

New axiidean Decapoda from the Albian (Lower Cretaceous) chemosynthetic community of Hokkaido, Japan

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Abstract

Callianassa s.l. hayanoi, new species (Axiidea, Callianassidae) is described from the Albian (Lower Cretaceous) cold seep sediments included in the Middle Yezo Group of Hokkaido. This species represents the first record of a decapod from the fossil chemosynthetic communities in Japan. The discovery of *Callianassa s.l. hayanoi* extends the geologic range for the Callianassidae from the chemosynthetic communities back to the Albian.

Key words: Decapoda, Axiidea, Albian, Cretaceous, chemosynthetic community, cold seep, Hokkaido, Japan

Introduction

Information on decapods from fossil chemosynthetic communities is poor. Bishop and Williams (2000) first reported four brachyurans from the Campanian (Upper Cretaceous) cold seep sediments of South Dakota and Colorado, U.S.A. After that, Peckmann et al. (2002) listed the occurrence of two species of callianassids from the methane-seep deposits from the Oligocene Lincoln Creek Formation of Washington, U.S.A. Most recently, Peckmann et al. (2007) reported two unnamed species of a callianassid associated with the ichnofossil *Palaxius* Brönniman and Norton, 1960, from the methane-seep limestone included in the Eocene Humptulis Formation of Washington and Schweitzer and Feldmann (2008) described *Shinkaia katapsyxis*, a new galatheid anomalan from the hydrocarbon seep limestone of this formation.

Majima et al. (2005) reported 75 localities of fossil chemosynthetic communities in Japan. Most of them are thought to have been cold seep dependent (Majima et al., 2005). However, decapods have not yet been found in the fossil chemosynthetic communities in Japan. The purpose of the present paper is to describe a new species of the Callianassidae from the Upper Albian chemosynthetic community of Hokkaido. The specimens were collected from siltstone of the lower part of the Middle Yezo Group exposed at Loc. IK2031 (43°16'30"N, 141°59'20"E) (Kanie et al., 1993; Kanie and Sakai, 1997), Ponbetsu, Mikasa City, central Hokkaido. Kanie et al. (1993) and Kanie and Sakai (1997) reported bivalve species such as *Nipponothracia ponbetsuensis* Kanie and Sakai, 1997, *Solemya* sp., and *Calyptogena* sp. at the locality. Therefore, Kanie et al. (1993) thought

that these mollusks represented the cold water-dependent chemosynthetic community. $\delta^{13}\text{C}$ values of carbonate nodules containing *Calyptogena* sp. range from -26.7 to -25.2‰ and $\delta^{18}\text{O}$ values range from -4.9 to -4.2‰ (Ogiwara, 2005). Ogiwara (2005) also showed by biomarker analysis that the carbonate nodules were represented by only ANME-1 group Archaea. The geologic age of the sediments including mollusks and decapods is the early Cretaceous (early late Albian, about 106 Ma) based upon the occurrence of *Dipoloceras* (*Dipoloceras*) *cristatum* (Brongniart in Cuvier and Brongniart, 1822) (Kanie et al., 1993; Kanie and Sakai, 1997).

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

Systematics

Superfamily Callianassoidea Dana, 1852

Family Callianassidae Dana, 1852

Genus *Callianassa* Leach, 1814, *sensu lato*

Callianassa s.l. hayanoi, new species

(Figs. 1, 2)



Figs. 1, 2. *Callianassa s.l. hayanoi*, new species. 1, Major cheliped, MFM247023 (holotype), lateral view; 2, major cheliped, MFM247024 (paratype), mesial view. Scale bar = 1 cm.

Diagnosis: Moderate-sized callianassid. Dactylus of major cheliped strongly curved ventrally with smooth dorsal margin and sinuous occlusal margin. Fixed finger short, gently curved dorsally; occlusal margin with broad proximal tooth; ventral margin smooth. Palm subrectangular in lateral view, long; dorsal margin smooth, slightly convex; ventral margin smooth, slightly sinuous; lateral surface smooth. Carpus short, subrectangular in lateral view, without dentitions. Merus rhomboidal in lateral view, slightly longer than carpus, with longitudinal ridge on lateral surface; margins without dentitions; ventral hook absent.

Etymology: The specific name is dedicated to H. Hayano, who is a collaborator of the Mizunami Fossil Museum.

