Cretaceous Research 88 (2018) 227–272

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

Aptian and Albian ammonites of the Miyako Group, Japan (Lower Cretaceous ammonites of the Miyako Group, Part 11)

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ARTICLE INFO

Article history:
Received 10 March 2017
Received in revised form
12 August 2017
Accepted in revised form 15 September 2017
Available online 21 November 2017

Keywords:
Systematic description
Ammonite biostratigraphic zones
Morphological analysis
Transgression population appearance ratio

ABSTRACT

Thirty-four upper Aptian to lower Albian ammonite species from the Miyako Group, northeast Japan are described herein: seven phylloceratids, three lytoceratids, one gaudryceratid, one tetragonitid, one oppelid, eight desmoceratids, one cleoniceratid, one hoplitid, three ptychoceratids, four anisoceratids, two douvilleiceratids, and two parahoplitids. Among the described species, *Valdedorsella kasei*, *Diptychoceras iwatense*, *Protanisoceras* (*P.*) *hanaii*, and *Hypacnthoplites regina* are proposed as new species. To date, fifty-five species belonging to 35 genera have been described from the ammonite fauna of the Miyako Group. This ammonite fauna can be subdivided into three ammonite biostratigraphic zones (*Hypacanthoplites subcornuerianus* Zone, *Diadochoceras nodosocostatiforme* Zone and *Douvilleiceras mammilatum* Zone in ascending order), and these zones are defined. These zones can be correlated with the upper Aptian to lower Albian of the European standard zonation. Ammonites of the Miyako Group diversified morphologically with transgression, and expanded the range of their habitation area. This expansion developed by chance at approximately the even level for each taxon. Ammonite biogeography is interpreted to be controlled by oceanic currents of the circum Pacific rim.

1. Introduction

The Miyako Group has the richest Aptian-Albian ammonite assemblages in Japan. These assemblages contain common taxa with other areas of the circum-Pacific rim and also western Europe. The Early Cretaceous ammonite faunas of Japan were greatly influenced by the Tethyan, Boreal and North Pacific realms (Matsukawa, 1988; Obata and Matsukawa, 1988, 2009; Matsukawa et al., 2012) and we can assess Early Cretaceous ammonite evolution around the circum-Pacific rim in terms of biogeography and oceanic circulation. Oceanic circulation patterns particularly can be invoked to explain the distribution of faunas across the "Bering Strait" region during the Early Cretaceous. To understand such a system fully, a comprehensive understanding of the geographical distribution of ammonite faunas is required.

Before the study, thirty-two species of ammonites have been described from the Miyako Group (Shimizu, 1931; Obata, 1967a, b, 1969, 1973, 1975; Obata and Matsukawa, 1980, 2012; Obata and Futakami, 1991, 1992; Obata et al., 2010; Hoffmann et al., 2013) (Table 1). In this context, we made full descriptions of the thirty-four species, including four new species, and we redescribed eight species of ammonites from the Miyako Group.

The Cretaceous Miyako Group crops out in many small areas along north Honshu Island facing to Pacific Ocean (Figs. 1, 2, 3, 4, 5). The group lies unconformably over various kinds of Neocomian and older sedimentary and effusive rocks, which are folded and intruded by granodiorite (Miyako and Taro granodiorites). The group is composed mainly of calcareous sandstone and sandy shale, containing abundant and well-preserved neritic molluscs at numerous localities and stratigraphic levels, and is subdivided into four units through its entire outcrops, i.e., the Raga, Tanohata, Hiraiga, and Aketo formations (Figs. 6, 7).

To have a clear understanding of the detailed geological age, the paleogeography, and the paleoecology of the Miyako Group, we provide a summary of the biostratigraphic succession and the stratigraphic correlation of each area of the group.

2. Geological and paleoenvironmental setting

The Miyako Group is distributed sporadically in five principal areas in Iwate Prefecture, northeast Japan; (1) the type section of

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https://doi.org/10.1016/j.cretres.2017.09.010
0195-6671/

Table 1
List of Aptian and Albian ammonite species from the Miyako Group described in previous works. Excepting for species redescribed in this paper.

