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Pleistocene Radiolaria from Leg 119 Site 738B (Sections 1H1-1H2): Systematics and Biostratigraphy

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ABSTRACT

This paper presents a record of radiolarian species from the sections (1H1-1H2) Leg 119 Site 738B of Southern Ocean region. Well diversified taxa of typical Antarctic assemblage are present in the sections. Thirty species were identified and illustrated from twenty-nine samples. On the basis of appearance, disappearance and abundance of taxa, viz. Omega and Psi zones are established and systematics of stratigraphically important species is described. These zones are equivalent to NR1 and NR2 of Upper Quaternary.

Keywords: Pleistocene Radiolaria; Systematics; Biostratigraphy; Southern Indian Ocean

1. Introduction

The study area lies in the southern part of Kerguelen Plateau at latitude 62˚42.54'S and longitude 82˚47.25'E (**Figure 1**). The identified species shows well preserved Antarctic assemblage collected at a water depth of 2252.5 mbsf. Twenty-nine samples from two sections (1H1-1H2) were used for this study. The total length of studied samples is 2.850 m (**Figure 2**). The Leg 119 site 738B consists of nanno fossil ooze, calcareous chalk and limestone. [1] began the study on radiolarian bearing sediments in the Southern Ocean and described twenty species from the Antarctic sector of the Indian Ocean. [2] reported some species of radiolaria from Indian Ocean sector of Antarctica. [3] studied the radiolaria from the Wilhelm II Coast of Antarctica and Kerguelen Island. [4] worked on the B.A.N.Z. Antarctic Research Expedition and collected sediment samples to carry out detail study on radiolaria. [5] described Antarctic radiolarian species from the Super family Liosphaericae. [6-17] established Neogene radiolarian biostratigraphy along with illustrations and descriptions of important taxa. [18-22] carried out the detailed study on Antarctic Neogene radiolarian biostratigraphy. [23] proposed radiolarian biostratigraphy of late Tertiary Antarctic Seas of the Southern Ocean Region. [24] marked radiolarian zones of Quaternary and Upper Tertiary deposits of middle Asia. [25-33] worked on biostratigraphy and paleoclimate of the Antarctic region. [34] established Pliocene-Pleistocene radiolarian biostratigraphy and paleoclimatic history from the samples collected near the Antarctic and subtropical convergence of the Southern Ocean region. [35] studied the bottom sediments of the Bellingshausen Basin in the Antarctic Sea. [36-38] established Neogene biostratigraphy of Falkland Plateau and Weddell Sea. [39] did the study on radiolarian biostratigraphy and magnetostratigraphy of siliceous microfossils from Antarctic sediments. [40] identified two new genera and seventeen new species from the Neogene sediments of the Kerguelen plateau. [41] carried out work on the biochronology and magnetostratigraphy of the Antarctic sediments. [42] established radiolarian from Eocene to Recent biostratigraphy, biogeography, diversity, and history of Southern Ocean. [43] carried out detail study on Neogene radiolaria from ODP Legs 119 and 120. [44] worked on sections of ODP Site 745 in the Kerguelen Plateau and placed the last occurrence datum of *Stylatractus universus*. [45] reported Antarctic Neogene radiolaria from ODP Leg 119 and described environmental control of radiolarian diversity, evolutionary rates and taxa longevities. [46,47] identified and described 83 radiolarian taxa and established two Pleistocene zones of Tasman region. [48] worked on radiolarian assemblage proxies for productivity in the 0 - 6 Ma on DSDP Site 532 and ODP Site 1084. [49] carried out the work on radiolarian paleo-productiv-

