Report

Permian lyttoniid brachiopod *Petasmaia* from Akasaka, Mino Belt, central Japan

Jun-ichi Tazawa* and Teruo Ono**

Received May 14, 2012

Accepted September 11, 2012

* Hamaura-cho 1-260-1, Chuo-ku, Niigata 951-8151, Japan

** Honden 1552-141, Mizuho, Gifu Prefecture 501-0236, Japan

Corresponding author: J. Tazawa,
j1025-tazawa@memoad.jp

Abstract: A lyttoniid brachiopod species, *Petasmaia expansa* Cooper and Grant, 1969, is described from the middle member (*Neoschwagerina margaritae* Zone; upper Murgabian) of the Akasaka Limestone within the Mino Belt of central Japan. *Petasmaia* is a rare brachiopod genus, with the only two known species identified so far obtained from the Lower and Middle Permian of West Texas and from the Middle Permian of Akasaka. The presence of *P. expansa* in the Akasaka area suggests that reef-seamount complexes of the Mino Belt, including those within the Akasaka area, formed in a mid-Panthalassan equatorial region between the Palaeotethys and the North American continent in the Middle Permian.

Keywords: Akasaka, Mino Belt, Panthalassa, Permian, *Petasmaia expansa*

Introduction

Akasaka has been a famous and classic locality for palaeontological study in Japan since the pioneering works of Schwager (1883), Gottsche (1884) and Ozawa (1927). Permian marine faunas of Akasaka are important for interpretations of the Late Palaeozoic to Mesozoic palaeobiogeography and tectonics of Japan, particularly for the accretion model (Mizutani, 1990) of Permian limestone–basalt blocks of the Mino Terrane (Belt), the most widely distributed Jurassic accretionary terrane in the Japanese Islands.

This paper describes systematically a warm-water indicator species, the lyttoniid brachiopod *Petasmaia expansa* Cooper and Grant, 1969, from the middle member of the Akasaka Limestone in the Akasaka area, Mino Belt, central Japan, and discusses the palaeobiogeography of the genus *Petasmaia* and its implications for the palaeogeography of Permian reef–seamount

complexes of the Mino Belt, including those of the Akasaka area.

Petasmaia is a lyttoniid brachiopod genus characterized by a large and broadly expanded shell with numerous, symmetrically disposed and anteriorly arcuate lateral septa with sharp crests (anguliseptate) in the ventral valve. The genus was proposed by Cooper and Grant (1969) with *Petasmaia expansa* from the Cathedral Mountain Formation (Leonardian), Glass Mountains, West Texas, USA as type species. Among the lyttoniid brachiopod genera, *Leptodus* Kayser, 1883 is readily distinguished from *Petasmaia* by its elongate outline and the lateral septa with blunt crests (solidiseptate) in the ventral valve. *Oldhamina* Waagen, 1883 also has lateral septa with sharp crests like *Petasmaia*, but it differs from the latter by its more strongly arcuate lateral septa in the ventral valve.

The material was collected by the junior author (T. Ono) from black limestone in a limestone quarry of Hanaokayama (Long. 136°34'30" E, Lat. 35°23'45" N) in the Akasaka area of Ogaki City, Gifu Prefecture (Fig. 1). The fossil-bearing black limestone is assigned to the middle member of the Akasaka Limestone (Ozawa and Nishiwaki, 1992), and to the *Neoschwagerina margaritae* Zone (upper Murgabian) (Zaw Win, 1999). The specimens described herein are registered with the prefix NU-B, and housed in the Department of Geology, Faculty of Science, Niigata University, Niigata, Japan.

Systematic descriptions

Order Productida Sarytcheva and Sokolskaya, 1959
Suborder Lyttoniida Williams, Harper and Grant, 2000

Superfamily Lyttonioidea Waagen, 1883

Family Lyttoniidae Waagen, 1883

Subfamily Lyttoniinae Waagen, 1883

Genus *Petasmaia* Cooper and Grant, 1969

Type species. –*Petasmaia expansa* Cooper and Grant, 1969, from the Cathedral Mountain Formation of the Glass Mountains, West Texas, USA.

Petasmaia expansa Cooper and Grant, 1969

Fig. 1. Map showing the fossil locality (asterisk), using the topographical map of “Ogaki” scale 1 : 25,000 published by the Geospatial Information Authority of Japan.

Figs. 2, 3

Petasmaia expansa Cooper and Grant, 1969, p. 10, pl. 2, figs. 15–18; Cooper and Grant, 1974, p. 430, pl. 163, figs. 1–8; pl. 164, figs. 1–16; pl. 165, figs. 1–23; pl. 169, figs. 11–16.

Material. —Seven specimens, interior of seven ventral valves, NU-B1727–1733.

Description. —Shell large size for genus, transversely wider elliptical in outline, with greatest width at about midlength; length 62 mm, width 97 mm in the largest specimen (NU-B1727). Ventral valve almost flattened in lateral and anterior profiles. Interior of ventral valve with numerous, regularly and symmetrically arranged lateral septa on both sides of a low median septum; lateral septa with sharp crests (see Fig. 3) and broad interspaces, being nearly straight to gently arcuate anteriorly and slightly dipping towards the front in lateral profile; total of 13 pairs of septa in the largest specimen.

Remarks. —The specimens from Akasaka are abraded and more or less fragmented. However, these specimens can be referred to *Petasmaia expansa* on account of the

large, transverse shell and the presence of numerous, regularly arranged lateral septa with sharp crests in the ventral valve.

Petasmaia sp. 1 by Cooper and Grant (1974, p. 432) from the uppermost part of the Road Canyon Formation of West Texas, is an indefinite species without detailed description and illustration. Therefore, comparison with that species is difficult.

