

Foraminifera from the Kuromatsunai and Setana Formations in southwestern Hokkaido, Japan -Preliminary report-

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Key words : foraminifera, Kuromatsunai Formation, Setana Formation, Pliocene, Pleistocene,
southwestern Hokkaido.

1. Introduction

Neogene to Quaternary deposits distributed along the Japan Sea side in Hokkaido, implying a history of development and changes of the Japan Sea, are one of most important subjects for the study to understand geological and geographical frameworks of the present Japanese Islands. In spite of these facts, there have not been enough data about the environmental changes of these areas, near the northern end of the Japan Sea areas, or around the Oshima Peninsula.

The Oshima Peninsula in southwestern Hokkaido is regarded geologically as the northern extension of the "Green Tuff" region of the Inner Zone of the Northeast Japan (e.g. Kato et al. eds., 1990). The peninsula has extensive distributions of the Neogene and Quaternary deposits which unconformably overlie pre-Tertiary sedimentary and igneous rocks. This region has been one of stratigraphical standards of the Neogene in Hokkaido since the study by Nagao and Sasa (1933).

Neogene to Pleistocene marine sediments in this region are generally classified into the following ascending-ordered formations, Kunnui, Yakumo, Kuromatsunai, and Setana (Nagao and Sasa, 1933). These formations are well exposed in middle to northern parts of the peninsula. Such stratigraphy first proposed by Nagao and Sasa (1933) has been accepted, but recent biostratigraphical data reveal that the Setana Formation should be of Pleistocene age (e.g. Nojo et

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al., in press). General relationships among these formations are as follows: from the Kunnui to Kuromatsunai Formation they contact conformably each other, but they are clinounconformably overlain by the Setana (e.g. Nagao and Sasa, 1933; Matsui et al., 1955; Hashimoto et al., 1963; Oka and Mitani, 1981; Nojo et al., 1994).

There are a few reports on microfossils in the Kuromatsunai and Setana Formations. In particular, despite abundant yieldings of foraminifera from the Setana Formation, there have not been so many reports on foraminifera (Asano, 1936a, b, 1937, 1939; Asano and Nakamura, 1937; Shirai, 1959, 1960; Masatani and Ohkura, 1980MS; Takahashi et al., 1980MS; Tsuchi and Ibaragi, 1982; Tsubakihara et al., 1989; Nojo et al., 1997), and we have only chronostratigraphical data by Nojo et al. (in press), which are related to paleoenvironmental changes on the basis of micropaleontological analyses.

The rock materials for this study were sampled from the formations in northern to middle part of the Oshima Peninsula, and were analyzed in 1994 to 1998 by the author when he was a curator of Imakane Borad of Education. Some data of these works have been reported by Nojo et al. (1997: Tab. 1). This study is preliminary report and list of foraminifera from the Kuromatsunai and Setana Formations to indicate a history of paleoenvironmental changes. The author mainly describes about some occurrences of foraminifera (Tab. 2) and shows their faunal list with plates in this report. A detailed discussion about paleoenvironmental changes is left for another opportunity.

Table 1 Foraminifera from the Kuromatsunai and Setana Formation in Imakane area (after Nojo et al., 1997)

Sample number (Kmu: Sakkurubetsu Pyro. Mem., Kms: Okusawa Sand. Mem, Ss: Setana F.)	Kmu-1	Kmu-2	Kmu-3	Kmu-4	Kmu-5	Kms-1	Ss-1	Ss-2
Planktonic Foraminifera								
<i>Globigerina bulloides</i> d'Orbigny	+	+		+		+	+	
<i>Globigerina quinqueloba</i> Natland			+					
<i>Globigerina</i> sp.							+	
<i>Globigerinita glutinata</i> (Egger)				+				
<i>Globigerinita uvula</i> (Ehrenberg)		+					+	
<i>Neoglobobulimina incompta</i> (Cifelli)	+	+	+	+		+	+	
<i>Neoglobobulimina pachyderma</i> (Ehrenberg) (dextral)	+	+	+					
<i>Neoglobobulimina pachyderma</i> (Ehrenberg) (sinistral)	+	+	+	+			+	
Benthic Foraminifera								
<i>Ammonia</i> sp.							+	
<i>Angulogerina kokuzuraensis</i> Asano			+	+				
<i>Angulogerina</i> sp.		+						
<i>Asterononion hamadaense</i> Asano			+	+				
<i>Bolivina decussata</i> Brady				+				
<i>Bolivina</i> spp.		+	+					
<i>Bolivinita quadrilatera</i> (Schwager)	+							
<i>Buccella frigida</i> (Cushman)			+	+				
<i>Buccella tenerima</i> (Bandy)		+						
<i>Buccella</i> sp.			+					
<i>Bulimina</i> sp.							+	
<i>Cibicides lobatulus</i> (Walker & Jacob)			+				+	
<i>Cibicides refulgens</i> de Montfort		+						
<i>Cibicides subdepressus</i> (Asano)		+		+			+	
<i>Cibicides</i> spp.	+			+				
<i>Criboelphidium yabei</i> (Asano)			+				+	
<i>Criboelphidium</i> sp.							+	
<i>Dyocibicides perforata</i> Cushman & Valentine	+							
<i>Elphidium crispum</i> (Linne)		+					+	
<i>Elphidium excavatum</i> (Terquem) forma <i>clavata</i> (Cushman)			+	+				
<i>Elphidium jenseni</i> (Cushman)		+						
<i>Elphidium subarcticum</i> Cushman				+				
<i>Elphidium</i> spp.		+					+	
<i>Epistominella pulchella</i> Husezima & Maruhashi		+						
<i>Epistominella</i> sp.		+					+	
<i>Eponides</i> ? spp.		+		+				
<i>Fissurina annectens</i> (Burrows & Holland)			+					
<i>Fissurina baccata</i> (Hollon-Allen & Earland)	+							
<i>Fissurina marginata</i> (Montagu)	+	+	+	+			+	
<i>Fissurina orbignyana</i> Seguenza				+				
Benthic Foraminifera								
<i>Fissurina</i> cf. <i>rizae</i> Seguenza				+				
<i>Fissurina</i> cf. <i>subquadrata</i> Parr		+						
<i>Fissurina</i> sp.			+					
<i>Glabratalia</i> spp.		+						
<i>Globocassidulina bisecta</i> Nomura	+	+	+	+			+	
<i>Globocassidulina jamesoni</i> (McCulloch)				+				
<i>Globocassidulina</i> spp.			+			+		
<i>Gutulina yabei</i> Cushman & Ozawa							+	
<i>Gutulina</i> sp.		+					+	
<i>Gutulina</i> spp.	+	+					+	+
<i>Hanzawata nipponica</i> Asano				+				
<i>Heterolepa praecincta</i> (Karrer)			+					
<i>Heterolepa subhaidingerii</i> (Parr)								
<i>Islandiella japonica</i> (Asano & Nakamura)	+		+				+	+
<i>Islandiella norcrossi</i> (Cushman)		+						
<i>Islandiella setanaensis</i> (Asano & Nakamura)	+		+					
<i>Islandiella sublimbata</i> (Asano & Nakamura)	+	+	+			+	+	+
<i>Islandiella yabei</i> (Asano & Nakamura)	+	+	+	+			+	+
<i>Islandiella</i> spp.	+	+					+	
<i>Lagena acuticosta</i> Reuss	+							
<i>Lagena aptopleura</i> Loeblich & Tappan			+					
<i>Lagena striata</i> (d'Orbigny)	+							
<i>Lagena</i> spp.	+			+				
<i>Lenticulina</i> sp.	+							
<i>Melonis pompilioides</i> (Fichtel & Moll)	+							
<i>Melonis uchioi</i> Hasegawa	+							
<i>Nonion</i> sp.		+						
<i>Nonionellina labradorica</i> (Dawson)			+					
<i>Oolina striatopunctata</i> (Parker & Jones)							+	
<i>Ordosalsis umbonatus</i> (Reuss)	+							
<i>Planoglabratalia subopercularis</i> (Asano)	+							
<i>Polystomellina discorbinoides</i> Yabe & Hanzawa		+						
<i>Pseudoparrella takayanagi</i> (Iwasa)			+					
<i>Pullenia apertura</i> Cushman			+					
<i>Pyrgo ezo</i> Asano					+			
<i>Silostomella</i> sp.	+							
<i>Uvigerina akitaensis</i> Asano							+	
<i>Uvigerina junccea</i> Cushman & Todd	+							
<i>Uvigerina schencki</i> Asano								
<i>Uvigerina</i> spp.			+					

