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Axiidea and Brachyura (Decapoda) from the Miocene Shimo Formation, Uchiura Group, Fukui Prefecture, Japan

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Abstract

Three axiideans and eight brachyurans are recorded from the Shimo Formation of the Uchiura Group (early–early middle Miocene) of Takahama-cho, Fukui Prefecture, central Japan. Among these, *Enoplolambrus shibatai*, a new species of the parthenopid crab is the first Miocene record for *Enoplolambrus*. *Ctenocheles* sp. (Axiidea: Ctenochelidae) represents the first occurrence of the genus in the Japanese Miocene.

Key words: Decapoda, Axiidea, Brachyura, Miocene, Shimo Formation, Uchiura Group, Japan

Introduction

The Shimo Formation (Nakagawa et al., 1985) of the Lower–lower Middle Miocene Uchiura Group is distributed in the western part of Fukui Prefecture and the eastern part of Kyoto Prefecture. The formation contains tropical, shallow marine mollusks (Kobayashi and Horikoshi, 1958; Nakagawa and Takeyama, 1985; Ozawa et al., 1986; Nakagawa, 2009). Most recently, Nakagawa (2009) reported rich mollusks from the Shiokumitohge Conglomerate and Sandstone Member of the Shimo Formation distributed in Ogurui, Takahama-cho, Fukui Prefecture and recognized two types of the tropical, shallow marine molluscan assemblages.

The purpose of this paper is to record eleven species of decapods collected from sandstone, sandy siltstone and siltstone of the Shiokumitohge Conglomerate and Sandstone Member exposed at Ogurui (Fig. 1). Nakagawa (2009) studied detailed geological settings and molluscan assemblages at the locality. He described the *Conus* (*Chelyconus*)–*Turbo* (*Marmorostoma*) assemblage indicating a rocky bottom environment and the *Cernina–Aturia* assemblage representing a sandy bottom. The geologic age of the Shimo Formation is assigned to the early–early middle Miocene (N8b of Blow's (1969) scale) based upon planktonic foraminifera (Nakagawa et al., 1985; Nakagawa, 2009).

The specimens described here are deposited in the Fukui City Museum of Natural History (FCMNH-GF) and the Mizunami Fossil Museum (MFM).

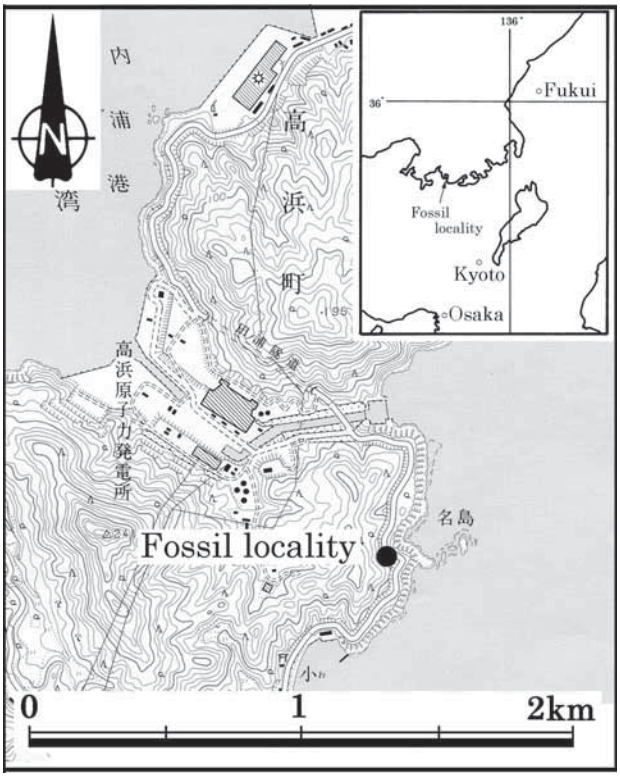

Fig. 1. Map showing the fossil-bearing locality. The topographic map "Nabae", scale 1:25000, issued by the Geographic Survey Institute of Japan.

