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656. A RECORD OF *MORTONICERAS* (CRETACEOUS AMMONITE) FROM GOSHONOURA ISLAND, KYUSHU

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九州御所浦島産モルトニセラスの記録：熊本県御所浦島江口において，御所浦層群中部の IIb 部層からアンモナイトが産出したので記載・報告する。これは住房が保存され，特有の殻口縁突出（rostrum）も観察できるよい標本である。英国の上部アルビアン上部産の *Mortoniceras* (*Mortoniceras*) *rostratum* に酷似するが，詳細な点で差異がある。同種の変異が十分よくわかっていない現状では，この化石を *M.* (*M.*) sp. aff. *M.* (*M.*) *rostratum* とよんでおく。この産出により IIb 部層は上部アルビアンと確定し，すでに知られた IIe は，*Graysonites* の産出により下部セノマニアンであるから，上・下白亜系の境は IIb-IIe 間のどこかにあることとなる。他の軟体動物化石がこの間でどのような変化を示すかが今後の課題となる。なおこのアンモナイトについて，堆積環境や生活様式に関する論議を試みる。

松本達郎・田代正之

Introduction

Goshonoura Island of Kumamoto Prefecture (Fig. 1) is well known for the abundant occurrence of Cretaceous molluscan fossils. As was described in detail by one of us (MATSUMOTO, 1938), the island is geologically made up of the "Middle" Cretaceous Goshonoura Group in the main part, the Senonian Himenoura Group in the northwestern coastal belt, and a faulted block of basement granite cropping out at the northeastern corner. The Goshonoura Group consists primarily of sandstones of various grades of coarseness with some red beds. Its molluscan fossils are primarily bivalvia and gastropoda of shallow sea facies and partly those of brackish water or non-marine facies. Hence it used to be called the *Trigonia* Sandstone (e. g. YEHARA, 1923). Ammonites are rather rare and limited to particular beds.

Among previously reported ammonites, *Graysonites* sp. cf. *G. fountaini* YOUNG, from Member IIe, is the most important, because it indicates the lower part of Lower Cenomanian (MATSUMOTO, 1960).

Fortunately we have recently acquired another good age indicator, an ammonite referable to *Mortoniceras*, from a bed of different horizon. In this paper we give a palaeontological description of this ammonite, discuss the age of the Goshonoura Group and attempt to consider the palaeoecology and palaeoenvironment.

Before going further we thank Mr.

* Received June 17, 1975; read June 14, 1975 at Morioka.

