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On the Occurrence of Late Cretaceous Molluscan Assemblages from the Menabe Area, Southwestern Madagascar*

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Introduction

Menabe area is situated in the southwestern part in the Madagascar Island (Fig. 1), and celebrated for the abundant occurrence of Cretaceous molluscs such as ammonoid and inoceramid in a favorable condition for preservation. Thus, the Cretaceous biostratigraphy in the Menabe area is regarded as a standard scheme at the southern part of Africa (BESAIRIE & COLLIGNON, 1960), and is correlated with those in the European areas. Some ammonoids and inoceramids from Madagascar are in common with those from Japan, therefore the exact comparison of the faunas from the both countries is required (e.g. COLLIGNON, 1977).

For the purpose of elucidating the relationship between the break-up of the Gondwana land and the subsequent changes in fauna and flora, the party of the National Science Museum, Tokyo carried out a Paleontological expeditions to Madagascar in 1973 and 1975, over a period of 70 days from August to October, respectively. As one of the topics of study Y. KANIE participated in the preliminary field work of marine Cretaceous strata at Menabe area in 1973, and I. OBATA, Y. KANIE, C. RANAIVOSON, and Y. RATSIMBA made a geological survey and fossil collecting in 1975 with the assistance of Mr. EVELYST of the Geological Survey of Madagascar.

After the research, all the fossil specimens collected in 1973 were sent back to Madagascar. Collections made in 1975 are still in the Geologial Survey of Mada-

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gascar without being subjected to any research since 1975, pending a permission of Malagasy Government. Results of the study on fossil specimens collected in 1973 and the field work in 1975 in the Menabe area are reported in this paper.

The 1973 and the 1975 National Science Museum Parties, having been granted permission by the Malagasy Government, carried out field work, in cooperation with the Service Géologique, Direction des Mines et de l'Energie, Repoblika Malagasy. The authors are deeply indebted to Mr. RASOAMAHENINA-ANDRIAMAZOTO, the former Chief of the Service Géologique, who kindly made arrangements for the field work, and allowed them to use utilities and equipments of the Service Géologique. The officials on the Japanese embassy at Tananarive assisted them in various ways. They wish to record here their gratitude to the following persons of the National Science Museum parties in 1973 and 1975, who helped them in this study in various ways: Dr. Kazuo ASAMA; Dr. Ienori FUJIYAMA; Dr. Yoshikazu HASEGAWA, who is now a professor of Yokohama National University; Dr. Hiroshi UJIIÉ, who is now a professor of the University of the Ryukyus; Dr. Satoshi MATSUBARA. The Somapeche Company Ltd. at Majunga, Madagscar and the Taiyo-gyogyo Company Ltd. at Tokyo offered facilities to the National Science Museum parties for transportation of the collected specimens and the surveying instruments. The study was financially supported by a Grant in Aid for Overseas Scientific Survey, defrayed from the Ministry of Education, Science and Culture, Japan.

Historical Reviews

Studies of the Cretaceous sequence and fossils of Madagascar have been mainly performed by French geologists. On the Menabe area the Belo-sur-Tsiribihina sheet of the 1: 200,000 geological map was published by the Service Géologique de Madagascar in 1934, and the explanatory text was written by HOURCQ (1956). Afterwards, the Behamotra-Ampolipoly sheet and the Belo-sur-Tsiribihina-Berevo sheet of the 1: 100,000 geological map were published (COLLIGNON & HOURCQ, 1958; HOURCQ & COLLIGNON, 1958).

The significance of the Upper Cretaceous ammonites from Madagascar was noted by COLLIGNON (1932, 1937), who gave his careful consideration on such geological and paleontological problems as the Cenomanian and Turonian fossils (COLLIGNON, 1939), the Santonian ammonites (COLLIGNON, 1966a, 1966b), the lower Campanian fauna (COLLIGNON, 1969a, 1969b), and the middle and upper Campanian fauna (COLLIGNON, 1970) in the Menabe area. Furthermore, COLLIGNON monographed several families of the Upper Cretaceous ammonites (1948a, 1948b, 1955a, 1955b, 1956, 1961). And various inoceramids were described (SORNAY, 1962, 1964, 1968, 1969; NODA & KANIE, 1978).

As a result of the molluscan studies, the international correlation of the Upper Cretaceous formations between Madagascar and the other realms, e.g. Europe, India and Japan, was done by COLLIGNON (1959, 1968, 1977). He had a special interest on

the endemic fauna and the sedimentary environment in the Menabe area (1971, 1972). BESAIRIE summarized the geology of Madagascar in a voluminous paper (1972). Results of studies by the parties of the National Science Museum, Tokyo, based on the fossil specimens collected in 1973 and the field work in 1975, have been reported in thirteen papers in the *Bulletin of the National Science Museum*.

Stratigraphy and Fossils

The studied area is indicated in Fig. 1.

A. Menabe Area

The Upper Cretaceous formations along the routes of Andimaky, Behamotra, Antsirasira, Ankerabe, Ankilizato-nord, Bevaho, Merotsy, Bemoky etc., north of Belo-sur-Tsiribihina were investigated. As shown in Fig. 2, the strata mainly consisting of muddy sediments in the area generally extend to NNW-SSE in direction and gently dip west.

According to the Behamotra-Ampolipoly sheet of the 1: 100,000 geological map, the stratigraphic sequence of the area from east to west is summarized in ascending order as follows: C6 (Turonian), Basalt bed, C7a (Coniacian), C7b (Santonian), C8a (lower Campanian), C8b (middle Campanian), C8c (upper Campanian), C9 (Maastrichtian).