Foraminifera from the Kuromatsunai and Setana Formations

Table 2 Foraminifera from the Kuromatsunai and Setana Formations

Sampling horizon	Upper Kuromatsunai F.	Lower Setana F.	Upper Setana F.	Sampling horizon	Upper Kuromatsunai F.	Lower Setana F.	Upper Setana F.
Planktonic Foraminifera				Benthic Foraminifera			
Globigerina bulloides d'Orbigny	A	A	A	Discorbinella bertheloti (d'Orbigny)	-	-	R
Globigerina quinqueloba Natland	R	C	F	Discorbinella spp.	R	-	VR
Globigerinita glutinata (Egger)	F	F	F	Eilohedra spp.	R	-	-
Globigerinita uvula (Ehrenberg)	R	VR	F	Elphidiella arctica (Parker & Jones)	C	-	-
Globigerinoides ruber (d'Orbigny)	-	-	R	Elphidium aculeatum (d'Orbigny)	-	-	VR
Globorotalia inflata (d'Orbigny)	C	C	VR	Elphidium advena (Cushman)	-	-	VR
Globigerina spp.	-	-	R	Elphidium bartletti Cushman	R	F	R
Neoglobobulimina cf. asanoi (Maiya, Saito, and Sato)	VR	-	-	Elphidium crispum (Linné)	F	F	F
Neoglobobulimina dutertrei (d'Orbigny)	VR	-	-	Elphidium excavatum (Terquem) forma clavata Cushman	-	R	F
Neoglobobulimina incompta (Cifelli)	C	A	A	Elphidium frigidum Cushman	R	-	R
Neoglobobulimina pachyderma(D) (Ehrenberg)	F	A	C	Elphidium hanzawai Asano	-	VR	-
Neoglobobulimina pachyderma(S) (Ehrenberg)	F	C	C	Elphidium incertum (Williamson)	-	-	VR
Neoglobobulimina sp.	-	VR	R	Elphidium janseni (Cushman)	VR	-	R
Gen. et sp. indet.	VR	R	VR	Elphidium macellum (Fichtel & Moll)	VR	-	-
TOTAL COUNTED	296	308	5035	Elphidium subarcticum Cushman	-	F	C
Benthic Foraminifera				Elphidium subgranulosum Asano	-	-	F
Alabamina japonica (Asano)	VR	-	-	Elphidium subincertum Asano	-	R	-
Ammonia beccarii (Linné)	-	VR	-	Elphidium translucens Natland	-	-	R
Ammonia ketienziensis (Ishizaki)	-	VR	-	Elphidium spp.	F	VR	R
Ammonia inflata (Seguenza)	-	R	-	Epistominella pulchella Husezima & Maruhasi	R	VR	R
Ammonia takanabensis (Ishizaki)	-	VR	-	Epistominella spp.	VR	-	R
Ammonia spp.	-	VR	R	Eponides? sp.	R	-	R
Angulogerina hughesi (Galloway and Wissler)	R	VR	R	Fissurina annectens (Burrows & Holland)	-	-	R
Angulogerina kokozuraensis Asano	R	-	R	Fissurina cf. annectens (Burrows & Holland)	VR	-	-
Anomalina rostrata (Brady)	-	-	VR	Fissurina lacunata (Burrows & Holland)	-	-	R
Anomalina spp.	-	-	R	Fissurina lucida (Williamson)	-	-	R
Anomalinoides globulosus (Chapman & Parr)	VR	-	R	Fissurina marginata (Walker & Boys)	R	R	F
Astacolus hyalaculus Loeblich and Tappan	VR	-	VR	Fissurina obscuricostata Galloway & Wissler	VR	-	R
Astronion aomoriense Asano	-	VR	-	Fissurina orbignyana Seguenza	R	-	VR
Astronion hamadaense Asano	-	F	R	Fissurina cf. rizzae Seguenza	-	-	R
Astronion spp.	R	-	VR	Fissurina semimarginata (Reuss)	VR	R	-
Bolivina decussata Brady	F	-	R	Fissurina cf. subquadrata Parr	-	-	R
Bolivina sp. A	VR	R	R	Fissurina spp.	R	VR	R
Bolivina spp.	R	-	R	Gavelinopsis praegeri (Heron-Allen & Earland)	-	-	R
Brizalina alata (Seguenza)	-	-	VR	Gavelinopsis spp.	R	-	R
Brizalina spp.	-	-	R	Glauertella cf. aurantista Seiglie & Bermúdez	-	-	R
Buccella frigida (Cushman)	VR	R	R	Glauertella murabilis panamensis Seiglie & Bermúdez	-	-	R
Buccella makiyamai (Chiji)	VR	R	C	Glauertella pulvinata (Brady)	-	-	R
Buccella nipponica (Husezima & Maruhasi)	-	VR	R	Glauertella sp. A	-	-	R
Buccella tanaii (Uchio)	-	-	R	Glauertella sp. B	-	-	R
Buccella tenerima (Bandy)	R	-	C	Glauertella spp.	VR	-	R
Buccella spp.	VR	VR	R	Glandulina ovula d'Orbigny	-	-	-
Bulimina cf. imamura Tai	R	-	-	Globocassidulina bisecta Nomura	F	R	R
Buliminella elegantissima (d'Orbigny)	-	-	F	Globocassidulina canalisuturata Eade	-	R	-
Cancris auriculus (Fichtel & Moll)	-	-	VR	Globocassidulina neobrocha	-	-	R
Chrysalidinella dimorpha (Brady)	-	-	VR	Globocassidulina spp.	F	R	F
Cibicides cf. kamadai Asano	-	-	VR	Guttulina spp.	VR	-	R
Cibicides lobatulus (Walker & Jacob)	A	A	F	Gyroldina spp.	-	-	R
Cibicides refulgens de Montfort	C	C	C	Hanzawaia nipponica Asano	R	VR	R
Cibicides subdepressus (Asano)	R	F	R	Haynesina sp.	-	-	R
Cibicides tani Iwasa and Kikuchi	F	R	R	Heronallenia sp.	-	-	VR
Cibicides spp.	R	R	R	Heterolepa subhaidingerii (Parr)	-	-	R
Cibicoides pachydermus (Rzehak)	R	-	VR	Heterolepa sp.	VR	-	-
Cornuspira involvens (Reuss)	-	-	R	Islandiella helenae Feyling-Hassen & Buzas	-	-	R
Cribroelphidium oregonense (Cushman & Grant)	-	-	VR	Islandiella islandica (Nørbang)	F	-	-
Cribroelphidium yabei (Asano)	-	-	R	Islandiella japonica (Asano & Nakamura)	F	C	R
Cribroloides curta (Cushman)	-	-	VR	Islandiella norcrossi (Cushman)	-	-	R
Cycloforia contorta (d'Orbigny)	-	VR	R	Islandiella sublimbata (Asano & Nakamura)	A	A	F
Cystamina pauciloculata (Brady)	VR	-	-	Islandiella yabei (Asano & Nakamura)	F	F	-
Discorbinella araucana (d'Orbigny)	R	VR	F	Islandiella spp.	-	R	R

Table 2 Foraminifera from the Kuromatsunai and Setana Foramtions (continued)