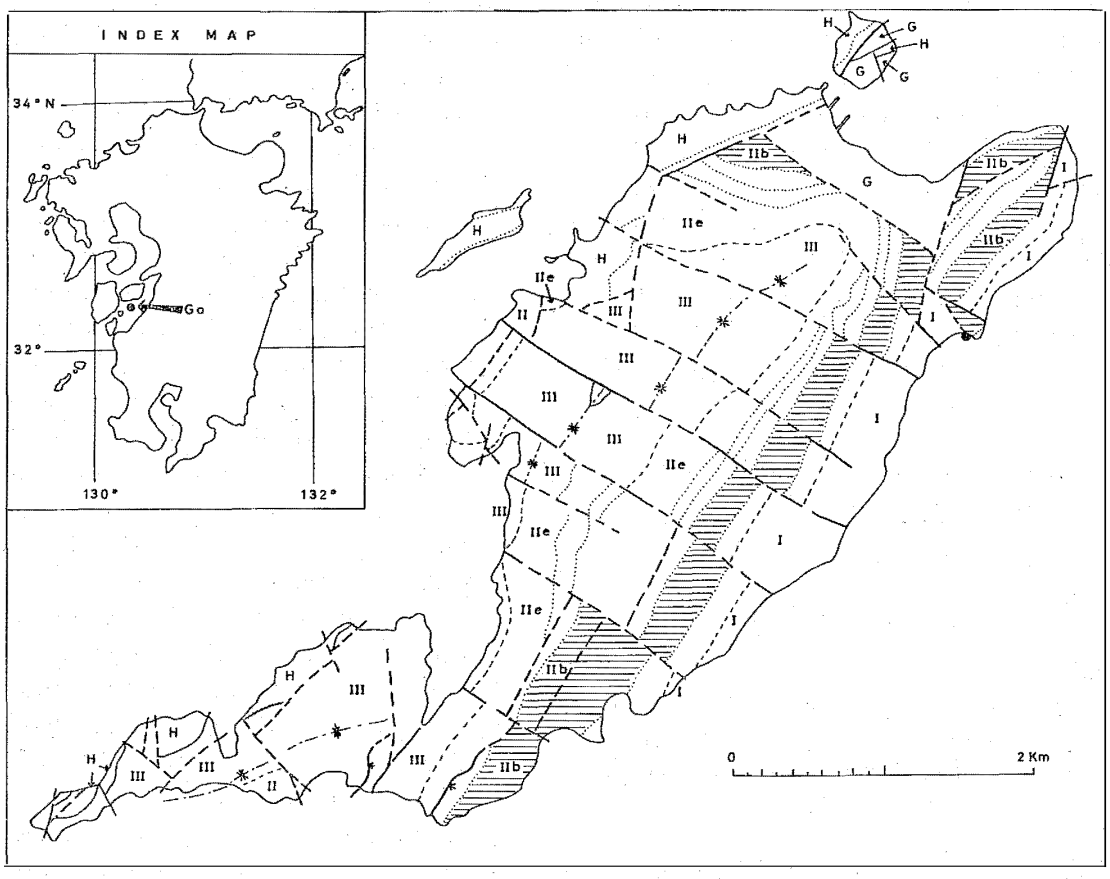

Fig. 1. Outline geological map of Goshonoura island, showing the locality of *Mortoniceras* with a solid circle (•).

Outcrop of Member IIb is indicated with ruled areas; boundary of members with dotted line; that of formation with fine broken line. I, II, III: Lower, Middle and Upper Formations of the Goshonoura Group; H: Himenoura Group; G: Granite.

Inset is a map of Kyushu (upper left corner), indicating with a solid circle the location of Goshonoura Island (Go).

(Adapted from MATSUMOTO, 1938, with revision)

Sanemi KOMATSU, teacher of Kameba (Hondo) Primary School (formerly teacher of Amura Primary School), who cooperated with one of us (M. T.) in collecting fossiliferous rocks. Miss Mutsuko HAYASHIDA has assisted us in preparing the manuscript. This work is one of the contributions to the IGCP Mid-Cretaceous Events.

Palaeontological description

Superfamily Acanthocerataceae

Family Brancoceratidae

Subfamily Mortoniceratinae SPATH, 1925

Genus *Mortoniceras* MEEK, 1876

Type-species: Ammonites vespertinus MORTON, 1834.

Remarks: One of us (T. M.) had opportunities to study the syntypes (ANSP. 4783) of MORTON (1834, p. 40, pl. 17, fig. 1) at the Academy of Natural Sciences,

Philadelphia, and other good examples from the Duck Creek Limestone in the collection of U. S. Geological Survey, Denver, by courtesy of Dr. W.A. COBBAN, gave a brief note on them (MATSUMOTO, 1960, p. 37, fig. 1), and as a result, agreed WRIGHT's (1957, p. L406) definition of the genus and also the subgenus *Mortoniceras* (s. s.), rejecting YOUNG's (1957, p. 3) concept in which the characters of the type-species were ignored.

Mortoniceras (*Mortoniceras*)
sp. aff. *M.* (*M.*)
rostratum (J. SOWERBY)

Pl. 25, Fig. 1; Text-fig. 2

Compare:
1932. *Mortoniceras* (*Pervinquieria*) *rostratum* (J. SOWERBY, 1817), SPATH, Ammonoidea of the Gault, part 9, p. 400 (with full synonymy list).

Material: KE. 2241, collection of M. TASHIRO, from Enokuchi, Goshonoura island, Amakusa-gun, Kumamoto Prefecture. It is represented by an external mould in the sandstone and partly by an internal mould, but the shell material is dissolved away. A plaster cast of this specimen, GK. H5738, is preserved at Kyushu University.