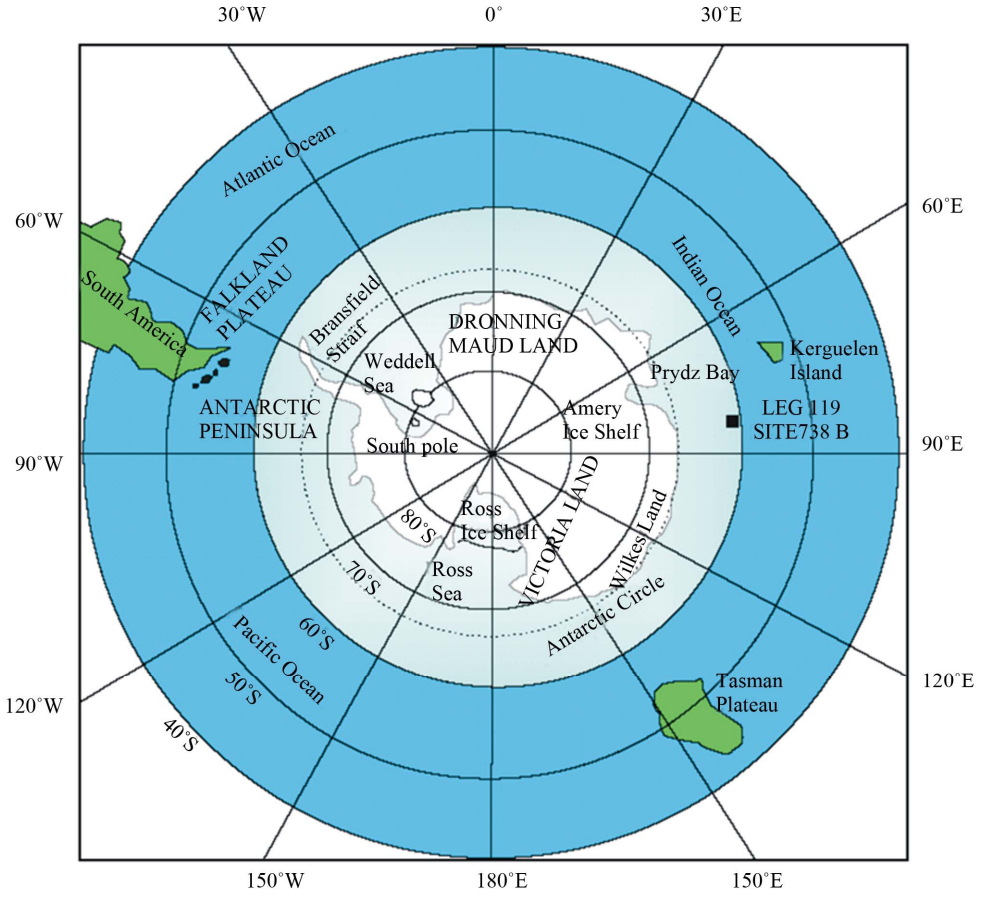

Figure 1. Showing the position of study area of Leg 119 Site 738 B.

ity variation from the ODP Site 1084 in late Pleistocene. [50,51] described 71 radiolarian species and established one radiolarian zone *i.e.* lower and upper Chi from the Pleistocene sediments of South East Indian area of the Antarctic continental margin. [52,53] described 45 radiolarian species and proposed the placement of NR1 and NR2 zonal boundary at a shallow depth of 6.63 mbsf from Southern Ocean region.

2. Methodology

Twenty nine samples from two sections (1H1-1H2) of Leg 119 Site 738B were used to carry out the present study. Sediment samples of about 3 - 4 g were disaggregated in dilute Hydrogen peroxide (H_2O_2) for 1 - 2 hour followed by heating to just below the boiling point. One teaspoonful of Calgon (Hexametaphosphate) was added to further boil and disaggregate the sediment samples for 1 - 2 hours and complete the treatment. The samples were sieved through a 63 micron mesh sieve and dried. The strewn slides were prepared by using an eye dropper and Canada balsam as a mounting medium. Generally, minimum 2 - 3 slides (of cover slip size 22:22 mm) were examined for taxonomic and stratigraphic work, depending on their abundance *i.e.* generally between 950 - 1000 individual radiolarians.

3. Systematic Palaeontology

The classification of the subclass Radiolaria followed here is that of [54-57]. Remarks on observed morphological features and their modifications have been added for many taxa. Species within a genus and genera within a family are arranged alphabetically. Characteristic morphological features for each new species and those given in open nomenclature are described. The synonymy for each taxon is incomplete and consists of references of interest to the present study. The distribution of each species is estimated as percentage of the total number of radiolaria present in the slides of each sample. The following scheme was followed to note the distribution-VA = Very Abundant (>50%); A = Abundant (20% - 50%); C = Common (5% - 20%), F = Few (0.5% - 5%), R = Rare (<0.5%), but more than single specimen; + = Very Rare (single specimen), − = absent) and preservation G = Good, M = Moderate and P = Poor are indicated for each sample in **Table 1**. The microphotographs of all the identified species are illustrated in **Plate I**.

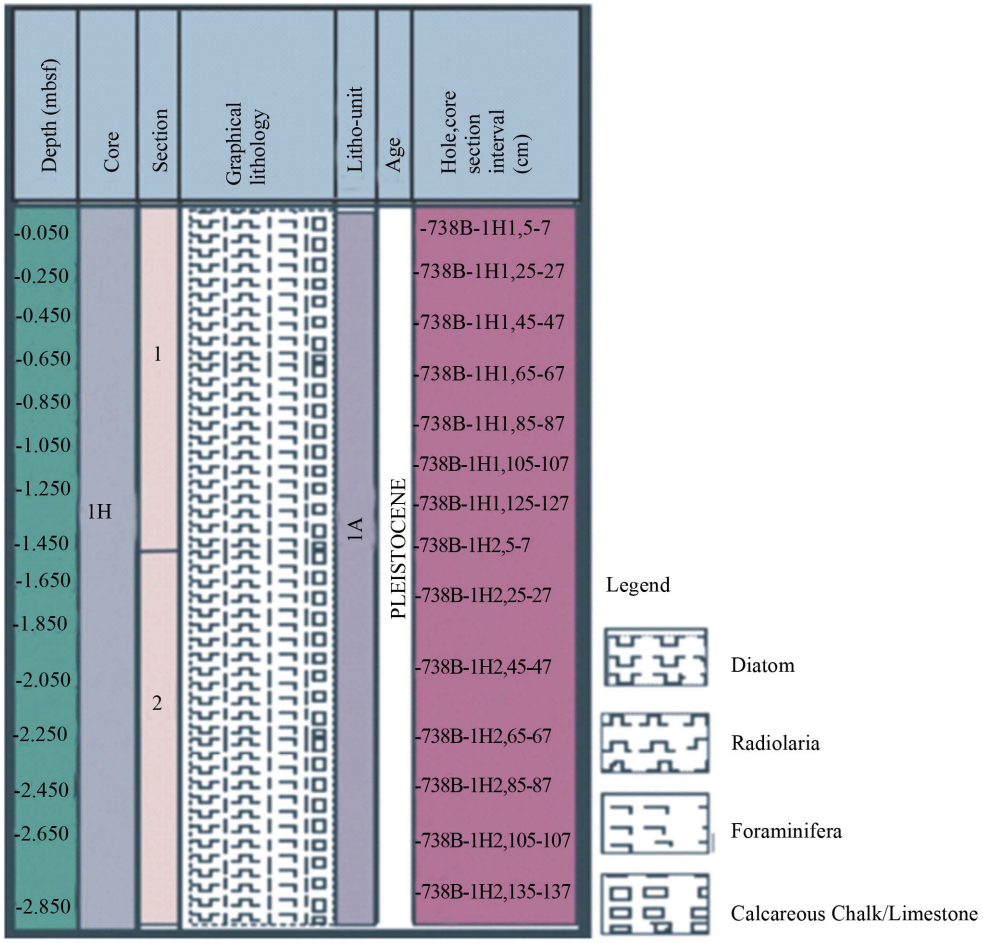

Figure 2. Showing age, position of the samples, lithostratigraphic succession and depth of Leg 119 Sites 738B.