Sampling horizon	Upper Kuromatsunai F.	Lower Setana F.	Upper Setana F.	Sampling horizon	Upper Kuromatsunai F.	Lower Setana F.	Upper Setana F.
Benthic Foraminifera				Benthic Foraminifera			
Karrerella baccata japonica Asano	-	VR	-	Quinqueloculina akneriana d'Orbigny	R	R	R
Karrerella spp.	R	-	R	Quinqueloculina costata d'Orbigny	-	-	R
Lagena acuticosta (Reuss)	-	-	VR	Quinqueloculina elongata Natland	-	-	R
Lagena apiopleura (Loeblich & Tappan)	VR	VR	R	Quinqueloculina kuromatsunaiensis Asano	-	-	R
Lagena sulcata spicata Cushman & McCulloch	-	-	R	Quinqueloculina sawanensis Asano	-	-	R
Lagena sp.	-	-	VR	Quinqueloculina seminulum (Linné)	-	VR	R
Lenticulina nikobarensis (Schwager)	-	-	VR	Quinqueloculina vulgaris d'Orbigny	-	R	R
Lenticulina sp.	-	-	VR	Quinqueloculina cf. vulgaris d'Orbigny	-	-	VR
Melonis pacificus (Cushman)	VR	-	VR	Quinqueloculina yezoensis Asano	-	-	R
Melonis uchioi Hasegawa	-	-	VR	Quinqueloculina sp. B	-	-	R
Melonis spp.	VR	-	-	Quinqueloculina sp. C	-	-	R
Miliolinella circularis (Bornemann)	-	-	R	Quinqueloculina sp. F	-	-	R
Miliolinella spp.	-	-	R	Quinqueloculina sp. G	-	-	R
Neonorbina stachi (Asano)	-	VR	-	Quinqueloculina sp. H	-	-	R
Neoponides procerus (Brady)	-	R	R	Quinqueloculina spp.	R	R	F
Neoponides spp.	VR	-	-	Rectobolivina rephanus (Parker & Jones)	-	-	VR
Nodosarina? sp.	-	-	VR	Rosalina australis (Parr)	VR	VR	R
Nonion japonicus Asano	-	-	R	Rosalina bradyi (Cushman)	VR	VR	F
Nonion spp.	R	VR	R	Rosalina isabelleana d'Orbigny	-	-	R
Nonionella stella Cushman & Moyer	-	-	R	Rosalina vilardeboana d'Orbigny	-	-	R
Nonionoides grateloupi (d'Orbigny)	-	-	VR	Rosalina spp.	R	VR	R
Oolina carteri Albani and Yassini	VR	-	-	Sigmohauerina sp.	-	-	VR
Oolina costata (Williamson)	-	-	VR	Sigmoidella pacifica Cushman & Ozawa	-	-	VR
Oolina melo d'Orbigny	-	VR	R	Sigmoidella spp.	VR	-	-
Oolina striatopunctata (Parker & Jones)	-	-	VR	Sigmolima sigmoidea compressa Cushman	-	R	-
Oolina sp.	-	-	VR	Sigmolima sp.	-	-	VR
Oridosalis umbonatus (Reuss)	-	-	VR	Sigmomorphina spp.	-	VR	-
Oridosalis cf. umbonatus (Reuss)	VR	-	-	Sigmomorphina semitecta terquemiana (Fornasini)	-	-	R
Osangularinella umbonifera (Cushman)	VR	-	-	Sigmomorphina trilocularis (Bagg)	VR	-	-
Paracassidulina sulcata Belford	-	-	R	Sigmovirgulina sp.	-	-	VR
Pararotalia nipponica (Asano)	-	-	R	Sphaeroidina japonica Brady	VR	-	-
Patellina corrugata Williamson	-	VR	R	Sphaeroidina spp.	-	-	-
Patellinella hanzawai Asano	-	-	R	Spirillina limbata Brady	-	-	VR
Pateoris hauerinoides (Rhmbler)	-	-	F	Spirillina vivipara Ehrenberg	-	-	R
Planoglabratella australensis (Heron-Allen & Earland)	-	-	R	Spirillina sp.	-	-	VR
Planoglabratella opercularis (d'Orbigny)	-	-	R	Spiroloculina hadai Thalmann	-	-	R
Planoglabratella pateriformis (Brady)	-	-	R	Spiroloculina sp.	-	-	VR
Planoglabratella subopercularis (Asano)	R	R	F	Spiroplectammina sp. A	-	-	R
Planoglabratella? sp. C	-	-	VR	Spiroplectammina sp.	-	-	VR
Polystomellina discorbinoides Yabe & Hanzawa	-	VR	R	Spiroplectinella wrightii (Silvestri)	-	-	R
Poroepionides cribrerepondus Asano & Uchio	-	-	R	Textularia conica d'Orbigny	-	-	VR
Pseudononion japonicum Asano	-	VR	R	Textularia spp.	-	-	R
Pseudononion spp.	-	VR	VR	Triloculina rotunda d'Orbigny	-	VR	-
Pseudoparrella naraensis Kuwano	VR	-	F	Triloculina sutuensis Asano	-	-	R
Pseudoparrella takayanagii (Iwasa)	VR	R	F	Triloculina tricarinata d'Orbigny	-	-	VR
Pseudoparrella spp.	-	-	R	Triloculina sp. A	-	-	VR
Pseudopolymorphina sp.	-	-	VR	Uvigerina juncea Cushman	-	VR	-
Pullenia apertura Cushman	VR	-	-	Uvigerina spp.	VR	-	-
Pyrgo ezo Asano	VR	-	-	Valvulinera hamanaoensis (Ishiwada)	-	-	VR
Pyrgo fornasinii Chapman & Parr	-	R	-	Valvulinera japonica Asano	-	VR	-
Quinqueloculina agglutinata Cushman	-	-	R	Gen. et sp. indet.	R	F	F
				Total counted			
				869 780 4652			

A: 80.5-13.5%, C: 13.5-4.5%, F: 4.5-1.5%, R: <1.5%, VR: two or less occurrences, -: no occurrence

2. Faunal Reference List

Foraminiferal species from the Kuromatsunai and Setana Formations are alphabetically listed below, under the categories of planktons and benthos. The selected species are illustrated with scanning electron micrographs in Plates 1 to 12. The original references are given for species. Additional references are selected from those with helpful remarks and illustrations about the species from the areas studied in this report. All specimens are catalogued and deposited in Department of Science Education, Iwamizawa College, Hokkaido University of Education.

Planktonic Foraminifera

Globigerina bulloides d'Orbigny

Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., Paris, ser. 1, v. 7, p. 277, Modèle nos. 17, 76; Brady, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 593, pl. 79, figs. 7a-c.

Globigerina quinqueloba Natland

Globigerina quinqueloba Natland, 1938, Bull. Scripps Inst. Oceanogr., Tech. Ser., v. 4, no. 5, p. 149, pl. 6, figs. 7a-c.

Globigerinita glutinata (Egger)

Globigerina glutinata Egger, 1893, Abhandl. K. Bayer. Akad. Wiss. Munchen, CLII, v. 18, p. 371, pl. 13, figs. 19-21.

Globigerinita glutinata (Egger), Parker, 1962, Micropal. v. 8, no. 2, p. 246, pl. 9, figs. 1-16.

Globigerinita uvula (Ehrenberg)

Pyloides uvula Ehrenberg, 1861, K. Preuss., Akad. Wiss. Berlin, Monatsber., p. 276, 277, 308.

Globigerinita uvula (Ehrenberg), Parker, 1962, Micropal., v. 8, no. 2, p. 252, pl. 8, figs. 14-26.

Globigerinoides ruber (d'Orbigny)

Globigerina rubra d'Orbigny, 1839, in Sagra, R. de la, Hist. Ohys. Pol. Nat. Cuba, Foraminiferes, p. 82, pl. 4, figs. 12-14.

Globigerinoides rubra (d'Orbigny) (sic.), Cushman, 1927, Cushman Lab. Foram. Res., Contr., v. 3, pt. 1, p. 87, pl. 19, figs. 6a-c.

Globorotalia inflata (d'Orbigny)

Globigerina inflata d'Orbigny, 1839, in Barker-Webb and Berthelot, Hist. Nat. Canaries, v. 2, pt. 2, Zool., p. 134, pl. 2, figs. 7-9.

Globorotalia inflata (d'Orbigny), sensu strict, Maiya Saito and Sato, 1976, in Takayanagi and Saito eds. Progress in Micropaleontology, Micropal. Press, p. 408, pl. 2, figs. 5-7.

Neogloboquadrina cf. *asanoi* (Maiya, Saito, and Sato)

cf. *Globoquadrina asanoi* Maiya, Saito, and Sato, 1976, Progress in Micropaleontology. p.

409, pl. 3, figs. 1a-c, 2a-c, 3.

cf. *Neogloboquadrina asanoi* (Maiya, Saito, and Sato), Thompson, 1980, Init. Rep. DSDP, v. 56-57, pl. 3, figs. 10-12.

Neogloboquadrina dutertrei (d'Orbigny)

Globigerina dutertrei d'Orbigny, 1839, Foraminiferés, p. 84, pl. 4, figs. 19-21.

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Neogloboquadrina incompta (Cifelli)

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Neogloboquadrina pachyderma (Ehrenberg)

Aristerspira pachyderma Ehrenberg, 1861, K. Preuss. Akad. Wiss, Berlin, Monatsber. p. 276, 277, 303.

Globigerina pachyderma (Ehrenberg), Brady, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 600, pl. 114, figs. 19, 20.

Neogroboquadrina pachyderma (Ehrenberg), Rogl and Bolli, 1973, Init. Repts. DSDP, v. 15, p. 571, pl. 11, figs. 2-6; pl. 16, fig. 12.

Benthic Foraminifera

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Pseudoparrella japonica Asano, 1949, Jour. Paleont., 23 (4), p.430, fig. 2, Nos. 2-4.

Alabamina japonica (Asano), Takayanagi and Hasegawa, 1987, Checklist and bibliography of post-Paleozoic foraminifera established by Japanese workers, 1890-1986, p. 39.

Ammonia beccarii (Linné)

Nautilus beccarii Linne, 1758, Syst. Nat., se. 10, p. 710.

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Ammonia ketienziensis (Ishizaki)

Stebulus ketienziensis Ishizaki, 1948, Acta Geol. Taiwan, 2 (1), 59, pl. 1, figs. 2a-c.

Ammonia ketienjiensis (Ishizaki), Huang, 1964, Micropaleont. v. 10, no. 1, p. 53, pl. 1, figs. 13a-c.

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Uvigerina hughesi Galloway and Wissler, 1927, Jour. Pal., v. 1, p.76, pl. 12, figs. 5a, b.

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Angulogerina kokozuraensis Asano

Angulogerina kokozuraensis Asano, 1949, Jour. Pal., v. 23 no. 4, p. 428, text-fig. 1, nos. 50-53; 1950, Illust. Cat.Japan. Tert. Small. Foram., pt. 2, p. 19, figs- 94-96.

Trifarina kokozuraensis (Asano), Matoba, 1967, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.),

v.38, no.2, p. 257, pl. 26, fig.3.

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Anomalina grosserugosa Brady, 1884, Challenger Foram., p.675, pl. 94, figs. 4, 5.