Description: This single specimen is secondarily modified to an elliptical outline, owing probably to a tectonic deformation. It is about 155mm in the longest diameter of the deformed shape and the width of the umbilicus is measured at 39 percent of the diameter. The ratio of whorl-breadth to height cannot be precisely measured, but the whorl seems to be somewhat higher than broad.

Despite the secondary deformation the living chamber is almost wholly preserved. It occupies a little more than a half (200°) of the outer whorl and the rostrum at its apertural margin shows a recurved shape, although the very apex of the rostum is not preserved.

The main part of this adult living chamber is ornamented with fairly distant, coarse, strong, equally long ribs, each of which has a bullate umbilical, nodate mediolateral, prominent inner ventrolateral and clavate outer ventrolateral tubercles. The last two tend to be approximated as the shell grows, resulting in a doubled appearance. They are finally amalgamated into a large ventrolateral tubercle at the stage anteriorly about 90° from the last suture. On the last part (about 30°) of the living chamber the ribs gradually become less distant, by which the tubercles tend to be absorbed, and finally the ribs remain on the inner half and branched to riblets and lirae on the outer part which extends to the rostrum.

The keel, which is partly preserved, is fairly sharp on the internal mould but moderately thick on the external mould.

The septate whorl is ornamented with densely spaced ribs which consist of primaries and inserted or branched secondaries. The umbilical tubercles are bullate; the mid-lateral tubercules are at first indiscernible, then becoming more distinct on the later part, although not so strong as those on the living chamber.

The last suture, which is preserved at the posterior end of the fragmentary internal mould, shows the broad, massive, bipartite saddle between E and L and the widely open L.

Comparisons: If the deformed shape be restored, this specimen closely resembles the holotype of *Mortoniceras* (*Mortoniceras*) *rostratum* (J. SOWERBY), from the Malmstone of Oxfordshire, England (see SPATH, 1932, text-fig. 136). The two specimens show the same recurved shape

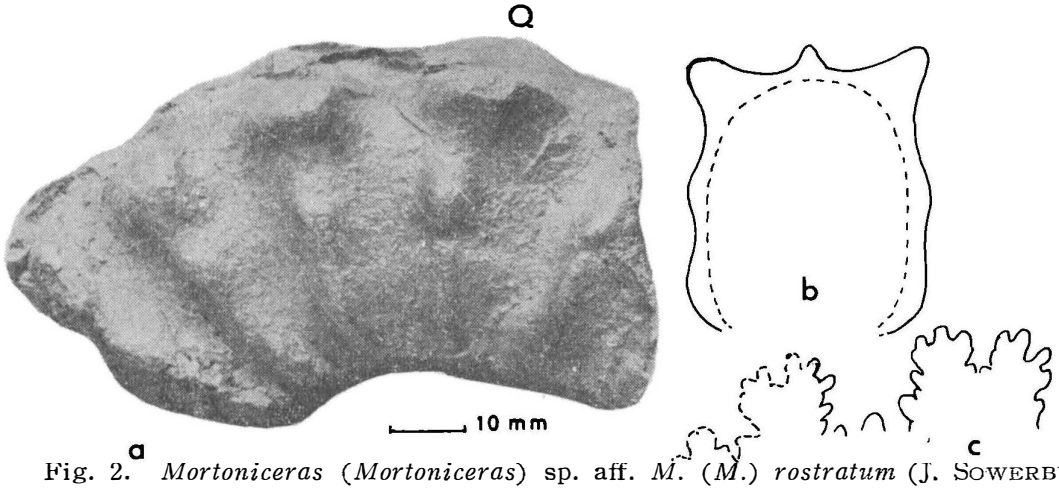

Fig. 2. *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY). Internal mould of the posterior part of the living chamber (part of KE. 2241), with the last septum at its end. Side view (a), restored whorl-section (b) at Q, and the last suture (partly restored from that of the other side) (c). See Pl. 25, Fig. 1d for the ventral view.

of the rostrum. In another typical specimen of *M.* (*M.*) *rostratum* from the Malmstone, illustrated by SPATH (1931, pl. 36, fig. 6), the lateral tubercles seem to appear earlier and are more distinct on the inner whorl than in the present specimen but as strong as ours on the outer whorl; they are situated closer to the ventrolateral tubercles than in ours.