Phylum Sarcodina Hertwig and Lesser, 1874

Class Actinopoda Calkins, 1909

Subclass Radiolaria Müller, 1858

Order Polycystina Ehrenberg, 1875, emend. Riedel, 1967b

Sub order Spumellaria Ehrenberg, 1875.

Family Collosphaeridae Müller, 1858

Genus *Acrosphaera* Haeckel, 1881

Acrosphaera sp. *A*

(Pl. I, Figure 1)

Abundance: Rare to Few

Distribution: [50] also showed its presence from very rare to few in the Antarctic region.

Remarks: Thick spherical lattice shell having the pores of different size and is irregularly spaced. The outer wall is slightly banded. The lattice spines vary in size from tubular to conical.

Family Actinommidae Haeckel, 1862, *emend*. Riedel, 1967a

Genus *Stylatractus* Haeckel, 1887

Stylatractus sp.

(Pl. I, Figure 12)

Description: Ellipsoidal shell, having three concentric lattice shells. Two unequal, heavy polar spines and cylindro-conical in shape. Innermost shell spherical, thin walled with subcircular pores. Second lattice shell thick walled with subcircular pores. The shells are interconnected by radial beams and having spiny surface with large irregular pores.

Abundance: Rare

Stylatractus spp.

(Pl. I, Figure 30)

?*Stylatractus neptunus* Haeckel, 1887, p. 328, pl. 17, Figure 6; Riedel, 1958, p. 226, pl.1, Figure 9.

Stylatractus spp. Nigrini and Moore, 1979, p. S55, pl. 7, Figures 1(a), (b).

Abundance: Rare

Distribution: [4] considered this species as a cosmopolitan, [58] showed its distribution in the Southern Ocean region.

Stylatractus universus Hays

(Pl. I, Figure 14)

Stylatractus sp. Hays, 1965, p. 167, pl. 1, Figure 6.

Stylatractus universus Hays, 1970, p. 215, pl. 1, Figures 1-2.