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Astacolus hyalacrulus Loeblich and Tappan, 1953, Smithsonian Misc. Coll. v. 121, no. 7, p.52, pl. 9, figs. 1-4.

Astrononion aomoriense Asano

Astrononion aomoriense Asano, 1950, Illust. Cat. Japan. Tert. Small. Foram., pt.1, p. 5, figs. 25, 26.

Astrononion hamadaense Asano

Astrononion hamadaense Asano, 1950, Illust. Cat. Japan. Tert. Small. Foram., pt.1, p.6, figs. 29-31.

Bolivina decussata Brady

Bolivina decussata Brady, 1881, Quart. Jour. Micr. Sci., n.s., v. 21, p. 28; 1884, Voy. Challenger, Rep., Zool., v. 9, p. 423, pl. 53, figs. 12-13.

Bolivina sp.A

This form is identified to *Bolivina* sp. A of Hasegawa (1979), and is similar to *Bolivina decussata* Brady in its outline, but differs from it in less developed, and rounded lobes on the wall surface.

Bolivinita quadrilatera (Schwager)

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- Chrysalidinella dimorpha* (Brady), Schubert, 1908, Neues Jb. Min. Geol. Pa., 1., Beil.-Bd. 25, p. 242.
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Cibicides refulgens de Montfort, 1808, Conch. Syst., v. 1, p. 122.
Truncatulina refulgens (Montfort), Brady, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 659, pl. 92, figs. 7-9.
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Planulina subdepressa Asano (sic.), 1951, Illust. Cat. Japan. Tert. Small. Foram., pt. 13, p. 15, figs. 16-18.
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Operculina involvens Reuss, 1849, Denkschr. Akad. Wiss., Wien, vol. 1, p. 370, pl. 45, fig. 20.
Cornuspira involvens (Reuss), Barker, 1960, SEPM, Spec. Publ., 9, pl. 11, figs. 1-3.
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Elphidium oregoense Cushman and Grant (sic.), 1927, San Diego Soc. Nat. Hist., Trans., V, no. 6, 79, viii, 3.
- Criboelphidium yabei* (Asano)
Elphidium yabei Asano, 1938, Geol. Soc. Japan, Jour., v. 45, no. 538, p. 589, pl. 14, figs. 9-10.
Criboelphidium yabei (Asano), Asano, 1950, Illust. Cat. Japan. Tert. Small. Foram., pt. 1, p. 11, figs. 64-65.
- Cribrulinoides curta* (Cushman)
Quinqueloculina disparilis d'Orbigny var. *curta* Cushman, 1917, U.S. Nat. Mus. Bull. v. 71, no. 6, p. 49, pl. 14, fig. 2.
Cribrulinoides curta (Cushman), Cushman and Leroy, 1939, Contr. Cushman Lab. Foram. Res., v. 15, no. 1, p. 17, pl. 3, figs. 1-11; pl. 4, figs. 1-13.
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Cycloforia contrita d'Orbigny, 1846, Foram. Foss. Viene, p. 298, pl. 20, figs. 4-6.
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- Discorbinella araucana* (d'Orbigny), Jones, 1994, Challenger Foraminifera, p. 93, pl. 86, figs. 10, 11.
- Discorbinella bertheloti* (d'Orbigny)
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- Elphidium arcticum* (Parker and Jones), Cushman, 1930, U. S. Nat. Mus. Bull. 104, pt. 7, p. 27, pl. 11, figs. 1-6.
- Elphidiella arctica* (Parker and Jones), Cushman, 1939, U. S. Geol. Surv. Prof. Pap. 191, p. 65, pl. 18, figs. 11-14.
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- Polystomella aculeata* d'Orbigny (sit.), 1846, Foraminifères fossiles du Bassin Tertiaire de Vienne (Autriche). Gide et Comp. p. 131, pl. 6, figs. 27-28.
- Elphidium aculeatum* (d'Orbigny), Thalmann, 1932, Ecologiae Geologicae Helvetiae, v. 25, 293-312.
- Elphidium advena* (Cushman)
- Polystomella advena* Cushman, 1922, Carnegie Inst. Washington, Publ. 311, p. 56, pl. 9, figs. 11, 12.
- Elphidium advenum* (sit.), Cushman, 1930, U.S. Nat. Mus., Bull. 104, pt. 7, p. 25, pl. 10, figs. 1, 2.
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- Elphidium bartletti* Cushman
- Elphidium bartletti* Cushman, 1933, Smithsonian Misc. Coll., v. 89, no. 9., p. 4, pl. 1, figs. 9a, b.

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Elphidium excavatum (Terquem) forma *clavata* Cushman

Elphidium incertum (Williamson) var. *clavatum* Cushman, 1930, U. S. Nat. Mus., Bull. 104, pt. 7, p. 20, pl. 7, figs. 10a, b.

Elphidium decipiens (Costa), Hada, 1931, Tohoku Imp. Univ. Sci., Rep., 4th, ser. v. 6, no. 3, p. 126, text-figs. 83a, b.

Elphidium hughesi foraminosum Cushman, Asano, 1950, Illust. Cat. Japan. Tert. Small. For., pt. 1, p. 8, text-figs. 46, 47.

Elphidium clavatum Cushman, Loeblich and Tappan, 1953, Smith. Misc. Coll., v. 121, no. 7, p. 98, pl. 19, figs. 8-10.

Elphidium excavatum (Terquem) forma *clavata* Cushman, Takayanagi, 1955, Tohoku Univ., Inst., Geol., Pal., Contr., no. 45, p. 42, pl. 1, fig. 25.

Elphidium frigidum Cushman

Elphidium frigidum Cushman, 1933, Smithsonian Misc. Coll., vol. 89, no. 9, p. 5, pl. 1, fig. 8.

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Elphidium incertum (Williamson)

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Polystomella jenseni Cushman, 1924, Carnegie Inst. Washington, Publ. 342, p. 49, pl. 16, figs. 4 (?), 6.

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Elphidium macellus (Fichtel and Moll) var., 1798, Testacea microscopia, aliaque minuta ex generibus Argonauta et Natutilus, ad naturam picta et descripta. p. 68, pl. 10, figs. h, i, k.

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- Elphidium subgranulosum* Asano, 1938, Jour. Geol. Soc. Japan, 45, p. 586, pl. 14, figs. 4a, b.
- Elphidium subincertum* Asano
- Elphidium subincertum* Asano, 1951, Illust. Cat. Japan Tert. Small Foram., pt. 1, p. 10, figs. 56, 57.
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- Lagena annectens* Burrows and Holland, 1895, in Jones, Parker and Brady, 1985, Palaeontogr. Soc., London, Part II, p. 203, pt. vii, II.
- Fissurina annectens* (Burrows and Holland), Barker, 1960, Spc. Publ., Soc. Economic Paleontologists and Mineralogists, 9.
- Fissurina baccata* (Hellon-Allen and Earland)
- Lagena orbignyana* var. *baccata* Hellon-Allen and Earland, 1922, Terra Nova Exped., Zool., VI, no. 2, p. 162, pt. vi, figs. 15, 16.
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- Fissurina lacunata* (Burrows and Holland)
- Lagena castrensis* Brady (not of Schwager), 1884, Voy. Challenger, Rep. Zool., v. 9, p. 485, pl. 60, figs. 1, 2.
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- Entosolenia marginata* (Montagu) var. *lucida* Williamson, 1848, Ann. Mag. Nat. Hist., ser. 2, v. I, p. 17, pl. 2, fig. 17.
- Fissurina lucida* (Williamson), Loeblich and Tappan, 1953, Smithsonian Misc. Coll., v. 121, no. 7, p. 76, pl. 14, fig. 4.
- Fissurina marginata* (Montagu)
- Vermiculum marginatum* Montagu, 1803, Testacea Britannica, p. 524.
- Fissurina marginata* (Montagu), Loeblich and Tappan, 1953, Smithsonian Misc. Coll., v. 121, no. 7, p. 77, pl. 14, figs. 6-9.
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Fissurina orbignyana Seguenza

Fissurina orbignyana Seguenza, 1862, Foram. monotal. Mioc. Messina, p. 66, pl. 2, figs. 24, 26.

Fissurina cf. *rizzae* Seguenza

cf. *Fissurina rizzae* Seguenza, 1862, Foram. monotal., Mioc. Messina, p. 72, pl. 2, fig. 50.

Fissurina semimarginata (Reuss)

Lagena sp. (Nos. 64-65) von Schlicht, 1870. Die Foraminiferen Septarienthones Pielzpuhl, p. 11, pl. 4, figs. 4-6, 10-12.

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Fissurina semimarginata (Reuss), Barker, 1960, Spc. Publ., Soc. Economic Paleontologists and Mineralogists, 9.

Fissurina cf. *subquadrata* Parr

cf. *Fissurina subquadrata* Parr, 1954, Roy. Soc. Victoria, Proc., n. s., LVI, pt. 2, 203, ix, 5.

Gavelinopsis praegeri (Heron-Allen and Earland)

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Gavelinopsis praegeri (Heron-Allen and Earland), Hofker, 1951, Siboga Exped., Mon. IV, pt. 3, p. 485, figs. 332-334.

