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Title	Note on the Carboniferous and Permian Faunas of Japan
Author(s)	Hayasaka, Ichiro; Minato, Masao
Citation	Journal of the Faculty of Science, Hokkaido University. Series 4, Geology and mineralogy, 8(4), 375-379
Issue Date	1954-03
Doc URL	http://hdl.handle.net/2115/35873
Type	bulletin (article)
File Information	8(4)_375-380.pdf

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NOTE ON THE CARBONIFEROUS AND PERMIAN FAUNAS OF JAPAN

By

Ichiro HAYASAKA and Masao MINATO

(With 2 Tables)

Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaidô University, Sapporo, No. 523

Until more than ten years ago no occurrence of the Carboniferous formation was known in our country except the Viséan series with fossil evidence in certain parts of the country. Recently some fossiliferous deposits of the early Lower Carboniferous have been found in several places in the Kitakami Mountains, northern Honshû. The Carboniferous fauna there consists chiefly of brachiopods, corals, cephalopods, gastropods, pelecypods, echinoderms, bryozoans and trilobites, being found distributed in several different horizons of the deposits. As many as more than eighty species have been determined among them, some of which being new to science, and others widely distributed cosmopolitan forms. There are also many species bearing close affinity to, or even identical with those of the Lower Dinantian of Europe or of the Mississippian of North America. It is especially worthy of note, however, that some brachiopods of the Kitakami region show a strong affinity to those of Eastern Australia, as was mentioned by MINATO sometime ago.

The formations between the Onimaru and the Kanôkura series, comprizing the horizons ranging from the later Viséan to the Artinskian, are dominantly of calcareous facies in Japan. This is especially true with the Abukuma and Kitakami mountains where we find abundant species of corals beside foraminifers and other organic remains. To speak of corals, the coral fauna of the Onimaru series is of a special interest because it shows similarities in various ways to that of Europe. Namely, in the Kitakami fauna there are such species as *Heterophyllia kitakamiensis*, *Hexaphyllia elegans* and *japonica*, two species of *Rhobdophyllum*, that is, *Rh. sugiyamai* and *yokoyamai*, *Dibunophyllum bristolense* and

related forms, *Carciniphyllum onukii*, *Stylidophyllum japonicum* of *floriformis* type, *Siphonodendron martini* and *pauciradiale*, *Diphyphyllum gracile* and *Palaeosmilia kitakamiensis*. Moreover, *Hexaphyllia* and *Heterophyllia* are especially important in the consideration of the problem of faunal migration during that period: these two genera had until recently been known only from Scotland and Central Russia. The faunal similarity between Northwestern Europe and Japan is remarkable also in some other groups. *Saccaminopsis carteri*, for instance, occurs in the Upper Viséan of Japan and Northwestern Europe, which fact can be taken as another evidence of the faunal communication between these remote regions.

As to the paleo-zoogeographical position of the Japanese islands at the Viséan age, the geosyncline around there no doubt belonged to, or connected with, the so-called Neo-Cathaysian Geosyncline of which the south China sea is a relict, but not with the European Carboniferous sea.

Speaking of corals again, *Kueichouphyllum* comes first which is quite abundant in individuals in the Viséan deposits in the Kitakami and Abukuma mountain regions and in Kyûsyû. *Kueichoupora* and *Yuanophyllum*, the characteristic elements of the *Yuanophullum* zone of southern China, are also found in the Kitakami mountainland. *Dibunophyllum* cf. *kankouense* Yü and *Diphyphyllum platiforme* Yü var. *kakisakoense* nov. var. described and figured by KANMERA from the Viséan deposit of Kyûsyû are quite similar to the respective type species from southern China, except for a few minor points in the structure of corallites.

Of the stratigraphical position of the deposits yielding species of *Amygdalophyllum* and *Nagatophyllum* in Southwestern Japan, opinions are not unanimous, but it appears to us that they most likely indicate the lower part of the Middle Carboniferous rather than the uppermost Viséan.

