Taxonomy and Distribution of Neogene Radiolaria of Leg 119 Site 738B, Southern Indian Ocean.

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ABSTRACT

This paper documents a comprehensive study on Neogene radiolaria from the Antarctic region. Seventy six well preserved taxa from ninety six core samples were identified and described from Leg 119 Site 738B of Southern Indian Ocean region. Their systematics, morphological variability and distribution in the samples are given and also compared with similar data available from other regions. First time, sixteen new taxa are encountered but not formally named. The detailed study provides a more extensive data base and new species for comparative studies of other parts of the ocean sectors of Antarctica.

Keywords: Distribution, Taxonomy, Neogene Radiolaria, Southern Indian Ocean Region.

1. Introduction

The study area, Leg 119 Site 738B is located on a large sediment drift at the base of the Southern slope of the Kerguelen Plateau at a water depth 2252.5 m and lies at a latitude 62˚42.54'S and longitude 82˚47.25'E (Fig.1).

The work on Antarctic Radiolarian study began with the first report of Russian scientists Tilesius von Tilenau (1806–1809). [1] began the study on Southern Ocean radiolarians and described 20 taxa from the Antarctic sector of the Indian Ocean. [2, 3] dealt with the radiolarian systematics of the Southern ocean region. [4] reported radiolaria from the Wilhelm II Coast of Antarctica and the Kerguelen Island. [5] reported radiolaria from sediment samples collected during the British Australian-New Zealand Antarctic Research Expedition. [6] described Antarctic radiolarian taxa from Super Family Liosphaericae.

Neogene radiolarian taxonomy and stratigraphy were carried out by [7-12]. The detail study was carried out on Antarctic biostratigraphy and paleoclimate studies by [13-17].

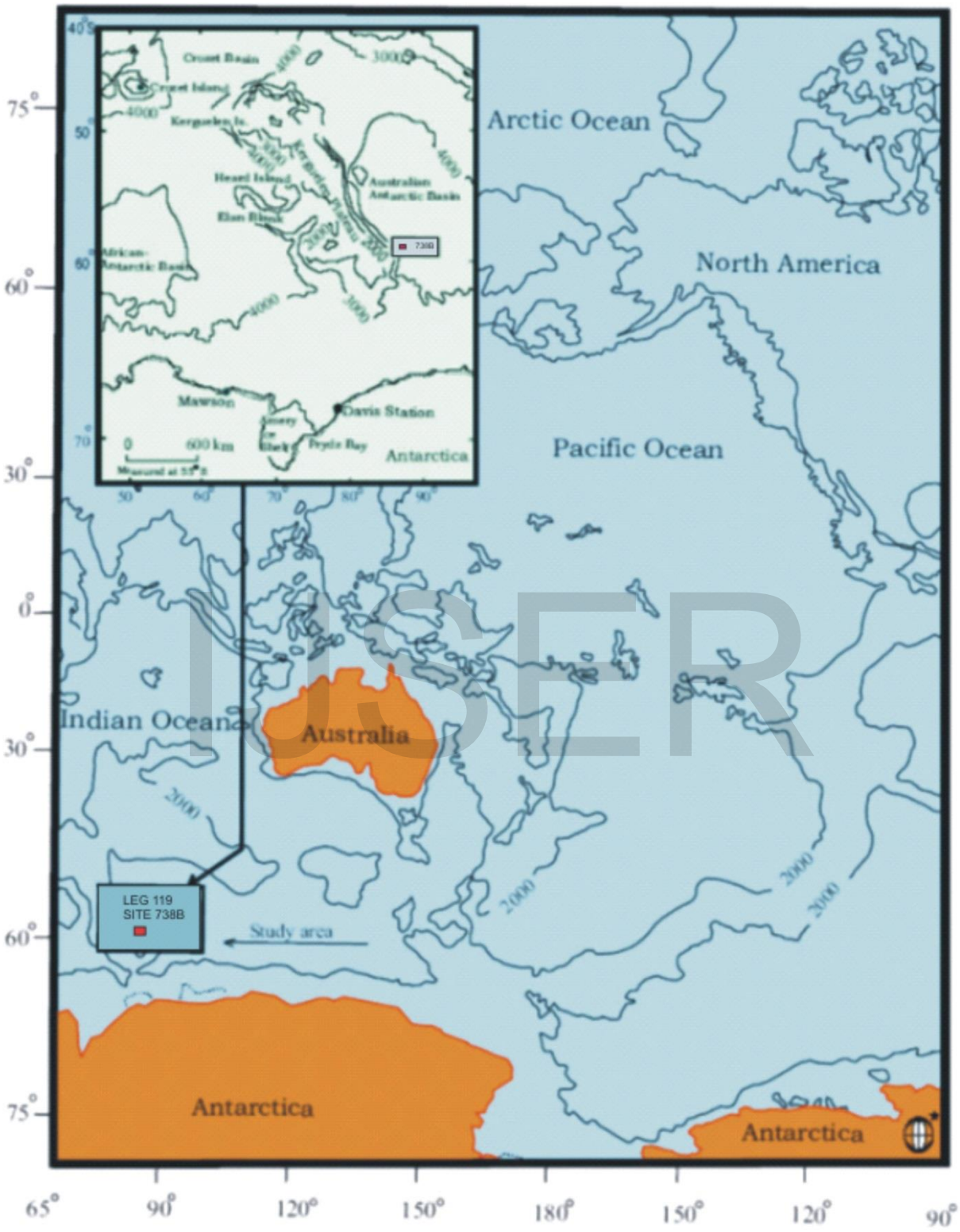

Fig. 1: Map showing the location of study area Leg119 Site 738B.

[18, 19] established Neogene biostratigraphy on cored sections of the Falkland Plateau and Weddell Sea. [20] Studied radiolarian magneto-biostratigraphy and [21] produced a biochronology and magnetostratigraphy for Antarctic sediments. [22] introduced two new genera, seventeen new species and described biostratigraphy and paleo-ceanography from the Neogene sediments of the Kerguelen Plateau. [23] carried out work on biostratigraphy, biogeography, diversity and history of Eocene to Recent radiolarians of the Southern Ocean. [24] presented radiolarian stratigraphy of Middle Miocene to Holocene sediments of different sites from ODP Legs 119 and 120. [25] worked on the siliceous sediments of ODP, Site 745 on the Kerguelen Plateau and placed the last occurrence datum of *Stylatractus universus* Hays at 24.8-24.4 mbsf corresponding to an age of 30 ka. [26] described the environmental controls on radiolarian diversity, evolutionary rates and taxa longevities of Antarctic Neogene radiolaria from ODP Leg 119. [27, 28] carried out a detailed study on Pleistocene sediments and reported 83 radiolarian taxa, and recognized two radiolarian zones of the Tasman Sea. [29] discussed the bipolar distribution of Phaeodaria, Radiolaria and Medusozoa and identified 46 bipolar radiolarian species. [30, 31] reported 75 radiolarian species from the Pleistocene sediments of the SE Indian area of the Antarctic continental margin and recognized one radiolarian zone, i.e., the lower and upper Chi zone of the Antarctic continental margin.

2. Methodology

In the present study, 96 samples from eight sections (From 2H4 to 3H4) of core Leg 119 Site 738B of a length of 10.895 m were used. Litho-stratigraphically, it consists of three units (Unit I, II and III). The unit I is divided into two subunits 1A and 1B which consist of diatom and calcareous foraminiferal ooze and have radiolaria and nannofossils. Unit II consists of calcareous nannofossil ooze, and contains radiolaria, diatom, silicoflagellates and foraminifera. Unit III consists predominantly of calcareous nannofossil ooze and foraminifera (Fig 2).

About 3-4g of sediment was first disaggregated in dilute hydrogen peroxide (H_2O_2) for 1-2 hours, followed by heating to just below the boiling point. One teaspoonful of Calgon (R) was added to further disaggregate the samples and complete the treatment. The sample was then sieved through a 63μm mesh stainless sieve. After final wet sieving the residual material was dried and used for the preparation of slides with the help of Canada balsam. About 1000 radiolaria were taken from total radiolarian population for each sample and about 224 slides were prepared.

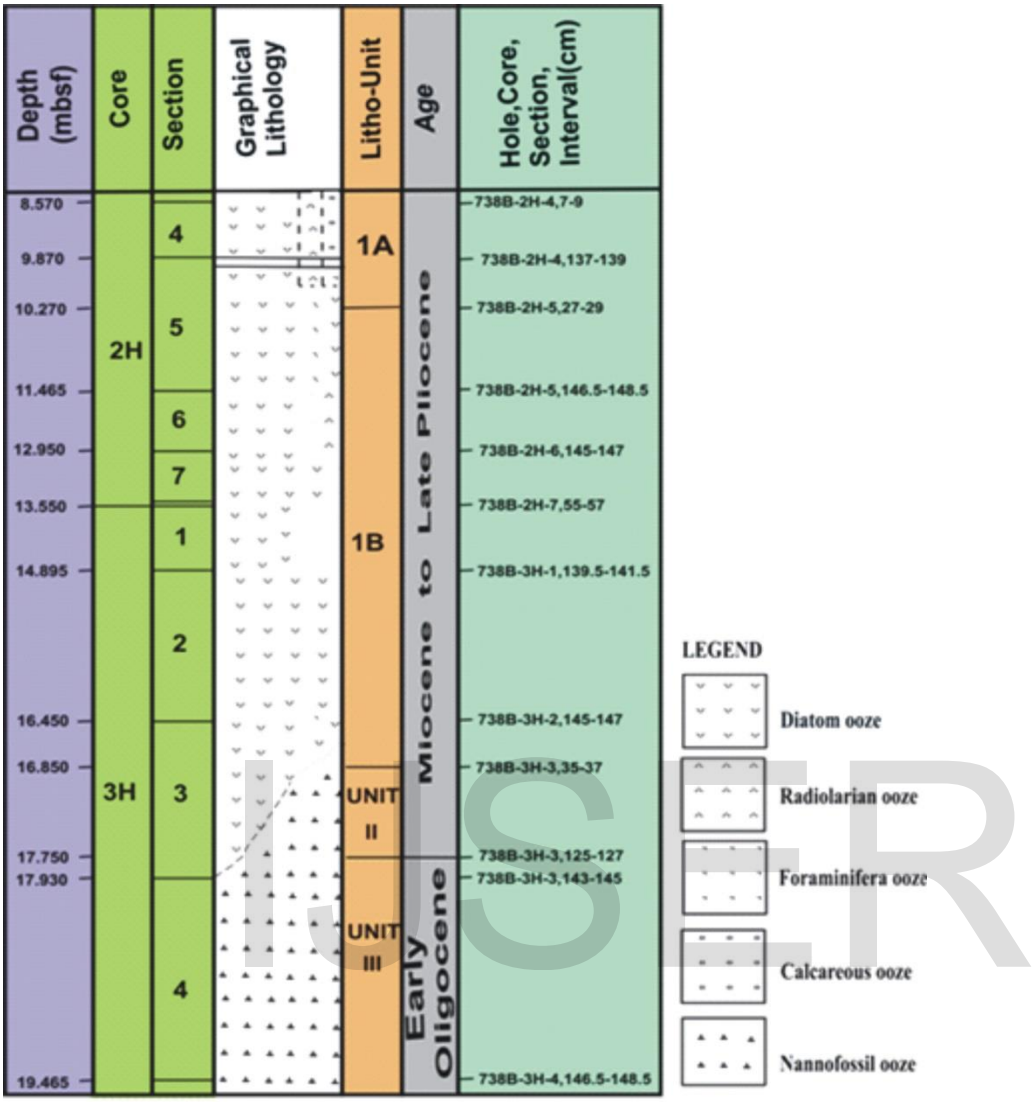

Fig.2 Showing the age, position of samples, lithostratigraphic succession and depth of Leg119 Site 738B.

3. Systematic Palaeontology

The classification of the subclass Radiolaria mainly follows the scheme of [32-34, 19]. Remarks on observed morphological features and their modifications have been added for many species. Species within a genus and genera within a family are arranged alphabetically. Each new species have characteristic morphological features which are described by open nomenclature. The synonymy of each taxon is incomplete and consists of references of interest to the present study.

The semi-quantitative estimates of radiolarian abundance [VA = very abundant (> 50%), A= abundant (20-50%), C= common (5-20%), F = few (0.5-5%), R= rare (<0.5%, but more than a single specimen), + = single specimen, blank = absent] and preservation (G = good, M= moderate, P= poor) are indicated for each sample in Table 1. The microphotographs of all the identified taxa are illustrated in Figures 1-6.

Phylum Sarcodina Hertwig and Lesser, 1874

Class Actinopoda Calkins, 1909

Subclass Radiolaria Müller, 1858

Order Polycystina Ehrenberg, 1838, *emend*. Riedel, 1967b

Suborder **Spumellaria** Ehrenberg, 1875.

Family **Collosphaeridae** Müller, 1858

Genus ***Acrosphaera*** Haeckel, 1881

Acrosphaera australis Lazarus, 1990

(Figs. 3R,S)

1990 *Acrosphaera australis* – Lazarus, p.712, pl. 1, figs. 1-6.

2014 *Acrosphaera australis* Lazarus - Dayal, pl.1, fig. A, B. p.21. (unpublished Ph.D thesis)

Distribution: [35] reported its presence from Site 745B of Kerguelen Plateau very rare to rare.

Remarks: Renaudie (Radiolaria.org) showed its presence in Southern Kerguelen Plateau, Antarctica.