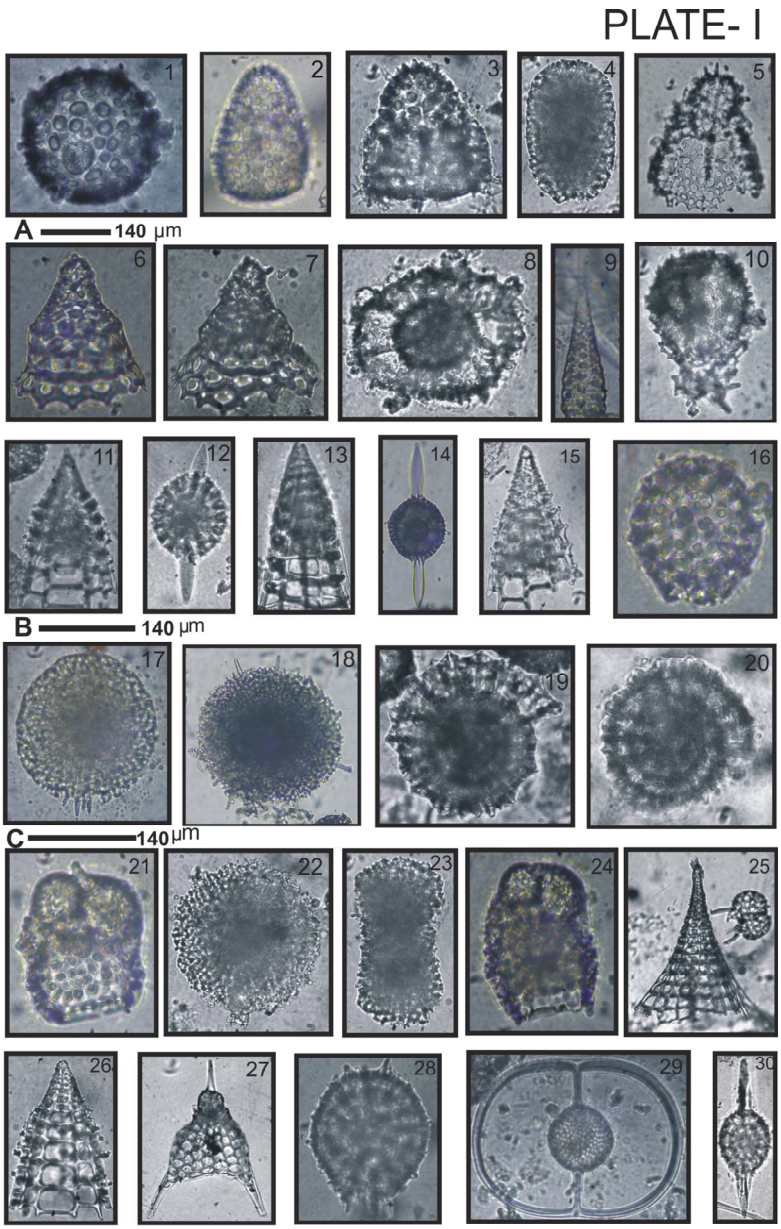

Plate I. 1. ***Acrosphaera*** **sp. A, 738B-1H-1, 5-7; focused on surface. 2.** ***Antarctissa cylindrica*** **Ehrenberg, 738B-1H-1, 15-17; focused on outer shell. 3.** ***Antarctissa denticulata*** **Ehrenberg, 738B-1H-1, 15-17; focused on surface. 4.** ***Spongurus pylomaticus*** **Riedel, 738B-1H-1, 55-57; focused on cortical shell. 5.** ***Antarctissa strelkovi*** **Petrushevskaya, 738B-1H-1,115-117; focused on outer portion. 6.** ***Cycladophora robusta*** **Lombari and Lazarus, 738B-1H-2, 57-57; focused on surface. 7.** ***Cycladophora davisiana*** **Ehrenberg, 738B-1H-1, 15-17; focused on surface. 8.** ***Phorticium pylonium*** **(*clevei*) Haeckel, 738B-1H-1, 5-7; focused on cortical shell. 9.** ***Cornutella stiligera*** **Ehrenberg, 738B-1H-2, 15-17; focused on outer surface. 10.** ***Mitrocalpis araneafera*** **Reidel 738B-1H-1, 25-27; focused on outer shell. 11.** ***Peripyramis circumtexta*** **Haeckel, 738B-1H-1, 105-107; focused on surface. 12.** ***Stylatractus*** **sp., 738B-1H-1, 35-37; focused on outer portion. 13.** ***Cinclopyramis*** **sp. 738B-1H-1, 105-107; focused on outer part. 14.** ***Stylatractus universus*** **Hays, 738B-1H-1, 135-137; focused on shells. 15.** ***Cornutella profunda*** **Ehrenberg *7*38B-1H-1, 5-7; focused on surface. 16.** ***Prunopyle*** **sp. 738B-1H-1, 5-7; focused on outer part. 17.** ***Spongopyle osculosa*** **Dreyer, 738B-1H-1, 15-17; focused on surface. 18.** ***Spongotrochus glacialis*** **Popofsky, 738B-1H-1, 5-7; focused on surface. 19.** ***Lithelius nautiloides*** **Popofsky, 738B-1H-1, 15-17; focused on outer surface. 20.** ***Lithelius minor*** **Jörgensen 738B-1H-1, 5-7; focused on shell surface. 21.** ***Saccospyris preantarctica*** **Petrushevskaya, 738B-1H-1,115-117; focused on surface. 22.** ***Spongopyle*** **sp. 738B-1H-1, 15-17; focused on shell. 23.** ***Spongurus*** **sp. 738B-1H-1, 85-87; focused on outer shell. 24.** ***Saccospyris antarctica*** **Hackers, 738B-1H-1, 115-117; focused on outer part. 25.** ***Plectopyramis dodecomma*** **Haeckel, 738B-1H-1, 105-107; focused on outer periphery. 26.** ***Bathropyramis*** **sp. 738B-1H-1, 15-17; focused on shell surface. 27.** ***Pterocanium charybdeum trilobum*** **Haeckel, 738B-1H-2, 135-137; focused on surface. 28. ?*Prunopyle antarctica*** **Dreyer, 738B-1H-1, 15-17; focused on shells. 29.** ***Saturnalis circularis*** **Haeckel, 738B-1H-1, 105-107; focused on surface. 30.** ***Stylatractus*** **sp. 738B-1H-1, 5-7; focused on outer part.**

Table 1. Occurrences of radiolarian species in the samples ((a) to (d)).

(a)

	Serial no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	Sample Name-738B (Hole, Core, Section, Interval)	1H1, 5-7	1H1, 15-17	1H1, 25-27	1H1, 35-37	1H1, 45-47	1H1, 55-57	1H1, 65-67	1H1, 75-77	1H1, 85-87	1H1, 95-97	1H1, 105-107	1H1, 115-117	1H1, 125-127	1H1, 135-137	1H1, 145-147
b	Depth(mbsf)	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05	1.15	1.25	1.35	1.45
c	Total counts	1000	1000	980	1000	1000	990	1500	900	1113	900	1200	800	1000	982	1000
d	Age			P	L	E	I	S	T	O	C	E	N	E		
e	Abundance	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
f	Preservation	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
	Name of species															
1	*Acrosphaera* sp. *A*	F	R	R	-	+	-	+	+	+	-	R	-	-	-	R
2	*Antarctissa denticulata*	C	C	C	A	A	A	C	C	A	A	A	A	A	A	C
3	*Antarctissa cylindrica*	F	C	F	C	F	C	C	F	C	C	C	C	F	F	F
4	*Antarctissa strelkovi*	F	F	F	R	R	F	R	R	R	F	F	F	R	F	F
5	*Bathropyramis* sp.	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-
6	*Cornutella profunda*	+	+	-	-	-	-	-	-	-	-	R	R	-	+	+
7	*Cinclopyramis* sp.	-	+	-	+	-	-	-	+	-	R	R	-	R	R	+
8	*Cornutella stiligera*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
9	*Cyclodophora davisiana*	-	R	-	+	-	-	+	-	-	-	-	+	-	+	-
10	*Cyclodophora robusta*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	*Lithelius minor*	+	R	+	-	-	-	R	R	+	-	F	R	R	R	+
12	*Lithelius nautiloides*	R	F	F	R	+	+	+	R	F	R	F	+	F	R	+
13	*Mitrocalpis arenifera*	-	+	R	-	-	-	+	-	-	-	+	-	-	-	-
14	*Peripyramis circumtexta*	-	+	R	-	-	-	+	-	-	-	+	-	-	-	-
15	*Phorticium pylonium*	F	-	-	+	-	-	-	-	-	+	-	-	+	-	-

(b)