Of the Japanese *Amygdalophyllum*, such species as *A. naosoidea* having a prominent *naos* trend of septa, shows an intimate relation with certain species of Australian *Amygdalophyllum*. *Nagatophyllum* of Japan and *Symplectophyllum* of Australia, although placed in different genera, are related to one another in possessing an equally strong *naos* trend in septal development. However, *Nagatophyllum* and some species of *Amygdalophyllum* are found in the decidedly Middle Carboniferous formation in Japan.

In the meantime, the Middle Carboniferous corals with a strong

naos trend in the septal development, as mentioned above, are found only in the Southwestern Japan, as far as the writers are aware at present. In Northeastern Japan, in the Kitakami mountainland, on the contrary, none such has been found up to present: as a matter of fact Middle Carboniferous corals are rather rare in this region. The Middle Carboniferous corals as a whole seem to be closely related rather to those of southern Manchuria, northern China and the Moscow basin. As was pointed out by HILL, *Amygdalophyllum* with a strong *naos* trend of septa has been recorded only in the western Pacific region, including Southwestern Japan and Eastern Australia.

From what has been explained above the writers are led to an assumption that there existed a barrier of some kind somewhere around Central Japan, and interrupted the free communication between the waters of the northeastern and southwestern Japanese geosynclines during the Middle Carboniferous age, resulting in the inequality of the coral faunas of this age of the two regions. It is quite likely, the writers think, that the Middle Carbiniferous formation of Southwestern Japan was deposited in the sea spread over Southern China, or in the sea directly in communication with it, while that of Northeastern Japan was formed under the Northern Chinese sea. The faunal affinity between Southwest Japan and South China is not so strong as that between Northeastern Japan and North China and Manchuria.

A distinct change in the coral faunas of the Carboniferous and the Permian is recognizable. Among CLISIOPHYLLIDAE *Waagenophyllum*, *Wentzelella*, *Wentzelloides*, *Yatsengia*, *Lonsdaleiastraea*, *Verbeekiella*, *Geyerophyllum*and *Akiyoshiphyllum*, among others, newly appeared in the Permian period, while such genera as *Dibunophyllum*, *Corwenia*, *Rhodophyllum*, *Carcinophyllum*, *Setamainella* and *Amygdalophyllum* had become extinct. The existence of *Sochikineophyllum* and many species of *Lophophyllidium* belonging to LOPHOPHYLLIDAE in the Permian together with such peculiar elements, as for instance, *Khmeria problematica* and *Omphalophyllia yamanbaensis* is worthy of note. As far as is known, *Geyerophyllum* has been hitherto recorded only from the Moscovian and Gsherian in the Carnic Alps, but the Japanese representative is of the Permian age, as is indicated by the associated fusulinid foraminifers. Of the Permian corals, *Verbeekiella* seems to have been known only from the Ural mountains and the island of Timor, as well as from the outer zone of Japan: *Omphalophyllia* from the Carnic Alps and Sumatra; *Khmeria* from French

Indochina and Japan; *Lonsdaleiastrea* from the Urals and the Himalayas, *Sochikineophyllum* from the Urals and Japan; *Yatsengia* from Southern China and Japan.

From the above it is quite manifest that the Permian coral fauna of Japan originated in the geosynclines represented by the Tethys. *Waagenophyllum* and *Wentzelella* are the most characteristic of the elements of the Tethys fauna. Most of the corals enumerated above seems to have appeared in the dawn of the Permian period: among them *Waagenophyllum* and *Wentzelella* came into existence in the lowest niveau of the *Pseudoschwagerina* zone.

The brachiopod fauna of the Japanese Permian also is very rich in species that belong to the Tethys element. Detailed studies on the recently acquired material is now being carried on. However, the occurrences of several important forms have been known up to present. For instance, such genera as *Scacchinella, Geyerella, Gemmellaroia,* and a few species of *Enteletes,* occur in Southwestern Japan, while species of *Richthofenia* and *Scacchinella* have been reported from Northeastern Japan—in the Kitakami mountains. In the latter region a *Streptorhynchus*-like brachiopod *Hamletella* HAYASAKA[1] and a cephalopod *Hanieloceras*[2] have been found recently. The former has its representative in the Permian of Timor, and in all probability also in the upper Permian of Northern Caucasus. It has a very high and distorted ventral beak, a prominent pseudodeltidium and a pair of thin, parallel delthyrial supporting-plates. The latter is an ammonoid of the *Waagenoceras* type which is typified by *Waagenoceras intermedium* WANNER from the upper Permian of Timor.