In the same character and in the narrower ribs as well as broader whorls, *M.* (*M.*) *stoliczkai* SPATH, 1921, from India (STOLICZKA, 1865), Angola (SPATH, 1925) and Madagascar (COLLIGNON, 1963), is distinguished from ours, but its ribbing on the inner whorl is as densely spaced as ours.

In the mode of ribbing and tuberculation on the outer whorl the Goshonoura form is similar to *M.* (*M.*) *vespertinum* (MORTON), but the latter has distinctly coarser ribs on the inner whorl and a depressed section and larger size of the adult whorl. The apertural margin is not known in this Gulf Coast species.

Despite the well known specific names, the true extent of variation and the relationships of the three species mentioned above are not necessarily clear. Therefore it is hardly decided whether or not the above described differences are great enough for specific or subspecific distinction. Moreover, our material itself is insufficient. For the time being the described specimen from Goshonoura is called *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY).

Occurrence: The described ammonite was collected from one of the fallen blocks of sandstone at Enokuchi, southeastern coast of Goshonoura island. It was associated with *Glycymeris* (*Hanaia*) *solida*, *Acanthotrigonia ogawai*, *Crassatellites* (*Pachythaerus*) *nagaoi*, *"Callista" crenulata*, etc. The block was undoubtedly derived from Member IIb, middle formation of the Goshonoura Group.

Age of the Goshonoura Group

The Goshonoura Group is lithostratigraphically divided as follows in ascending order (MATSUMOTO, 1938; OKADA,

1961):

I. Lower Formation, 200m.
Ia. Coarse-grained, feldspathic arenite, sometimes conglomeratic, cross-laminated, massive or thick bedded, with lenticular red beds, almost barren of fossils.
Ib. Feldspathic wacke of various grades of coarseness, bedded, with thin coaly seams, mudstone and several prolific fossiliferous layers of shallow sea to brackish water facies.

II. Middle Formation, about 550m. Sandstones (mainly feldspathic wacke and partly feldspathic and quartz-feldspathic wacke and partly feldspathic and quartz-feldspathic arenite) containing molluscan fossils of generally shallow sea environments (the so-called *Trigonia* Sandstone). This is subdivided into five members, IIa to IIe in ascending order. Members IIb (180m) and IIe (150m) consist of massive well-sorted, medium- to fine-grained sandstones, containing abundantly molluscan fossils (trigonians, *Cucullaea*, *Anthonya*, "*Callista*" etc.) of shallow open sea facies in lenticular beds and calcareous nodules. Ammonites are occasionally associated with them. Members IIa (100m) and IIc (70m) are ill-sorted, coarse-grained, sometimes conglomeratic, feldspathic wacke, containing trigonians and other mollusca. Member IId (50m) consists of conglomerate and sandstone with some red beds and brackish-water mollusca.

III. Upper Formation, 200 m or less. Sandstones of various grades of coarseness, conglomerate (sometimes boulder-bearing), mudstone and red beds, with fossiliferous layers of brackish to fresh water facies. Sandstones are mainly of lithic wacke.

This formation may be subdivisible into several members in accordance with the predominant rock assemblage among the above, but there is lateral change in the details of facies.

One of us (MATSUMOTO, 1938) once stated that the Goshonoura Group is mid-Cretaceous, that its main part is approximately referable to Cenomanian [Gyliakian] and that its lower part possibly ranges down to Albian [Upper Monobegawa]. This conclusion was a rough estimation on the basis of the provisional study of the molluscan fauna as well as the stratigraphic sequence, but it is now confirmed on more reliable evidence.

Mortoniceras (*Mortoniceras*) *rostratum* occurs, according to SPATH (1932, p. 405), in the Zone of *Stoliczkaia dispar*, upper part of Upper Albian in England and France. *M.* (*M.*) *stoliczkai* occurs from the Upper Albian of southern India, Madagascar and Angola. *M.* (*M.*) *vespertinum* probably came from the Duck Creek Limestone (ADKINS, 1928), which is assigned to the lower part of Upper Albian (STEPHENSON et al., 1942).