Glabratella cf. *aurantista* Seiglie and Bermúdez

cf. *Glabratella aurantista* Seiglie and Bermúdez, 1965, Monographia de la familia de foraminíferos Glabratellidae, Geos, 1965, no. 12,

Glabratella mirabiris panamensis Seiglie and Bermúdez

Glabratella mirabiris panamensis Seiglie and Bermúdez, 1965, Geos, 12, p. 33, pl. 6, a-b, 7, 8.

Glabratella pulvinata (Brady)

Discorbina pulvinata Brady, 1884, Rept. on the Sci. Reslt. of the Voy. of the H. M. S. Challenger during the years 1873-1876, Zoology, v. 9,

Glabratella pulvinata, (Brady), Barker, 1960, SEPM Spec. Publ., 9, pl. 88, figs. 10a, b.

Glabratella sp.A

This species is somewhat resembles *G. crassa* Hofker but differs from it in having more rounded and inflated chambers, and five to six chambers in final whorl.

Glabratella sp.B

This species is characterized in having planoconvex test with low trochospiral coiling and with long spines in its periphery.

Glandulina ovula d'Orbigny

Glandulina ovula d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 29, pl. 1, figs. 6, 7.

Globocassidulina bisecta Nomura

Globocassidulina bisecta Nomura, 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 53, no. 1, p. 73-77, pl. 2, figs. 2, 3; pl. 14, figs. 8-12; pl. 15, figs. 1-5.

Globocassidulina jamesoni (McCulloch)

Cassidulina (?) *jamesoni* McCulloch, 1977, Quantitative observations on Recent foram. tests, with emphasis on the eastern Pacific, p. 390, pl. 164, figs. 15a-c.

- Globocassidulina jamesoni* (McCulloch), Nomura, 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 54, no. 1, p. 33, 34, pl. 3, figs. 7a-c, 8a, b; pl. 19, figs. 1, 2.
- Globocassidulina canalisuturata* Eade
Globocassidulina canalisuturata Eade, 1967, N.Z. Jour. Mar. Freshwater Res., 1. no. 4, p. 440, fig. 3 (5-7), fig. 5 (7, 8).
- Globocassidulina neobrecha* Nomura
Globocassidulina neobrecha Nomura, 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 53, no. 1, p. 67-68, pl. 1, figs. 16a-c; pl. 19, figs. 3-6.
- Guttulina yabei* Cushman and Ozawa
Guttulina yabei Cushman and Ozawa, 1929, Japan Jour. Geol. Geogr., v. 6, nos. 3-4, p. 68, pl. 13, fig. 2, pl. 14, fig. 6.
- Hanzawaia nipponica* Asano
Hanzawaia nipponica Asano, 1943, Jour. Geol. Soc. Japan, v. 51, no. 606, p. 98, pl. 4, figs. 1-2.
- Heterolepa praecincta* (Karrer)
Rotalia praecinctus Karrer, 1868, Sitz. Akad. Wiss. Wien, v. 58, p. 189, pl. 5, fig. 7.
Truncatulina praecincta Cushman, 1915, U.S. Nat. Mus. Bull., v. 71, no. 5, p. 39, pl. 26, fig. 2. *Eponides praecinctus* (Karrer), Asano, 1951, Illust. Cat. Japan Tert. Small Foram., pt. 14, p. 11, figs. 30-32.
- Heterolepa subhaidingerii* (Parr)
Cibicides subhaidingerii Parr, 1950, Foraminifera, Rep. B.A.N.Z. Antarctic Res. Exp. 1929-1931, Ser. B. (Zoology and Botany), 5, p. 364, pl. 15, fig. 7.
Heterolepa subhaidingerii (Parr), Tappan and Loeblich, 1982, Synopsis and Classification Living Organisms, pl. 53, fig. 10.
- Islandiella helenae* Feyling-Hanssen and Buzas
Cassidulina teretis Tappan, Loeblich and Tappan (not of Tappan, 1951), 1953, Smithsonian Misc. Coll., v. 121, no. 7, p. 121, pl. 24, figs. 3, 4.
Islandiella helenae Feyling-Hanssen and Buzas, 1976, Jour. Foram. Res., v. 6, no. 2, p. 155, figs. 1-4.
- Islandiella islandica* (Nørbang)
Cassidulina islandica Nørbang, 1945, Foraminifera. in the Zoology of Iceland. v.2, p. 42, text-figs. 7, 8d-f.
Islandiella islandica (Nørbang), Nørbang, 1958, Vidensk. Medd. Dansk Natur-hist. Foren., v. 120, p. 27, 28, pl. 6, figs. 1a, b, 2-5, pl. 7, figs. 6a, b, 7a, b.
- Islandiella japonica* (Asano and Nakamura)
Cassidulina japonica Asano and Nakamura, 1937, Japan Jour. Geol. Geogr., v. 14, nos. 3-4, p. 144, pl. 13, figs. 1, 2.
Islandiella japonica (Asano and Nakamura), Troitskaja, 1970, Usloviya obitaniya i raspredelenie foraminifer v Yaponskom More (semeistva Elphidiidae, Cassidulinidae i Islandiellidae). In Fursenko A.V. ed., Obstchie voprosy izucheniya mikrofauny Sibiri, dalnego vostoka i drugikh raionov. Instituta Geologii i Geofiziki, Akademiyi Nauk SSSR, Sibirskoe Otdelenie, Trudy, vol. 71, p. 150, pl. 6, figs. 3, 4.
- Islandiella norcrossi* (Cushman)

- Cassidulina norcrossi* Cushman, 1933, Smithsonian Misc. Coll., v. 89, no. 9, p. 7, pl. 2, figs. 7a-c.
- Islandiella norcrossi* (Cushman), Nørbang, 1958, Dansk Naturh. Foren. København Vidensk. Meddel., v. 120, p.26.
- Islandiella setanaensis* (Asano and Nakamura)
- Cassidulina setanaensis* Asano and Nakamura, 1937, Japan Jour. Geol. Geogr., v. 14, nos. 3-4, pl. 13, figs. 7a,b
- Islandiella setanaensis* (Asano and Nakamura), Nomura, 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 53, no. 1, p. 1-101, pl. 3, fig. 6, pl.4, figs. 3,4, pl. 10, fig. 11, pl.11, fig. 1-3; 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 54, no. 1, p. 5, pl. 1, figs. 3a-c.
- Islandiella sublimbata* (Asano and Nakamura)
- Cassidulina sublimbata* Asano and Nakamura, 1937, Japan Jour. Geol. Geogr., v. 14, nos. 3-4, p. 146, pl. 14, figs. 3, 4a, b.
- Islandiella sublimbata* (Asano and Nakamura), Nomura, 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 53, no. 1, pl. 3, fig. 7, pl. 4, fig. 2, pl. 5, fig. 7, pl. 9, figs. 1-8; 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 54, no. 1, p. 9, pl. 1, figs. 6-8.
- Islandiella yabei* (Asano and Nakamura)
- Cassidulina yabei* Asano and Nakamura, 1937, Japan. Jour. Geol. Geogr., v. 14, nos. 3-4, p. 145, pl. 14, figs. 1a, b.
- Islandiella yabei* (Asano and Nakamura), Nomura, 1983, Tohoku Univ. Sci. Rep., 2nd ser. (Geol), v. 53, no. 1, pl. 3, fig. 1; pl. 4, fig. 7; pl. 9, figs. 9-12, pl. 10, figs. 1-3.
- Karreriella baccata* (Schwager) *japonica* Asano
- Karreriella baccata* (Schwager) *japonica* Asano, 1938, Japanese Jour. Geol. Geogr., v.15, nos. 1-2, p. 90, pl. 10, figs. 1a-c.
- Lagena acuticosta* Reuss
- Lagena acuticosta* Reuss, 1861, Sitz. Akad. Wiss. Wien., v. 44, no. 1, p. 305, pl. 1, fig. 4.
- Lagena apiopleura* Loeblich and Tappan
- Lagena apiopleura* Loeblich and Tappan, 1953, Smithsonian Misc. Coll., v. 121, no. 7, p. 59, pl. 10, figs. 14, 15.
- Lagena striata* (d'Orbigny)
- Oolina striata* d'Orbigny, 1839, Voy. Amer. Merid., Foraminifères, v. 5, pt. 5, p. 21, pl. 5, fig. 12.
- Lagena striata* (d'Orbigny), Asano, 1938, Tohoku Imp. Univ., Sci. Rep., 2nd ser. (Geol.), v. 19, p. 217, pl. 27, fig. 26; pl. 28, fig. 28.
- Lagena sulcata spicata* Cushman and McCulloch
- Lagena sulcata* var. *spicata* Cushman and McCulloch, 1950, Allan Hancock Pacific Exped., v. 6, no. 6, p. 360, pl. 48, figs. 3-7.
- Lenticulina nikobarensis* (Schwager)
- Cristellaria nikobarensis* Schwager, 1886, Novara Exp. Geol. Thell., 2, p. 243, pl. 6, fig. 87.
- Robulus nikobarensis* (Schwager), Asano, 1938, Sci. Rep. Tohoku Univ. ser. 2, 19 (2), p. 204, pl. 28, figs. 5, 6; pl. 29, fig. 8.
- Lenticulina nikobarensis* (Schwager), Loeblich and Tappan, 1988, Foraminiferal genera and their classification. p. 405. Pl. 446, figs. 9, 10.