Because of the relatively scanty informations on the Permian fossils of Southwestern Japan it is not easy for us at present to find the details of the relation between the faunas of this and Northeastern Japan. The two faunas do not seem to be fundamentally different from each other, there being elements of the Tethys fauna in both of them: moreover, *Lyttonia* is widely distributed in the fossiliferous Permian limestones of Japan.

To sum up, the lowest Lower Carboniferous fauna of Japan, except that of the Onimaru series, shows a certain degree of affinity to that of Eastern Australia, and it does not appear to have any direct relation with that of Southern China. With respect to the Viséan formation, on the contrary, its coral fauna especially shows a very close kinship to that of Southern China. Down in the Middle Carboniferous period,

the fauna of Northeastern Japan bears some resemblance to that of Northern China, while that of Southwestern Japan more or less resembles those of Southern China and Eastern Australia. Lastly, it is quite evident that the Permian fauna of Japan consists chiefly of species of corals, brachiopods and fusulinid foraminifers beside some other less important fossils belonging to the faunal elements of the Tehtys. The Permian sea of Japan, therefore, must have been a part of the eastern extension of the Tethys.

In the annexed tables the writers try to sum up the hitherto known occurrences of more important groups, that is, corals and brachiopods, of the Carboniferous and the Permian fossils of Japan, to show more in detail what has been explained and discussed in the forgoing pages. These tables are the adoptations with little change from an unpublished table of the Paleozoic fossils of Japan prepared, in March, 1953, by HAYASAKA, for the symposium on the Paleozoic of Japan.

Reference.

1) HAYASAKA, Ichirô: (1953) *Hamletella*, a New Permian Genus of Brachiopoda, and a New Species from the Kitakami Mountains, Japan. Transac. Proc. Palaeont. Soc. Japan, N. S., no. 12, pp. 89-95, 1 pl.

2) HAYASAKA, Ichirô (in the press): Younger Paleozoic Cephalopods from the Kitakami Mountains, Japan. Jour. Fac. Sci., Hokkaidô Univ., ser. iv, vol. 8. no. 4. *Hanieloceras intermedium* (WANNER) is described together with a few other questionable forms