Age: *Amphymenium challengerae* Zone of Late Miocene. (Radiolaria.org)

Abundance: Very rare to rare

FAMILY **Actinommidae** Haeckel, 1862, *emend*. Sanfilippo and Riedel, 1980

Genus ***Actinomma*** Haeckel, 1860, *emend*. Nigrini, 1967 *emend*. Bjørklund, 1977

Actinomma golownini Petrushevskaya, 1975

(Figs.3A,B)

1975 *Actinomma golownini* - Petrushevskaya p. 569, pl. 2, fig. 16.

1990 *Actinomma golownini* - Lazarus, p. 713, pl. 7, figs. 6-8.

Remark: The studied species differ from the [9] by not having the pores of the same size and shape.

Abundance: Very rare

***Actinomma* sp.1**

(Fig. 3E,F)

Description: Three concentric shell joined by eight to ten radial beams. The inner medullar shell having the small rounded to sub rounded pores while the outer shell shows the large rounded pores. The outer most shell of varying shape and size and covered by spines.

Abundance: Very rare to few

Actinomma sp.2

(Figs. 3C,D)

Description: Three shelled, inner most circular. Cortical shell irregular and thick walled. 20 pores of varied size on half equator. Eight small spines arises from inner most part of shell.

Abundance: Very rare to rare

Genus ***Cenosphaera*** Ehrenberg, 1854a.

?Cenosphaera cristata Haeckel

(Figs. 3G,H)

1854 (?) *Cenosphaera plutonis* – Ehrenberg, pl. 35B, fig. 20.

1887 ?*Cenosphaera cristata* - Haeckel, p. 66.

1984 ?*Cenosphaera cristata* Haeckel - Nigrini and Lombari, p. S 15, pl. 2,

Distribution: [36] showed its distribution in the Southern Ocean region. [35] reported its presence from Site 745B of Kerguelen Plateau very rare to rare.

Abundance: Very rare to few

***Cenosphaera* sp.**

(Figs. 3I,J)

Description: Single shell, 20 sub-circulars to circular pores on half equator and pores having framework. Surface covered with small spines which arises from each node.

Abundance: Very rare to rare

Genus ***Hexacontium*** Haeckel, 1881

***Hexacontium* sp.**

(Figs.3L,M)

Description: Three shelled, cortical shell thick and rough, pores regular, circular about 12 to 14 on the half equator. Six spines triangular pyramidal arises from the inner most shell nearly as long as diameter of the outer shell.

Abundance: Very rare

Genus ***Stylatractus*** Haeckel, 1887

***Stylatractus* sp.**

(Figs. 3N,O)

2013 *Stylatractus* sp. – Sharma and Kanojia, pl.1, fig.12, p.2.

Abundance: Very rare

FAMILY **Saturnalidae** Deflandre, 1953

Genus ***Saturnalis*** Haeckel, 1881

Saturnalis circularis Haeckel

(Fig. 3K)

1887 *Saturnalis circularis* - Haeckel, p. 131.

2017 *Saturnalis circularis* Haeckel - Sharma and Deepti, pp.236, pl. 1, fig. 9.

Distribution: [31] reported its presence from very rare to rare in the Antarctic region. [37] reported several types of *Saturnalis* and *Saturnulus* from the Site 745B.

Abundance: Very rare to rare

Range: [10] and [11] reported its occurrence from Oligocene to lower Pleistocene. [26] showed its occurrence from 0-17.5 Ma.

FAMILY **STAUROSPHAERIDAE** Haeckel, 1882

Genus ***Staurolonche*** Haeckel, 1882

***Staurolonche* sp**.

(Figs. 3T,U)

Description: Two concentric lattice shell with four bladed radial spines in a plane forming a right angle cross. Pores regular and surface smooth.

Abundance: Very rare to rare

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

Genus ***Spongurus*** Haeckel, 1860

Spongurus pylomaticus Riedel

(Figs. 3P,Q)

1958 *Spongurus pylomaticus* - Riedel, p. 226, pl. 1, figs. 10,11.

Distribution: [29] reported *S. pylomaticus* as a bipolar species**.** [31] reported its presence from very rare to few in the Antarctic region.

Abundance: Very rare to few

Range: Neogene (Keany, 1979).

Spongurus sp.

(Figs. 4M,N)

2017 *Spongurus* sp. - Sharma and Deepti, pl. 1, fig. 28.

Abundance: very rare to rare

Genus ***Spongocore*** Haeckel, 1887

Spongocore puella Haeckel, 1887

(Fig. 4T)

1887 *Spongocore puella* - Haeckel p. 347; pl. 48, fig. 6

Distribution: [2] and [38] considered *S. Puella* as a cosmopolitan and upwelling species. [39] reported this species from the Southern Kerguelen Plateau and showed its presence in *Cycladophora humerus* zone of Middle Miocene.

Abundance: very rare to rare

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

Genus ***Dictyocoryne***, Ehrenberg, 1860

***Dictyocoryne* sp.**

(Fig. 4K)

Description: Test having three, broad, spongy arms, equally to bilaterally disposed, without a spongy petagium. Central region not spongy and consisting of 5 to 8 concentric lattice discoidal shells, arms narrow proximally for a short distance and become broad distally.

Abundance: very rare

Genus ***Stylodictya*** Ehrenberg, 1847b, *emend*. Petrushevskaya and Kozlova, 1972

Stylodictya aculeata Jörgensen

(Fig. 4L)

1905 *Stylodictya aculeata* – Jörgensen, p. 119, pl. 10, fig. 41.

Distribution: [29] reported it as a bipolar species. [31] showed *Stylodictya aculeata* presence from very rare to few in the Antarctic region.

Abundance: Very rare to few

Stylodictya validispina Jörgensen

(Fig. 4P)

1905 *Stylodictya validispina* – Jörgensen, p. 119, pl. 10, fig. 40.

2017 *Stylodictya validispina* Jörgensen - Sharma and Deepti, pl. 1, fig. 23.

Distribution: [36] reported *S. validispina* around the Tasman region. [27] reported its presence from rare to common in this region. [29] considered it as a bipolar species.

Abundance: Very rare to few

Range: Neogene [40] and [11].

Genus ***Porodiscus*** Haeckel , 1881 *emend*. Petrushevskaya and Kozlova, 1972

***Porodiscus* sp.**

(Fig. 4E)

Description: Disk shape shell, inner ring spiral while outer rings are concentric. Central part thickened. Widths of the chambers are equal at the periphery. Pores regular, large usually 1-2, lying on the seam and between the chambers of neighboring rings, 5-7 numbers of rings. Radial needles extending from the margins of the shell. In most specimens, margins are broken.

Distribution: [27] reported this species from rare to few in the Tasman region.

Abundance: Very rare to few

Genus ***Stylochlamydium*** Haeckel, 1887

Stylochlamydium venustum Bailey

(Fig. 4U)

1856 *Perichlamidium venustum* - Bailey, p. 5, pl. 1, figs. 16-17.

1971 *Stylochlamydium venustum* - Ling *et al*., p.711-712, pl.1, figs.7-8.

Distribution: [29] considered *Stylochlamydium venustum* as bipolar.

Abundance: Very rare to few

Genus ***Spongopyle*** Dreyer, 1889

Spongopyle osculosa Dreyer

(Fig. 4J)

1889 *Spongopyle osculosa* - Dreyer, p. 42, pl. 11, figs, 99, 100.

Distribution: [31] and [27] reported its presence from very rare to few and rare to abundant in the Antarctic and Tasman regions respectively.

Abundance: very rare to few

Range: [10] and [11] - Neogene.

Genus ***Spongotrochus*** Haeckel, 1860

Spongotrochus glacialis Popofsky group

(Fig. 4O)

1908 *Spongotrochus glacialis* - Popofsky, p. 228, pl. 26, fig. 8, pl. 27,fig. 1, pl. 28, fig. 2.

2017 *Spongotrochus glacialis* Popofsky group - Sharma and Deepti, pp.238, pl. 1, fig. 2.

Distribution: [5] reported *S. glacialis* in the Antarctic region, while [41] showed its presence in the Sub Antarctic region. [42] considered it as a cosmopolitan species. [27] also reported its presence from rare to abundant in the Pleistocene sediments of Tasman region. [29] interpreted it as a bipolar species.

Abundance: Rare to few

Range: Miocene to Recent [9]; Neogene and Oligocene? [10]; Neogene [11]. [26] showed its presence from 0 to 13.3 Ma.

Genus ***Amphymenium*** Haeckel,1881

Amphymenium challengerrae Weaver 1983

(Fig. 4S)

1983 *Amphymenium challengerrae* - Weaver, pl.6, figs.1-2.

Distribution: [24] reported this species from the Kerguelen plateau and observed its range from latest Miocene.

Abundance: Very rare to rare

FAMILY **Pyloniidae** Haeckel, 1881

Genus ***Phorticium*** Haeckel, 1881,p.964;1887,p.709

Phorticium pylonium (Clevei) Haeckel

(Figs. 4D,F)

1887 *Phorticium pylonium* - Haeckel, p. 709, pl. 49, fig.10.

2017 *Phorticium pylonium* (Clevei) Haeckel - Sharma and Deepti, pp.238, pl. 1, fig. 30.

Distribution: [5] showed presence of *P. pylonium* (Clevei) Haeckel , in the Antarctic region. [37] showed its occurrence as very rare to few from Site 745B.

Abundance: Very rare to few

Range: Miocene to Recent [9].

Genus ***Prunopyle*** Dreyer, 1889

? Prunopyle antarctica Dreyer

(Figs. 4G,I)

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

2017 ?*Prunopyle antarctica* Dreyer - Sharma and Deepti, pp.238, pl. 1, fig. 10.

Distribution: [5] and [43] reported this species from Antarctic and sub polar region. [29] considered as a bipolar species.

Abundance: very rare to rare

Range: [10] mentioned the presence of *P.antarctica* from Pleistocene to Recent. [26] showed its presence from 0- 1.6Ma.

Remarks: [33] considered those taxa of ?*Prunopyle antarctica* which are having four shells. Whereas, authors counted those species also which are having three and four shells also.

Prunopyle tetrapila Hays

(Figs. 4A, B)

1965 *Prunopyle tetrapila* – Hays, pl. 2, fig.5.

1990 *Prunopyle tetrapila* Hays - Abelmann, pl. 3, fig. 14.

Abundance: Very rare to rare

Range: Neogene (and Oligocene?) [10].

Prunopyle titan Campbell and Clark

(Figs. 4Q, R)

1944 *Prunopyle titan* - Campbell and Clark, p.20.pl.3, figs.1-3.

2015a *Prunopyle titan* Campbell and Clark - Sharma and Dayal, pl.I, figs. 28.

Abundance: Very rare to rare

Remarks: The studied specimens show dense, spongy shell and having interior part spiral and poorly developed.

Range: [26] showed its first occurrence at 9.8Ma and last occurrence 3.7 Ma.

FAMILY **Litheliidae** Haeckel, 1862

Genus ***Larcopyle*** (Dreyer, 1889) *emend*. Lazarus *et al*., 2005

Larcopyle eccentricum Lazarus *et al*.,

(Figs. 5A, B)

1990 *Prunopyle titan*- Abelmann, 693,pl.3,fig.16.

2005 *Larcopyle eccentricum* - Lazarus *et al*., p.111,pl.6,figs.1-15.

Abundance: Very rare to rare

Remarks: [44] identified as a new sp. *Larcopyle eccentricum.n.sp.,* whereas, Abelman included *Prunopyle titan* into *L. eccentricum.n.sp.* They showed their occurrence from early Miocene to middle Miocene rare occurrence in the early Pliocene. [35] reported it from Site 745B of Kerguelen Plateau.

Larcopyle hayesi Chen

(Figs. 5C, D)

1975 *Prunopyle hayesi* - Chen p.454; pl.9, figs.3-5

2005 *Larcopyle hayesi* - Lazarus *et al*., p.119; pl.11, figs.1-21

Abundance: Very rare to rare

Range: lower Oligocene to Miocene. (Chen, 1975)

Larcopyle polyacantha Lazarus *et al*.,

(Figs. 4C, H)

2005 *Larcopyle polyacantha* - Lazarus *et al*., p.120; pl.10, figs.5-7

Abundance: Very rare to rare

Remark: [44] showed its abundance in the Kerguelen Plateau of Site 745B and very rare to rare in Site 738B.

Range: Early Miocene to Early Pliocene [44]

Genus ***Lithelius*** Haeckel, 1862

Lithelius minor Jörgensen

(Fig. 5F)

1900 *Lithelius minor* – Jörgensen, p. 65, pl. 5, fig. 24.

2017 *Lithelius minor* Jörgensen - Sharma and Deepti, pp.238, pl. 1, fig. 15.

Distribution: [36] showed its presence near the Antarctic region. [31] reported its presence from very rare to few in the Antarctic region.

Abundance: Very rare to rare

Lithelius nautiloides Popofsky

(Fig.5E)

1908 *Lithelius nautiloides* – Popofsky, p. 230-231, pl. 27, fig. 4.

2017 *Lithelius nautiloides* Popofsky - Sharma and Deepti, pp.239, pl. 1, fig. 16.

Distribution: [31] reported its distribution from very rare to common in the Antarctic region.

Abundance: Very rare to rare

Range: Pliocene to Recent –[10] and [11]. [7] reported *L. nautiloides* to be endemic in the present day Antarctic region.

Suborder Nassellaria Ehrenberg, 1875

Family **Acanthodesmiidae** Haeckel

Genus ***Desmospyris*** Haeckel,1881

Desmospyris spongiosa Hays

(Fig. 5N)

1965 *Desmospyris spongiosa* – Hays, p.173-175,pl.ll,fig.1.

Distribution: Sharma and Dayal (2015b) reported its presence in Kerguelen Plateau of Site 745B.