Melonis pompilioides (Fichtel and Moll)

Nautilus pompilioides Fichtel and Moll, 1798, Testacea microscopica, p. 31, pl. 2, figs. a-c.

Melonis etruscus Montfort, 1808, Conch. Syst., p. 67.

Melonis pompilioides (Fichtel and Moll), Voloshinova, 1958, Mikrofauna SSSR, Sbornik 9, VNIGRI, Trudy, p. 149, pl. 3, fig. 1

Melonis uchioi Hasegawa

Melonis uchioi Hasegawa, 1991, Trans. Proc. Palaeont. Soc. Japan, N.S., no. 164, p. 1003.

Melonis pacificus (Cushman)

Nonion umbilicatula var. *pacifica* Cushman, 1924, Carnegie Inst. Wash., v. 342, p. 48, pl. 16, fig. 3.

Nonion pacificum Cushman, 1939, U.S. Geol. Surv., Prof. paper v. 191, p.25, pl. 6, fig. 25.

Melonis pacificus (Cushman), Hasegawa, 1979, Tohoku Univ., Sci. Rep., 2nd ser. (Geol), v. 49, no. 2, p. 151.

Miliolinella circularis (Bornemann)

Triloculina circularis Bornemann, 1855, Zeit. deutsch. Geol. Ces., v. 7, p. 349, pl. 19, fig. 4

Miliolinella circularis (Bornemann), Asano, 1951, Illust. Cat. Japan. Tert. Small. Foram., pt. 6, p. 9, figs. 65-67.

Neoconorbina stachi (Asano)

Discopulvinulina stachi Asano, 1951, Illust. Cat. Japan Tert. Small. Foram., pt. 14, p. 7, figs. 46-48.

Neoconorbina stachi (Asano), Matoba, 1970, Tohoku Univ., Sci. Rep., 2nd ser. (Geol), v. 42, no. 2, p. 57, pl. 4, flgs. 6a-c.

Neoeponides procerus (Brady)

Pulvinulina procera Brady, 1884, Voy. Challenger, Rep., Zool., v. 9, p. 698, pl. 105, figs.

7a-c. *Neoeponides procerus* (Brady), Reiss, 1960. Israel Geol. Surv., Bull. no. 29, p. 17.

Nonion japonicus Asano

Nonion japonicum Asano (sic.) , 1938, Jour. Geol. Soc. Japan, v. 45, no. 593, pl. 15(4), figs. 1, 2.

Nonionella stella Cushman and Moyer

Nonionella miocenica Cushman var. *stella* Cushman and Moyer, 1930, Cushman Lab. Foram. Res., Contr., v. 6, pt. 1, p. 56, pl. 7, figs. 17a-c.

Nonionellina labradorica (Dawson)

Nonionina labradorica Dawson, 1860, Canad. Nat., v. 5, p. 191, text-fig. 4.

Nonionellina labradorica (Dawson), Voloshinova, 1958, Mikrofauna SSSR, Sbornik 9, VNIGRI, Trudy, no. 115, p. 142.

Nonionoides grateloupi (d'Orbigny)

Nonionina grateloupi d'Orbigny, 1826, Annales des Sciences Naturelles v. 7, p. 294,

Nonionoides grateloupi (d'Orbigny), Saidova, 1975, Bontosnye Foraminifery Tikhogo Okeana, 3 vol., p. 248.

Oolina carteri Albani and Yassini

Oolina carteri Albani and Yassini, 1989, Aust. J. Mar. Freshw. Res., v. 70, p. 385, fig. 3r-s.

Oolina costata (Williamson)

Entosolenia costata Williamson, 1858, Recent Foraminifera Great Britain, p. 9, pl. 1, fig.

18.

Lagena costata (Williamson), Cushman, 1923, U.S. Nat. Mus. Bull. v. 104, pt.4, p.12, pl.1, fig. 16, pl. 2, figs. 1, 2 (not pl. 3, fig. 8)

Oolina costata (Williamson), Parker, 1952, Bull. Mus. Comp. Zool., v. 106, no. 9, p. 409, pl. 4, figs. 20,21.

Oolina melo d'Orbigny

Oolina melo d'Orbigny, 1839, Voy. Amer. Merid., Foraminifères, v. 5, pt. 5, p. 20, pl. 5, fig. 9.

Oolina striatopunctata (Parker and Jones)

Lagena sulcata (Walker and Jacob) var. *striatopunctata* Parker and Jones, 1865, Philos. Trans. Roy. Soc. London, v. 155, p. 350, pl. 13, figs. 25-27.

Entosolenia striatopunctata (Parker and Jones) Dawson, 1870, Can. Nat., n.s., v. 5, p. 178, fig. 11. *Lagena striatopunctata* Parker and Jones, Brady, 1878, Ann. Mag. Nat. Hist., ser. 5, v. 1, p. 434, pl. 20, fig. 3.

Oolina striatopunctata (Parker and Jones) Loeblich and Tappan, 1953, Smithsonian Misc. Coll. v. 121, no. 7, p. 74, pl. 12, figs. 2-5.

Oridorsalis umbonatus (Reuss)

Rotalia umbonata Reuss, 1851, Deutsch. geol. Gesell., Zeitschr., v. 3, p. 75, pl. 5, figs. 35a-c.

Oridorsalis umbonatus (Reuss), Parker, 1964, Jour. Pal., v. 38, no. 4, p. 626, pl. 99, figs. 4-6.

Osangulariella umbonifera (Cushman)

Pulvinulinella umbonifera Cushman, 1933, Cushman Lab. Foram. Res., Contr., 9, 90.

Osangulariella umbonifera (Cushman), Jones, 1994, Challenger Foraminifera, p. 99, pl. 95, figs. 9, 10.

Paracassidulina sulcata Belford

Paracassidulina sulcata Belford, 1966, Bur. Min. Resour. Aust. Rep., no. 79, p. 142, 144, pl. 24, figs. 11-14, text-fig. 16, nos. 7, 8.

Pararotalia nipponica (Asano)

Rotalia nipponica Asano, 1936, Jour. Soc. Japan, v. 43, no. 515, p. 614, pl. 30, figs. 2a-c.

Pararotalia nipponica (Asano), Ujiie, 1966, Palaeont. Soc. Japan, Trans. Proc., N.S.m no. 61, p. 192, text-figs. 1-3; pl. 24, figs. 1-7; pl. 25, figs. 1-5.

Patellina corrugata Williamson

Patellina corrugata Williamson, 1858, Rec. Foram. Gt. Britain, p. 46, pl. 3, figs. 86-89.

Patellinella hanzawai Asano

Patellinella hanzawai Asano, 1936, Jour. Geol. Soc. Japan, v. 43, no. 515, p. 613, pl. 31, figs. 3a-c.

Pateoris hauerinoides (Rhumbler)

Quinqueloculina subrotunda (Montagu) forma *hauerinoides* Rhumbler, 1936, Foram. der Kieler Bucht, Teil II-Ammodisculinidae bis Textulinidae, v. 1, no. 1, p. 206, 217, 226, text-figs. 167, 208-212.

Pateoris hauerinoides (Rhumbler) Loeblich and Tappan, 1953, Smithsonian, Misc. Coll. v. 121, no. 7, p. 42, pl. 6, figs. 8-12, text-figs. 1A, B.

Planoglabratella australensis (Heron-Allen and Earland)

Discorbis australensis Heron-Allen and Earland, 1932, Discovery Repts., IV, 416.

Glabratella australensis (Heron-Allen and Earland), Loeblich and Tappan, 1964, Treatise on Invertebrate. p. 588.

Planoglabratella opercularis (d'Orbigny)

Rosalina opercularis d'Orbigny, 1839, Foraminifères, p. 93, pl. 3, figs. 24, 25.

Discorbis opercularis Cushman, 1915, U.S. Nat. Mus. Bull., vol. 71, no. 5, p. 18, pl. 11, fig. 3.

Planolabratella opercularis (d'Orbigny), Seiglie and Bermúdez, 1965, Geos, 1965, no. 12, 15-65.

Planoglabratella patelliformis (Brady)

Discorbina patelliformis Brady, 1884, Rept. on the Sci. Reslt. of the Voy. of the H. M. S. Challenger during the years 1873-1876, Zoology, v. 9,

Glabratella patelliformis (Brady), Seiglie and Bermúdez, 1965, Monographia de la familia de foraminíferos Glabratellidae, Geos, 1965, no. 12,

Planoglabratella subopercularis (Asano)

Discorbis subopercularis Asano, 1951, Illust. Cat. Japan Tert. Small Foram., pt. 14, p. 3, figs. 17-19.