TABLE I

Carboniferous and Permian Corals from Japan 1953

	Kyûsyû	Shikoku	Chûgoku (Western Honsyû)	Chûbu (Central Honsyû)	Kantô (Kwantô) Mountains	Abukuma Mountains	Inner Tôhoku Mountains	Southern Kitakami Mountains			Carboniferous											Permian				
											Mississippian								Pennsylvanian							
											Hikoroitî (Hikoroichi) series	Arisu series		Ohdaira series		*Millerella* zone		*Profusulinella* zone	Nagaiwa series, *Fusulinella* zone	Kuriki series, *Fusulina* zone	Hikawa series, *Triticites* zone	*Pseudoschwagerina* zone	*Parafusulina* zone	*Neoschwagerina* zone	*Yabeina* zone	
												Hinozuti stage	Jûmonji stage	Maide stage	Kozubo stage	Onimaru series						Sakamotosawa series		Kanôkura series		Toyoma series
											K	P	Sy	Br	Su	D	M	Pf	Fu	Fs	T	Ps	Pa	N	Y	Nu
ANTHOZOA																										
TABULATA																										
CHAETETIDAE																										
Chaetetes asiatica YABE & HAYASAKA (MS)								+											—							
Chaetetes sp. (OZAWA)			+																—							
C. sp. (HAYASAKA)				+												?										
Pacyhpora chaetetoidea HAYASAKA								+																	?	
P. jabiensis WAAGEN & WENTZEL								+																	?	
FAVOSITIDAE																										
Michelinia (*Michelinopora*) *multitabuata* Y. & H.								+																—		
M. sp. (MABUTI MS)								+																	—	
SYRINGOPORIDAE																										
Sgringopora reticulata GOLDFUSS								+								—										
S. sp. (MABUTI MS)								+																	—	
S. sp. (MINATO)								+							—											
AULOPORIDAE																										
Pseudoromingeria kotoi (YABE & HAYASAKA)				+																				—		
TETRACORALLA																										
PETRAIAIDAE																										
Petraia ? sp. IIZAKA (MS)																							?			
POLYCOELIDAE																										
Polycoelia joponica OZAWA																			—							
STREPTELASMIDAE																										
Sochikineophyllum s-hashimotoi MINATO (MS)								+																	—	
HAPSIPHYLLIDAE																										
Meniscophyllum longiseptata MINATO (MS)			+																—							
ZAPHRENTIDAE																										
Amplexus nipponensis OISHI & MINATO								+						—												
A. sp. (MINATO)								+					—													
Pseudocaninia sp. (MINATO)								+								—										
Caninia juddi (THOMSON) var. *ozawai* MINATO								+								—										
LITHOSTROTIONIDAE																										
Siphonodendron pseudomartini (YABE & HAYASAKA)								+								—										
S. sp. a. (MINATO)						+		+								—										
S. sp. b. (MINATO)								+								—										
S. inugasirayamaensis MINATO								+								—										
S. martini (EDWARDS & HAIME)								+								—										
S. densitabulata (YABE & HAYASAKA)								+								—										
S. pauciradiale (M'COY)						+		+								—										
S. aff. hsianense YÜ	+															—										
Lithostrotion somaense YABE & HAYASAKA				+		+										—										
L. hinozutiense MINATO (MS)								+								—										
L. sp.				+												—										
Dorlodotia sp. (MINATO MS)								+								—										
Orionastraea sp. (HAYASAKA)				+												—										
Thysanophyllum aseptatum DOBROLYUBOVA								+											—							
Thysanophyllum sp. MINATO (MS)								+								—										
Lithostrotionella tingi CHI			+																							
Lithostrotionella sp. (HAYASAKA)																										
Cystophora manchurica forma *kikkawai* (Y. & H.)				+																		—				
Diphyphyllum equiseptatum YABE & HAYASAKA								+											—							
D. flexuosum YABE & HAYASAKA								+								—										
D. platiforme YÜ var. *kakisakoense* KANMERA	+															—										
Depasophyllum cf. *gracile* (M'COY)	+															—										
CLISIOPHYLLIDAE																										
Dibunophyllum bristolense GARWOOD & GOODYEAR								+								—										
D. asiaticum MINATO (MS)								+								—										
D. inugasirayamaense MINATO								+								—										
D. cf. *kankouense* YÜ	+															—										
Neokoninckophyllum sp. MINATO (MS)				+															—							