	Serial no.	16	17	18	19	20	21	22	23	24	25	26	27	28	29
a	Sample Name-738B (Hole, Core, Section, Interval)	1H2, 5-7	1H2, 15-17	1H2, 25-27	1H2, 35-37	1H2, 45-47	1H2, 55-57	1H2, 65-67	1H2, 75-77	1H2, 85-87	1H2, 95-97	1H2, 105-107	1H2, 115-117	1H2, 125-127	1H2, 135-137
b	Depth(mbsf)	1.55	1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45	2.55	2.65	2.75	2.85
c	Total counts	1022	906	1027	1168	1062	1176	960	1110	1161	1193	1049	697	529	516
d	Age			P	L	E	I	S	T	O	C	E	N	E	
E	Abundance	C	C	C	C	C	C	C	C	C	C	C	C	C	C
F	Preservation	G	G	G	G	G	G	G	G	G	G	G	G	G	G
	Name of species														
1	*Acrosphaera* sp. *A*	R	-	R	-	-	+	+	-	-	-	-	-	+	+
2	*Antarctissa denticulata*	F	C	C	C	C	C	C	C	C	C	F	F	F	C
3	*Antarctissa cylindrica*	C	C	C	C	C	C	C	C	C	C	F	C	F	C
4	*Antarctissa strelkovi*	F	C	C	C	C	C	C	C	C	C	F	F	F	C
5	*Bathropyramis* sp.	-	-	-	-	-	-	-	+	-	+	F	-	-	+
6	*Cornutella profunda*	+	-	-	-	-	-	-	-	+	+	-	R	+	R
7	*Cinclopyramis* sp.	R	+	-	-	-	-	-	-	+	-	+	+	-	-
8	*Cornutella stiligera*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	*Cyclodophora davisiana*	-	+	-	R	+	R	R	+	-	-	+	+	-	R
10	*Cyclodophora robusta*	-	-	-	-	-	+	-	-	-	-	-	-	-	-
11	*Lithelius minor*	R	+	-	R	+	-	R	-	+	-	-	+	-	R
12	*Lithelius nautiloides*	-	-	+	-	-	F	R	-	+	F	-	F	R	R
13	*Mitrocalpis arenifera*	-	-	-	-	+	R	-	-	-	-	-	-	-	-
14	*Peripyramis circumtexta*	-	-	-	-	+	R	-	-	-	-	-	-	-	-
15	*Phorticium pylonium*	-	-	-	-	-	+	-	-	F	-	-	-	-	+

(c)

	Serial no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	Sample Name-738B (Hole, Core, Section, Interval)	1H1, 5-7	1H1, 15-17	1H1, 25-27	1H1, 35-37	1H1, 45-47	1H1, 55-57	1H1, 65-67	1H1, 75-77	1H1, 85-87	1H1, 95-97	1H1, 105-107	1H1, 115-117	1H1, 125-127	1H1, 135-137	1H1, 145-147
b	Depth (mbsf)	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05	1.15	1.25	1.35	1.45
c	Total counts	1000	1000	980	1000	1000	990	1500	900	1113	900	1200	800	1000	982	1000
d	Age			P	L	E	I	S	T	O	C	E	N	E		
e	Abundance	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
f	Preservation	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
	Name of species															
16	*Plectopyramis dodecomma*	+	-	-	-	-	+	-	-	-	-	-	-	-	+	-
17	? *Prunopyle antarctica*	-	R	-	-	-	+	-	-	+	+	+	R	-	-	-
18	*Prunopyle* sp.	F	R	R	F	R	+	+	+	R	R	R	R	R	+	-
19	*Pterocanium c. trilobum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	*Saccospyris antarctica*	-	F	+	R	F	F	R	F	F	F	F	F	F	F	F
21	*Saccospyris preantarctica*	R	R	+	R	F	+	R	R	F	R	F	F	R	R	-
22	*Spongopyle osculosa*	R	F	F	F	R	F	F	F	F	R	F	F	F	+	-
23	*Spongopyle* sp.	+	R	-	R	-	R	R	R	-	R	R	R	-	-	-
24	*Spongotrochus glacialis*	F	R	F	F	-	F	F	F	F	R	F	F	F	-	-
25	*Saturnalis circularis*	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-
26	*Stylatractus* spp.	-	-	-	+	+	-	+	-	R	-	R	-	+	-	-
27	*Stylatractus* sp.	F	R	+	+	-	-	+	-	-	-	+	+	-	-	-
28	*Stylatractus universus*	-	-	+	-	-	-	-	-	-	-	R	+	+	R	+
29	*Spongurus pylomaticus*	R	F	R	F	-	R	R	+	F	F	F	F	F	R	R
30	*Spongurus* sp.	F	F	F	F	F	R	R	F	F	F	F	F	F	F	F

(d)