Description: Moderate-sized *Callianassa*. Dactylus of major cheliped strongly curved ventrally with acutely pointed tip; dorsal margin smooth; occlusal margin slightly sinuous without clearly defined teeth. Fixed finger about 70 % dactylus length, gently curved dorsally, with acutely pointed tip; occlusal margin bearing broad proximal tooth; ventral margin smooth, gently convex. Palm subrectangular in lateral view, about 1.3–1.45 times longer than high, about 2.2–2.3 length of dactylus; dorsal margin slightly convex, ventral margin slightly sinuous, both margins smooth without dentitions; proximal margin sinuous; lateral surface smooth, longitudinally inflated; mesial surface nearly flattened, smooth. Carpus short, subrectangular in lateral view, about 33 % length of palm, height about 60% length; distal margin concave, dorsal margin nearly straight, proximal and ventral margins strongly convex, those margins smooth without dentitions; lateral surface smooth, convex longitudinally; mesial surface smooth, flattened. Merus rhomboidal in lateral view, slightly longer than carpus, height about 50% length; dorsal margin nearly straight, ventral margin convex, both margins without dentitions; ventral hook absent; lateral surface with longitudinal ridge dorsally. Ischium and basis not preserved.

Other appendages, carapace, and abdomen not preserved.

Remarks: The family Callianassidae has a large number of taxa for the Axiidea. In the recent works, Sakai (2005) recognized eight subfamilies and 14 genera for the extant Callianassidae, whilst De Grave et al. (2009) recognized ten subfamilies, 40 genera for the Callianassidae including extinct taxa. The family contains at least 187 extant and 206 fossil species (De Grave et al., 2009). Most recently, Schweitzer et al. (2010) made the systematic list of fossil decapods and listed 218 species of callianassids. The definition of the extant callianassids includes detailed characters of the carapace, abdomen, eyes, and maxilliped 3, which are not available for study in fossil specimens. The generic placement of the present species awaits the discovery of well-preserved materials and it is considered best to place it in *Callianassa* s.l. for the time being.

The new species resembles *Callianassa* s.l. *sakakuraorum* Karasawa, 2000, from the Barremian of Japan, but differs in that the merus has a longitudinal ridge on the lateral surface and the fixed finger bears a broad tooth on the occlusal margin. This species represents the first record of the Albian decapods from

Japan.

Material examined: MFM247023 (holotype), 247024 (paratype).

Review of the Axiidea from extant and fossil chemosynthetic communities

Lin et al. (2007) reviewed axiideans from the chemosynthetic communities such as hydrothermal vents or cold seeps of the world and described *Nihonotrypaea thermophila*, a new callianassid from deep-water hydrothermal vents of Taiwan. Zarenkov (1989) described the new axiid, *Calocaris lev* (= *Calocarides lev*), from deep-water hydrothermal vents in the Gulf of California. Dando et al. (1995) reported *Callianassa truncata* Giard and Bonnier, 1890 (Callianassidae) from shallow water vents in the Hellenic Volcanic Arc of the Aegean Sea. Türkay and Sakai (1995) described *Paraglypturus calderus*, a new genus and species of a callianassid from an active submarine volcano in the Mariana Arc. Sakai and Türkay (1999) described the new genus and species of a callianassid, *Bathycalliax geomar*, from the deep water cold seeps off Oregon. *Calaxius carneyi* Felder and Kensley, 2004, an axiid is known from deep-water cold seeps in the Gulf of Mexico (Felder and Kensley, 2004). Dworschak and Cunha (2007) described *Vulcanocalliax arutyunovi*, a new genus and species of the Callianassidae from deep-water mud volcanoes in the Gulf of Cádiz. Thus, five species of callianassids and two species of axiids are known from the extant chemosynthetic communities. Additionally, Martin and Haney (2005) noted the occurrence of two unnamed species in the methane seeps off Louisiana.

The oldest record of decapods from the fossil chemosynthetic communities seems to have the Jurassic of France (Peckmann et al., 1999; Campbell, 2006). Additionally, the crustacean microcoprolites from the hydrocarbon seep deposits have originated in the Jurassic (Senowbari-Daryan et al., 2007; Peckmann et al., 2007). The callianassids from the fossil chemosynthetic communities are known from the Oligocene of Washington and Alaska (Goedert and Campbell, 1995; Packmann et al., 2002) and the Eocene of Washington (Peckmann et al., 2007). The occurrence of *Callianassa* s.l. *hayanoi* extends the geologic range for the Callianassidae from the chemosynthetic communities back to the late Albian (early Cretaceous).

Acknowledgements

I thank H. Hayano (Kasugai, Aichi) for offering his specimens for the study and Y. Ando (MFM) for providing useful comments.

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