Rhodophyllum yokoyamai MINATO								+								—										
Rh. sugiyamai MINATO								+								—										
Waagenophyllum indicum (WAAGEN & WENTZEL)	+	+	+	+		+	+	+																?	—	
W. indicum var. *usuginuense* MINATO (MS)								+																	—	
Waagenophyllum akasakensis (YABE)		+	+	+				+																	—	
W. akagoensis OZAWA			+	+																			—			
W. polyseptata MINATO (MS)				+				+																—	—	
Wentzelella sekii MINATO (MS)				+																			—			
W. ozawai MINATO (MS)			+																						—	
W. iwaizakiensis YABE & MINATO								+																?	—	
W. kitakamiensis YABE & MINATO								+																?	—	
W. subtimorica HUANG								+																?	—	
Wentzelloides maiyaensis YABE & MINATO						+		+																	—	
Yatsengia kiangsuensis var. *mabutii* MINATO (MS)								+																?	—	
Y. ibukiensis MINATO (MS)			+	+																			—			
Y. kabayamaensis MINATO (MS)								+															—			
Iranophyllum permicum MINATO (MS)								+														—				
Pseudoyatsengia kuzuensis YABE					+																		—			
Huangia hasimotoi (NAGAO & MINATO)		+						+														—				
Verbeekiella japonicum YABE & MINATO								+																	—	
Leonardophyllum ? sp. (MINATO MS)			+																				—			
Lonsdaleia katoi OZAWA			+																						—	
Corwenia ? *omiensis* (YABE & HAYASAKA)				+												—										
Stylidophyllum japonicum (YABE & HAYASAKA)								+								—										
S. sikokuense MINATO		+																							?	
S. yokoyamai (OZAWA)			+																				—			
Lonsdaleiasraea nipponica MINATO (MS)			+																						—	
L. yamanbaensis MINATO		+																					—	?		
Clisiaxophyllum ofukuense (OZAWA)			+																—							
C. awa MINATO			+	+															—							
Nagatophyllum satoi OZAWA			+	+															—							
Carruthersella gerthi (OZAWA)			+																						—	
Setamainella hayasakai MINATO						+		+								—										
Arachnolasma cf. *sinensis* (YABE & HAYASAKA)					+											—										
Yuanophyllum yabei (NAGAO & MINATO)								+								—										
AMYGDALOPHYLLIDAE																										
Taisyakuphyllum rostifer MINATO (MS)			+																—							
Amygdalophyllum naosoideum MINATO			+																—							
A. ? *gracile* (HAYASAKA)				+												?			—							
A. giganteum (YABE & HAYASAKA)				+												—										
A. setamaiensis YABE &MINATO								+								—										
Akiyosiphyllum stylophorum YABE & SUGIYAMA			+	+																					—	
LOPHOPHYLLIDAE																										
Sugiyamaella carbonarium YABE & MINATO								+							—											
Lophophyllidium suetomii MINATO (MS)								+														—				
L. sp. (MINATO MS)								+														—				
GEYEROPHYLLIDAE																										
Geyerophyllum hunabuseum MINATO (MS)				+																					—	
Lonsdaleoides enormis (OZAWA)			+	+															—							
CYATHOPHYLLIDAE																										
Cyathophyllum ? sp. (MINATO)								+								—										
Palaeosmilia kitakamiensis MINATO								+								—										
Kueichouphyllum latifossulatum KANMERA	+															—										
K. yabei MINATO						+		+								—										
K. yabei var. (MINATO)								+								—										
K. yahagiensis MINATO (MS)								+								—										
Camophyllum sp. (MINATO MS)				+															—							
HETEROPHYLLIDAE																										
Hexaphyllia sp. (KANMERA)	+															—										
H. sp. YABE & SUGIYAMA								+								—										
H. elegans YABE & SUGIYAMA								+								—										
Heterophyllia japonica YABE & SUGIYAMA								+								—										
H. kitakamiensis YABE & SUGIYAMA								+								—										
HEXACORALLA																										
ANABASIIDAE																										
Omphalophyllia yamanbaensis YABE & SUGIYAMA		+																					—	?		
PSEUDOPAVONIIDAE																										
Pseudopavonia taisyakuana YABE, SUGIYAMA & EGUCHI			+																—							
GENUS OF UNKNOWN SYSTEMATIC POSITION																										
Khmeria problematica MANSUY			+																						—	