Systematics

Infraorder Axiidea de Saint Laurent, 1979
Superfamily Callianassoidea Dana, 1852
Family Callianassidae Dana, 1852
Subfamily Callichirinae Manning and Felder, 1991
Genus *Neocallichirus* Sakai, 1988

Neocallichirus sp. aff. *N. hattai* Karasawa and Nakagawa, 2010

(Fig. 2.12)

Material examined: Chelipeds, FCMNH-GF8868.

Remarks: This species has close affinities with *Neocallichirus hattai* Karasawa and Nakagawa, 2010, from the Kunimi Formation, but slightly differs by lacking minute denticles on the dorsal and ventral margins of the major cheliped.

Subfamily Eualliacinae Manning and Felder, 1991
Genus *Eucalliax* Manning and Felder, 1991

Eucalliax yatsuoensis (Karasawa, 1993)

(Fig. 2.1–2)

Callianassa yatsuoensis Karasawa, 1993, p. 33, pl. 3, figs. 2, 3.
Eucalliax yatsuoensis (Karasawa); Sakumoto, 1997, p. 64, pl. 1, fig. 2; Karasawa, 1997, p. 34, pl. 5, figs. 10, 11.

Material examined: Both chelipeds, FCMNH-GF8869 and MFM83992.

Remarks: This species is predominated in the Shiokumitohge Conglomerate and Sandstone Member.

Family Ctenochelidae Manning and Felder, 1991
Subfamily Ctenochelinae Manning and Felder, 1991
Genus *Ctenocheles* Kishinouye, 1926

Ctenocheles sp.

(Fig. 2.3–6)

Material examined: Incomplete chelipeds, FCMNH-GF8870, FCMNH-GF8872, MFM83993, MFM83994.

Remarks: This species resembles *Ctenocheles sujakui* Imaizumi, 1958, from the Oligocene Kishima Formation. The specific identification of this species awaits the discovery of better material. This is the first Miocene record from Japan.

Infraorder Brachyura Linnaeus, 1758
Section Eubrachyura de Saint Laurent, 1980
Superfamily Dorippoidea MacLeay, 1838
Family Dorippidae MacLeay, 1838
Subfamily Dorippinae MacLeay, 1838

Genus and species indeterminate

(Fig. 2.7)

Material examined: One incomplete carapace, MFM83995.

Remarks: The material is very poorly preserved, making a description impossible, but it is clearly referable to the Dorippinae, based upon the carapace outline of the specimen. More complete material will be necessary to confirm identification of the specimens.

Superfamily Leucosioidea Samouelle, 1819
Family Matutidae de Haan, 1841
Genus *Ashtoret* Galil and Clark, 1994

Ashtoret sp.

(Fig. 2.9)

Material examined: One incomplete carapace, MFM83996.

Remarks: The Japanese Miocene matutid comprises only one species, *Ashtoret* sp. from the Miocene Kurosedani Formation (Karasawa, 2002). The present species differs from *Ashtoret* sp. by having the well-developed anterolateral teeth and lateral spine.

Superfamily Parthenopoidea MacLeay, 1838
Family Parthenopidae MacLeay, 1838
Subfamily Parthenopinae MacLeay, 1838
Genus *Enoplolambrus* A. Milne Edwards, 1878

Enoplolambrus shibatai, new species

(Fig. 2.16a–c)

Material examined: One incomplete carapace, MFM83073, holotype.