How far the zonal sequence established in western Europe can be maintained in Japan, which was much distant and belonged to a different biogeographical province, may be a question. This is especially questionable when the species are not quite identical.

So far as the better studied material is concerned, most of the species belonging to the Acanthocerataceae do not show discrepancy in the biostratigraphic succession at substage level between Europe and Japan, if identical or closely allied species are taken into consideration (e. g. MATSUMOTO, 1975). Of course there can be local difference in the subzonal succession. Consequently we are reasonably led to regard the age of

Member IIb as Upper Albian, if not convinced of the upper Upper Albian. To determine whether it is upper Upper Albian or otherwise, we should complete the list of associated ammonites.

It has already been concluded (AMANO et al. *in* MATSUMOTO, 1960) that Member IIe is most probably assigned to lower Lower Cenomanian on account of *Graysonites* cf. *fountaini* YOUNG and *Desmoceras kossmati* MATSUMOTO obtained from it. In Texas *G. fountaini* occurs in the Zone of *Graysonites adkinsi*, which is in the lower, but not basal, part of Lower Cenomanian, since the Zone of *Plesioturrilites brazoensis* is allocated at the base of the Cenomanian (YOUNG, 1958). Should this succession be maintained in Japan, there would be some room below Member IIe for the basal Cenomanian. In other words Member IId may still be within Lower Cenomanian. As the fossils contained in IId are mostly of endemic species, direct evidence for the correlation with the international scale is not available for IId.

To sum up, the Albian-Cenomanian boundary would be either at the base of IId or at the base of IIc; or could be somewhere within Member IIc. Since ammonites could scarcely be expected from IId and IIc in view of their facies, further search for more ammonites from Members IIb and IIe would give evidence to decide one of the alternatives. Another problem to be settled in the future is whether and how other molluscan fossils, such as species of the Trigoniidae and Glycymeridae, are changed or unchanged across the Albian-Cenomanian boundary in the Goshonoura and other sequences in Japan.

Incidentally the Upper Formation of the Goshonoura Group is most probably correlated with the lower part of the Mifune Group, southwest of Kumamoto, on account of common occurrence of such diagnostic species as *Matsumotoa japonica* OKADA, *M. unisulcata* (AMANO), *Acanthotrigonia yeharai* (NAKANO and NUMANO) and *Crassostrea* sp., as clearly discussed by TAMURA et al. (1968). Recently *Eucalycoceras* sp. cf. *E. spathi* (COLLIGNON) and *Inoceramus concentricus costatus* NAGAO and MATSUMOTO have been discovered from a part of the Lower Mifune, which indicate Middle to Upper Cenomanian (TAMURA et al. 1974). Therefore, the Goshonoura Group is not likely to extend to Turonian in age and there should be an unconformity or hiatus between the Goshonoura Group and the Senonian Himenoura Group.

Further remarks

(Tatsuro MATSUMOTO*)

It should be noted that the adult living chamber is preserved in the specimen of *Mortoniceras* from Member IIb as in the case of *Graysonites* from Member IIe. This implies that the sedimentary condition was rather quiet during the deposition of IIb and IIe. The petrographical characters of the sandstones (well sorted, medium to fine-grained wacke with muddy matrix) support this as investigated by OKADA (1960).

The bottom sediments where adult shells of *Mortoniceras* were embedded are not always of the same kind. For instance, Malmstone (fine-grained glauconitic sandstone) in the case of Oxfordshire examples, and limestone in the case of Duck Creek ones, and medium to fine grained sandstone with muddy matrix in our case. They are all sediments

* T. MATSUMOTO alone is responsible for this article.

under calm shallow sea, although the absolute depth is hardly estimated with the available data.

As can be judged from the difference in the characters of ribbing and tuberculation between the adult and immature shells, the animals of *Mortoniceras* may have changed to some (if not great) extent their mode of living during their life history. Especially the rostrum at the apertural end of the shell suggests a particular mode of life of the adult animal. The function of the rostrum, especially a recurved one as in *M. rostratum*, has not yet been sufficiently investigated, although the morphology itself was noticed long ago (e. g. STIELER, 1922).