TABLE II

Carboniferous and Permian Brachiopods from Japan 1953

	Kyûsyû	Shikoku	Chûgoku (Western Honsyû)	Chûbu (Central Honsyû)	Kantô (Kwantô) Mountains	Abukuma Mountains	Inner Tôhoku Mountains	Southern Kitakami Mountains			Carboniferous											Permian				
											Mississippian							Pennsylvanian								
											Hikoroiti (Hikoroichi) series	Arisu series: Hinozuti stage	Arisu series: Jûmonji stage	Ondaira series: Maide stage	Ondaira series: Kozubo stage	Onimaru series	*Millerella* zone	*Profusulinella* zone	Nagaiwa series, *Fusulinella* zone	Kuriki series, *Fusulina* zone	Hikawa series, *Triticites* zone	Sakamotosawa series: *Pseudoschwagerina* zone	Sakamotosawa series: *Parafusulina* zone	Kanôkura series: *Neoschwagerina* zone	Kanôkura series: *Yabeina* zone	Toyoma series
											K	P	Sy	Br	Su	D	M	Pf	Fu	Fs	T	Ps	Pa	N	Y	Nu
SCHIZOPHORIIDAE																										
Schizophoria indica (WAAGEN)		+																					—			
Sch. sp. (NONAKA)		+																					—			
Sch. spp. (IJIRI & MINATO)								+			—															
Orthotichia japonica HAYASAKA					+																		—			
O. japonica subsp. *striata* HAYASAKA					+																		—			
O. derbyi (WAAGEN)		+																					—			
Enteletes akasakensis OZAWA				+																				—		
E. minoensis HAYASAKA				+																				—		
E. suessi SCHELLWIEN				+																			—			
E. acutiplicatus HAYASAKA					+																			—		
Schizophoria resupinata (MARTIN)								+																		
Camarophoria humbletonensis HOWSE				+				+																—		
C. globulina (PHILLIPS)				+																			—			
C. sp. (MABUTI)								+																—		
C. mutabilis TSCHERNYSCHEW		+																					—			
STROPHOMENIDAE																										
Leptaena cf. *convexa* WELLER								+			—															
L. convexa WELLER								+			—															
L. analoga (PHILLIPS)								+			—															
Derbyia hemisphaerica WAAGEN								+																—		
D. depressa DEMANET var. *transversa* MINATO								+																		
Orthotetes rugosa FREDERIKS								+																—		
O. keokuk (HALL)								+																		
O. sp. (MINATO)								+					—													
Meekella gigantea HAYASAKA					+																		—			
Meekella striato-costata (COX)								+																—		
Meekella ? sp. (NONAKA)		+																					—			
Orthotetes planoconvexa HAYASAKA					+																		—			
O. eusarkos ABICH subsp. *lata* HAYASAKA					+																		—			
Schellwienella izirii MINATO								+			—															
S. ? sp. (MINATO)								+			—															
Streptorhynchus pseudopelargonatus (BROILI)		+																					—			
S. tubifera MINATO					+																		—			
Hamletella kitakamiensis HAYASAKA								+																—		
Geyerella sp. (HAYASAKA)								+																—		
CHONETIDAE																										
Chonetes blanfordi COWPER-REED var. *lata* H.								+																—		
C. sinuosa SCHELLWIEN								+																—		
(?) *Davisiella comoides* (SOWERBY) subsp. H.				+																			—			
PRODUCTIDAE																										
Productella aff. *caperata* (SOWERBY)								+			—															
Planoproductus gigantoides MINATO								+			—															
Prod. (*Echinoconchus*) *defensus* (THOMAS)					+																		—			
P. flemingi DE KONINCK								+																—		
P. horridus SOWERBY								+																—		
P. vishnu WAAGEN								+																—		
P. semireticulatus MARTIN				+												—										
P. cora (D'ORBIGNY)								+																—		
P. villiersi kozlowskiana FREDERIKS								+																—		
P. striatus EISCHER				+												—										
P. punctatus MARTIN var. (HAYASAKA)				+												—										
P. elegans MCCOY				+												—										
P. cf. *aculeatus* MARTIN				+												—										
P. sp. (OZAWA)			+										(—)													
P. sp. (MINATO)								+				—	—	—												
P. spp. (MABUTI MS)								+																—		
Gigantoproductus edelburgensis PHIL				+												—										
Pustula cf. *tenuipustulata* THOMAS								+																		
P. sp. (MINATO)								+							—											