Remarks: [7] reported this species as abundant in Phi zone and have a similar range as of *Eucyrtidium calvertense*.

Abundance: Very rare to few

Age: Pliocene [10]

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

Genus ***Antarctissa*** Petrushevskaya, 1967, p. 85; 1971b, p.120.

Antarctissa cylindrica Petrushevskaya

(Fig. 5G)

1967 *Antarctissa denticulata* var. *Cylindrica* – Petrushevskaya,p.89, pl. 49, fig. 6, pl. 50, fig.1.

1972a *Antarctissa cylindrica* – Petrushevskaya, pl. 1, fig. 8, pl. 2, fig. 6.

Distribution: [31] reported *Antarctissa cylindrica* as very rare to common from Pleistocene sediments of Antarctica.

Abundance: Very rare to few

Range: [19] [26] reported its last appearance in the Psi zone and occurrence from 0.6 - 6.4 Ma in the Antarctic region.

Antarctissa denticulata (Ehrenberg)

(Figs. 5I,J)

1844b *Lithobotrys denticulata* - Ehrenberg, p. 203.

1968 *Antarctissa denticulata* (Ehrenberg) - Petrushevskaya, p. 84-86, fig. 49,

1-1V.

Distribution: [31] showed its presence in Pleistocene sediments of Antarctica.

Abundance: Very rare to common

Range: [9] presented its range from the Pleistocene to the Recent whereas, [10] assigned it from Pliocene - Pleistocene. [11] reported it from Pliocene to Recent. [26] showed its presence from 0 -2.6 Ma in the Antarctic region.

Antarctissa strelkovi Petrushevskaya

(Figs. 5K,L)

1908 *Helotholus histricosa* Jörgensen - Popofsky, p. 279-281, pl. 32, figs. 1-5, pl. 36, fig.2.

1968 *Antarctissa strelkovi* – Petrushevskaya, p. 88-90, figs. 51, 111-V1.

Distribution: [31] showed its presence from Antarctic region as very rare to common in the Pleistocene sediments.

Abundance: Very rare to few

Range: [9] showed its occurrence from Miocene to Recent, while [10] and [11] reported its existence from Pliocene to Recent. [26] demonstrated its presence from 0 - 2.5 Ma in the Antarctic region.

Genus ***Helotholus*** Jörgensen, 1905

Helotholus praevema Weaver

(Figs. 5R, S)

1983 *Helotholus praevema* – Weaver, pl. 3, figs. 1, 5-15.

Distribution: [37] reported its presence in the Site 745B of Kerguelen Plateau as very rare to rare.

Abundance: Very rare to rare

Helotholus vema Hays

(Figs. 5M, Q)

1965 *Helotholus vema* – Hays, p.176, pl.II, fig.3.

Abundance: Very rare to rare

Range: Pliocene [10]

Genus ***Zygocircus*** Bütschli, 1882

Zygocircus piscicaudatus Popofsky

(Figs. 5O,P)

1913 *Zygocircus piscicaudatus* - Popofsky p. 287. Taf. XXVIII, Fig. 3

Abundance: Very rare to few

Genus ***Ceratocyrtis*** Butschli, 1882, *emend*. Petrushevskaya, 1971b

***Ceratocyrtis* sp**.

(Fig. 5T)

Description: Shell companulate with cephalis having the one apical spine and several small spines present on the thorax. Pores irregular, polygonal and of varying sizes.

Abundance: Very rare to rare

FAMILY **Trissocyclidae** Haeckel, 1881, *emend*. Goll, 1968 (=**Acanthodesmiidae**

Haeckel, 1862 in Riedel, 1971)

Genus ***Triceraspyris*** Haeckel, 1881

***Triceraspyris* sp.**

(Figs.6V, W)

Description: Shell thin smooth and slight or pronounced saggital constrictions. Usually three basal, bladed feet and length of the feet is smaller than cephalis. Saggital ring D-shape and without apical spine. Pores circular to subcircular and large.

Abundance: Very rare to rare

FAMILY **Theoperidae** Haeckel, 1881, *emend*. Riedel, 1967b, p. 296.

Genus ***Bathropyramis*** Haeckel, 1882

***Bathropyramis* sp.**

(Fig. 5H)

2004 *Bathropyramis* sp. - Sharma *et al*., pl. 7, fig. 16, p.332.

2017 *Bathropyramis* sp.- Sharma and Deepti, pl. 1, fig. 25.

Description: Test consisting of a small subspherical poreless cephalis without an apical spine or horn. Thorax conical, consisting of six to eight longitudinal bars joined by transverse bars. The pores are sub rectangular and increases in size distally. Specimens encountered have both smooth and spiny surfaces.

Distribution: [27] reported *Bathropyramis* sp. presence as rare in Tasman region. [45] also showed its occurrence in the upper part of the section of 738B of Kerguelen Plateau.

Abundance: Very rare to rare

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

Cornutella profunda Ehrenberg

(Figs. 6I,S)

1854a *Cornutella clathrata profunda* – Ehrenberg, p. 241.

1958 *Cornutella profunda* Ehrenberg - Riedel, p. 232, pl. 3, figs. 1,2.

Distribution: [5] considered it as a cosmopolitan species. [27] and [31] reported its presence in Tasman and Antarctic region respectively.

Remark: In the studied section, those taxa having large and small apical spine, hexagonal pores and spiny surface are counted.

Abundance: Very rare to few

Range: Oligocene to Recent- [10] and Miocene to Recent- [9].

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

Cycladophora davisiana Ehrenberg

(Figs. 6E,F)

1861 *Cycladophora davisiana* – Ehrenberg, p.297; 1873, pl.2, fig.11.

Distribution: [5] considered it as a cosmopolitan and showed high abundance in high latitudes than at low. [36] reported its presence in Southern Ocean region and also considered as cosmopolitan. [29] reported it as a bipolar species. [31] showed its presence in the Antarctic as very rare to common. [37] reported its occurrence from Kerguelen Plateau of Leg119 Site 745B as very rare to rare.

Abundance: Very rare to rare

Range: Pliocene to Recent [11] and 0 - 2.7 Ma. [26]

Cycladophora pliocenica Hays

(Figs. 6A,B)

1965 *Clathrocyclas bicornis* – Hays, p. 179, pl. 3, fig.3.

1988 *Cycladophora pliocenica* Hays - Lombari and Lazarus, p. 104.

Distribution: [40] demostrated *C. bicornis* existence from Pliocene to Pleistocene.

Abundance: Very rare to rare

Range: The last appearance of *Clathrocyclas bicornis* (Hays) =*Cycladophora pliocenica*, [46] was observed by [8] and [19] and reported its presence within Chi zone.

Cycladophora robusta Lombari and Lazarus

(Figs. 6C, D)

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

pl. 1, fig. 21.

Distribution: [45] showed its occurrence from upper part of the section of Leg119 Site 738B as very rare to rare.

Abundance: very rare to rare

Range: Miocene – [46].

Genus ***Calocyclas*** Ehrenberg, 1847

Calocyclas asperum Ehrenberg

(Figs. 6J,K)

1873 *Eucyrtidium asperum* – Ehrenberg, p. 226; 1875, pl. 15.

1991 *Calocyclas asperum* – Caulet, p. 537, pl. 4, fig. 8.

Abundance: Very rare to few

Remarks: [22] reported this species from the Kerguelen Plateau and showed its presence in the early Oligocene.

Calocyclas semipolita Clark and Campbell

(Figs. 6M,N)

1942 *Calocyclas semipolita* – Clark and Campbell p.83; pl.8, fig.12,14,17-19,21-23

1975 *Calocyclas semipolita* – Chen pl.6, fig. 3-6

Abundance: Very rare to few

Occurrence: Oligocene – [10]

Genus ***Cyrtopera*** Haeckel,1881

Cyrtopera laguncula Haeckel

(Figs. 6G, H)

1887 *Cyrtopera laguncula* - Haeckel p. 1451; pl. 75, fig. 10

1998 *Cyrtopera laguncula* - Boltovskoy fig. 15.151

Remarks: Renaudie (Radiolaria.org) reported *C. laguncula* from the site 748B of Southern Kerguelen Plateau. He showed its presence in the Middle Miocene of *Cycladophora spongothorax* Zone.

Abundance: Very rare

Genus ***Dictyophimus,*** Ehrenberg, 1847a

Dictyophimus mawsoni Riedel

(Fig. 6O)

1958 *Dictyophimus mawsoni* – Riedel, p. 234, pl. 3, figs. 6,7.

Abundance: Very rare

Range: Pliocene to Recent [10]

Genus ***Lithomelissa,*** Ehrenberg,1847 b

Lithomelissa ehrenbergii Bütschli

(Figs. 6P, Q)

1875 *Lithomelissa macroptera* - Ehrenberg pl.3, fig.8 (*non* fig.9-10)

1882 *Lithomelissa ehrenbergii* - Bütschli p.517, pl.33, fig.21a-b

Remarks: This species is reported by Renaudie (Radiolaria.org.) from the site 748B in Southern Kerguelen Plateau and showed its presence in the Middle Miocene of *Eucyrtidium punctatum* Zone.

Abundance: Very rare to rare.

Lithomelissa sphaerocephalis Chen

(Figs. 6L, R)

1975 *Lithomelissa sphaerocephalis* - Chen pl. 8, figs. 1-2

Abundance: Very rare to rare.

Occurrence: lower Oligocene [10]

Lithomelissa stigi Bjørklund

(Figs. 6T, U)

1975 *Lithomelissa* sp. *C* – Chen p. 458, pl. 11, figs. 4, 5

1976 *Lithomelissa stigi* - Bjørklund p. 1125, pl. 15, figs. 12-17

Abundance: Very rare to rare.

Remarks: [47] observed *L.stigi* as discontinous occurrence and showed variable morphology.

Range: Renaudie (Radiolaria.org) reported its age of late Miocene of *Cycladophora spongothorax* Zone. [26] reported its age from 10.5 to 9.0 Ma.

Genus ***Eucyrtidium*** Ehrenberg 1847b, *emend*. Nigrini, 1967

Eucyrtidium calvertense Martin

(Figs. 7A,B)

1904 *Eucyrtidium calvertense* - Martin, p. 450, pl. 80, fig. 5.

Distribution: [7] and [19] reported its presence in Antarctic region. [37] reported it as a reworked species from Leg119 Site 745B and occurs as very rare to rare.

Abundance: Very rare to rare

Range: Pliocene [10], [11].

***Eucyrtidium calvertense - E.pseudoinflatum* (Transitional)**

(Fig. 7E)

1990 *Eucyrtidium calvertense - E.pseudoinflatum* (Transitional)- Lazarus, p.716, pl.6, figs.3.

Abundance: Very rare to rare

Remark: [19] observed that *E. cienkowskii* gives rise to *E.pseudoinflatum* in late Miocene whereas *E. cienkowskii* present throughout in the range of *E.pseudoinflatum* and transitional species. They showed their presence in this stratigraphic interval.

Eucyrtidium cienkowskii Haeckel

(Figs. 7H,I)

1887 *Eucyrtidium cienkowskii* - Haeckel, pl. 80, fig. 9.

1990 *Eucyrtidium cienkowskii* Haeckel - Lazarus, pl. 6, figs. 1-3.

Abundance: Very rare

Remarks: *E. cienkowskii* is very similar to as described by [2] except in lacking the density of pores and arranged transversely.

Range: Miocene [10]

Eucyrtidium pseudoinflatum Weaver

(Figs. 7F, G)

1983 *Eucyrtidium pseudoinflatum* – Weaver, pl. 5, figs. 8-9.

Distribution: [19] reported this species from early Pliocene (Tau zone) in Kerguelen- Heard Plateau.

Abundance: Very rare to rare

***Eucyrtidium* sp.1**

(Figs. 7C, D)

Description: Shell smooth spindle shaped with seven joints. Cephalis sub spherical without pores having a very short horn. Strictures marked by internal transverse septa. Thorax conical, widely irregularly spaced pores. The third, fourth and fifth segments are of irregular length. Shell usually reaches maximum width and then tapers to a constricted mouth. Pores of last segment are irregular in size.

Abundance: Very rare to rare.

***Eucyrtidium* sp.2**

(Figs. 7K, L)

Description: Shell smooth sub conical with five distinct strictures. Third joint broadest, mouth wide, cephalis hemispherical with small horn and pores regular, circular, longitudinally aligned.

Abundance: Very rare to rare

Genus ***Stichocorys*** Haeckel

Stichocorys peregrina Riedel

(Fig. 7V)

1970 *Stichocorys peregrina* – Riedel, p.451,pl.1,fig.10.

1991 *Stichocorys peregrina* Riedel - Caulet,p.524.

Distribution: Sanfilippo, [48] reported *S. peregrina* in latitude higher than 20 degree and found in areas of cold boundary current. The skeleton of *S. peregrina* is more robust and third segment is shorter and less conical while fourth segment is rarely pronounced and wider than the third segment.

Abundance: Very rare

Genus ***Pterocanium*** Ehrenberg, 1847b

***Pterocanium* sp.**

(Figs. 7R,S)

Description: Cephalis sub spherical, with large pores and bladed apical spine present along with small spines. Thorax campanulate, surface covered with short, thin, conical spines and having small to large sub polygonal to subcircular pores. Basal margin wide, feets inward bladed and latticed.

Abundance: Very rare

Genus ***Theocorys*** Haeckel, 1882

Theocorys redondoensis (Campbell and Clark)

(Figs. 7T,U)

1944 *Theocyrtis redondensis* - Campbell and Clark pl. 7, fig.4

1973 *Theocorys redondoensis* - Kling, pl. 11, figs. 26-28

Discussion: Similar to as described by [49] but the base of the abdomen does not show the presence of the short downwardly directed spine.