Presumably the animal of *Mortoniceras* must not have been a rapid swimmer. The rectiradiate, strong ribs with fairly strong tubercles and the subquadrate whorl section would be shell characters against the stream. The adult animal may have moved up and down in the sea-waters to some extent, controlling the buoyancy of air-chambers, and also could have swimmed slowly backward. The raised or recurved rostrum may have served as a kind of anchor when she settled herself on the bottom sediments under the sea water. A moderately long and broad living chamber occupied by the animal would make the entire shell less buoyant.

The above is a working hypothesis which should be examined further by some model experiment or by theoretical calculation. Another, more serious probblem is about the funnel. In *Nautilus* and most of Paleozoic Ammonoidea (Goniatitida defined by MATSUMOTO, 1974) the hyponomic sinus is distinctly present on the ventral (i. e. external) side of the shell. In most of the Mesozoic Ammonoidea (Ceratitida and Ammonitida, except some Lytoceratina), there is no hyponomic sinus on the ventral side but instead the external part of the shell is more or less projected. This is extreme in the case of *Mortoniceras* which bears rostrum. I dare propose an idea as a working hypothesis that the funnel in many Mesozoic ammonoids may have doubled openings or have been in pair, being produced somewhere at the ventrolateral part. HOEPEN (1951) described a distinct sinus at the ventrolateral part (or outer lateral part) of "*Pervinquieria*" *scobina*. This sinus may correspond to the hyponomic sinus (one of the pair). Many other Mesozoic ammonites (e. g. *Holcophylloceras, Harpoceras, Desmoceras* etc.) show a more or less sinuous apertural margin which has a pair of outer lateral (or ventrolateral) and inner lateral or umbilical) sinuses. The former is presumably one of a paired hyponomic sinuses, while the latter is certainly an ocular sinus. How to prove or disprove this working hypothesis a future problem.

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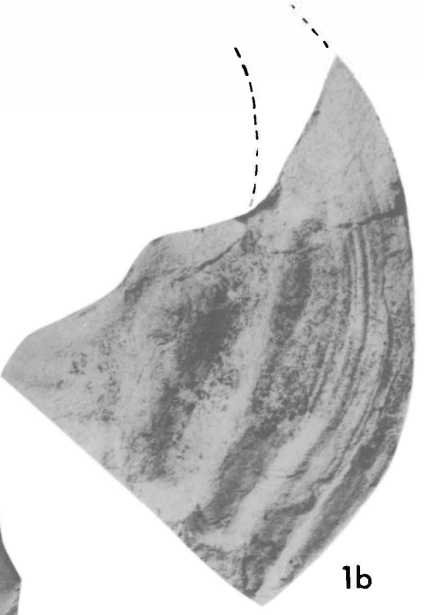
Explanation of Plate 25

Fig. 1. *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY). Specimen from Goshonoura island, KE. 2241. Lateral view (a), the other side of a part of the rostrum (b), the other side (c) of the plaster cast; ventral view of the internal mould of the posterior part of the living chamber (d) (see Text-fig. 2 for the same internal mould). All figures of natural size. Repository: Department of Geology, Faculty of Education, Kumamoto University, Kumamoto 860.

Amakusa	天草	Honto	本渡
Amura	阿村	Kameba	亀場
Enokuchi	江口	Kumamoto	熊本
Goshonoura	御所浦	Mifune	御船
Himenoura	姫浦		

1a



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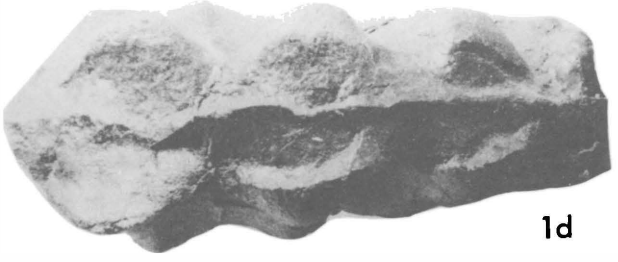

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