	Serial no.	16	17	18	19	20	21	22	23	24	25	26	27	28	29
a	Sample Name-738B (Hole, Core, Section, Interval)	1H2, 5-7	1H2, 15-17	1H2, 25-27	1H2, 35-37	1H2, 45-47	1H2, 55-57	1H2, 65-67	1H2, 75-77	1H2, 85-87	1H2, 95-97	1H2, 105-107	1H2, 115-117	1H2, 125-127	1H2, 135-137
b	Depth (mbsf)	1.55	1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45	2.55	2.65	2.75	2.85
c	Total counts	1022	906	1027	1168	1062	1176	960	1110	1161	1193	1049	697	529	516
d	Age			P	L	E	I	S	T	O	C	E	N	E	
E	Abundance	C	C	C	C	C	C	C	C	C	C	C	C	C	C
F	Preservation	G	G	G	G	G	G	G	G	G	G	G	G	G	G
	Name of species														
16	*Plectopyramis dodecomma*	-	+	-	-	-	-	-	-	-	-	-	-	-	-
17	? *Prunopyle antarctica*	-	-	+	-	-	+	-	-	-	+	-	-	-	-
18	*Prunopyle* sp.	R	-	-	+	-	F	F	-	+	+	+	+	R	F
19	*Pterocanium c. trilobum*	-	-	-	-	-	-	-	-	-	-	-	-	-	+
20	*Saccospyris antarctica*	F	R	R	F	R	F	R	R	F	F	-	R	R	R
21	*Saccospyris preantarctica*	+	+	+	R	-	F	+	F	R	R	-	+	-	-
22	*Spongopyle osculosa*	R	R	R	+	R	F	F	R	F	F	R	F	F	R
23	*Spongopyle* sp.	-	-	-	+	-	-	R	-	-	+	-	+	+	R
24	*Spongotrochus glacialis*	F	F	F	F	F	C	C	F	F	F	F	C	C	F
25	*Saturnalis circularis*	-	-	-	-	-	-	-	-	-	-	-	+	+	+
26	*Stylatractus* spp.	-	-	-	-	R	+	-	-	-	R	R	R	F	-
27	*Stylatractus* sp.	-	-	-	+	-	+	+	-	+	R	-	R	R	+
28	*Stylatractus universus*	R	+	-	-	+	-	-	-	-	-	-	-	-	-
29	*Spongurus pylomaticus*	F	R	R	F	F	+	R	F	F	F	F	R	-	-
30	*Spongurus* sp.	F	F	F	C	C	C	F	C	C	F	F	F	F	F

Abundance: Rare

Range: [9] reported its consistent presence in the Pleistocene sediments, whereas [11] showed its presence in Neogene.

Family Saturnalidae Deflandre, 1953

Genus *Saturnalis* Haeckel, 1881

Saturnalis circularis Haeckel

(Pl. I, Figure 29)

Saturnalis circularis Haeckel, 1887, p. 131.

Abundance: Very rare

Range: [7,12] reported its occurrence from Oligocene to lower Pleistocene.

Distribution: [46] reported its rare presence in the Tasman region. [51] Showed its distribution and taxonomy of the Southern Ocean region.

Family Sponguridae Haeckel, 1862, *emend*. Petrushevskaya, 1975

Genus *Spongurus* Haeckel, 1860

Spongurus pylomaticus Riedel

(Pl. I, Figure 4)

Spongurus pylomaticus Riedel, 1958, p. 226, pl. 1, Figures 10, 11.

Abundance: Rare to Few

Range: Neogene [12].

Spongurus sp.

(Pl. I, Figure 23)

Abundance: Rare to Common

Remark: Here, this species include only the spongy forms.

Family Spongodiscidae Haeckel, 1862, *emend*. Riedel, 1967b

Genus *Spongopyle* Dreyer, 1889

Spongopyle osculosa Dreyer

(Pl. I, Figure 17)

Spongopyle osculosa Dreyer, 1889, p. 42, pl. 11, Figures 99, 100.

Abundance: Rare to Few

Range: [7,12] reported its presence in Neogene.

Distribution: [46] reported its presence from rare to abundant in Tasman region. [51] showed its distribution and taxonomy of the Southern Ocean region.

Spongopyle sp.

(Pl. I, Figure 22)

Description: Spongy, biconvex shell. Shape more or less circular, central part thickened and having dense spongy mass compared to marginal part. Mantle and radial spines absent. Pylome distinct and funnel shaped.

Abundance: Rare to Few

Genus *Spongotrochus* Haeckel, 1860

Spongotrochus glacialis Popofsky group

(Pl. I, Figure 18)

Spongotrochus glacialis Popofsky, 1908, p. 228, pl. 26, Figure 8; pl. 27, Figure 1, pl. 28, Figure 2.

Spongotrochus glacialis Popofsky group Petrushevskaya, 1975, p. 575, pl. 5, Figure 8, pl. 35, Figures 1-6.

Abundance: Rare to Common

Range: Miocene to Recent [14] Neogene and Oligocene? [7,12]

Distribution: [4] reported its occurrence in the Antarctic region while [59] reported it in the sub-Antarctic region. [60] Considered as a cosmopolitan species. [46] also reported its presence from rare to abundant in the Pleistocene sediments of Tasman region.

Family Pyloniidae Haeckel 1881

Genus *Phorticium* Haeckel 1881

Phorticium pylonium Haeckel

(Pl. I, Figure 8)

Phorticium pylonium Haeckel, 1887, p. 709, pl. 49, Figure 10.

Abundance: Rare

Range: Neogene.

Genus *Prunopyle* Dreyer, 1889

? *Prunopyle antarctica* Dreyer

(Pl. I, Figure 28)

? *Prunopyle antarctica* Dreyer, 1889, p. 24-25, pl. 5, Figure 75.

Abundance: Rare

Range: Pleistocene to Recent (Chen, 1975a)

Distribution: [4,13] reported this species from Antarctic and sub polar regions. [46] reported its presence from rare to abundant from Tasman region. [58] showed its distribution and taxonomy from Southern Ocean region.

Prunopyle sp.

(Pl. I, Figure 16)

Description: Two concentric shells connected by numerous radial bars. Pores small, circular. Cortical shell thick and bears small spines, pylome large and having spines.

Abundance: Rare to Few

Family Litheliidae Haeckel, 1862

Genus *Lithelius* Haeckel, 1862

Lithelius minor Jörgensen

(Pl. I, Figure 20)

Lithelius minor Jörgensen, 1900, p. 65, pl. 5, Figure 24.