Diagnosis: Small-sized carapace, subtriangular, slightly wider than long, widest at lateral angle. Dorsal surface strongly convex longitudinally and transversely. Front narrow. Orbit small with deep, closed upper orbital fissure. Outer orbital angle broadly triangular. Hepatic margin nearly straight, finely dentate. Hepatobranchial notch shallow, V-shaped. Epibranchial margin strongly convex, fringed with irregular tubercles; 7 triangular,

Fig. 2. **1**, **2.** ***Eucalliax yatsuoensis*** **(Karasawa, 1993),** both chelipeds, 1. MFM83992; 2, FCMNH-GF8869. **3–6.** ***Ctenocheles*** **sp.,** 3, FCMNH-GF8872, manus of right minor cheliped, lateral view; 4, FCMNH-GF8870, dactylus of left cheliped, lateral view; 5, MFM83993, manus of right major cheliped, lateral view lateral view; 6, MFM83994, both chelipeds. **7. Dorippinae, genus and species indeterminate,** carapace, dorsal view, MFM83995. **8.** ***Scylla*** **sp**., fixed finger of right cheliped, lateral view, FCMNH-GF8871. **9.** ***Ashtoret*** **sp**., carapace, dorsal view, MFM83996. **10.** ***Miosesarma japonicum*** **Karasawa, 1989,** carapace and pereiopods, dorsal view, T. Kozuki coll. **11, 14.** ***Anatolikos itoigawai*** **(Karasawa, 1990)**, 11, carapace, dorsal view, Y. Sowa coll.; 14, right chela, lateral view, K. Kozuki coll. **12.** ***Neocallichirus*** **sp. aff.** ***N. hattai*** **Karasawa and Nakagawa, 2010,** both chelipeds, FCMNH-GF8868. **13.** ***Anisospinos odosensis*** **(Imaizumi, 1962),** carapace, dorsal view, MFM83997. **15.** ***Minohellenus quinquedentatus*** **Karasawa, 1990,** carapace, dorsal view, T. Takenouchi coll. **16.** ***Enoplolambrus shibatai,*** **new species,** carapace, MFM83073 (holotype), a, dorsal; b, frontal; c, ventral view. All scale bars = 1 cm.

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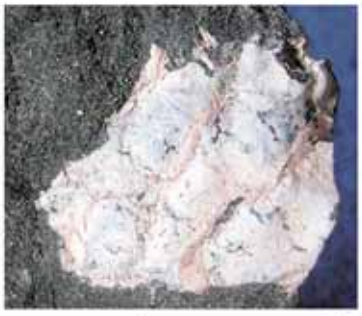

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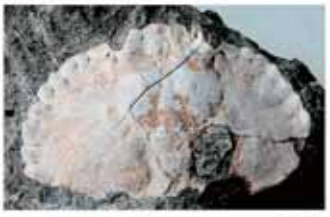

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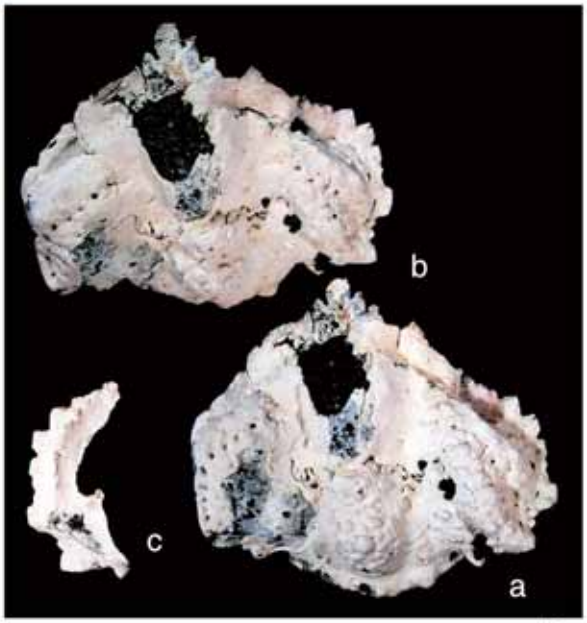

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marginal teeth present. Mesobranchial margin short with small, acute tooth. Metabranchial margin also short, nearly straight. Posterior margin narrow, gently convex, fringed with 5 small tubercles; small tooth at posterolateral corner. Interorbital depression shallow. Gastric region strongly inflated; metagastric region tuberculate with conical median tubercle. Cardiac region strongly convex, highest part densely tuberculate with conical median tubercle. Hepatic region smooth. Epibranchial region strongly inflated, densely tuberculated, with row of pit forming convex-arc parallel to epibranchial margin. Mesobranchial and metabranchial regions convex, differentiated, tuberculated. Intestinal region smooth, flattened. Pterygostomial ridge denticulate, separated from subepibranchial ridge by subhepatobranchial notch.