	Publication	Taxa	Formation
1	Shimizu (1931)	*Salfeldiella causacia* (Sayn)	H
2	Shimizu (1931)	*Torneutoceras*? aff. *intermedium* (Sowerby)	H
3	Shimizu (1931)	*Puzosia* ? *yabei Shimizu*	H
4	Shimizu (1931)	*Saynella matsushimaensis* Shimizu	H
5	Shimizu (1931)	*Pseudohaploceras nipponicum* Shimizu	H
6	Shimizu (1931)	*Hoplites*aff. *dentatus* (Soweby)	A
7	Shimizu (1931)	*Parahoplites yaegashii* Shimizu	H
8	Shimizu (1931)	*Acanthoplites subcornuerianus* Shimizu	H
9	Shimizu (1931)	*Douvilleiceras nodosocostatiforme* Shimizu	H
10	Obata (1967a)	*Valdedorsella akuschaensis* (Anthula)	T, H, O
11	Obata (1967a)	*V. getulina* (Coquand)	H, O
12	Obata (1967a)	V. sp.	H
13	Obata (1967b)	*Miyakoceras tanohatense* Obata	T, H
14	Obata (1967b)	*M.* aff. *tanohatense* Obata	H
15	Obata (1967b)	*M. hayamii* Obata	H
16	Obata (1969)	*Eodouvilleiceras matsumotoi* Obata	H
17	Obata (1969)	*E.*aff. *matsumotoi* Obata	H
18	Obata (1969)	*Douvilleiceras mammillatum* (Schlotheim)	H, A
19	Obata (1973)	*Pseudoleymeriella hataii* Obata	O, A
20	Obata (1973)	*P. hiranamensis* Obata	A
21	Obata (1975)	*Diadochoceras nodosocostatiforme* (Shimizu)	H
22	Obata (1975)	D.?aff. *nodosocostatiforme* (Shimizu)	H
23	Obata and Matsukawa (1980)	*Hypacnthoplites subcornuerianus* (Shimizu)	T, H
25	Obata and Futakami (1991)	*Marshallites miyakoensis* Obata and Futakami	A
26	Obata and Futakami (1992)	*Hypacnthoplites kawakamii* Obata and Futakami	T
27	Obata and Futakami (1992)	*H. subcornuerianus* (Shimizu)	H
28	Obata and Futakami (1992)	*Nolaniceras yaegashii* (Shimizu)	H
29	Obata and Futakami (1992)	*Oshimaceras kanazawai* Obata and Futakami	H
30	Obata and Futakami (1992)	*Eotetragonites aketoensis* Obata and Futakami	A
31	Obata and Futakami (1992)	*Ammonoceratites (A.) crenocostatus* (Whiteaves)	A
32	Obata and Futakami (1992)	*Hamites* sp.	A
33	Obata, Matsukawa and Tsuda (2010)	Ammonoceratites giganteus Obata, Matsukawa and Tsuda	A
34	Obata and Matsukawa (2012)	*Pseudohaploceras nipponicum* Shimizu	H
35	Obata and Matsukawa (2012)	*Melchiorites* sp.	pobably T
36	Obata and Matsukawa (2012)	*Miyakoceras tanohatense* Obata	uncertain
37	Obata and Matsukawa (2012)	*Diadochoveras nodosocostatiforme* (Shimizu)	H
38	Obata and Matsukawa (2012)	*Douvilleiceras mammillatum* (Schlotheim)	H
39	Obata and Matsukawa (2012)	*Hypacnthoplites* aff. *crassus* (Sinzow)	H
40	Obata and Matsukawa (2012)	*Hypacnthoplites subcornuerianus* (Shimizu)	T
41	Obata and Matsukawa (2012)	*Parahoplites* aff. *vectensis* Casey	H
42	Hoffmann et al. (2013)	*Pictetia astieriana* Orbigny	A

T: Tanohata Formation, H: Hiraiga Formation, O: Orbitolina Facics, A: Aketo Formation.

the group at Hiraiga of the Tanohata Village (Fig. 1A); (2) the Moshi area in Iwaizumi Town (Fig. 1B); (3) the Taro area in Miyako City (Fig. 1C); and (4) the Sakiyama area in Miyako City (Fig. 1D); and (5) the Miyako area in Miyako City (Fig. 1).

(1) In the type section of the group at Hiraiga, Iwate Prefecture, the Miyako Group (A in Fig. 1) is composed of the following four sedimentary cycles (Hanai et al., 1968, fig. 2) (Figs. 2, 8), with the terminology used by Yabe and Yehara (1913), who first reported on the group, given parentheses:

4th cycle Aketo Formation (=Aketo sandstone)
3rd cycle *Orbitolina* facies (=*Orbitolina* sandstone)
2nd cycle Hiraiga Formation (=Hiraiga sandstone)
1st cycle Tanohata Formation (=Moshi sandstone + Tanohata sandy shale)
−disconformity−
Raga Formation (= Raga conglomerate)
~Unconformity~
Basement complex

Regolith on the surface of the basement rocks is overlain by fluvial deposits, which constitute the main portion of the Raga Formation of the Miyako Group (Shibata and Matsukawa, 2016).

In the type area and other areas, Tanohata Formation directly overlies the Raga Formation, and in the northern part of the outcrop area it overlies the uneven surface of the basement rocks. Some sedimentological studies have been done on the Tanohata Formation. For example, a distinct beachrock was discovered in the formation (Hanai and Oji, 1981), comprising solid calcareous sandstone only seen along tropical and subtropical coasts. Furthermore, the structure and depositional processes of a gravelly tsunami deposit have been recognized in the shoreface deposits of the lower Tanohata Formation (Fujino et al., 2006).

The overlying Hiraiga Formation consists mainly of well-sorted, medium- or fine-grained calcareous sandstone, with layers that contains abundant shells. It was probably formed under the shallow open sea in which sediments were much affected by currents and waves. In the type area, calcareous sandstone changes laterally and northwardly into *Orbitolina* − bearing coquina deposits, which directly overlie the basement rocks. Accordingly, the accumulation of shell fragments may be related to the topographical relief of the basement and the orientation of the bottom currents. Based on oxygen isotope analysis of a belemnite, an average marine temperature of 18 °C was obtained by Lowenstam and Epstein (1954) for the Hiraiga Formation. The pachyodonts, nerineans, hexacorals, calcareous algae, larger foraminifera, etc., also provide evidence to infer that the deposition of entire Miyako Group was deposited under the influence of the subtropical sea water.

The youngest formation of the group, the Aketo Formation consists of muddy fine-grained sandstone and contains thin-