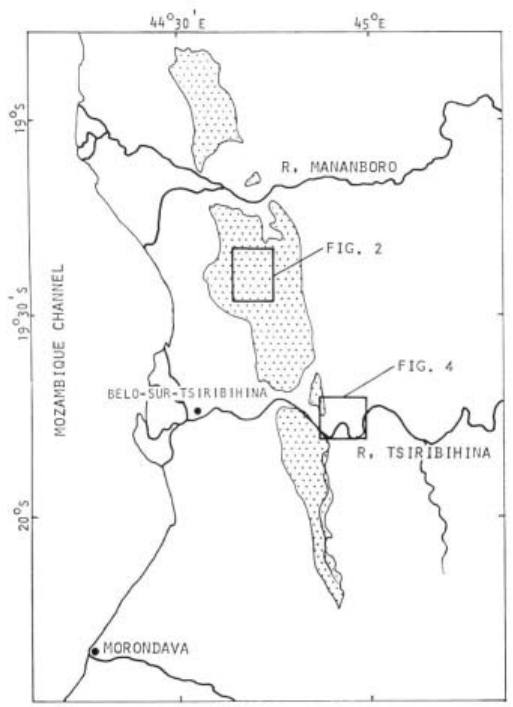

Fig. 1. Studied area in the southwestern part of Madagascar. Meshes represent the outcrop areas of the Late Cretaceous deposits.

For convenience the above divisions of COLLIGNON & HOURCQ (1958) were used here. The authors present here the locality map of the investigated area (Fig. 2) and

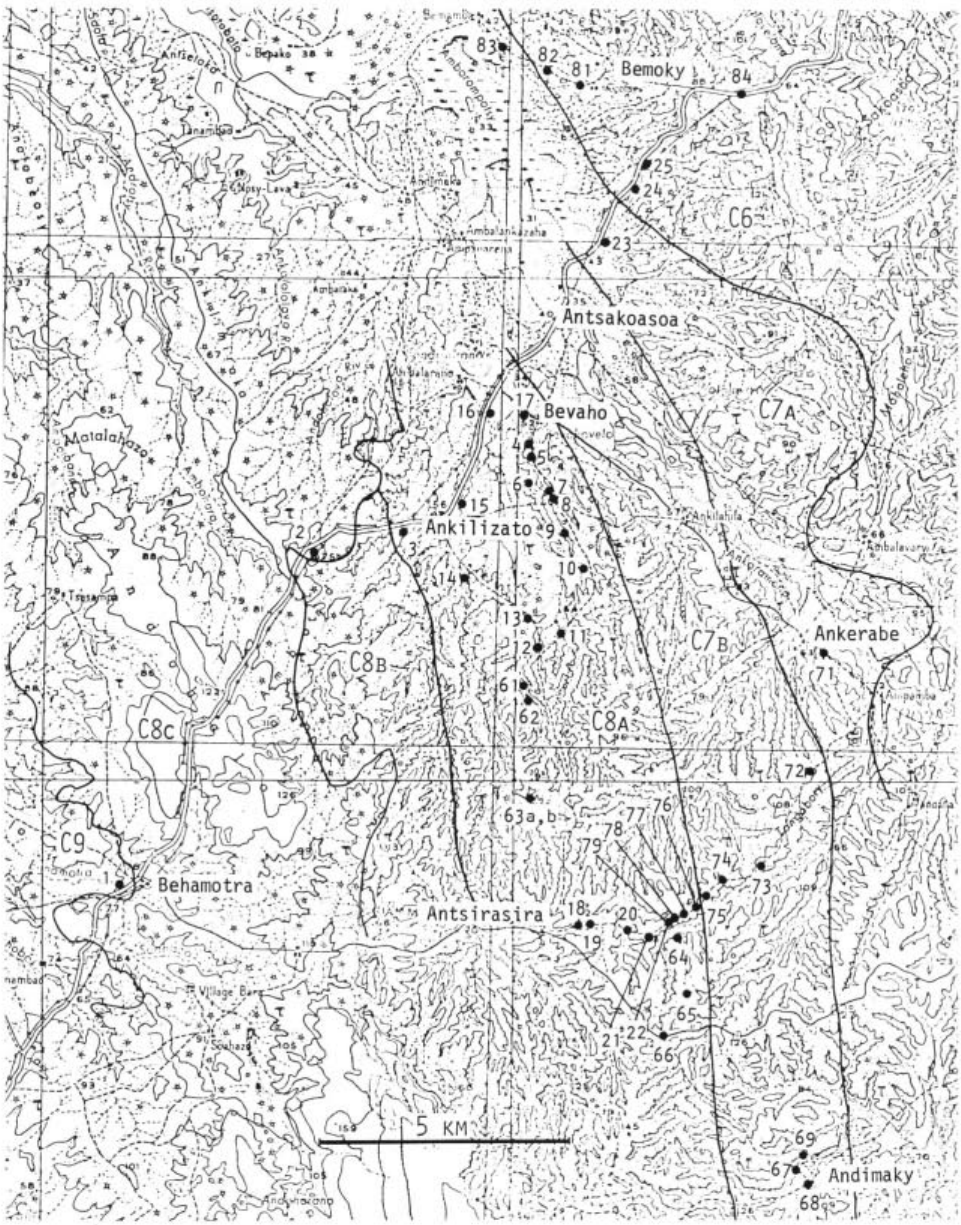

Fig. 2. Locality map of central part of the Menabe area (sheet map 1/100,000 F48, G48). Locality numbers beginning with prefix Mb. The boundaries between each two formations are adapted from the Service Géologique de Madagascar (1958).