Derivation of name: In honor of the late Dr. H. Shibata (Nagoya), whose advise, support, and kindness helped us in different times.

Description: Carapace small-sized for the genus, subtriangular in outline, slightly wider than long, widest at lateral angle; dorsal surface strongly inflated longitudinally and transversely. Front-orbital margin about 33% maximum carapace width. Front poorly preserved, narrow, triangular, projected anteriorly, with shallow median depression. Orbit small; upper orbital margin concave with deep, closed orbital fissure; outer orbital angle broadly triangular. Hepatic margin nearly straight, finely dentate. Hepatobranchial notch present, shallow, V-shaped. Epibranchial margin strongly convex, fringed with irregular tubercles; 7 triangular, marginal teeth present, irregular in size, separated by V-shaped gaps; anterior tooth smallest; anterior 5 teeth directed anterolaterally; 6th tooth at lateral angle, tip broken, directed laterally; last one directed posterolaterally. Mesobranchial margin short with posteriorly directed small, acute tooth. Metabranchial margin short, nearly straight. Posterior margin narrow, gently convex, fringed with five small tubercles; small, triangular tooth at posterolateral corner. Interorbital depression shallow. Gastric region strongly inflated, anterior part missing; metagastric region tuberculate with conical median tubercle. Cardiac region strongly convex, highest part densely tuberculate with conical median tubercle, separated from gastric region by shallow groove. Hepatic region smooth, flattened. Epibranchial region strongly inflated, densely tuberculated, with row of pit forming convex-arc parallel to epibranchial margin. Mesobranchial and metabranchial regions convex, differentiated, tuberculated. Intestinal region smooth, flattened. Pterygostomial ridge denticulate, separated from subepibranchial ridge by subhepatobranchial notch.

Remarks: This species represents the first fossil record for *Enoplolambrus*. The new species is similar to the extant species, *Enoplolambrus laciniatus* (de Haan, 1839), but differs in having densely tuberculated cardiac and epibranchial regions and lacking well-developed anterolateral teeth or spines. Karasawa and Kishimoto (1996) descrived *Parthenope* (*Platylambrus*) sp. from the early middle Miocene Katsuta Group and the dorsal carapace characters of this species has close affinities with those of the present new species; however, in *P*. sp. the carapace margins have not been preserved. More well preserved carapace is need to confirm identification of the species.

Superfamily Cancroidea Latreille, 1802
Family Cancridae Latreille, 1802
Subfamily Cancrinae Latreille, 1802
Genus *Anatolikos* Schweitzer and Feldmann, 2000

Anatolikos itoigawai (Karasawa, 1990)

(Fig. 2.11, 14)

Cancer (*Glebocarcinus*) *itoigawai* Karasawa, 1990, p. 7, pl. 1, fig. 10; Karasawa, 1993, p. 50, pl. 10, fig. 3; Karasawa, 1997, p. 45, pl. 11, fig. 7.

Cancer (*Glebocarcinus*) sp. cfr. C. (*G.*) *itoigawai* Karasawa, 1990, p. 7, pl. 1, fig. 10; Karasawa, 1993, p. 50, pl. 10, fig. 3.

Anatolikos itoigawai (Karasawa, 1990); Schweitzer and Feldmann, 2000, p. 229.

Material examined: One nearly complete carapace, Y. Sowa coll.; left chela, K. Kozuki coll.

Genus *Anisospinos* Schweitzer and Feldmann, 2000

Anisospinos odosensis (Imaizumi, 1962)

(Fig. 2.13)

Cancer odosensis Imaizumi, 1962, p. 239, pl. 40, fig. 15.