Distribution: [19] showed its presence in Miocene sediments of Southern ocean region.

Abundance: Very rare to few

Occurrence: Miocene [10]

Genus ***Lophocyrtis*** Haeckel, 1887

Lophocyrtis (Cyclampterium) milowi Riedel and Sanfilippo

(Figs. 7M, N)

1971 *Cyclampterium (?) milowi* - Riedel and Sanfilippo p.1593, pl. 3B, fig. 3; pl. 7, figs. 8, 9

1990 *Lophocyrtis (Cyclampterium) milowi* - Sanfilippo p.306-307, pl.1, figs. 13-16; pl.2, figs.1-2

Remarks: Williams (Radiolaria.org) reported *Lophocyrtis (Cyclampterium) milowi* in Oligocene of Southern Ocean region.

Abundance: Very rare to rare

Occurrence: Oligocene – Williams (Radiolaria.org)

Genus ***Gondwanaria*** n.gen. Petrushevskaya, 1975

Gondwanaria campanulaeformis **(**Campbell and Clark)

(Figs. 7P,Q)

1944 *Lithomelissa campanulaeformis* - Campbell and Clark p. 41

2000 *Gondwanaria campanulaeformis* - Funakawa p.100; pl.1, figs.1a-1d; pl.7, figs.1a-1b; text-fig.4

Abundance: Very rare to rare

FAMILY **Acropyramididae** Haeckel,1881

Genus ***Peripyramis*** Haeckel, 1881

Peripyramis circumtexta Haeckel

(Fig. 7O)

1887 *Peripyramis circumtexta* - Haeckel,p.1162, pl. 54, fig. 5.

2017 *Peripyramis circumtexta* Haeckel - Sharma and Deepti, pl. 1, fig. 14.

Distribution: [31] reported its distribution from very rare to few in the Pleistocene sediments of Antarctic region. [37] reported its presence in Leg119 Site745B and also [45] showed its presence in the upper part of the sections of Site 738B.

Abundance: Very rare to rare

Range: [9]- Miocene (?) to Recent; [10]- Oligocene and Neogene and [11]- Neogene.

Genus ***Plectopyramis*** Haeckel, 1881

Plectopyramis dodecomma Haeckel

(Fig. 7J)

1887 *Plectopyramis dodecomma* – Haeckel, p.1258, p.54, fig. 6.

2013 *Plectopyramis dodecomma* Haeckel - Sharma and Kanojia, p. 435, pl.I, figs. 25.

Distribution: [45] showed its occurrence in the upper part of the section of Leg119 Site 738B of Kerguelen Plateau.

Abundance: Very rare

Range: Neogene – [11].

Remarks: Similar to as described by [33], but the authors incorporates the specimens of less spiny thoracic surface and thick apical spine on the cephalis.

FAMILY **Pterocorythidae** Haeckel, 1881, *emend*. Riedel, 1967b, *emend*. Moore,1972

Genus ***Lamprocyrtis*** Kling 1973

***Lamprocyrtis* sp.**

(Figs. 8A,B)

Description: Two segmented pterocorythid, pores size increases distally in a regular fashion. Shell compact, heavy and spiny, broadly flared, apical spine large bladed and bifurcated.

Abundance: Very rare

Genus ***Lychnocanium*** Ehrenberg, 1847

Lychnocanium grande Campbell and Clark

(Figs. 8U, V)

1944 *Lychnocanium grande* – Campbell and Clark, pl. 6, figs. 3, 4, 6.

Distribution: [35] reported this species from Site 745B as very rare to few.

Abundance: Very rare to few

Range: Miocene –Pliocene [11]; [19] divided the Tau zone on the basis of *L. grande* and considered its LCO at 4.4 Ma.

Genus ***Pterocorys*** Haeckel,1881

Pterocorys hirundo Haeckel

(Figs. 8I,J)

1887 *Pterocorys hirundo* – Haeckel, pl. 71, fig. 4.

1975 *Pterocorys hirundo* Haeckel - Chen, pl. 19, fig. 3.

Abundance: Very rare to rare

Remarks: [5] reported this species from both the American and Indian Ocean sectors of Antarctic water and considered it as cosmopolitan.

Range: Pliocene to Recent [10]

Genus ***Stichopilium*** Haeckel, 1881

Stichopilium bicorne ? Haeckel

(Figs. 8P,Q)

1887 *Stichopilium bicorne*? – Haeckel, p. 1437, pl. 77, fig. 9

1992 *Stichopilium bicorne*? – Lazarus, p.798, pl. 9, figs. 12-17

Abundance: Very rare to rare

Remarks: [24] reported this species from Leg119 and 120 of Kerguelen Plateau and proposed its first occurrence 16.9 Ma and last occurrence 10.8 Ma.

FAMILY **Artostrobiidae** Riedel, 1967a, *emend*. Foreman, 1973

Genus ***Artostrobus*** Haeckel, 1887

Artostrobus annulatus Bailey

(Figs. 8R,S)

1856 *Cornutella* (?) *annulata* – Bailey, p. 3, pl. 1, figs. 5a-b.

1887 *Artostrobus annulatus* – Haeckel, p. 1481.

1998 *Artostrobus annulatus* Haeckel - Bjørklund *et al*., pl. 2, figs. 9-10.

Distribution: [5] showed its occurrence in the Indian Ocean sector of Antarctic waters and in the tropical parts of Pacific and considered cosmopolitan species. [29] showed it as a bipolar species.

Abundance: Very rare

Genus ***Botryostrobus*** Haeckel, 1887, *emend*. Nigrini, 1977

Botryostrobus bramlettei Campbell and Clark

(Figs. 8E, M)

1944 *Lithomitra (Lithomitrissa) bramlettei* - Campbell and Clark p.53; Pl. 7, figs 10-14

1977 *Botryostrobus bramlettei* - Nigrini p.248; Pl. 1,figs. 7.8

Abundance: Very rare to rare

Remarks: Similar to as described by [50] except the studied specimen does not show the pore less band.

Botryostrobus bramlettei cf. Botryostrobus bramlettei Campbell and Clark

(Figs. 8C, D)

1944 *Lithomitra (Lithomitrissa) bramlettei* - Campbell and Clark, p.53; Pl. 7, figs 10-14

1989 *Botryostrobus bramlettei* Campbell and Clark - Alexandrovich, Pl. 3, fig. 5

Abundance: Very rare to rare

Remarks: Similar to as described by [50] but the studied specimens differ by not having the three transverse rows of sub circular pores in the thorax.

Genus ***Phormostichoartus*** Cambell 1951, *emend.* Nigrini, 1977

Phormostichoartus pitomorphus Caulet

(Fig. 8F)

1986 *Phormostichoartus pitomorphus* - Caulet pl. 3, figs. 3,4,9,10,12

Distribution: [51] reported its presence in the upper part of the section of 738B of Kerguelen Plateau.

Abundance: Very rare

Genus ***Lithomitra*** Bütschli, 1882

Lithomitra lineata (Ehrenberg)

(Figs. 8N, O)

1839 *Lithocampe lineata* – Ehrenberg, p.130 (not Figured)

1887 *Lithomitra lineata* Ehrenberg - Haeckel, p.1484.

Distribution: *Lithomitra lineata* (Ehrenberg) found in all the oceans and considered as cosmopolitan [5].

Abundance: Very rare

Range: Miocene–Recent [9].

FAMILY **Stichocorythidae**, Haeckel, 1887

Genus ***Cyrtocapsa*** Haeckel, 1882

***Cyrtocapsa* sp.**

(Fig. 8T)

1958 *Cyrtocapsa* sp. Haeckel - Riedel, p. 244, pl. 4, figs. 11.

Remarks: Similar as to describe by [5] except in the absence of collar pores.

Abundance: Very rare

FAMILY **Cannobotryidae** Haeckel, 1881

Genus ***Saccospyris*** Haecker, 1908

Saccospyris antarctica Haecker

(Figs. 8G,H)

1908 *Saccospyris antarctica* - Haecker, p. 447, pl. 84, figs. 584, 589, 590.

Distribution: [30], [31] showed its occurrence in the Antarctic region. [37] also showed its presence from Site 745B as very rare to few.

Abundance: Very rare to few

Range: Pliocene-Pleistocene [9].

***Saccospyris preantarctica* (**Petrushevskaya)

(Figs. 8K,L)

1972a *Saccospyris* sp. – Petrushevskaya, pl. 2, fig. 7.

1975 *Saccospyris preantarctica* - Petrushevskaya, p. 589, pl. 13, figs. 19, 20.

Distribution: [31] reported its presence from very rare to few in the Antarctic region.

Abundance: Very rare to few

Range: Miocene to Recent [9].

4. Conclusions

The following conclusions are made:

1. All the sections of the core are composed of siliceous and calcareous oozes and having well diversified assemblages of radiolaria.
2. The radiolarian assemblage typically show of Antarctic and predominantly having 76 identified taxa in which 16 unnamed new taxa.
3. Certain radiolarian taxa reported herein are bipolar like *Dictyophimus mawsoni, Antarctissa strelkovi, Spongotrochus glacialis, Ceratocyrtis, Lithomelissa stigi, Lychnocanium grande group, Prunopyle terapila, Prunopyle?antarctica, Spongurus pylomaticus, Stylodictya aculeate, Stylodictya validispina, Stylochlamydium venustum, Artostrobus annulatus* and *Lithomitra lineate* as their presence is also observed in the Arctic region.
4. The Leg119 Site 738B, contains abundant and well preserved radiolarian in late Miocene to Pliocene sections but sporadic occurrence in middle and late Miocene while moderately preserved in Oligocene time. The age of the core is assigned from 1.9 Ma to 23.7 Ma (Communicated).

5. Acknowledgements

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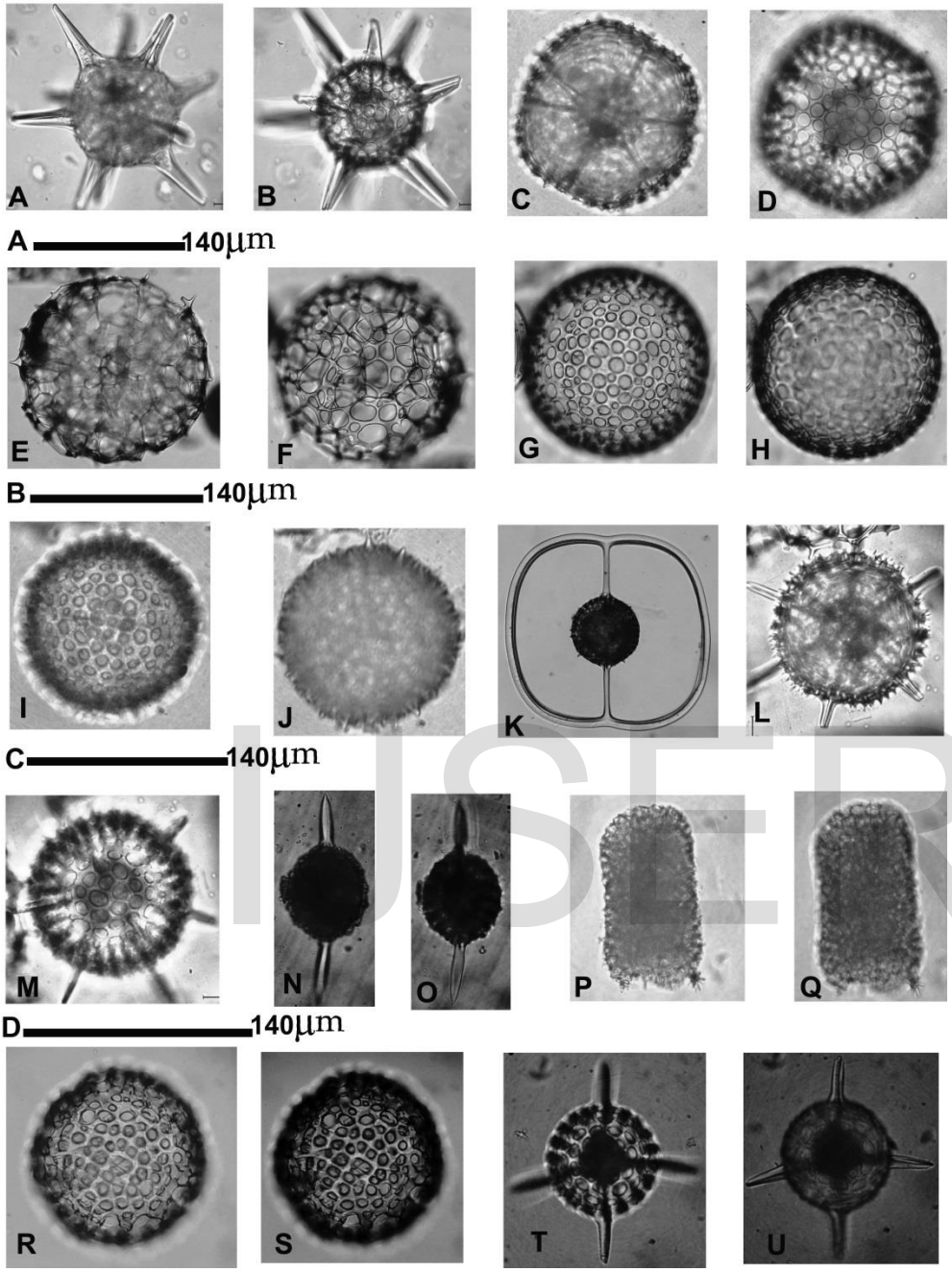

Fig 3. (A),(B)**.** *Actinomma golownini*, Petrushevskaya A. focused on outer portion; B. focused on inner portion; 738B- 3H-2,106.0-108.0. Scale bar A. (C),(D). *Actinomma* sp.2., C. focused on outer portion; D. focused on inner portion; 738B- 3H-4,4.0-6.0. Scale bar C. (E),(F). *Actinomma* sp.1., E. focused on outer portion; F. focused on inner portion; 738B- 2H-6,95-97. Scale bar B. (G),(H). ?*Cenosphaera cristata*, Haeckel G. focused on inner portion; H. focused on outer portion;738B-2H-6,85-87. Scale bar C. (I),(J). *Cenosphaera* sp., I. focused on inner portion; J. focused on outer portion; 738B-2H-4,77-79. Scale bar C. (K). *Saturnalis circularis*, (Haeckel) focused on outer portion; 738B-2H-4,77-79. Scale bar D. (L),(M). *Hexacontium* sp., L. focused on outer portion; M. focused on inner portion; 738B-2H-4,77-79. Scale bar D. (N),(O). *Stylatractus* sp.,N. focused on outer portion; O. focused on inner portion; 738B-2H-4,77-79. Scale bar C. (P),(Q) *Spongurus pylomaticus*, Riedel P. focused on outer portion; Q. focused on inner portion; 738B-2H-4,77-79. Scale bar A. (R),(S). *Acrosphaera australis*., Lazarus R. focused on outer portion; S. focused on inner portion; 738B-2H-4,77-79. Scale bar D. (T),(U). *Staurolonche* sp., T. focused on inner portion; U. focused on outer portion; 738B-2H-4,77-79. Scale bar C.