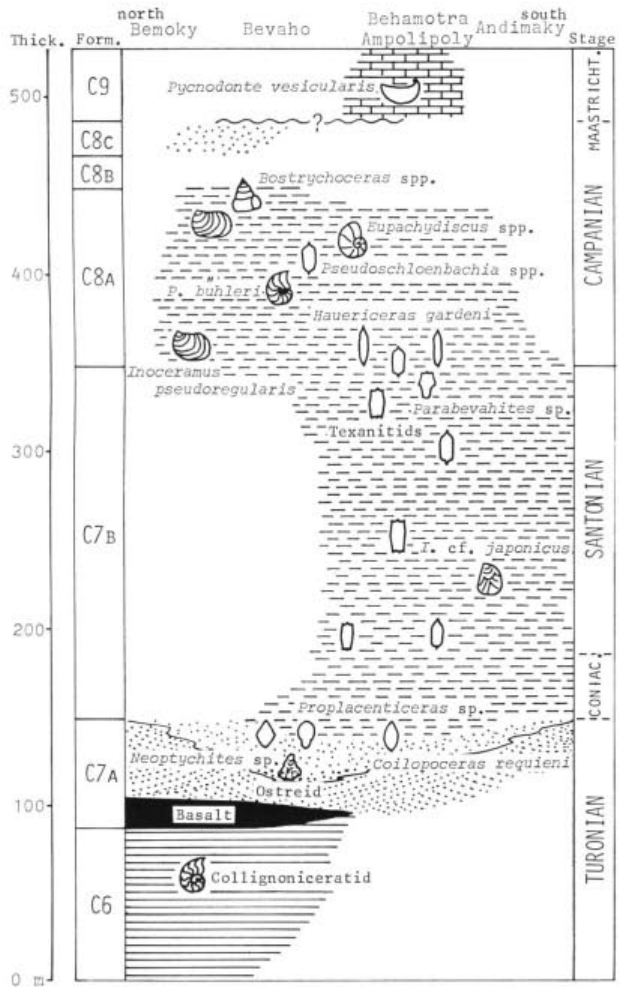

Fig. 3. Columnar section of the Upper Cretaceous, showing the occurrence of selected molluscs in the studied area.

a columnar section of the Upper Cretaceous, showing the occurrence of selected molluscs in the Menabe area (Fig. 3). The authors wish to record some stratigraphic notes as below.

1. Formation C6

The strata are distributed in the north-eastern part of the area. Locs. Mb24 and Mb25 consist of sandstone containing septaria. Locs. Mb81 and Mb82 consist of siltstone which contains calcareous concretions. Fossils are rarely found in concretions. A collignoniceratid ammonite and *Eutrephoceras* sp., a nautiloid were obtained at loc. Mb81, and another collignoniceratid, *Phyllopachyceras* (?) sp. and *Eutrephoceras* sp. at loc. Mb82.

2. Basalt bed

A basaltic flow is widely distributed in Majunga area, northwestern Madagascar and its age is assigned to Turonian to Coniacian.

Loc. Mb84 in the northern margin of the investigated area is an example of the outcrop.

3. Formation C7a

Loc. Mb83 mainly consists of medium-grained sandstone, and loc. Mb23 fine-grained sandstone. The sandstone is frequently cross-laminated, having no concretions. No fossil was discovered at both the localities.

At the lowest part of loc. Mb71, the authors recognized an ostreid bank, above which at about three or four metres higher than the bank there is a fossiliferous mudstone. The authors identified the following ammonite species in their collection (Plates 1 and 2). The number in brackets is that of individuals obtained.

Kossmaticeras recurrense KOSSMAT	(10)
Proplacenticeras stantoni HYATT	(1)
Neoptychites subxentriformis COLLIGNON	(1)
Coilopoceras requieni D'ORBIGNY	(7)
Hourcquia cf. *H. ingens* COLLIGNON	(2)

These species are some of the elements composing *Romaniceras deverianum—Coilopoceras requieni* Zone by COLLIGNON (1965), which indicate the late Turonian.

The fossiliferous mudstone, the upper part of Formation C7a, grades downward to the ostreid bank of sandstone at the bottom of loc. Mb71.

Although loc. Mb71 appears to be regarded as a part of Coniacian strata by the Behamotra-Ampolipoly sheet, the present authors newly assigned the locality, on the basis of the ammonite assemblage, to the upper Touronian. *Neoptychites* generally occurs in the lower Turonian (MATSUMOTO, 1978), and KENNEDY & WRIGHT (1979) mentioned a doubt on the systematic position of *Neoptychites subxentriformis* COLLIGNON and *N.s.* var. *masiaposensis* COLLIGNON. Thus the further studies through the paleontological and biostratigraphical ways are needed. In any way the Formation C7a represents a deposit of the transgressive phase in the Turonian.

4. Formation C7b

The formation consists mainly of siltstone which includes numerous septaria. No fossils were found from the lowest part (ca 50 m in thickness) possibly corresponding to the Coniacian. The main part of the Formation C7b is characterized by occurrences of various texanitids. According to COLLIGNON (1966), Zones of *Texanites oliveti* (Lower Santonian), *Texanites hourcqui* (Middle Santonian), and *Pseudoschloenbachia umbulazi* (Upper Santonian) are recognized.

Table 1 shows a list of the molluscan species and the individuals obtained by the authors in 1975 from the Formation C7b. The specific identifications are still tentative, because the specimens were not examined in detail at the laboratory.

5. Formation C8a

The formation consists of siltstone and fine-grained sandstone, and it extends

Table 1. Molluscan species and the numbers of individuals obtained by the authors in 1975 from the Formation C7b.

C7b	low.	mid.				up.	
Loc. Mb	72	73	67	68	69	74	75
Gastropoda			1				
Inoceramus (Endocostea) cf. *japonicus* NAGAO & MATSUMOTO			1			2	
I. (E.) sp.			1	2			3
I. (Platyceramus) sp.							1
Eutrephoceras sp.	7			3	1	3	
Baculites cf. *capensis* WOODS	2					1	
B. sp.						1	10
Anisoceras sp.							2
Polyptychoceras sp.							1
Austiniceras (?) sp.				2			
Mesopuzosia (?) sp.	2						
Eupachydiscus sp.					13		
Canadoceras (?) sp.				3			
Pachydisciid gen. et sp. indet.	3						
Hauericeras gardeni BAILY				1			
Texanites spp.	3	1				8	2
Menabites sp.	3		2	6	2		
Pseudoschloenbachia (Bühreriella) bühreri COLLIGNON				1	2		
P. (Hourcquiella) sp.							8

Read *Buehreriella buehreri* for *Bühreriella bühreri*

southward with little change in general lithofacies. Abundant fossils were discovered in the nodules (Plates 3 and 4). In the Formation C8a the authors obtained 8 species of ornamented ammonites belonging to the Collignoniceratidae from 53 localities, 13 species of smooth ammonites belonging to the Desmoceratidae from 52 localities, and 6 species of heteromorphs from 21 localities. Fifteen species of inoceramids were obtained from 39 localities. Thus the main species of the collection are inoceramids, next in abundance are smooth ammonites, then ornamented ammonites. It is noted that the number of localities which yield the ammonites, is the largest for ornamented ones (53 localities), next is for smooth ones (52 localities), then for inoceramids (39 localities). Table 2 shows a list of molluscan fossils from the Formation C8a. Thus the formation may be assigned to the early Campanian, on the basis of the occurrence of *Submortoniceras* sp. and other associated species.