Glabratella subopercularis (Asano), Matoba, 1970, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 42, no. 1, p. 54, pl. 5, figs. Sa-c.

Planolabratella subopercularis (d'Orbigny), Seiglie and Bermúdez, 1965, Geos, 1965, no. 12, 15-65.

Planoglabratella ? sp. C

This species resembles *Planoglabratella subopercularis* (Asano). but differs from it in havng less number of chambers in final whorl.

Polystomelina discorbinoides Yabe and Hanzawa

Polystomdlna discorbinoides Yabe and Hanzawa , 1923, Japan Jour. Geol. Geogr., v. 2, p. 99, text-flgs. a-c.

Poroeponides cribrorepandus Asano and Uchio

Poroeponides cribrorepandus Asano and Uchio, 1951, Illust. Cat. Japan. Tert. Small. Foram., pt. 14, p.18, figs. 134, 135.

Pseudononion japonicum Asano

Pseudononion japonicum Asano, 1936, Jour. Geol. Soc. Japan, v. 43, no. 512, p. 347, text-figs. a-c.

Pseudoparrella naraensis Kuwano

Pseudoparrella naraensis Kuwano, 1950, Jour. Geol. Soc. Japan, v. 56, no. 657, p. 317, text-figs. 6a-c.

Pseudoparrella takayanagii (Iwasa)

Epistominella takayanagii Iwasa, 1955, Jour. Geol. Soc. Japan, v. 61, no. 712, p. 16, text-figs. 4a-c.

Epistominella suttsuensis Shirai, 1960, Jour. Fac. Sci. Hokkaido Univ., Ser. IV, vol X, 537-543, pl. 2,figs. 3a-c.

Pseudoparrella takayanagii (Iwasa), Hasegawa, 1979, Tohoku Univ., Sci. Rep., 2nd ser.

(Geol.), v. 49, no. 2, p. 153, pl. 5, figs. 7a-c.

Pseudopolymorphina suboblonga Cushman and Ozawa

Pseudopolymorphina suboblonga Cushman and Ozawa, 1930, U.S. Nat. Mus., Proc., v. 77, p. 91, pl. 23, figs. 3a-c.

Pullenia apertura Cushman

Pullenia apertura Asano (not of Cushman, 1927), 1951, Illust. Cat. Japan. Tert. Small. Foram., pt. 12, p. 10, figs. 3, 4.

Pyrgo ezo Asano

Pyrgo ezo Asano, 1938, Japanese Jour. Geol. Geogr., v.15, nos. 1-2, p.93, pl. 9, figs. 1-4, 6.

Pyrgo fomasinii Chapman and Parr

Pyrgo fomasinii Chapman and Parr, 1935, Roy. Soc. W. Australia, Jour., XXI, p. 5.

Quinqueloculina agglutinata Cushman

Quinqueloculina agglutinata Cushman, 1917, U.S. Nat. Mus., Bull. 71, pt. 6, p. 43, pl. 9, figs. 2a-c.

Quinqueloculina akneriana d'Orbigny

Quinqueloculina akneriana d'Orbigny, 1846, Foram. Foss. Bas. Vienne, p. 290, pl. 18, figs. 16-21.

Quinqueloculina costata d'Orbigny

Quinqueloculina costata d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 301. no. 3.

Quinqueloculina elongata Natland

Quinqueloculina elongata Natland, 1938, Bull. Scripps Inst. Oceanogr. Tech. Ser., v. 4, no.5, p. 141, pl. 4, fig. 5.

Quinqueloculina kuromatsunaiensis Asano

Quinqueloculina kuromatsunaiensis Asano, 1936, Jour. Geol. Soc. Japan, v. 43, no. 515, p. 621, pl. 32, figs. 4a-d.

Quinqueloculina sawanensis Asano

Quinqueloculina sawanensis Asano, 1951, Illust. Cat. Japan. Tert. Small. Foram., pt. 6, p. 6, figs. 40-42.

Quinqueloculina seminulum (Linné)

Serpula seminulum Linné, 1758, Syst. Nat., ed. 10, p. 786.

Quinqueloculina seminulum (Linné), d'Orbigny, 1826, Ann. Sci. Nat., Paris, ser. I, v. 7, . 303, no. 4.

Quinqueloculina vulgaris d'Orbigny

Quinqueloculina vulgaris d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 302, no. 33.

Quinqueloculina cf. *vulgaris* d'Orbigny

cf. *Quinqueloculina vulgaris* d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 302, no. 33.

Quinqueloculina yessoensis Asano

Quinqueloculina yessoensis Asano, 1936, Jour. Geol. Soc. Japan. 43, p. 620, pl. 32, figs. 3a-c.

Quinqueloculina sp.B

This species is somewhat similar to *Quinqueloculina elongata* Natland of Asano (1950) in its outline, but is distinguished from it by more inflated chambers and coarsely perforated wall.

Quinqueloculina sp.C

This species is somewhat similar to *Quinqueloculina contrita* d'Orbigny, but is distinguished by more rounded outline, short size, and apertural view.

Quinqueloculina sp.F

This form is similar to *Quinqueloculina yessoensis* Asano, but it differs from it in having a broadly oval test with more sharply angled periphery in apertural view. This is also similar to *Quinqueloculina kuromatunaiensis* Asano, but is distinguished in having angled periphery of chambers.

Quinqueloculina sp.G

This form is somewhat similar to *Quinqueloculina elongata* Natland, but is distinguished from it by its triangular appearance in apertural view.

Quinqueloculina sp.H

This form is similar to *Quinqueloculina hasimotoi* Asano, but differs from it in having a test without apertural protrusion.

Rectobolivina raphanuss (Parker and Jones)

Uvigerina (Sagrina) raphana Parker and Jones, 1865, Roy. Soc. London Philos. Trans, v. 155, p. 364, pl. 18, figs. 16, 17.

Rectobolivina raphana (sic.) (Parker and Jones), Loeblich and Tappan, 1964, Treatise on Invertebrate Pal., Moore, R.C., ed., pt. C, Protista 2, v. 2, p. C533, figs. 438 (9-11).

Rosalina australis (Parr)

Discorbis australis Parr, 1932, Roy. Soc. Victoria, Proc., XLIV (n.s.) p. 227, pl. xxii, 31.

Rosalina australis (Parr), Jones, 1994, Challenger Foram., pl. 87, figs. 5-7.

Rosalina bradyi (Cushman)

Discorbina globularis Brady (not of d'Orbigny, 1826), 1884, Voy. Challenger, Rep., Zool., v. 9, p. 86, figs. 8a-c.

Discorbina globularis var. *bradyi* Cushman, 1915, U.S. Nat. Mus., Bull. 71, pt. 5, p. 12, pl. 8, figs. 1a-c.

Rosalina bradyi (Cushman), Hornibrook and Vella, 1954, Micropal., v. 8, no. 1, p. 26.

Rosalina globularis d'Orbigny

Rosalina globularis d'Orbigny, 1926, Ann. Sci. Nat., Paris, ser. 1, v. 7, p. 271, no. 1, pl. 13, figs. 1-14; Modele no. 69.

Rosalina isabelleana d'Orbigny

Rosalina isabelleana d'Orbigny, 1839, Foraminifères. p. 43, pl. 6, figs. 10-12.

Rosalina vilardeboana d'Orbigny

Rosalina vilardeboana d'Orbigny, 1839, Voy. Amer. Merid., Foraminifères, v. 5, pt. 5, p. 44, pl. 6, figs. 13-15.

Rosalina vilardeboana d'Orbigny

Rosalina vilardeboana d'Orbigny, 1839, Voy. Amér. Mérid., Foraminifères, v. 5, pt. 5, p. 44, pl. 6, figs. 13-15.

Sigmoidella pacifica Cushman and Ozawa

Sigmoidella (Sigmoidina) pacifica Cushman and Ozawa, 1928, Cushman Lab. Foram. Res., Contr., v. 4, p. 19, pl. 2, fig. 13.

