shallow median depression; intestinal region poorly defined; hepatic regions tumid, ornamented with small tubercles; each epibranchial region divided into two by oblique groove; meso- and metabranchial region confluent.

Discussion: The fossil members of *Pilmunus* are known from the Miocene Mizunami Group (Karasawa, 1990) and the Pleistocene Shimosa Group (Kato and Karasawa, 1998). Both records are represented by fingers of the cheliped. The specific identification of this species awaits the discovery of more well-preserved specimen.

Superfamily Goneplacoidea MacLeay, 1838
Family Goneplacidae MacLeay, 1838
Genus *Carcinoplax* H. Milne Edwards, 1852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***Carcinoplax longimanus* (de Haan, 1833)**

(Figs. 2-1, 2)

Material examined: MFM142454, 142455 from Loc. SMJ-3.

Remarks: The present specimens are represented by juvenile ones and adult forms have not yet found.

Superfamily Portunoidea Rafinesque, 1815
Family Portunidae Rafinesque, 1815
Subfamily Portuninae Rafinesque, 1815
Genus *Portunus* Weber, 1795
Subgenus *Monomia* Gistel, 1848

***Portunus* (*Monomia*) *miyaku* sp. nov.**

(Figs. 3.7, 8)

Material examined: MFM142020 (holotype) from Loc. SMJ-3.

Diagnosis: Small-sized carapace; length about 60 % carapace width; front medially protruded anteriorly, axially notched, with 2 truncated lobes; orbit deeply concave; anterolateral margins with 9 spines, last spine longest; dorsal regions moderately defined without dorsal keels and ridges.

Etymology: The specific name is derived from the word, "miyaku", meaning "miyako", a fossil-bearing island name in the Ryukyuan Language.

Description: Carapace small-sized for *Portunus*; carapace wider than long, length about 60 % carapace width, widest at position of last anterolateral spine; carapace weakly vaulted transversely and longitudinally. Front about 15 % carapace width, medially protruded anteriorly, composed of 2 truncated lobes, axially notched, separated from inner orbital spine by V-shaped notch. Orbit deeply concave, about 30 % carapace width, with two shallow upper orbital fissures; outer orbital spine much stronger than inner orbital spine. Anterolateral margins bearing 9 spines including outer orbital spine; last spine longest, slightly directed posterolaterally. Posterolateral margins gently concave. Posterior margin nearly straight, about 35 % carapace width. Dorsal regions moderately defined; protogastric regions tumid without ridges; anterior mesogastric process well defined; mesogastric region with shallow median depression; cardiac region with median depression; intestinal region poorly defined; hepatic regions depressed; epibranchial regions tumid, arcuate, extending from last anterolateral spine terminating in large swelling adjacent to anterior-most cardiac region; meso- and metabranchial regions inflated axially.

Discussion: The present new species is most similar to the extant species, *Portunus* (*Monomia*) *brockii* (de Man, 1887) from the tropical West Pacific, but differs in medially protruded and truncated frontal lobes. This species represents the first record of the genus and subgenus of the Pliocene of Japan.

Subfamily Thalamitinae Paul'son, 1875
Genus *Charybdis* de Haan, 1833

***Charybdis* sp.**

(Figs. 3.1–6, 9)

Material examined: MFM142456–142462 from Loc. SMJ-2 and 3.

Remarks: The present specimens have characterized by lacking the meso- and cardiac ridges. However, the details of the frontal and anterolateral margins are not known. we do not make sufficient comparison because of the poorly preserved carapaces. Numerous broken juvenile specimens have been collected from Loc. SMJ-3. A bopyriform swelling is found on the right branchial region of the specimen (Fig. 2.5).

Order Isopoda Latreille, 1817
Suborder Cymothoida Wägele, 1989
Superfamily Cirolanoidea Dana, 1852
Family Cirolanidae Dana, 1852
Genus *Bathynomus* A. Milne Edwards, 1879