6. Formation C8b

The formation consists mainly of calcareous sandstone.

7. Formation C8c

From the calcareous, fine-grained sandstone, *Baculites* sp., *Eutrephoceras* sp., *Pycnodonte* sp., and siliceous woods were obtained (loc. Mb2).

8. Formation C9

A fragmentary whorl of an ammonite and *Pycnodonte* sp. were obtained from white marl (loc. Mb1).

Table 2. A list of the invertebrates and vertebrates obtained by the authors in 1975 and KANIE in 1973 from the Formation C8a.

Species	Loc. Mb
Linthia sp.	6, 17, 76
Gastropoda gen. et sp. indet.	8, 62
Inoceramus (Endocostea) flexus SORNAY	3
I. (E.) pseudoregularis SORNAY	3, 4, 7, 9, 11, 18, 61, 79
I. (E.) α aff. pseudoregularis SORNAY	3
I. (E.) β aff. pseudoregularis SORNAY	18
I. (E.) cf. heberti FALLOT	3
I. (E.) paraheberti SORNAY	12
I. (E.) ampambaensis SORNAY	3, 18, 21, 78
I. (E.) cf. arculiferus SORNAY	3, 18
I. (E.) aff. arculiferus SORNAY	7, 10
I. (E.) mitraikyensis SORNAY	3
I. (E.) balticus BÖHM	10, 18, 76, 78
I. regularis D'ORBIGNY	3, 9, 18
I. aff. bererensis SORNAY	3, 10
I. (Trachoceramus) aff. ianjoanensis SORNAY	18
I. sp.	62, 63a, 64, 65, 66, 76, 78
"Teredo" sp.	10
"Ostrea" sp.	18, 22
Pelecypoda gen. et sp. indet.	65
Eutrephoceras sp.	3, 4, 6, 7, 8, 9, 11, 13, 17, 18, 22, 62, 63b, 76, 78
Phylloceratid gen. et sp. indet.	6 6
Pseudophyllites peregrinus SPATH	12
P. (?) sp.	11, 22, 76
Baculites cf. *menabensis* COLLIGNON	62
B. sp.	11, 13, 76
Polyptychoceras sp.	4, 11
Diplomoceras (?) sp.	11, 62
Glyptoxoceras (?) sp.	4, 8
Bostrychoceras spp.	12-16, 18, 19, 22, 62, 63a, 64
Desmophyllites diphylloides FORBES	77
Austiniceras menabense COLLIGNON	3, 5, 11
"Mesopuzosia" bererensis COLLIGNON	77
Neopuzosia sp.	76, 79
Puzosiid gen. et sp. indet.	9, 15, 78
Anapachydiscus sp.	5, 78
Eupachydiscus grossouvrei KOSSMAT	12
E. spp.	3, 5-7, 9, 11, 13, 17, 18, 20-22, 61, 62, 64-66, 78, 79
Canadoceras hoepeni COLLIGNON	3, 14, 17
Hauericeras gardeni BAILY	4, 13, 18, 19, 21, 22, 62, 64, 66, 76, 77, 78
Submortoniceras sp.	78, 79
Menabites sp.	4, 10
Bevahites sp.	18
Texanitiid gen. et sp. indet.	10, 17, 77, 78
Pseudoschloenbachia (Pseudoschloenbachia) sp.	3, 79
P. (Bühreriella) bühreri COLLIGNON	3, 4, 8, 10-13, 18-22, 61, 62, 63a, 64, 65
P. (Bourcquiella) sp.	3, 9, 11, 16, 20, 62, 64, 65
P. spp.	6, 10, 12, 13, 76-79
Crustacea gen. et sp. indet.	18
Shark teeth gen. et sp. indet.	14

Read *Buehreriella buehreri* for *Bühreriella bühreri*

B. Amboloandro Area

The route surveyed is along the road from Amboloandro to Betomba, about 35 km east of Belo-sur-Tsiribihina (Fig. 4). The geology of the area is illustrated on the

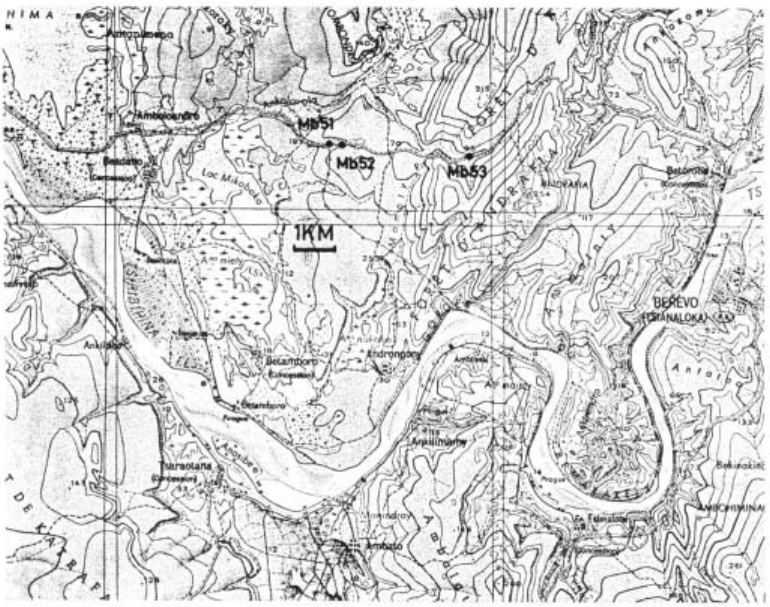

Fig. 4. Locality map of the Amboloandro area, eastern part of Belo-sur-Tsiribihina (sheet map 1/100,000 G49).