Aulosteges poyangensis (KAYSER)		+																					—			
RICHTHOFENIDAE																										
Richthofenia japonica MABUTI (MS)								+																—		
R. gigantea MABUTI (MS)								+																—		
R. sp. (HAYASAKA)								+																—		
Scacchinella cf. *gigantea* GEMMELLARO				+				+																—		
Gemmellaroia ozawai MABUTI			+																					—		
OLDHAMINIDAE																										
L. (*Leptodus*) *richthofeni* HAYASAKA em.			+	+		+		+															—	—		—
CAMAROTOECHINIDAE																										
Camarotoechia lethys (BILLIGS)								+																		
Pugnax acuminatus MARTIN				+												—										
P. pugnus forma *major* HAYASAKA				+												—										
Phynchonella (*Uncinulus*) *jabiensis* WAAGEN								+																—		
SPIRIFERIDAE																										
Delthyris aff. *clarksvillensis* (WINCHEL)								+			—															
D. sp. (MINATO)								+			—															
Squamulavia asiatica CHOW		+																					—			
S. rostrata (KUT.) var. nov. (NONAKA)		+																					—			
S. sp. (HAYASAKA)					+																			—		
Reticularia elliptica (PHILLIPS)				+													—									
R. lineata MARTIN				+													—							—		
R. waageni LOCZY				+																						
R. cf. *inaequilateralis* GEMMELLARO				+																				—		
R. sp. IZIRI & MINATO (MS)								+			—															
R. fimbriata CONRAD (OKUBO), (MS)								+																		
Kitakamithyris tyoanjiensis MINATO								+			—															
K. hikoroitiensis MINATO								+			—															
K. semicircularis MINATO								+			—		—													
Spirifer humerosus PHILLIPS				+												—										
S. cf. *crassus* DE KONINCK				+												—										
S. duplicicostus PHILLIPS				+												—										
S. cf. *saranae* VERN. *mut lita* FREDERIKS								+																—		
S. acutiplicatus HAYASAKA				+																				—		
S. cf. *logani* HALL								+			—															
S. ohmoriensis MINATO								+			—															
S. ultratransversa MINATO								+			—															
S. kozuboensis MINATO								+					—													
S. sp. MABUTI MS								+																—		
S. sp. indet. (OZAWA)			+																	(—)						
Brachythyrina nagaoi MINATO								+						—												
Brachythyris kitakamiensis MINATO								+			—															
B. aff. *pinguis* (SOWERBY)								+						—												
B. sp. (IZIRI & MINATO MS)								+			—															
Trigonotrea verneuili (MURCHISON)								+																		
Tylothyris cf. *laminosa* (M'COY) (IZ. MIN. MS)								+			—															
Fusella nipponotrigonalis MINATO								+					—													
Syringothyris jumonjiensis MINATO								+					—													
S. transversa MINATO								+					—													
S. cuspidata MARTIN				+												—										
S. kitakamiensis MINATO								+					—													
Plicatosyrinx singulare MINATO								+					—													
P. ? *kumanoi* MINATO								+					—													
Martinia linguiferoidea HAYASAKA				+																						
M. glabra MARTIN var. *decora* PHILLIPS				+												—										
M. orbicularis GEMMELLARO		+																					—			
M. sp. nov. (NONAKA)		+																					—			
M. sp. (HAYASAKA)					+																			—		
M. sp. indet. (HAYASAKA)								+																—		
SPIRIFERINIDAE																										
Spiriferina cristata KING								+																—		
S. multiplicata SOWERBY		+						+															—	—		
S. paratransversa MINATO								+			—															
S. nauta (WAAGEN) var. nov. (NONAKA)		+						+			—												—			
S. sp. (NONAKA)		+																					—			
ATHYRIDAE																										
Athyris protea ABICH (HAYASAKA MS '53)								+																—		
Cliothyridina royssi (L'EVILLE)								+					—													
Actinoconchus cf. *lamellosa* (L'EVILLE)								+					—													
A. planosulcatus (PHILLIPS)								+																		
DIELASMATIDAE																										
Dielasma cf. *biplex* WAAGEN								+																		
D. aff. *insigne* DE KONINCK				+												(—)										
D. cf. *kingi* DE KON var *douvillei* MANSUY				+												(—)										