Cancer (*Romaleon*) *sanbonsugii* Imaizumi, 1962; Karasawa, 1993, p. 50, pl. 10, fig. 6; Karasawa, 1997, p. 46, pl. 10, fig. 8.

Anisospinos odosensis (Imaizumi, 1962); Schweitzer and Feldmann, 2001, p. 230.

Material examined: One incomplete carapace, MFM83997.

Superfamily Portunoidea Rafinesque, 1815, sensu Karasawa et al., 2008
Family Macropipidae Stephenson and Campbell, 1960, sensu Karasawa et al., 2008
Genus *Minohellenus* Karasawa, 1990

Minohellenus quinquedentatus Karasawa, 1990

(Fig. 2.15)

Charybdis (*Minohellenus*) *quinquedentata* Karasawa, 1990, p. 21, pl. 6, figs. 7a–c, 8a, b; Karasawa, 1993, p. 56, pl. 13, figs. 3a, b, pl. 14, figs. 3a–c.

Minohellenus quinquedentatus Karasawa; Kato and Karasawa, 1994, p. 53; Karasawa, 1997, p. 49, pl. 12, figs. 5a–c, pl. 13, figs. 4a, b.

Material examined: One carapace, T. Takenouchi coll.

Family Portunidae Rafinesque, 1815, sensu Karasawa et al., 2008
Subfamily Necronectinae Glaessner, 1928, sensu Karasawa et al., 2008
Genus *Scylla* de Haan, 1833

Scylla sp.

(Fig. 2.8)

Material examined: A fixed finger of right cheliped, FCMNH-GF8871.

Remarks: The specimens are represented by the broken chelipeds. The specific identification of the specimens awaits the discovery of more complete material.

Superfamily Grapsoidea MacLeay, 1838
Family Varunidae H. Milne Edwards, 1853
Subfamily Cyclograpsinae H. Milne Edwards, 1853
Genus *Miosesarma* Karasawa, 1989

Miosesarma japonicum Karasawa, 1989

(Fig. 2.10)

Miosesarma japonica Karasawa, 1989, p. 24, pl. 3, figs. 10–13.
Miosesarma japonicum Karasawa, 1989; Karasawa, 1993, p. 82, pl. 23, figs. 3, 4, 8, pl. 24, fig. 10; Karasawa, 1997, p. 70, pl. 28, figs. 1, 5, 12, 13; Karasawa and Kato, 2001, p. 270, figs. 4.1–4.13, 4.15, 4.16.

Material examined: One carapace with some pereiopods, T. Kozuki coll.

Remarks on the Ogurui local fauna

Preservations of decapods are generally poor. Within brachyurans the isolated carapace and cheliped are preserved and the isolated and paired chelipeds of axiideans occurred. Therefore, these fossils are thought to be an allochthonous origin.

Karasawa and Nakagawa (1992) recorded three species of decapods from the Shimo Formation of the Uchiura Group. In their work *Callianassa nishikawai* Karasawa, 1993 (=*Callianassa* sp.) has been known from the Shiokumitohge Conglomerate and Sandstone Member and *Carcinoplax antiqua* (Ristori, 1889) and *Callianopsis titaensis* (Nagao, 1941) from the Kohnoura Shale Member covering the Shiokumitohge Conglomerate and Sandstone Member. However, the Ogurui local fauna from the Shiokumitohge Conglomerate and Sandstone Member at the present locality are quite different. The fauna seems to be compared with the local faunas known from the Kurosedani Formation of the Yatsuo Group (Karasawa, 1993) and the Korematsu Formation of the Bihoku Group (Sakumoto, 1997) because of the predominate occurrence of *Eucalliax yatsuoensis*. However, the Ogurui local fauna is unusual and lacks *Callianassa nishikawai*, *Saintlaurentiella imaizumii* (Karasawa, 1993) comb. nov. (=*Laurentiella imaizumii* Karasawa, 1993) (see Paiva et al., 2010), and *Carcinoplax antiqua*, which are the dominant species within the shallow marine, early middle Miocene decapod faunas (Karasawa, 1993).

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