Belo-sur-Tsiribihina and Berevo sheets of the 1: 100,000 geological map published by the Service Géologique de Madagascar. According to them, the surveyed area is shown as the Formation C7–6 composed of Turonian to Coniacian sandstone or marl. The strata, intercalating a basaltic flow, overlie the Albian to Cenomanian terrestrial reddish sandstones (Formation C5–3) in the south of the Tsiribihina River, and yield various ammonites of Turonian to Coniacian in the north (BESAIRIE & COLLIGNON, 1972).

An acanthoceratid was obtained from a calcareous nodule in the siltstone at loc. Mb51, and a puzosiid was obtained at loc. Mb52. Loc. Mb53 consists of coarse-grained arkose sandstone.

Occurrence of the Campanian Fossils

In this chapter the authors would like to remark on the early Campanian sedimentary basin of the investigated area, on the basis of the molluscan fossils obtained. Fig. 5 shows the frequency of several molluscan genera in occurrence in the Formation C8a at some selected localities. Fig. 6 shows the most abundant molluscs by symbols at each locality in the Formation C8a. The main constituents of the whole collection are *Inoceramus* (*Endocostea*) species, *Pseudoschloenbachia* species and *Hauericeras gardeni*, subordinates are *Eupachydiscus* species (Pl. 4, fig. 3) and *Bostrychoceras* species. The other ammonites also occur but less in abundance.

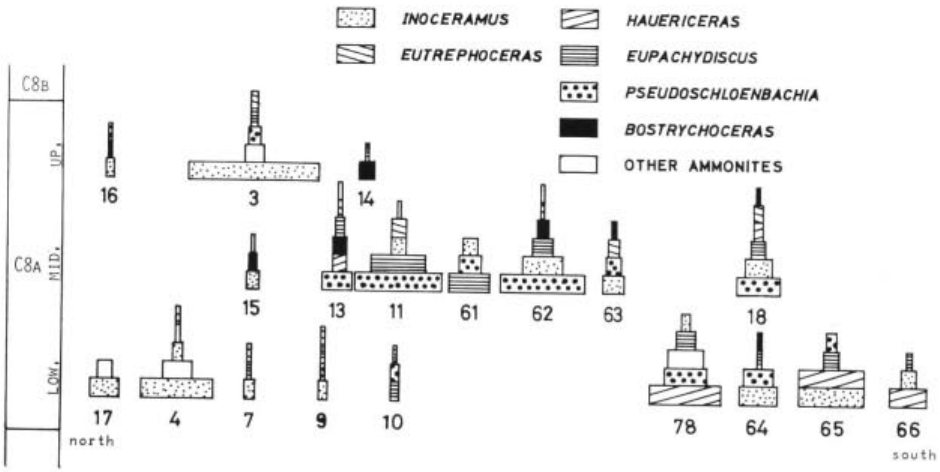

Fig. 5. Frequency of occurrence of several molluscan genera at selected localities in the Menabe area. The size of rectangles of legend represents 10 individuals . The locality numbers below piles of rectangles are the same in Fig. 2. Locality numbers beginning with prefix Mb.

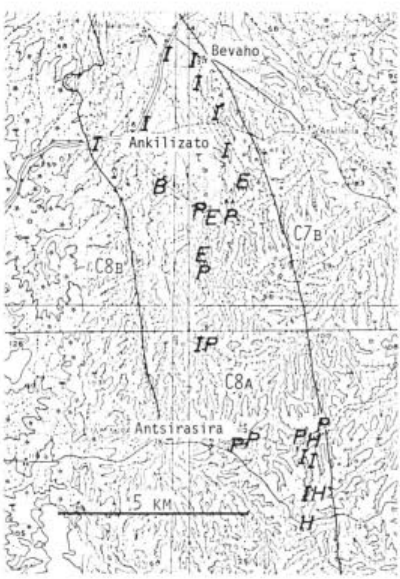

Fig. 6. The most abundant molluscs are shown by symbols at selected localities in the studied area. *I*: *Inoceramus*, *E*: *Eupachydiscus*, *B*: *Bostrychoceras*, *P*: *Pseudoschloenbachia*, *H*: *Hauericeras*.

Near Bevaho and Ankilizato in the northern part of the area surveyed, *Inoceramus* (*Endocostea*) species occur abundantly, with subordinate occurrence of ammonites. In the central part of the area ornamented *Pseudoschloenbachia* species predominate, and the next in abundance is *Eupachydiscus* species, then *Inoceramus* species. In the southern part of the area smooth discoidal whorl of *Hauericeras gardeni* often occurs,

and less often *Inoceramus* species and *Pseudoschloenbachia* species.

Many of inoceramids, e.g. *Inoceramus* (*Endocostea*) *pseudoregularis* (Pl. 3, fig. 1) and *I.* (*E.*) *ampambaensis*, are large and conjugated with the bivalves. In most of the obtained specimens of cephalopods the living chamber is well preserved without any destruction. Thus the fossils may be regarded as autochthonous shells.

Pseudoschloenbachia species, which were frequently discovered in the central part of the area, have compressed whorl with fastigate venter and high keel, being more or less ornamented (Pl. 3, figs. 3, 5, 6). Among the *Pseudoschloenbachia* species, the main constituent is *P.* (*Buehreriella*) *buehreri* (Pl. 3, fig. 3), next in abundance is *P.* (*Hourcquiella*) sp. (Pl. 3, fig. 6).

Hauericeras gardeni (Pl. 4, fig. 2), which was often found in the southern part of the area, is more compressed and less ornamented than the *Pseudoschloenbachia* species, and has sharp, high keel. *Eutrephoceras* sp., a nautiloid species, was obtained at 15 localities (Pl. 3, fig. 2). *Eutrephoceras* sp. seems to be common over the area surveyed, and the living chamber of the shell is often preserved.