Recently, Tazawa (in Tazawa and Miyake, 2011, p. 8) described a lyttoniid brachiopod species as *Petasmaia ehiro* Tazawa in Tazawa and Miyake 2011, from the upper part of the Toyoma Formation (Changhsingian) of Maeda in the Ofunato area, South Kitakami Belt, north-east Japan. However, the Kitakami species should be included into the genus *Oldhamina* because it has strongly arcuate lateral septa in the ventral valve.

Distribution of *Petasmaia*

Petasmaia is a rare lyttoniid brachiopod genus comprising only two known species, *Petasmaia expansa* and *Petasmaia* sp. 1. Stratigraphical and geographical distributions of the species are summarized below.

Petasmaia expansa: Cathedral Mountain Formation

Fig. 2. *Petasmaia expansa* Cooper and Grant, from Akasaka. Interior of four ventral valves, 1: NU-B1731; 2: NU-B1729; 3: NU-B1727; 4: NU-B1728.

Fig. 3. *Petasmaia expansa* Cooper and Grant, from Akasaka. Longitudinal section of a ventral valve (NU-B1733), showing lateral septa, a: anterior, p: posterior.

(Leonardian) of the Glass Mountains, West Texas, USA (Cooper and Grant, 1969, 1974); middle member of the Akasaka Limestone (*Neoschwagerina margaritae* Zone, upper Murgabian), Akasaka, Mino Belt, central Japan (this study).

Petasmaia sp. 1 of Cooper and Grant (1974): Uppermost part of the Road Canyon Formation (Roadian), Glass Mountains, West Texas, USA (Cooper and Grant, 1974).

Distributions of known species show that the genus *Petasmaia* is restricted to both West Texas and Akasaka, and absent in Boreal, Gondwanan and typical Tethyan regions (e.g., South China, Iran and Greece). The Permian brachiopod fauna of West Texas comprises nearly 1,000 species in more than 200 genera, with both tropical and anti-tropical elements (Cooper and Grant, 1969). Thus, *Petasmaia* appears to be one of the tropical elements of the West Texas fauna, and also a tropical

Panthalassan element.

Permian brachiopods of Akasaka

Six species of Permian brachiopods are known from Akasaka: *Scacchinella gigantea* Schellwien, 1900, described by Ando (1986), Okumura and Tomida (2000) and Shen et al. (2006); *Leptodus nobilis* (Waagen, 1883), described by Tazawa et al. (1998); *Coscinophora magnifica* Cooper and Grant, 1974, described by Sato (1919), Hayasaka (1925) and Tazawa et al. (1998); *Petasmaia expansa*, described by Tazawa and Ono (this study); *Geyerella* sp., described by Hayasaka (1932); and *Peltichia akasakensis* (Ozawa, 1927), described by Ozawa (1927), Hayasaka (1932) and Shen et al. (1999). *Enteleles suessi* (Schellwien, 1892) and *Enteleles minoensis* Hayasaka, 1932, both described by Hayasaka (1932) based on specimens from Akasaka, are junior synonyms of *Peltichia akasakensis* (Shen et al., 1999, p. 53).

Among the species from Akasaka, *C. magnifica* and *P. expansa* are tropical Panthalassan elements, occurring in both West Texas and Akasaka; *S. gigantea* and *L. nobilis* are Tethyan elements; and *Geyerella* sp. is a warm-water element, although its affinities with tropical Panthalassan or Tethyan elements is uncertain. Thus, the Akasaka fauna comprises a mixture of tropical Panthal-

assan and Tethyan elements, and is completely lacking in Boreal (anti-tropical) elements.

In this respect, the Permian brachiopod faunas of British Columbia (Yole, 1963; Logan and McGugan, 1968; Nelson and Nelson, 1985) differ from that of Akasaka, in having much Boreal elements (e.g., *Waagenoconcha*, *Yakovlevia*, *Megousia*, *Rhynchopora* and *Spiriferella*) and lacking *Coscinophora* or *Petasmaia*, although some Japanese researchers (e.g., Ozawa, 1987; Kobayashi, 1997) have presumed a close faunal relationship between the two regions, based on Permian fusulinid assemblages.

Tazawa and his colleagues (Tazawa and Shen, 1997; Tazawa et al., 1998; Shen et al., 2011) noted that the Permian brachiopod faunas of the Hi-yomo, Hatahoko and Akasaka areas of the Mino Belt indicate a close affinity with that of West Texas. Thus, Tazawa and Shen (2010) and Shen et al. (2011) concluded that the Mino reef-seamounts (including the Akasaka Limestone) were located in the equatorial region of mid-Panthalassa between the Palaeotethys and North American Continent in the Early to Middle Permian. At that time, a warm-water current transported the West Texas fauna, excluding the Boreal elements, from east to west. Consequently, the Mino fauna came to be a mixture of the Tethyan and the West Texas elements, and lacking the Boreal elements. The present report of *Petasmaia expansa* from Akasaka strongly supports the palaeobiogeographical scheme proposed by Tazawa and Shen (2010) and Shen et al. (2011).

Acknowledgements

We thank Yousuke Ibaraki (Fossa Magna Museum, Itoigawa) for his help drawing figures; Yoshiyuki Hasegawa (Professor Emeritus of Niigata University) for preparation of replica films of the brachiopod sections; and an editor, Katsumi Ueno (Fukuoka University) and two reviewers, Yuta Shiino (University of Tokyo) and an anonymous reviewer for their critical reviews and useful comments.

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* in Japanese

** in Russian

用語対比

Akasaka	赤坂
Hanaokayama	花崗山
Hatahoko	旗鉾
Hiyomo	日面
Ofunato	大船渡
Toyoma Formation	登米層