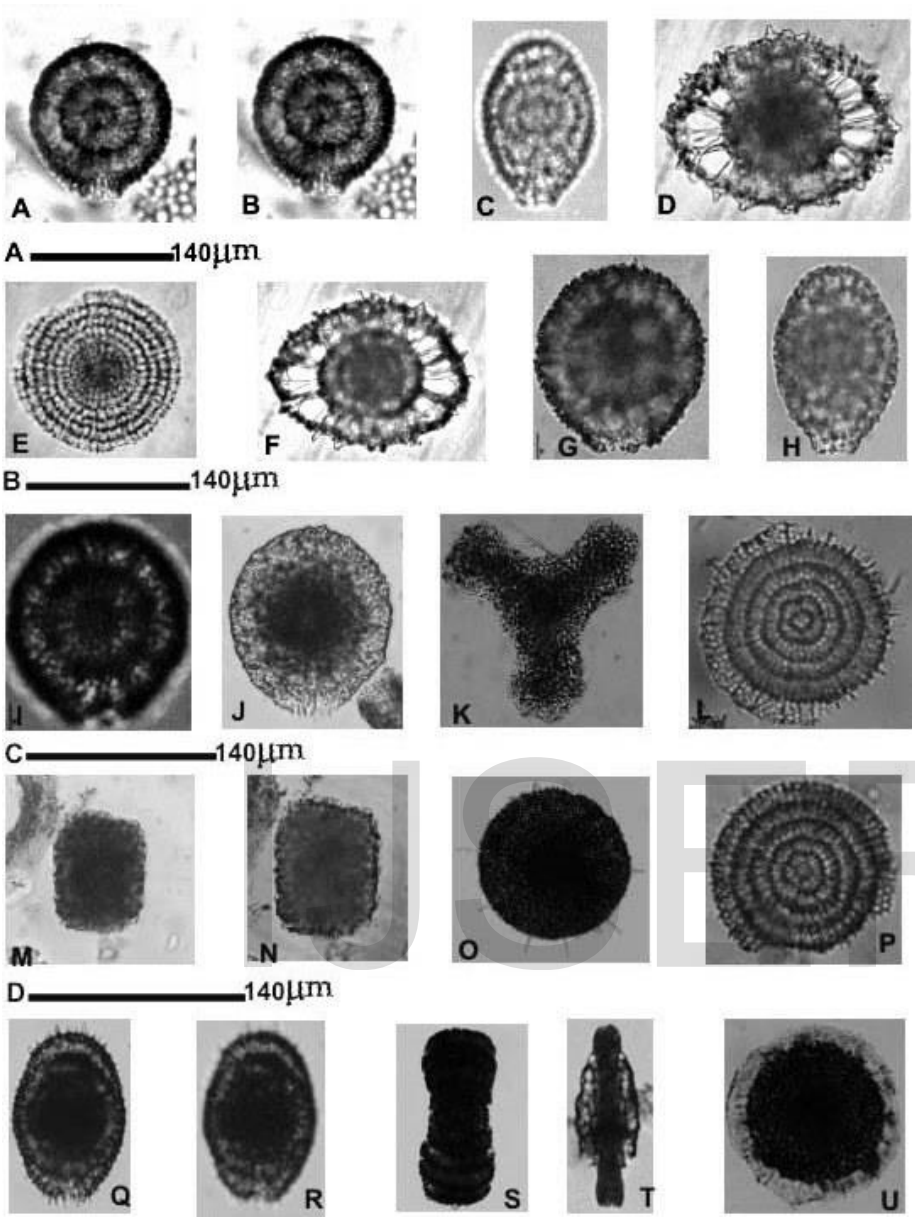

Fig 4. (A),(B) *Prunopyle tetrapila*, Hays A. focused on outer portion; B. focused on inner portion; 738B- 3H-2,106.0-108.0. Scale bar A. (C),(H) *Larcopyle polyacantha*, Lazarus *et al*., C. focused on inner portion; H. focused on outer portion; 738B-2H-4,77-79. Scale bar A. (D),(F) *Phorticium pylonium,* (Clevei) Haeckel D. focused on inner portion; F. focused on outer portion; 738B- 2H-6,95-97. Scale bar D. (E) *Porodiscus* sp. focused on inner portion; 738B-2H-6,85-87. Scale bar B. (G),(I) *Prunopyle antarctica*, Dreyer G. focused on outer portion; I. focused on inner portion; 738B-2H-4,77-79. Scale bar C. (J) *Spongopyle osculosa*, Dreyer J. focused on outer portion; 738B-2H-4,77-79. Scale bar C. (K) *Dictyocoryne* sp., K. focused on outer portion; 738B-2H-4,87-89. Scale bar A. (L) *Stylodictya aculeata,* Jörgensen focused on inner portion; 738B- 2H-6,66-68. Scale bar B. (M),(N) *Spongurus* sp., M. focused on inner portion; N. focused on outer portion; 738B-2H-4,77-79. Scale bar D. (O) *Spongotrochus glacialis*, Popofsky group. focused on outer portion; 738B-2H-4,77-79. Scale bar B. (P) *Stylodictya validispina*, Jörgensen. focused on inner portion; 738B- 2H-6,25-27. Scale bar B. (Q),(R) *Prunopyle titan*, Campbell and Clark Q. focused on outer portion; R. focused on inner portion; 738B-2H-4,77-79. Scale bar D. (S) *Amphymenium challengerae*, Weaver. focused on inner portion; 738B- 3H-3,15.0-17.0. Scale bar A. (T) *Spongocore puella*, Haeckel focused on outer portion; 738B-2H-4,77-79. Scale bar A. (U) *Stylochlamydium venustum*, (Bailey) focused on inner portion; 738B- 3H-2, 2H-4,37-39. Scale bar B.

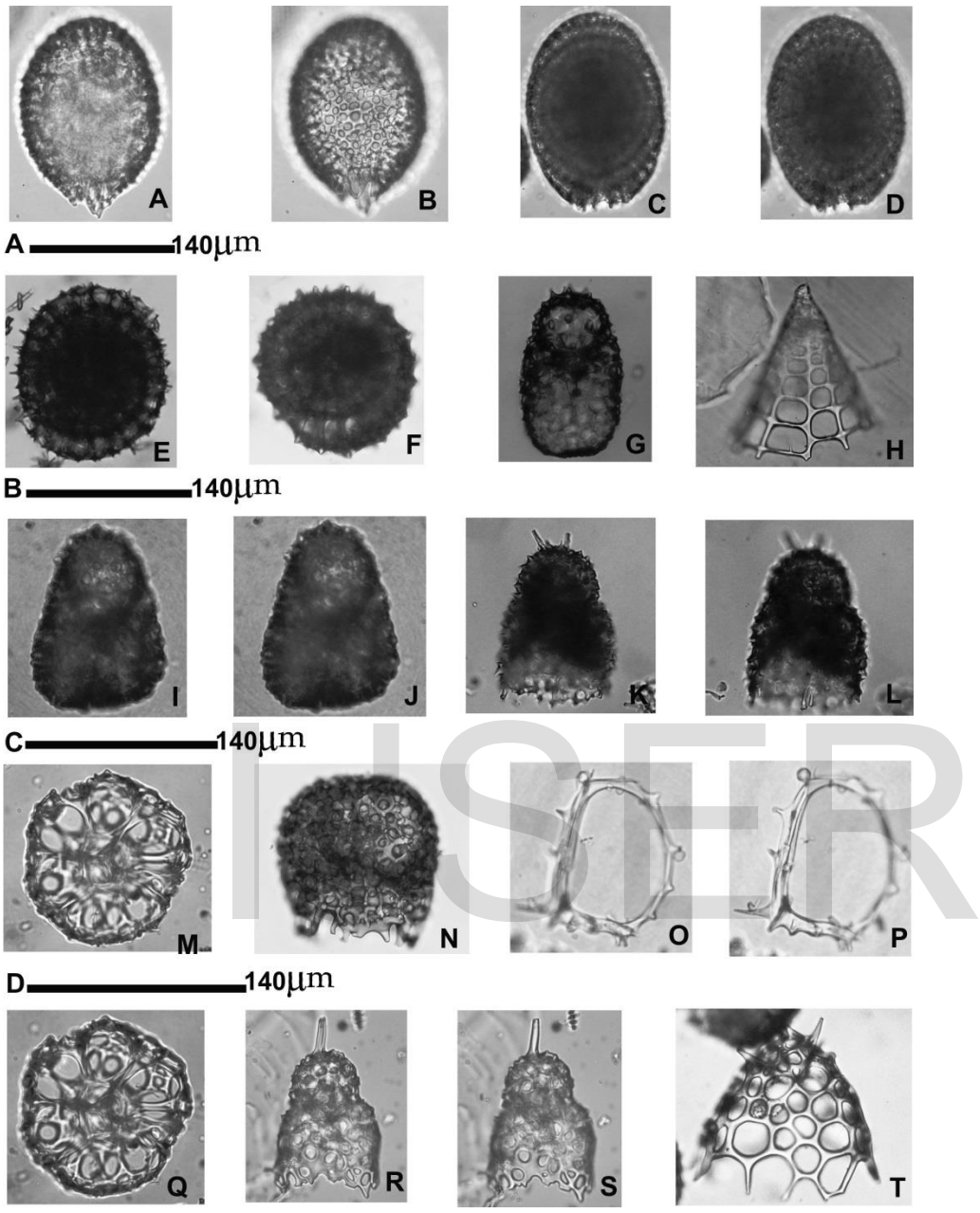

Fig 5. (A),(B) *Larcopyle eccentricum*, Lazarus *et al*., A. focused on outer portion; B. focused on inner portion; 738B-2H-4,77-79. Scale bar A. (C),(D) *Larcopyle hayesi*, (Chen) C. focused on inner portion; D. focused on outer portion; 738B-2H-4,77-79. Scale bar A. (E) *Lithelius nautiloides*, Popofsky focused on outer portion; 738B- 3H-4,4.0-6.0. Scale bar B. (F) *Lithelius minor*, Jörgensen focused on inner portion; 738B-2H-4,87-89. Scale bar B. (G) *Antarctissa cylindrica*, Petrushevskaya focused on outer portion; 738B- 2H-5,67-69. Scale bar C. (H) *Bathropyramis* sp., focused on inner portion; 738B-3H-4,4.0-6.0. Scale bar C. (I),(J) *Antarctissa denticulata*, (Ehrenberg) I. focused on inner portion; J. focused on outer portion; 738B-2H-5,67-69. Scale bar C. (K),(L) *Antarctissa strelkovi*, Petrushevskaya K. focused on outer portion; L. focused on inner portion; 738B-2H-5,67-69. Scale bar C. (M),(Q) *Helotholus vema*, Hays M. focused on inner portion; N. focused on outer portion; 738B-2H-6,55-57. Scale bar D. (N) *Desmospyris spongiosa*, Hays focused on inner portion; 738B- 2H-4,107-109. Scale bar D. (O),(P) *Zygocircus piscicaudatus*, Popofsky H. focused on outer portion; P. focused on inner portion; 738B- 2H-7,35-37. Scale bar D. (R),(S) *Helotholus praevema*, Weaver C. focused on inner portion; D. focused on outer portion; 738B- 3H-2,95.0-97.0. Scale bar C. (T) *Ceratocyrtis* sp. focused on outer portion; 738B- 3H-4,76.0-78.0. Scale bar D.