It has already been realized empirically that ammonoids are one of the most important biofacies indicators to estimate paleoenvironments and paleogeography since SCOTT's (1940) proposal on interpretation of habitats and bathymetric distribution of ammonoids (e.g. MATSUMOTO & OBATA, 1962). According to TANABE et al. (1978), good state of preservation of body chamber and occasional accompaniment of aptychi suggest that most of the collignoniceratids and heteromorphs in their material are autochthonous in a broad sense, judging from the distinct mode of occurrence, restricted geographic distribution in the marine Cretaceous basin of Hokkaido, north Japan. Thus litho- and biofacies characters of the Turonian containing them suggest that the former group might have lived under the inshore to nearshore shallow water environment, and the latter group under the nearshore to offshore environment of shallow to moderate depth, respectively. Furthermore, it is noted that the original habitat pattern and the wide post-mortem transportation or drift may both have controlled the distribution pattern of thanatocoenoses of smooth or weakly ornate type species (TANABE et al., 1978). Therefore the species of this type may have occupied the wide habitats ranging from the nearshore to the offshore, because of their wide geographic distribution in the Cretaceous basin of Hokkaido with a low frequency of occurrence at many localities regardless of lithofacies type.

As for the Madagascar ammonites, COLLIGNON has regarded the species belonging to *Inoceramus* (*Endocostea*), *Pseudoschloenbachia*, and *Bostrychoceras* from the Menabe area as endemic species, while *Hauericeras gardeni* and *Eupachydiscus* species as cosmopolitan (1971, 1972). Furthermore, COLLIGNON has supposed the sedimentary basin of the Menabe as a calm bay in which more than 50 species of *Pseudoschloenbachia* radiated in various ways. Excepting the case of the Menabe basin, only about 30 individuals were known from the other basins in the world. COLLIGNON interpreted that the post-mortem *Hauericeras gardeni* and *Eupachydiscus* species were transported from the open sea into the bay.

The authors inclined to, however, consider that the Campanian molluscan fauna from the studied area is autochthonous, because of the good state of the preservation of the body chamber in ammonoids and nautiloids, the conjugated state of the bivalves in inocerami and the limited distribution of the fossil occurrence. From these lines of evidence it may be suggested that the sea of Campanian basin of the area investigated is shallow at the north and gradually increase the depth toward the south. In any way for restoring the paleogeographic bay by COLLIGNON (1971, 1972) in detail, further discussion based on more data in the field is necessary.

Concluding Remarks

The Upper Cretaceous of the Menabe area ranges in ages from Turonian to Maastrichtian, and is represented by marine sediments consisting of siltstone and sandstone which include abundant fossils in calcareous nodules.

Resulting from the present study, the Formations C6–C7a are probably Turonian in age, and contain some intercalated terrestrial beds and a basaltic flow. On careful examination, fossil evidence suggests that the upper part of the Formation C7a is Turonian in age, though Coniacian was indicated on the Behamotra-Ampolipoly sheet of the 1: 100,000 geological map (COLLIGNON & HOURCQ, 1958).

The Formation C7b ranges in age probably from Coniacian to Santonian: the formation is characterized by the occurrence of various texanitid ammonite, but no Coniacian fossils were collected from the base of C7b. The Formations C8a, C8b and C8c are probably correlative with the lower, middle and upper Campanian, respectively. The former is composed of thick siltstone and fine-grained sandstone rich in well preserved molluscs, while the latter two are composed of sandy sediments rare in marine molluscs. The Formation C9 is composed of white marl which contains *Pycnodonte* sp. etc., and is probably Maastrichtian in age.

Fossils obtained from the Formation C8a are characterized by frequent occurrence of *Inoceramus* (*Endocostea*) species in the northern part of the studied area, *Pseudoschloenbachia* species in the middle part, and *Hauericeras gardeni* in the southern part. They are probably regarded as autochthonous, because of the presence of well preserved shells in abundance.

Remains of marine organisms furnish valuable clues to the depositional environment of a sedimentary rock. For instance, *Pseudoschloenbachia* group might have lived under the inshore to nearshore shallow water environment, and *Hauericeras gardeni* under the nearshore to offshore. Thus the presumable habitats and the depth of ammonoid morphotype groups must be taken into consideration. In short the authors are inclined to consider that the sedimentary basin of the Menabe in the early Campanian was probably shallow in the north and increased in depth toward the south.

The question arises whether the suggested Menabe bay in the early Campanian by COLLIGNON (1971, 1972) opened to the southward or not. Further consideration,

based on the geological study in detail on all over the Menabe area, is necessary before we come to our final conclusion.

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Explanation of Plates

Plate 1

Coilopoceras requieni D'ORBIGNY (×1/2)
Loc. Mb71, Ankerabe, Menabe area. Upper part of the Formation C7a, Turonian.
Photos by KANIE

Plate 2

(All figures ×1/2. Photos by KANIE)

Fig. 1. *Neoptychites subxentriformis* COLLIGNON
Loc. Mb71, Ankerabe, Menabe area. Upper part of the Formation C7a, Turonian.
Fig. 2. *Hourcquia* cf. *H. ingens* COLLIGNON
Loc. Mb71, Ankerabe, Menabe area. Upper part of the Formation C7a, Turonian.