Abundance: Few to Rare

Distribution: [58] showed its widespread distribution near the Antarctic region. [50] also showed its presence from very rare to few in the Southern Ocean region.

Lithelius nautiloides Popofsky

(Pl. I, Figure 19)

Lithelius nautiloides Popofsky, 1908, pp. 230-231, pl. 27, Figure 4.

Abundance: Few to Rare

Range: Pliocene to Recent [7,12,23] reported *L. nautiloides* to be endemic to the present day Antarctic fauna.

Distribution: [46] showed its distribution from rare to few in the Tasman region. [51] reported its occurrence in

the Southern Ocean region.

SUBORDER NASSELLARIA EHRENBERG, 1875

Family Plagoniidae Haeckel, 1881, *emend*. Riedel, 1967b

Genus *Antarctissa* Petrushevskaya, 1967

Antarctissa cylindrica Petrushevskaya

(Pl. I, Figure 2)

Antarctissa ewingi Chen, 1974, p. 486, pl. 3, Figures 4-6.

Antarctissa cylindrica Petrushevskaya, 1975, p. 591, pl. 11, Figures 19, 20.

Abundance: Few to Common

Antarctissa denticulata (Ehrenberg)

(Pl. I, Figure 3)

Lithobotrys denticulata Ehrenberg, 1844b, p. 203.

Antarctissa denticulata (Ehrenberg) Lazarus, 1990, p. 713, pl. 3, Figures 1-4.

Abundance: Few to Abundant

Range: [14] reported its range from Pleistocene to Recent whereas [7] assigned it from the Pliocene-Pleistocene. [12] reported its range from Pliocene to Recent from the Antarctic region.

Distribution: This species occurred as rare to common in Pleistocene sediments of Tasman region [46]

Antarctissa strelkovi Petrushevskaya, 1987

(Pl. I, Figure 5)

Helotholus historicosa Jörgensen Popofsky, 1908, p. 279, pl. 32, Figures 1-5; pl. 36, Figure 2.

Antarctissa strelkovi Petrushevskaya-Lazarus, 1990, p. 713, pl. 3, Figures 13-15.

Abundance: Few to Common

Range: [14] reported its occurrence from Miocene to Recent, whereas [7,12] reported its presence from Pliocene to Recent.

Distribution: [46] showed its presence from rare to abundant in the Pleistocene sediments of Tasman region.

Genus *Mitrocalpis* Haeckel, 1881

Mitrocalpis araneafera Popofsky

(Pl. I, Figure 10)

Mitrocalpis araneafera Popofsky, 1908, p. 273, pl. 30, Figure 11.

Abundance: Rare

Range: Pliocene to Recent [8]

Distribution: [51] reported its occurrence in the Southern Ocean region.

Family Theoperidae Haeckel, 1881, *emend*. Riedel, 1967b

Genus *Bathropyramis* Haeckel,1882

Bathropyramis sp.

(Pl. I, Figure 26)

Description: Cephalis subspherical and poreless without apical spine, Thorax conical with six to eight longitudinal bars joined by transverse bars. The pores are sub rectangular and increase in size distally.

Abundance: Very Rare

Genus *Cinclopyramis* Haeckel, 1879

Cinclopyramis sp.

(Pl. I, Figure 13)

Description: Pyramidal shell, thorax consisting of six to eight longitudinal bars joined by the transverse bars, network double quadrangular to rectangular pores, increasing in size distally, surface smooth and covered by mantle.

Abundance: Rare

Genus *Cornutella* Ehrenberg, 1838, *emend.* Nigrini, 1967.

Cornutella profunda Ehrenberg

(Pl. I, Figure 15)

Cornutella clathrata profunda Ehrenberg, 1854, p. 241.

Cornutella profunda Ehrenberg Riedel, 1958, p. 232, pl. 3, Figures 1, 2.

Abundance: Rare

Range: [7] reported its occurrence from Oligocene to Recent while [14] reported its presence from Miocene to Recent.

Distribution: [4] considered this species as a cosmopolitan species. [46] reported its distribution from rare to common in the Tasman region.

Cornutella stiligera Ehrenberg group

(Pl. I, Figure 9)

Cornutella stiligera Ehrenberg, 1854, pl. 36, Figure 1.

Cornutella stiligera Ehrenberg group, Petrushevskaya and Kozlova, 1972a, p. 551, pl. 30, Figures 14, 15.

Abundance: Very rare

Range: Oligocene [59]

Remark: In the studied samples, it occurs as a reworked form.

Genus *Cycladophora* Ehrenberg, 1872b, *emend*. Lombari and Lazarus, 1988

Cycladophora davisiana Ehrenberg

(Pl. I, Figure 7)

Cycladophora davisiana Ehrenberg Petrushevskaya, 1967, p. 122, pl. 69, Figures 1-7.

Abundance: Rare

Distribution: [4] considered it as a cosmopolitan species and showed its greater abundance in the high latitudes than at lower latitudes. [51] reported its occurrence in the Southern Ocean.

Cycladophora robusta Lombari and Lazarus

(Pl. I, Figure 6)

Cycladophora robusta Lombari and Lazarus, 1988, p. 105, pl. 2, Figures 1-14.

Abundance: Rare

Remark: On the margin of upper and lower part of thorax a prominent shoulder and well developed abdomen present.

Genus *Pterocanium* Ehrenberg, 1847

Pterocanium charybdeum trilobum Haeckel
(Pl. I, Figure 27)

Pterocanium trilobum (Haeckel), Hays, 1965, pp. 177-178, pl. 3, Figure 10, Nigrini (in part), 1967, pp. 71-72, pl. 7, Figure 3(a) (only).