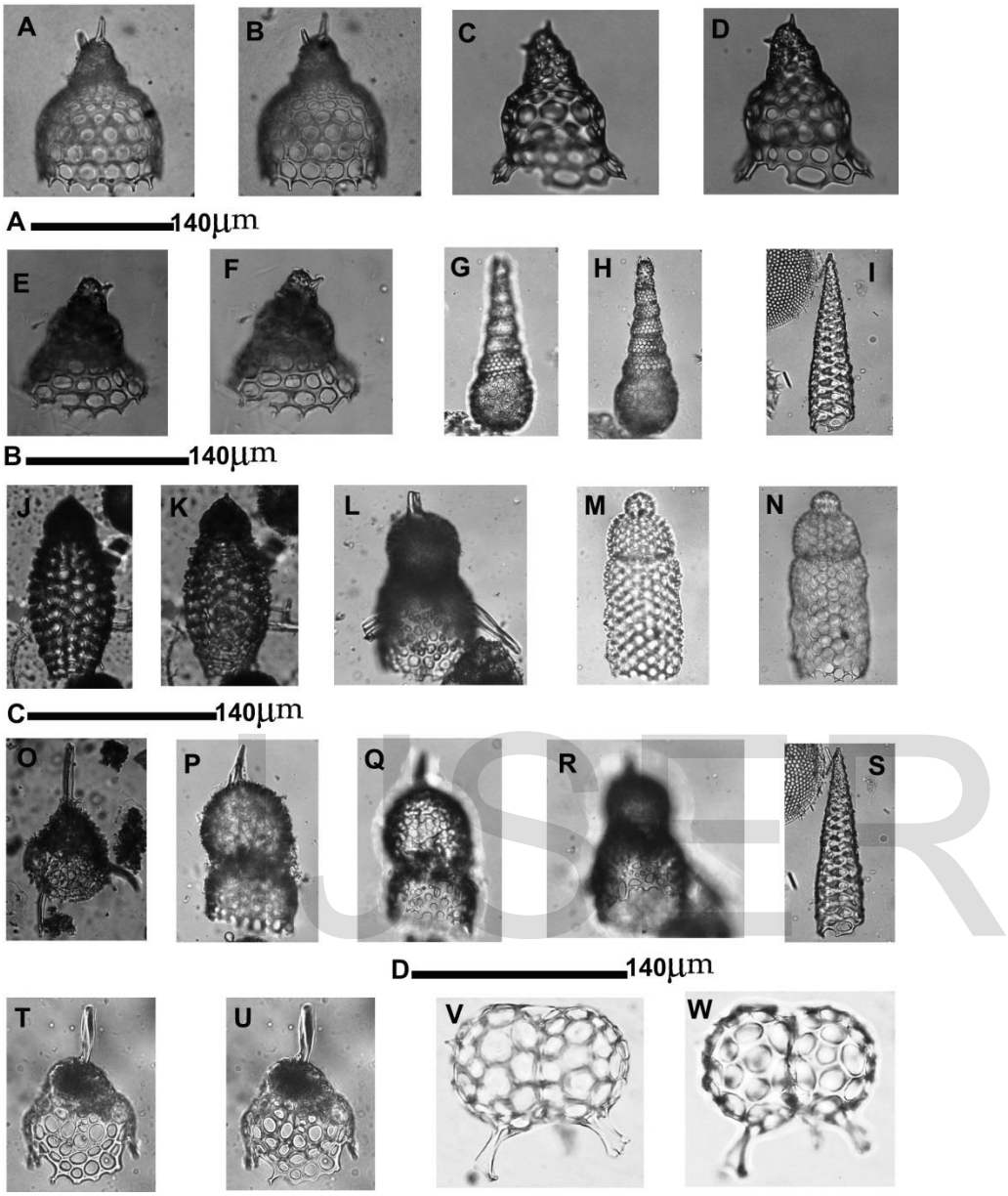

Fig 6. A,B. *Cycladophora pliocenica*, (Hays) A. focused on outer portion; B. focused on inner portion; 738B- 2H-6,55-57. Scale bar A. C,D. *Cycladophora robusta*, Lombari and Lazarus C. focused on inner portion; D. focused on outer portion; 738B- 2H-4,107-109. Scale bar C. E,F. *Cycladophora davisiana*, Ehrenberg E. focused on inner portion; F. focused on outer portion; 738B- 3H-2,25.0-27.0. Scale bar B. G,H. *Cyrtopera laguncula*, Haeckel G. focused on inner portion; H. focused on outer portion; 2H-6,95-97. Scale bar C. I,S. *Cornutella profunda*, (Ehrenberg) I. focused on inner portion; S. focused on inner portion; 738B- 2H-6,95-97. Scale bar C. J,K. *Calocyclas asperum*, (Ehrenberg) J. focused on inner portion; K. focused on outer portion; 738B-3H-4,4.0-6.0. Scale bar C. L,R. *Lithomelissa sphaerocephalis*, Chen L. focused on outer portion; R. focused on inner portion; 738B-3H-4,4.0-6.0. Scale bar D. M,N. *Calocyclas semipolita*, Clark and Campbell M. focused on outer portion; N. focused on inner portion; 738B-3H-4,4.0-6.0. Scale bar C. O. *Dictyophimus mawsoni*, Riedel focused on outer portion; 738B- 3H-2,35.0-37.0. Scale bar A. P,Q. *Lithomelissa ehrenbergii* , Bütschli P. focused on outer portion; Q. focused on inner portion; 738B-3H-3,125.0-127. Scale bar D. T,U. *Lithomelissa stigi*, Bjørklund, T. focused on inner portion; U. focused on outer portion; 738B-3H-4,4.0-6.0. Scale bar D. V,W. *Triceraspyris* sp., V. focused on outer portion; W. focused on inner portion; 738B- 3H-4,95.5-97. Scale bar D.

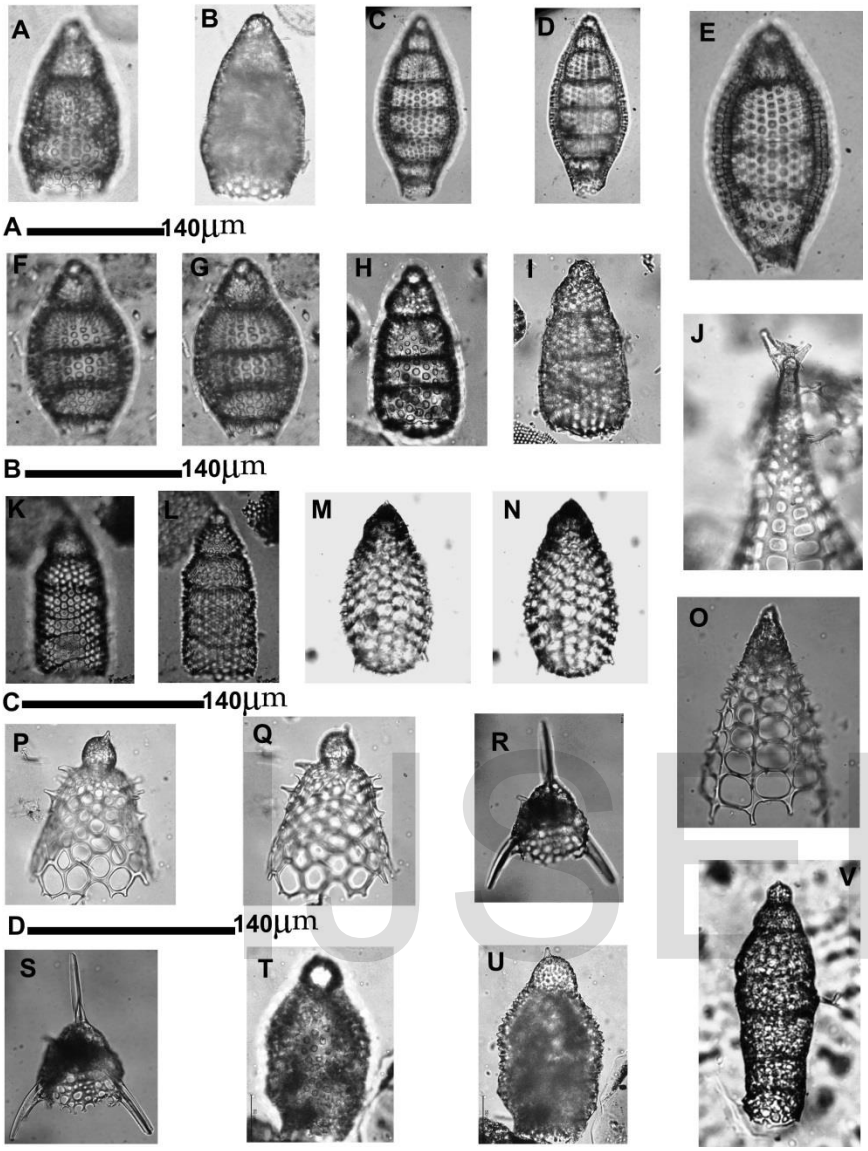

Fig 7. (A),(B) *Eucyrtidium calvertense*, Martin A. focused on inner portion; B. focused on outer portion; 738B- 2H-5,96-98. . Scale bar A. (C),(D) *Eucyrtidium* sp.1, C. focused on inner portion; D. focused on outer portion; 738B-2H-6,5-7. Scale bar A. (E) *Eucyrtidium calvertense - E.pseudoinflatum (Transitional)* focused on inner portion;738B- 2H-6,5-7. Scale bar A. (F),(G) *Eucyrtidium pseudoinflatum* Weaver, F. focused on inner portion; G. focused on outer portion; 738B- 2H-6,5-7. Scale bar B. (H),(I) *Eucyrtidium cienkowskii*, Haeckel H. focused on inner portion; I. focused on outer portion; 738B- 2H-6,85-87. Scale bar B. (J) *Plectopyramis dodecomma*, Haeckel focused on outer portion; 738B- 2H-6,85-87. Scale bar D. (K),(L) *Eucyrtidium* sp.2, J. focused on outer portion; K. focused on inner portion; 738B- 3H-4,4.0-6.0. Scale bar C. (M),(N) *Lophocyrtis (Cyclampterium) milowi*, Riedel and Sanfilippo L. focused on outer portion; M. focused on inner portion; 738B-3H-4,4.0-6.0. Scale bar C. (O) *Peripyramis circumtexta*, Haeckel focused on outer portion; 738B-2H-5,37-39. Scale bar D. (P),(Q) *Gondwanaria campanulaeformis*, O. focused on inner portion; P. focused on outer portion; 738B- 2H-5,7-9. Scale bar D. (R),(S) *Pterocanium* sp., S. focused on outer portion; T. focused on inner portion; 738B- 2H-5,7-9. Scale bar C. (T),(U) *Theocorys redondoensis*, Campbell and Clark U. focused on inner portion; V. focused on outer portion; 738B- 2H-6,5-7. Scale bar D. (V) *Stichocorys peregrina*, (Riedel) focused on inner portion; 738B- 2H-6,95-97. Scale bar D.