Plate 3

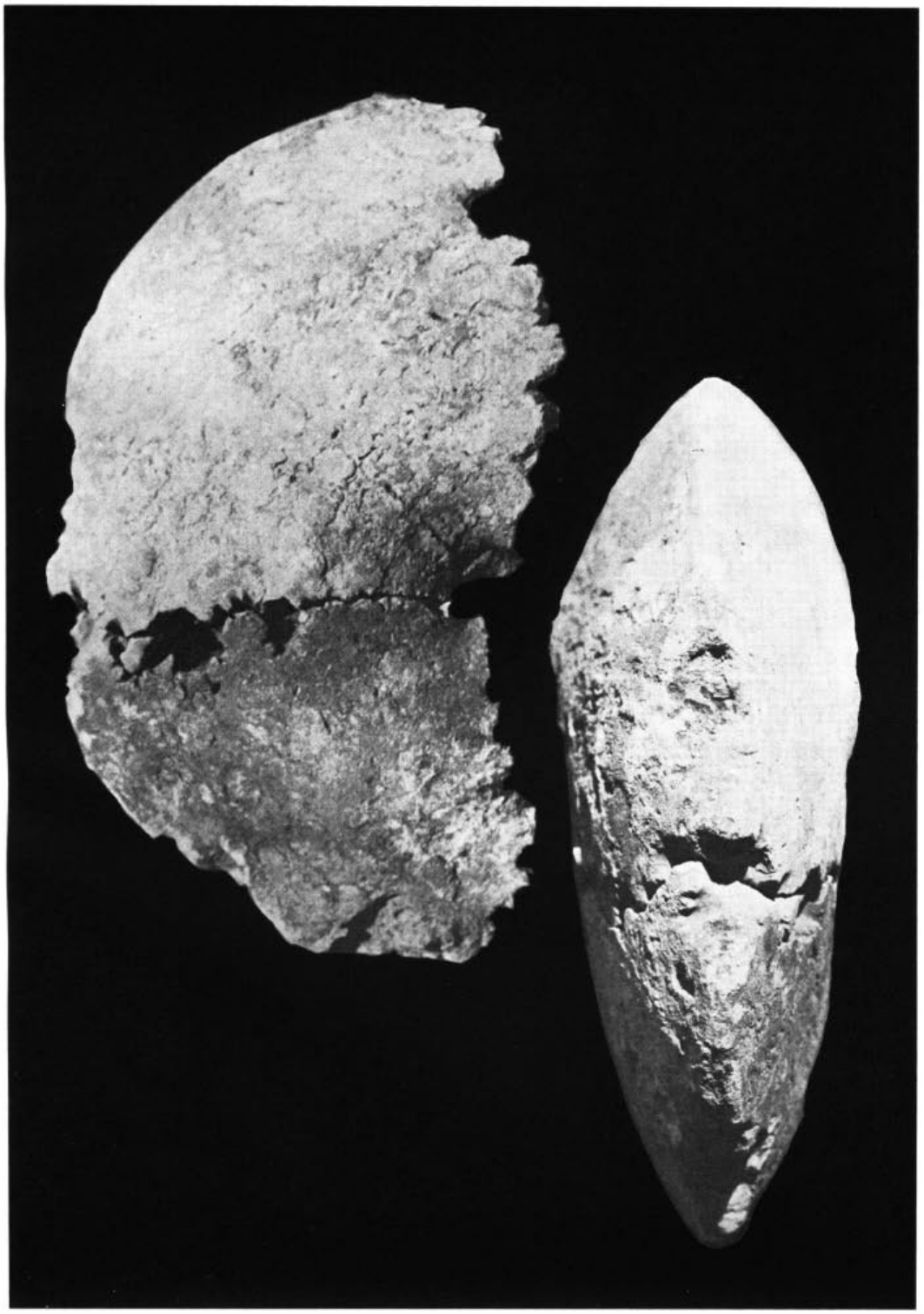
(All figures ×1/2. Photos by KANIE)

Fig. 1. *Inoceramus* (*Endocostea*) *pseudoregularis* SORNAY
Loc. Mb7, Bevaho, Menabe area. Lower part of the Formation C8a, Lower Campanian.
Fig. 2. *Eutrephoceras* sp.
Loc. Mb18, Antsirasira, Menabe area. Lower part of the Formation C8a, Lower Campanian.
Fig. 3. *Pseudoschloenbachia* (*Buehreriella*) *buehreri* COLLIGNON
Loc. Mb10, eastern Ankilizato, Menabe area. Lower part of the Formation C8a, Lower Campanian.
Fig. 4. *Menabites* sp.
Loc. Mb10, Ditto.
Fig. 5. *Pseudoschloenbachia* (*Pseudoschloenbachia*) sp.
Loc. Mb79, eastern Antsirasira, Menabe area. Lower part of the Formation C8a. Lower Campanian.
Fig. 6. *Pseudoschloenbachia* (*Hourcquiella*) sp.
Loc. Mb20, eastern Antsirasira, Menabe area. Lower part of the Formation C8a, Lower Campanian.

Plate 4

(All figures ×1/2. Photos by KANIE)

Fig. 1. *Pseudophyllites* (?) sp.
Loc. Mb12, southern Ankilizato, Menabe area. Middle part of the Formation C8a, Lower Campanian.
Fig. 2. *Hauericeras gardeni* BAILY
Loc. Mb21, eastern Antsirasira, Menabe area. Lower part of the Formation C8a, Lower Campanian.
Fig. 3. *Eupachydiscus grossouvrei* KOSSMAT
Loc. Mb12, southern Ankilizato, Menabe area. Middle part of the Formation C8a, Lower Campanian.
Fig. 4. *Austiniceras menabense* COLLIGNON
Loc. Mb11, southern Ankilizato, Menabe area, Middle part of the Formation C8a, Lower Campanian.