Pterocanium charybdeum trilobum Lazarus 1985, p. 195, Figure 10.

Abundance: Very Rare

Distribution: [25] showed its presence in early Pleistocene sediments of Antarctic

Range: Pleistocene [60]

Family Acropyramididae Haeckel, 1881

Genus *Peripyramis* Haeckel, 1881

Peripyramis circumtexta Haeckel
(Pl. I, Figure 11)

Peripyramis circumtexta Haeckel, 1887, p. 1162, pl. 54, Figure 5.

Abundance: Rare

Range: Miocene(?)-Recent [14], Neogene and Oligocene [7,12]

Genus *Plectopyramis* Haeckel, 1881

Plectopyramis dodecomma Haeckel
(Pl. I, Figure 25)

Plectopyramis dodecomma Haeckel, 1887, p. 1258, p. 54, Figure 6.

Abundance: Very Rare

Range: Neogene (Keany 1979).

Family Cannobotryidae Haeckel, 1881

Genus *Saccospyris* Haecker, 1908

Saccospyris antarctica Haecker
(Pl. I, Figure 24)

Saccospyris antarctica Haecker, 1907, p. 447, pl. 84, Figures 584, 589, 590.

Abundance: Rare to few

Range: Pliocene-Pleistocene (Petrushevskaya, 1975).

Distribution: [51] reported its occurrence in the Southern Ocean region

Saccospyris preantarctica Petrushevskaya
(Pl. I, Figure 21)

Saccospyris sp. Petrushevskaya, 1972a, pl. 2, Figure 7.

Saccospyris preantarctica Petrushevskaya, 1975b, p. 589, pl. 13, Figures 19, 20.

Abundance: Rare to Few

Range: Miocene to Recent [14].

4. Radiolarian Biostratigraphy

All the samples from the sections of Leg 119 Site 738B show good preservation, abundant and highly diverse radiolarian assemblages. The assemblage belongs to a typical Antarctic and consists of thirty taxa. The dominant species present in the sections are *Antarctissa denticulata*, *Antarctissa cylindrica*, *Antarctissa strelkovi*, *Lithelius minor*, *Lithelius nautiloides*, *Saccospyris antarctica*, *Saccospyris preantarctica*, *Spongopyle osculosa*, *Spongotrochus glacialis*, *Spongurus pylomaticus and Spongurus* sp. In this study, Antarctic Nogene radiolaria zonation of [25,61] and [38,45] are followed.Two zones has been recognised viz., Omega and Psi. [25] defined the base of the Omega zone (~0.43 Ma-Recent) as the last appearance of *Stylatractus universus* and top as Holocene. In the studied samples, *Stylatractus universus* is present very rare to rare from samples number 738B-1H1, 25 - 27 at a depth of 0.25 mbsf to 738B-1H2, 45 - 47 at a depth of 1.95 mbsf. However, [7] considered the zone NR1 as *Antarctissa denticulata* zone and defined the bottom of this zone as the last ocurrence of *S. universus*. In the studied sequence, its last appearance in the sample number 738B-1H1, 25 - 27 at a depth of 0.25 mbsf and occur as very rare. The zone NR1 of [64] is considered equivalent to Omega zone of [25]. The Psi zone (~0.8 - 0.43 Ma) was defined by [25] as the base of last appearance of *P. c trilobum* and top as the last appearance of *S. universus* [26].

In the studied samples, *P. c trilobum* is present in the samples 738B-1H2, 135 - 137 at a depth of 2.85 mbsf occurs as very rare, while *S. universus* continuosly shows its presence throughout the sections. [14] considered *A. cylindrica* as a better marker within this stratigraphic interval and occur as few to common. The zone NR2 as defined by Caulet, in part, and *S. universus* Zone of Chen, in part as top and bottom of this zone as the last occurances of *S. universus* and *Phormostichoartus pitomorphus* respectively. In the studied samples, the zone NR2 is demarcated at the sample 738B-1H1, 25 - 27 at a depth 0.25 mbsf. Thus the total age of the sections 1H1-1H2 lies between 0.8 Ma to Recent (**Figure 3**).

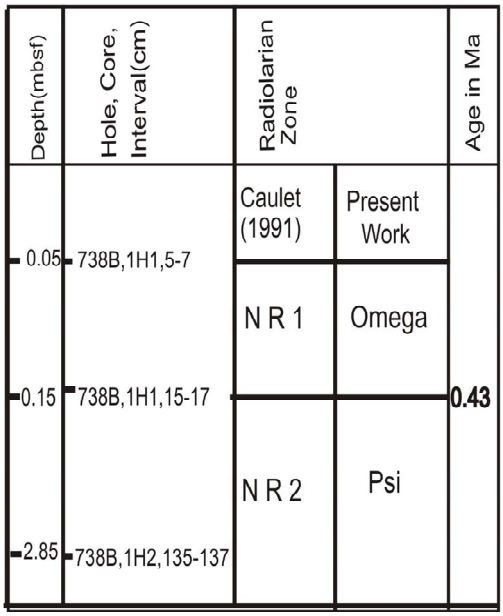

Figure 3. Showing the age and radiolarian zones of Leg 119 Site 738B, Sections 1H1-1H2.

5. Conclusion

Leg 119 Site 738B of sections 1H1-1H2 shows the typical assemblage of Antarctic radiolaria in Upper Pleistocene (0 - 0.8 Ma). Thirty radiolarian taxa were identified and their taxonomy notes of stratigraphically important taxa were given. Two radiolarian zones namely Omega and Psi were recognised on the basis of the first and the last common occurences of Upper Quaternary and are equivalent to NR1 and NR2 respectively. Further, the zonal boundary is marked at a depth of 0.15 mbsf.

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