***Bathynomus* sp.**

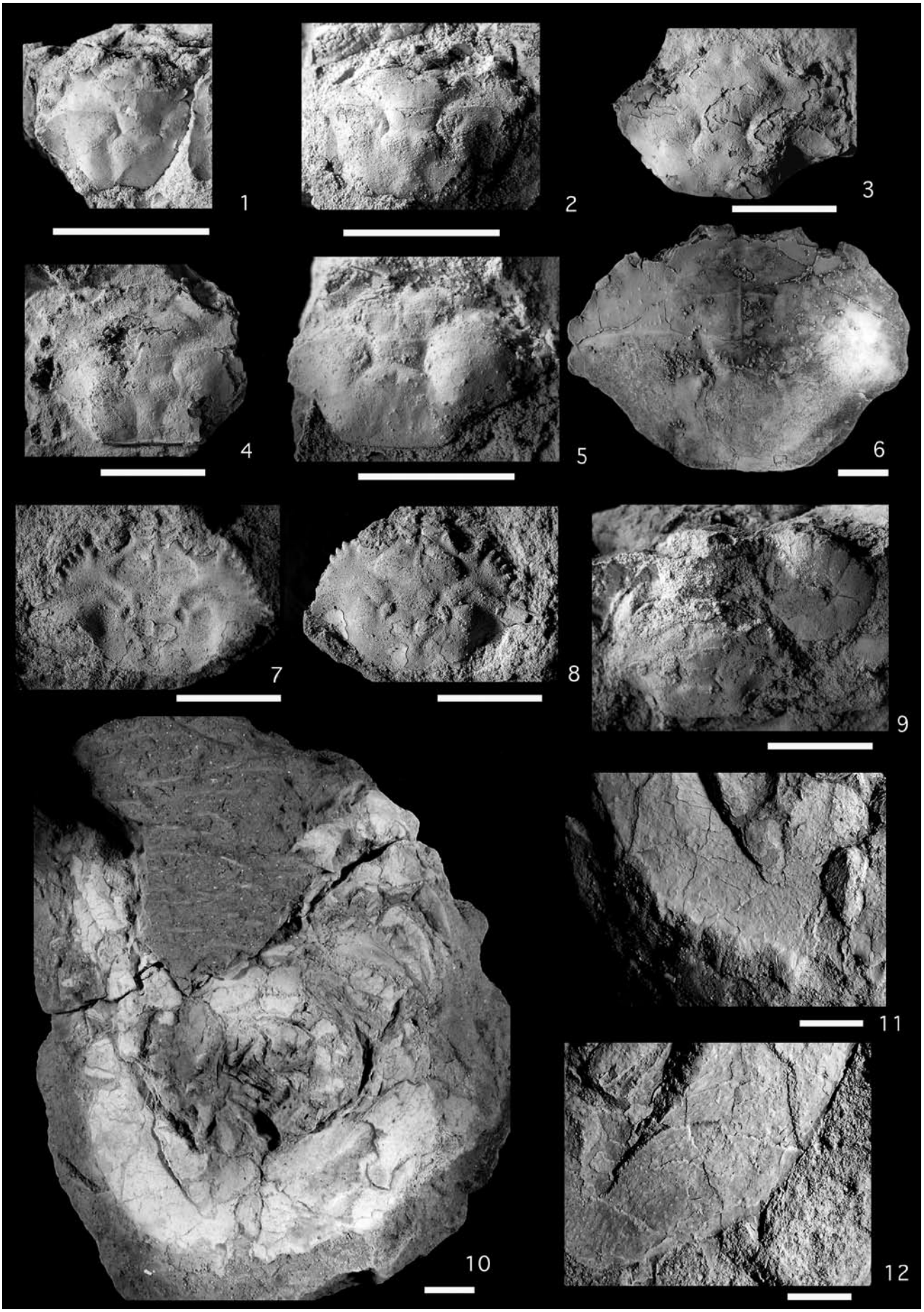
(Figs. 3.10−12)

Material examined: MFM142463 from Loc. SMJ-1.

Description: Large-sized for the genus, specimen about 11.5 cm long, showing pleonites 2–5 and pleotelson. Pleonites, pleotelson, and pereopods poorly preserved. Pleotelson much wider than long, length about 55 % its width, with median longitudinal ridge; posterior margin with spines, but number of spines unknown.

Discussion: In the present species the body length appears to be over 25 cm. According to Lowry and Dempsey (2006) this species belongs to their "supergiants (*Bathynomus giganteus*) group" within the genus. Members of this group have not yet been known from the Japanese waters, but only *Bathynomus kensleyi* Lowry and Dempsey, 2006, is recorded from the South China Sea in the Northwest Pacific. A large-sized body and a wide pleotelson readily distinguish the present species from two Japanese species, *Bathynomus dorderleini* Ortmann, 1892, from the Pliocene–Recent and the Miocene *B. undecimspinosus* (Karasawa et al., 1992). The specific identification of this species awaits the discovery of more

← Fig. 2. **1, 2. *Carcinoplax longimanus* (de Haan, 1833)**. 1, MFM142454; 2, MFM142455. Loc. SMJ-3. Dorsal view of carapace. **3–6. *Pilmunus* sp**. 3, MFM142450; 4, MFM142451; 5, MFM142452; 6, MFM142453. Loc. SMJ-3. Dorsal view of carapace. **7, 9. *Mursia* sp. aff. *M. australiensis* Campbell, 1971**. 7, MFM142444; 9, MFM142445. Loc. SMJ-2. Dorsal view of carapace. **8, 15–17. *Chorilia? yui* Hu, 1984**. 8, MFM142446; 15, MFM142447; 16, MFM142448; 17, MFM142449. Loc. SMJ-2. Dorsal view of carapace. **10, 11, 14. *Calappa pustulosa* Alcock, 1896.**10, MFM142441; 11, MFM142442; 14, MFM142443. Loc. SMJ-2. Dorsal view of carapace. **12, 13. *Paradorippe* sp**. 12, MFM142439, ventral view of thoracic sternum; 13, MFM142440, dorsal view of carapace. Loc. SMJ-2. Scale bar = 1 cm.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well-preserved specimens.

Acknowledgment

Field works by the junior author was supported by a Grant-in-Aid for Scientific Research (A) from the Japan Society for the Promotion of Science (no. 13740298).

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← Fig. 3. **1–6, 9. *Charybdis* sp**. 1, MFM142456; 2, MFM142457; 3, MFM142458; 4, MFM142459; 5, MFM142460; 6, MFM142461; 9, MFM142462. 1–6, dorsal view of carapace; 9, carapace and thoracic sternum. 1–4, 9, Loc. SMJ-3; 5, 6, Loc. SMJ-2. **7, 8. *Portunus* (*Monomia*) *miyaku* sp. nov**. MFM142020 (holotype). Carapace. 7, outer mould; 8, internal mould. Loc. SMJ-3. **10–12. *Bathynomus* sp.** MFM142463. Pleonites, pleotelson, and pereopods. 10, ventral view; 11, right half of pleotelson of outer mould; 12, right half of pleotelson of internal mould. Loc. SMJ-1. Scale bar = 1 cm.

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Manuscript accepted on August 10, 2007