Sigmoilina sigmoidea (Brady) *compressa* Cushman

- Sigmoilina sigmoidea* (Brady) *compressa* Cushman, 1946, Contr. Cushman Lab. Foram. Res., 22, no. 2, p. 32, pl. 5, figs. 10-12.
- Sigmomorphina semitecta terquemiana* (Fornasini)
Polymorphina amygdaloides Reuss var. *terquemiana* Fornasini, 1902, Mem. Accad. Inst. Sci. Bologna, ser. 5, no. 9, p. 72, fig. 25.
- Sigmomorphina semitecta* (Reuss) var. *terquemiana* Cushman and Ozawa, 1930, U.S. Nat. Mus. Proc., v. 77, no. 6, p. 129, pl. 33, figs. 4, 5; pl. 34, figs. 2, 3; pl. 35, fig. 1.
- Sigmomorphina trilocularis* (Bagg)
Polymorphina trilocularis Bagg, 1912, U. S. Geol. Surv. Bull., 513, p. 75, pl. 20, figs. 15-18.
- Sigmomorphina trilocularis* (Bagg), Cushman and Ozawa, 1930, U. S. Nat. Mus. Proc., v. 77, no. 6, p. 136, pl. 36, fig. 5.
- Sphaeroidina japonica* Asano
Sphaeroidina japonica Asano, 1953, Tohoku Univ., Inst. Geol. Paleont., Short Papers, no. 5, p. 17, pl. 2, figs. 43, 44.
- Spirillina limbata* Brady
Spirillina limbata Brady, 1879, Quart. Jour. Microscopic Sci., n.s., vol. 19, p. 64, pl. 8, figs. 26a, b.
- Spirillina vivipara* Ehrenberg
Spirillina vivipara Ehrenberg, 1843, Phys. Ab. K. Akad. Wiss. Berlin, 1841 (1), p. 323, 422, pl. 3, VII, fig. 41.
- Spiroloculina hadai* Thalmann
Spiroloculina costata Hada, 1931, Tohoku Univ. Sci. Rep., 4th ser., Biol., v. 6, no. 1, p. 84, text-figs. 37a,b.
- Spiroloculina hadai* Thalmann, 1933, Jour. Paleont., v. 7, no. 30, p. 354.
- Spiroplectammina* sp.A
 This form somewhat similar to *Textularia candeïana* d'Orbigny, but has a test with planispirally arranged chambers in the early portion.
- Spiroplectinella wrightii* (Silvestri)
Spiroplecta wrightii Silvestri, 1903, Accad. Pont. Nuovi Lincei, Atti, LVI, p. 59, pl. 1x, figs. 1-6.
- Textularia conica* d'Orbigny
Textularia conica d'Orbigny, 1839, Foraminifères, p. 143, pl. 1, figs. 19, 18.
- Triloculina rotunda* d'Orbigny
Triloculina rotunda d'Orbigny, 1826, Ann. Sci. Nat. v. 7, p. 299, no. 4.
- Triloculina suttuensis* Asano
Triloculina suttuensis Asano, 1936, Jour. Geol. Soc. Japan, v. 43, no. 515, p. 621, pl. 33, figs. 2a-c.
- Triloculina tricarinata* d'Orbigny
Triloculina tricarinata d'Orbigny, 1826, Ann. Sci. Nat., 7, p. 299, no. 7.
- Uvigerina akitaensis* Asano
Uvigerina akitaensis Asano, 1950, Illust. Cat. Japan. Tert. Small. Foram. pt. 2, p. 14, figs. 60-62.

Uvigerina juncea Cushman and Todd

Uvigerina juncea Cushman and Todd, 1941, Cushman Lab. Foram. Res., Contr., XVII, p. 78, pl. xx, 4-11.

Uvigerina schencki Asano

Uvigerina schencki Asano, 1950, Illust. Cat. Japan. Tert. Small. Foram. pt. 2, p. 17, figs. 74, 75.

Valvulineria hamanakoensis (Ishiwada)

Anomalina hamanakoensis Ishiwada, 1958, Geol. Surv. Japan Rep., no. 180, p. 18, text-figs. 3a-c; pl. 1, 24-27.

Valvulineria hamanakoensis (Ishiwada), Matoba, 1970, Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 42, no. 1, p. 63, pl. 4, figs. 12, 13.

Valvulineria japonica Asano

Valvulineria japonica Asano, 1951, Illust. Cat. Japan. Tert. Small. Foram. pt. 14, p. 7, figs. 49-51.

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Plates (Scale bar = 100 μ m)

Planktonic Foraminifera (Plate 1)

1. *Globigerina bulloides* d'Orbigny, 2. *Globigerina quinqueloba* Natland,
3. *Globigerinita uvula* (Ehrenberg), 4. *Globigerinita glutinata* (Egger),
5. *Globorotalia inflata* (d'Orbigny), 6. *Globigerinoides ruber* (d'Orbigny),
- 7-9. *Neogloboquadrina incompta* (Chifelli), 10-11. *Neogloboquadrina pachyderma* (Ehrenberg)

Benthic Foraminifera (Plate 2-12)

Plate 2

1. *Angulogerina kokozuraensis* (Asano), 2. *Uvigerina akitaenesis* Asano,
3. *Uvigerina schencki* Asano, 4. *Uvigerina juncea* Cushman and Todd,
5. *Rectobolivina rephanus* (Parker and Jones), 6. *Buliminella elegantissima* (d'Orbigny),
7. *Bolivinita quadrilatera* (Schwager), 8. *Spiroplectammia* sp. A, 9. *Bolivina* sp. A,
10. *Bolivina decussata* Brady, 11. *Spirillina limbata* Brady,
12. *Cancris auriculus* (Fichtel and Moll)

Plate 3

1. *Oolina melo* d'Orbigny, 2-3. *Lagena apiopleura* Loeblich and Tappan,
4. *Oolina costata* (Williamson), 5. *Fissurina lacunata* (Burrows and Holland),
6. *Lagena striata* (d'Orbigny), 7. *Oolina striatopunctata* (Parker and Jones),
8. *Lagena acuticosta* Reuss, 9. *Fissurina baccata* (Haddon-Allen and Earland),
10. *Fissurina orbignyana* Seguenza, 11. *Fissurina* cf. *rizae* Seguenza,
12. *Fissurina annectens* (Burrows and Holland), 13. *Fissurina* cf. *subquadrata* Parr,
14. *Fissurina marginata* (Montagu)

Plate 4

1. *Cibicides lobatulus* (Warker and Jacob), 2-3. *Cibicides refulgens* de Montfort,
- 4-5. *Cibicides subdepressus* (Asano), 6. *Heterolepa subhaidingerii* (Parr),
7. *Anomalinoides globulosus* (Cushman and Parr),
8. *Dyocibicides perforata* Cushman and Valentine

Plate 5

1. *Buccella frigida* (Cushman), 2. *Buccella makiyamai* (Chiji), 3. *Buccella tenerrima* (Brady),
4. *Patellinella hanzawai* Asano, 5. *Hanzawaia nipponica* Asano, 6. *Rosalina australis* (Parr),

7. *Rosalina bradyi* (Cushman), 8. *Guttulina yabei* Cushman and Ozawa

Plate 6

1. *Elphidium subgranulosum* Asano, 2. *Elphidium frigidum* Cushman,
3-5. *Elphidium subarcticum* Cushman, 6-7. *Elphidium crispum* (Linné),
8. *Polystomelina discorbinoides* Yabe and Hanzawa, 9. *Elphidium jenseni* (Cushman),
10. *Criboelphidium yabei* (Asano), 11. *Criboelphidium oregonensis* (Cushman and Grant)

Plate 7

- 1, 8. *Astrononion hamadaense* Asano,
2. *Elphidium excavatum* (Terquem) forma *clavata* Cushman,
3. *Nonion japonicus* Asano, 4. *Melonis uchioi* Hasegawa, 5. *Pullenia apertura* Cushman,
6. *Melonis pompilioides* (Fichtel and Moll), 7. *Lenticulina nicobarebsis* (Schwager),
9. *Nonionellina labradorica* (Dawson)

Plate 8

1. *Planoglabratella?* sp. C, 2. *Planoglabratella australensis* (Hellon-Allen and Earland),
3. *Planoglabratella opercularis* (d'Orbigny), 4. *Planoglabratella subopercularis* (Asano),
5. *Glabratella mirabiris panamensis* Seiglie and Bermúdez,
6. *Planoglabratella patelliformis* (Brady), 7-8. *Glabratella* sp. A,
9. *Glabratella pulvinata* (Brady), 10. *Glabratella* sp. B

Plate 9

1. *Planoglabratella subopercularis* (Asano), 2. *Epistominella pulchella* Husezima and Maruhasi,
3. *Ammonia beccarii* (Linné), 4. *Islandidilla norcrossi* (Cushman),
5. *Islandiella japonica* (Asano and Nakamura), 6. *Islandiella yabei* (Asano and Nakamura),
7. *Islandiella helanae* Feyling-Hanssen and Buzas,
8. *Islandiella sublimbata* (Asano and Nakamura),
9. *Pseudoparella takayanagii* (Iwasa), 10. *Pseudoparella naraensis* Kuwano

Plate 10

1. *Quinqueloculina* sp.G, 2. *Pateoris hauerinoides* (Rhunbler),
3. *Quinqueloculina costata* d'Orbigny, 4. *Quinqueloculina kuromatsunaiensis* Asano,
5. *Quinqueloculina agglutinata* Cushman, 6. *Quinqueloculina* sp.F

Plate 11

1. *Cycloforia contrita* (d'Orbigny), 2. *Quinqueloculina akneriana* d'Orbigny,

3. *Quinqueloculina* sp. C, 4. *Cribrolinoides curta* (Cushman), 5. *Quinqueloculina* sp. B,
6. *Quinqueloculina yessoensis* Asano

Plate 12

1. *Quinqueloculina akneriana* d'Orbigny, 2. *Quinqueloculina sawanensis* Asano,
3. *Triloculina suttuensis* Asano, 4. *Triloculina tricarinata* d'Orbigny, 5-6. *Pyrgo ezo* Asano