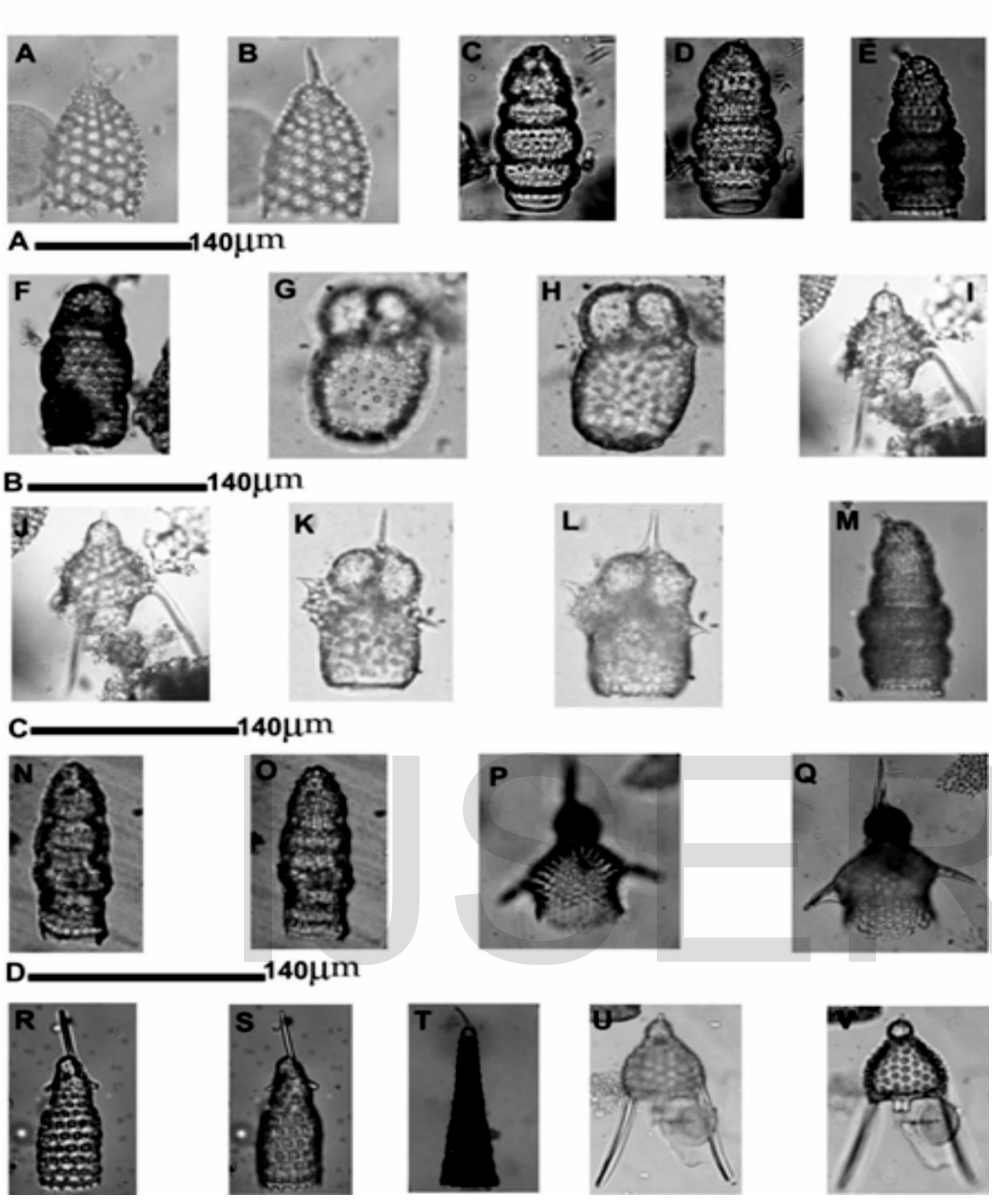

Fig 8. (A),(B) *Lamprocyrtis* sp., A. focused on outer portion; B. focused on inner portion; 738B- 2H-6,85-87. Scale bar A. (C),(D) *Botryostrobus bramlettei cf Botryostrobus bramlettei,* Campbell and Clark C. focused on inner portion; D. focused on outer portion; 738B- 2H-5,146.5-148.5. Scale bar B. (E),(M) *Botryostrobus bramlettei,* (Campbell and Clark) E. focused on inner portion; M. focused on outer portion; 738B- 2H-7,15-17. Scale bar C. (F) *Phormostichoartus pitomorphus,* Caulet focused on inner portion; 738B- 2H-4,87-89. Scale bar B. (G),(H) *Saccospyris antarctica,* (Haecker) G. focused on inner portion; H. focused on outer portion; 738B- 2H-6,115-117. Scale bar C. (I),(J) *Pterocorys hirundo* , Haeckel I. focused on inner portion; J. focused on outer portion; 738B-2H-6,55-57. Scale bar C. (K),(L) *Saccospyris preantarctica,* (Petrushevskaya) K. focused on inner portion; L. focused on outer portion; 738B- 2H-6,45-47. Scale bar C. (N),(O) *Lithomitra lineata,* (Ehrenberg) N. focused on inner portion; O. focused on outer portion; 738B-3H-4,4.0-6.0. Scale bar D. (P),(Q) *Stichopilium bicorne* ?, Haeckel P. focused on inner portion; Q. focused on outer portion; 738B-3H-4,4.0-6.0. Scale bar D. (R),(S) *Artostrobus annulatus,* (Bailey) R. focused on inner portion; S. focused on outer portion; 738B-3H-2,106.0-108.0. Scale bar D. (T) *Cyrtocapsa* sp. focused on outer portion; 738B- 2H-4,97-99. Scale bar C. (U),(V) *Lychnocanium grande,* Campbell and Clark U. focused on outer portion; V. focused on inner portion; 738B-2H-4,77-79. Scale bar D.

	Sample Name(Hole,Core,Section,Interval(cm) 738B-	2H-4,7-9	2H-4,17-19	2H-4,27-29	2H-4,37-39	2H-4,47-49	2H-4,57-59	2H-4,67-69	2H-4,77-79	2H-4,87-89	2H-4,97-99	2H-4,107-109	2H-4,117-119	2H-4,137-139	2H-5,7-9	2H-5,17-19	2H-5,27-29	2H-5,37-39	2H-5,49-51	2H-5,57-59	2H-5,67-69	2H-5,77-79	2H-5,87-89	2H-5,96-98	2H-5,107-109	2H-5,117-119
b	**Depth (mbsf)**	8.57	8.67	8.77	8.87	8.97	9.07	9.17	9.27	9.37	9.47	9.57	9.67	9.87	10.07	10.17	10.27	10.37	10.49	10.57	10.67	10.77	10.87	10.96	11.07	11.17
c	**Total counts**	1005	1030	1010	1005	1005	1020	1005	1050	1040	1020	1020	1050	1010	1005	1030	1010	1005	1005	1020	1005	1050	1040	1020	1020	1050
d	**Age**					P		L		I		O		C		E		N		E						
e	**Abundance**	C	C	C	C	C	C	C	C	C	C	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	G	G	G	G	G	G	G	G	G	G
g	**Radiolarian Zone**				P	H	I																			
	Name of Species																									
1	***Acrosphaera australis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	***Actinomma golownini***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	***Actinomma sp.1***	-	-	-	-	+	-	+	-	-	-	-	-	+	-	+	-	F	R	R	R	R	R	+	+	+
4	***Actinomma sp.2***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	***Amphymenium challengerae***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	***Antarctissa cylindrica***	F	F	F	F	F	F	F	F	F	F	R	F	R	F	R	F	R	R	R	R	R	R	F	F	F
7	***Antarctissa denticulata***	C	C	C	F	F	F	F	F	F	F	F	F	F	C	C	C	C	C	C	C	C	C	C	C	F
8	***Antarctissa strelkovi***	-	-	-	-	-	-	-	-	-	+	-	-	R	+	R	+	F	F	F	F	F	F	F	R	F
9	***Artostrobus annulatus***	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
10	***Bathropyramis sp.***	-	+	-	+	-	-	-	+	-	-	-	-	-	R	+	+	-	+	-	-	-	-	-	-	+
11	***Botryostrobus bramlettei***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	***B.bramlettei cf Botryostrobus bramlettei***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	***Calocyclas asperum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	***Calocyclas semipolita***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	***Cenosphera sp.***	+	-	+	-	-	+	-	R	-	-	-	-	-	+	-	+	-	-	+	-	+	+	+	+	R
16	***? Cenosphaera cristata***	+	-	R	R	R	-	R	+	R	R	R	+	R	F	R	F	R	R	R	R	R	F	F	R	F
17	***Ceratocyrtis sp.***	-	+	-	-	-	-	-	+	-	-	-	-	+	-	-	-	+	-	+	+	-	-	-	-	-
18	***Cyrtocapsa sp.***	+	-	-	-	+	-	-	-	+	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-
19	***Cornutella profunda***	F	F	+	R	R	+	R	R	+	+	R	R	R	R	R	R	+	R	R	+	-	+	+	R	+
20	***Cycladophora davisiana***	+	-	+	-	-	+	+	+	-	+	-	-	-	R	+	+	+	+	+	-	-	-	-	-	-
21	***Cycladophora pliocenica***	+	+	+	+	-	+	-	+	-	-	-	-	-	R	-	R	+	+	-	R	R	R	+	+	R
22	***Cycladophora robusta***	-	+	-	-	-	+	-	+	+	R	-	-	-	R	+	+	-	-	-	-	-	-	-	-	-
23	***Cyrtopera laguncula***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	***Desmospyris spongiosa***	-	-	+	-	+	+	+	+	-	+	F	-	F	-	-	-	F	F	F	F	F	F	F	F	F
25	***Dictyocoryne sp.***	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
26	***Dictyophimus mawsoni***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	***Eucyrtidium calvertense***	+	-	+	-	+	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-	+	-	R	-	+
28	***E.calvertense-E.pseudoinflatum(Transitiona***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-
29	***Eucyrtidium cienkowskii***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	***Eucyrtidium pseudoinflatum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-
31	***Eucyrtidium sp.1***	-	-	-	-	-	-	-	-	+	+	R	-	+	-	+	-	+	+	R	R	R	+	R	R	R
32	***Eucyrtidium sp.2***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	***Gondwanaria campanulaeformis***	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	+	-	-	+	-	-	-	-
34	***Helotholus praevema***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	***Helotholus vema***	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	+	R	R	R	R	+	R	R	R
36	***Hexacontium sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37	***Lamprocyrtis sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	***Larcopyle eccentricum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	***Larcopyle hayesi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3.1 occurences of Radiolarian Species in samples (Leg 119 Site 738B); 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 species; + = Single Species, - = absent / very rare.

a	Sample Name(Hole,Core,Section,Interval(cm) 738B-	2H-5,129.5-131.5	2H-5,137-139	2H-5,146.5-148.5	2H-6,5-7	2H-6,14-16	2H-6,25-27	2H-6,45-47	2H-6,55-57	2H-6,66-68	2H-6,75-77	2H-6,85-87	2H-6,95-97	2H-6,105-107	2H-6,115-117	2H-6,125-127	2H-6,135-137	2H-6,145-147	2H-7,5-7	2H-7,15-17	2H-7,25-27	2H-7,35-37	2H-7,45-47	2H-7,55-57	3H-1,118-120	3H-1,130-132
b	**Depth (mbsf)**	11.295	11.37	11.465	11.55	11.64	11.75	11.95	12.05	12.16	12.25	12.35	12.45	12.55	12.65	12.75	12.85	12.95	13.05	13.15	13.25	13.35	13.45	13.55	14.68	14.8
c	**Total counts**	1010	1010	1010	1005	1030	1010	1005	1005	1020	1005	1050	1040	1020	1020	1050	1010	1010	1005	1030	1010	1005	1005	1050	500	500
d	**Age**												T	O												
e	**Abundance**	C	C	C	C	C	C	C	C	C	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	G	G	G	G	G	G	G	G	G	G
g	**Radiolarian Zone**														U	P	S	I	L	O	N					
	Name of Species																									
1	***Acrosphaera australis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	***Actinomma golownini***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	***Actinomma sp.1***	+	+	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	***Actinomma sp.2***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	R
5	***Amphymenium challengerae***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	***Antarctissa cylindrica***	R	R	R	R	R	R	R	R	R	R	F	R	R	F	F	R	F	F	F	F	F	F	F	R	R
7	***Antarctissa denticulata***	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R
8	***Antarctissa strelkovi***	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	F	F	F	F	R	-	-	-	-	-
9	***Artostrobus annulatus***	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	***Bathropyramis sp.***	-	+	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	+	-	+	-	R	-	-	-
11	***Botryostrobus bramlettei***	-	-	-	-	-	-	+	+	+	-	R	-	R	R	-	+	-	-	-	-	-	-	-	+	-
12	***B.bramlettei cf Botryostrobus bramlettei***	-	-	-	-	-	-	-	-	+	-	-	+	+	-	-	-	-	-	+	-	+	-	-	+	-
13	***Calocyclas asperum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	***Calocyclas semipolita***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	***Cenosphera sp.***	+	-	R	R	R	R	+	R	R	R	R	+	+	R	R	R	+	R	R	R	+	R	R	R	+
16	***? Cenosphaera cristata***	R	R	F	F	F	F	R	R	F	F	F	R	R	R	R	R	R	R	R	R	+	F	R	R	+
17	***Ceratocyrtis sp.***	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
18	***Cyrtocapsa sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	***Cornutella profunda***	R	R	R	-	R	R	R	R	R	+	R	R	R	F	R	R	R	R	R	+	-	R	-	R	F
20	***Cycladophora davisiana***	+	-	-	-	-	+	+	+	+	R	+	R	-	-	-	-	-	-	-	-	-	-	-	-	-
21	***Cycladophora pliocenica***	+	-	+	+	-	+	-	R	+	+	-	+	-	+	+	R	+	+	-	-	-	+	+	-	-
22	***Cycladophora robusta***	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	***Cyrtopera laguncula***	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-
24	***Desmospyris spongiosa***	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	R
25	***Dictyocoryne sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	***Dictyophimus mawsoni***	-	-	-	-	-	-	-	+	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-
27	***Eucyrtidium calvertense***	-	+	-	+	-	-	-	-	+	-	+	+	-	R	-	+	+	-	-	+	+	+	-	-	-
28	***E.calvertense-E.pseudoinflatum(Transitiona***	+	+	+	-	-	-	+	-	-	-	R	-	+	R	+	+	-	-	-	-	+	+	-	-	R
29	***Eucyrtidium cienkowskii***	-	-	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
30	***Eucyrtidium pseudoinflatum***	+	+	+	+	-	-	-	-	+	-	+	-	-	R	+	+	-	+	-	-	-	+	-	-	-
31	***Eucyrtidium sp.1***	+	+	+	R	R	R	-	-	R	-	-	+	-	-	R	-	-	R	R	R	-	R	R	-	+
32	***Eucyrtidium sp.2***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	***Gondwanaria campanulaeformis***	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	-	+	R	-	-	-	-	-	-
34	***Helotholus praevema***	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	R	R	R	R	R	+
35	***Helotholus vema***	+	+	R	R	+	R	R	R	R	+	R	R	R	R	R	+	+	R	+	+	-	R	+	+	-
36	***Hexacontium sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37	***Lamprocyrtis sp.***	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	***Larcopyle eccentricum***	-	-	+	-	-	R	+	+	+	-	-	-	R	-	R	R	R	R	R	R	R	R	R	R	+
39	***Larcopyle hayesi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	R	+	-