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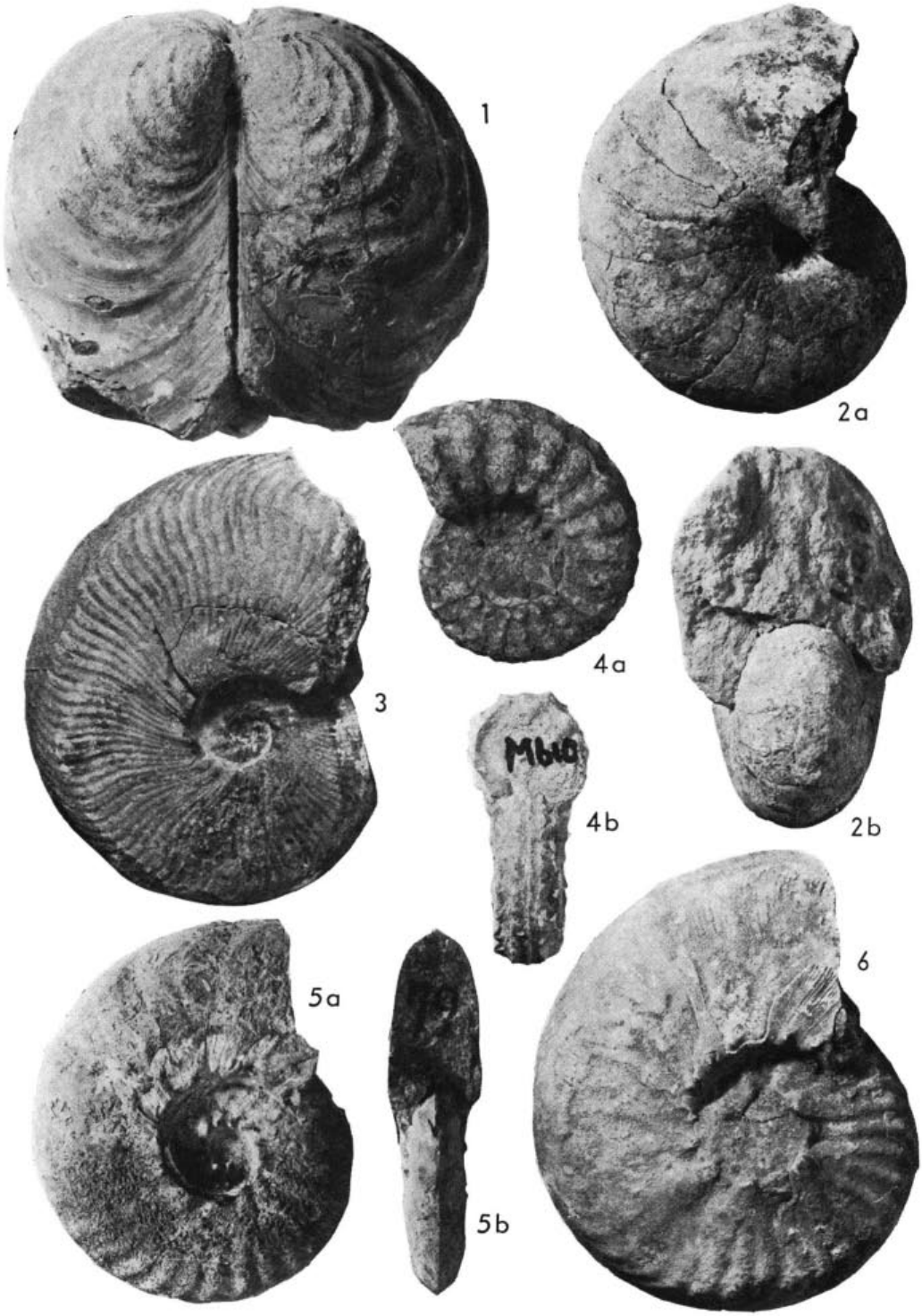
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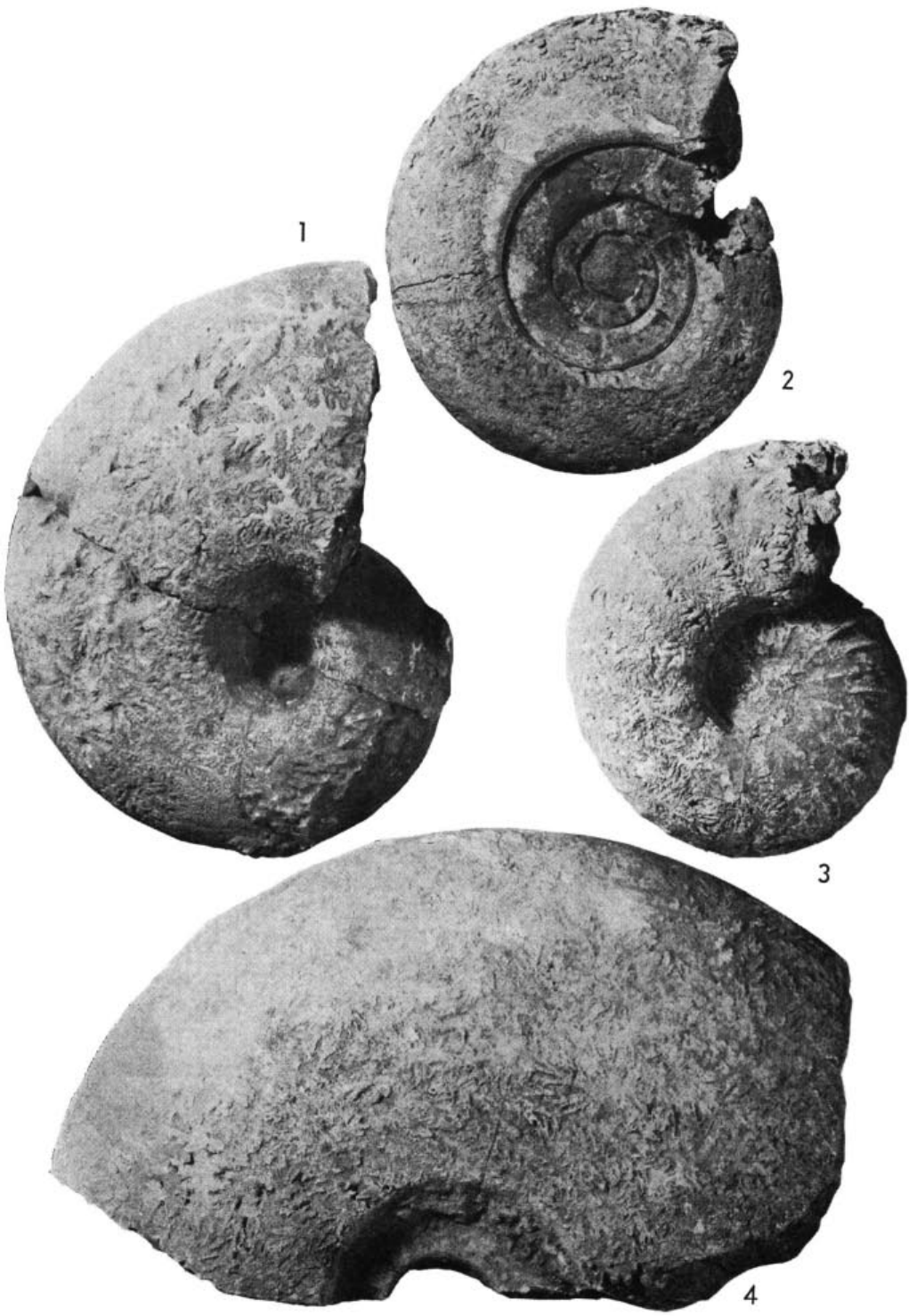
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