a	Sample Name(Hole,Core,Section,Interval(cm) 738B-	3H-1,139.5-141.5	3H-2,4.5-6.5	3H-2,15.0-17.0	3H-2,25.0-27.0	3H-2,35.0-37.0	3H-2,55.0-57.0	3H-2,65.5-67.0	3H-2,76.5-78.0	3H-2,84.5-86.0	3H-2,95.0-97.0	3H-2,106.0-108.0	3H-2,115.0-117.0	3H-2,125.0-127.0	3H-2,136.0-138.0	3H-2,145.0-147.0	3H-3,5.0-7.0	3H-3,15.0-17.0	3H-3,25.0-27.0	3H-3,35.0-37.0	3H-3,47.0-49.0	3H-3,55.0-57.0	3H-3,63.5-65.5	3H-3,75.0-77.0	3H-3,85.0-87.0	3H-3,95.0-97.0
b	**Depth (mbsf)**	**14.895**	**15.045**	**15.15**	**15.25**	**15.35**	**15.55**	**15.65**	**15.76**	**15.845**	**15.95**	**16.06**	**16.15**	**16.25**	**16.36**	**16.45**	**16.55**	**16.65**	**16.75**	**16.85**	**16.97**	**17.05**	**17.135**	**17.25**	**17.35**	**17.45**
c	**Total counts**	**550**	**500**	**450**	**500**	**550**	**700**	**600**	**700**	**600**	**650**	**500**	**450**	**400**	**500**	**400**	**50**	**100**	**50**	**100**	**70**	**50**	**50**	**50**	**30**	**30**
d	**Age**							**M**		**I**		**O**		**C**		**E**		**N**		**E**						
e	**Abundance**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
f	**Preservation**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**
g	**Radiolarian Zone**									**T**	**A**	**U**														
	Name of Species																									
1	***Acrosphaera australis***	-	+	-	-	R	-	+	+	+	R	+	+	-	+	-	-	+	+	+	+	+	+	+	-	-
2	***Actinomma golownini***	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	***Actinomma sp.1***	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
4	***Actinomma sp.2***	+	R	R	+	+	R	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
5	***Amphymenium challengerae***	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	R	-	-	-	-	-	-	-	-
6	***Antarctissa cylindrica***	R	R	R	R	-	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	***Antarctissa denticulata***	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	***Antarctissa strelkovi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	***Artostrobus annulatus***	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-		-	-	-	-	-	-	-	-	-
10	***Bathropyramis sp.***	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	***Botryostrobus bramlettei***	-	-	+	+	-	+	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
12	***B.bramlettei cf Botryostrobus bramlettei***	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-
13	***Calocyclas asperum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	***Calocyclas semipolita***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	***Cenosphera sp.***	R	+	R	R	+	R	-	-	R	-	+	-	R	+	-	-	-	+	R	R	R	R	R	R	-
16	***? Cenosphaera cristata***	F	F	F	F	F	R	R	F	F	F	F	F	F	F	-	R	R	+	+	+	+	+	+	+	-
17	***Ceratocyrtis sp.***	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	***Cyrtocapsa sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	***Cornutella profunda***	F	R	+	F	+	F	R	R	R	R	+	R	+	F	+	-	-	+	-	-	+	+	-	R	R
20	***Cycladophora davisiana***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	***Cycladophora pliocenica***	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	***Cycladophora robusta***	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	***Cyrtopera laguncula***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	***Desmospyris spongiosa***	R	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	R	R	F	F	R	F	F	R
25	***Dictyocoryne sp.***	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
26	***Dictyophimus mawsoni***	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	***Eucyrtidium calvertense***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	***E.calvertense-E.pseudoinflatum(Transitiona***	R	-	+	+	-	R	+	+	+	R	R	+	+	R	R	-	-	-	-	-	-	-	-	-	-
29	***Eucyrtidium cienkowskii***	+	-	-	-	-	-	+	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-
30	***Eucyrtidium pseudoinflatum***	+	R	-	R	R	R	R	R	R	R	R	R	+	R	R	-	+	-	-	+	-	+	+	-	-
31	***Eucyrtidium sp.1***	-	+	R	+	R	R	R	R	R	R	+	R	R	R	+	-	-	-	-	-	-	-	-	-	-
32	***Eucyrtidium sp.2***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	***Gondwanaria campanulaeformis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	***Helotholus praevema***	+	R	+	R	+	R	+	R	+	R	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
35	***Helotholus vema***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	***Hexacontium sp.***	-	-	-	-	-	-	-	+	+	+	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-
37	***Lamprocyrtis sp.***	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	***Larcopyle eccentricum***	R	-	-	-	+	-	+	R	-	R	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-
39	***Larcopyle hayesi***	+	+	-	-	-	R	+	+	-	-	-	-	-	R	+	-	-	-	-	-	-	-	-	-	-

a	**Sample Name(Hole,Core,Section,Interval(cm) 738B-**	3H-3,105.0-107.0	3H-3,115.0-117.0	3H-3,125.0-127.0	3H-3,135.0-137.0	3H-3,143.0-145.0	3H-4,4.0-6.0	3H-4,13.0-15.0	3H-4,24.0-26.0	3H-4,34.5-36.5	3H-4,44.0-46.0	3H-4,53.0-55.0	3H-4,61.0-63.0	3H-4,68.0-70.0	3H-4,76.0-78.0	3H-4,84.5-85.5	3H-4,95.5-97.5	3H-4,105.5-107.5	3H-4,113.5-115.5	3H-4,125.5-127.5	3H-4,137.5-139.5	3H-4,146.5-148.5
b	**Depth (mbsf)**	17.55	17.65	17.75	17.85	17.93	18.04	18.13	18.24	18.345	18.44	18.53	18.61	18.68	18.76	18.845	18.955	19.055	19.135	19.255	19.375	19.465
c	**Total counts**	20	20	20	10	10	100	150	200	100	100	100	500	550	600	600	550	600	600	700	550	600
d	**Age**						L	A	T	E		O	L	I	G	O	C	E	N	E		
e	**Abundance**	R	R	R	R	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
f	**Preservation**	P	P	P	P	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
g	**Radiolarian Zone**					*A.*		*a*	*u*	*s*	*t*	*r*	*a*	*l*	*i*	*s*						
	Name of Species																					
1	***Acrosphaera australis***	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	***Actinomma golownini***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	***Actinomma sp.1***	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-
4	***Actinomma sp.2***	-	-	-	-	-	R	R	-	-	+	+	-	-	-	-	-	+	+	+	-	-
5	***Amphymenium challengerae***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	***Antarctissa cylindrica***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	***Antarctissa denticulata***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	***Antarctissa strelkovi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	***Artostrobus annulatus***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	***Bathropyramis sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	***Botryostrobus bramlettei***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	***B.bramlettei cf Botryostrobus bramlettei***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	***Calocyclas asperum***	-	-	-	-	-	R	R	-	R	R	+	-	-	+	+	-	-	-	-	-	R
14	***Calocyclas semipolita***	-	-	-	-	-	R	R	-	R	R	R	R	R	R	R	R	R	R	R	R	R
15	***Cenosphera sp.***	-	-	-	-	-	-	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
16	***? Cenosphaera cristata***	-	+	-	+	-	R	+	-	-	+	R	R	R	R	R	R	R	R	F	R	R
17	***Ceratocyrtis sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
18	***Cyrtocapsa sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	***Cornutella profunda***	R	R	R	-	-	R	R	-	R	-	R	+	R	-	R	R	-	R	R	R	R
20	***Cycladophora davisiana***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	***Cycladophora pliocenica***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	***Cycladophora robusta***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	***Cyrtopera laguncula***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	***Desmospyris spongiosa***	R	R	R	-	+	F	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	***Dictyocoryne sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
26	***Dictyophimus mawsoni***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	***Eucyrtidium calvertense***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	***E.calvertense-E.pseudoinflatum(Transitiona***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	***Eucyrtidium cienkowskii***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	***Eucyrtidium pseudoinflatum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	***Eucyrtidium sp.1***	-	-	-	-	-	R	-	-	-	+	+	-	+	+	+	-	-	R	R	+	R
32	***Eucyrtidium sp.2***	-	-	-	-	-	+	+	-	-	+	-	-	+	-	R	-	R	R	-	-	R
33	***Gondwanaria campanulaeformis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	***Helotholus praevema***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	***Helotholus vema***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	***Hexacontium sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37	***Lamprocyrtis sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	***Larcopyle eccentricum***	-	+	-	-	-	+	-	-	-	+	-	-	+	R	R	-	R	R	R	+	+
39	***Larcopyle hayesi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Sample Name(Hole,Core,Section,Interval(cm) 738B-	2H-4,7-9	2H-4,17-19	2H-4,27-29	2H-4,37-39	2H-4,47-49	2H-4,57-59	2H-4,67-69	2H-4,77-79	2H-4,87-89	2H-4,97-99	2H-4,107-109	2H-4,117-119	2H-4,137-139	2H-5,7-9	2H-5,17-19	2H-5,27-29	2H-5,37-39	2H-5,49-51	2H-5,57-59	2H-5,67-69	2H-5,77-79	2H-5,87-89	2H-5,96-98	2H-5,107-109	2H-5,117-119
b	**Depth (mbsf)**	8.57	8.67	8.77	8.87	8.97	9.07	9.17	9.27	9.37	9.47	9.57	9.67	9.87	10.07	10.17	10.27	10.37	10.49	10.57	10.67	10.77	10.87	10.96	11.07	11.17
c	**Total counts**	1005	1030	1010	1005	1005	1020	1005	1050	1040	1020	1020	1050	1010	1005	1030	1010	1005	1005	1020	1005	1050	1040	1020	1020	1050
d	**Age**					P		L		I		O		C		E		N		E						
e	**Abundance**	C	C	C	C	C	C	C	C	C	C	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	G	G	G	G	G	G	G	G	G	G
g	**Radiolarian Zone**				P	H	I																			
	Name of Species																									
40	***Larcopyle polyacantha***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	***Lithelius minor***	+	R	-	-	-	-	+	R	+	-	-	-	-	R	R	R	R	R	+	+	-	R	R	+	+
42	***Lithelius nautiloides***	R	R	-	R	+	+	R	R	R	+	+	-	-	+	R	R	+	R	R	+	R	+	+	R	R
43	***Lithomelissa ehrenbergii***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	***Lithomelissa sphaerocephalis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	***Lithomelissa stigi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	***Lithomitra lineata***	-	+	-	-	+	-	-	+	+	-	-	-	-	+	+	+	-	-	-	-	-	-	-	+	-
47	***Lophocyrtis (Cyclampterium) milowi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	***Lychnocanium grande***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	***Peripyramis circumtexta***	R	R	+	+	+	+	-	+	-	+	-	+	-	+	R	R	R	R	+	+	+	-	-	+	-
50	***Phormostichoartus pitomorphus***	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	***Phorticium pylonium***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	+	+	+	+	R	-	+	R	+
52	***Plectopyramis dodecomma***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	***Porodiscus sp.***	-	-	-	-	-	-	+	R	+	+	-	-	R	R	+	-	+	-	R	+	-	+	R	+	+
54	***?Prunopyle antarctica***	-	-	R	-	-	-	R	-	-	-	+	-	-	R	+	R	R	+	+	R	R	+	-	-	+
55	***Prunopyle tetrapila***	-	-	-	+	-	-	-	-	-	-	-	-	R	+	+	-	-	-	+	-	-	-	-	-	-
56	***Prunopyle titan***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	***Pterocanium sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	***Pterocorys hirundo***	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	R	-	-	-	-	-	-	-
59	***Saccospyris antarctica***	R	F	R	+	R	R	+	R	R	+	+	R	-	F	F	R	F	F	F	F	R	R	+	R	R
60	***Saccospyris preantarctica***	+	R	+	R	R	R	R	R	R	R	F	F	+	F	F	F	F	F	F	F	F	R	R	R	F
61	***Saturnalis circularis***	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	+	-	+	-	-	-
62	***Spongocore puella***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	***Spongopyle osculosa***	R	R	R	R	+	R	+	+	+	R	+	R	R	R	R	R	R	R	R	R	R	+	R	R	R
64	***Spongotrochus glacialis***	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
65	***Stichocorys peregrina***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	***Stichopilium bicorne ?***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
67	***Spongurus sp.***	R	R	+	-	+	-	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
68	***Spongurus pylomaticus***	R	R	R	-	+	-	-	-	-	-	-	+	-	F	F	R	+	+	+	-	-	-	-	+	+
69	***Staurolonche sp.***	-	-	-	-	-	-	-	-	+	-	-	-	-	+	+	+	-	-	-	-	+	-	+	-	+
70	***Stylatractus sp.***	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	***Stylochlamydium venustum***	+	R	R	R	R	R	+	R	R	+	+	R	+	R	R	+	R	R	+	-	+	+	R	+	+
72	***Stylodictya aculeata***	R	R	-	R	-	-	-	-	+	+	+	+	-	R	R	R	R	R	R	-	R	-	R	R	R
73	***Stylodictya validispina***	R	+	-	-	+	-	+	-	+	-	-	-	-	-	+	-	-	+	+	+	-	-	+	R	-
74	***Theocorys redondoensis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	***Triceraspyris sp.***	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
76	***Zygocircus piscicaudatus***	-	-	+	-	-	-	-	-	-	-	+	-	-	-	+	-	R	-	-	-	-	-	-	-	-

	a Sample Name(Hole,Core,Section,Interval(cm) 738B-	2H-5,129.5-131.5	2H-5,137-139	2H-5,146.5-148.5	2H-6,5-7	2H-6,14-16	2H-6,25-27	2H-6,45-47	2H-6,55-57	2H-6,66-68	2H-6,75-77	2H-6,85-87	2H-6,95-97	2H-6,105-107	2H-6,115-117	2H-6,125-127	2H-6,135-137	2H-6,145-147	2H-7,5-7	2H-7,15-17	2H-7,25-27	2H-7,35-37	2H-7,45-47	2H-7,55-57	3H-1,118-120	3H-1,130-132
b	**Depth (mbsf)**	11.295	11.37	11.465	11.55	11.64	11.75	11.95	12.05	12.16	12.25	12.35	12.45	12.55	12.65	12.75	12.85	12.95	13.05	13.15	13.25	13.35	13.45	13.55	14.68	14.8
c	**Total counts**	1010	1010	1010	1005	1030	1010	1005	1005	1020	1005	1050	1040	1020	1020	1050	1010	1010	1005	1030	1010	1005	1005	1050	500	500
d	**Age**												T	O												
e	**Abundance**	C	C	C	C	C	C	C	C	C	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	G	G	G	G	G	G	G	G	G	G
g	**Radiolarian Zone**														U	P	S	I	L	O	N					
	Name of Species																									
40	***Larcopyle polyacantha***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	***Lithelius minor***	R	-	-	-	R	-	+	R	-	-	-	-	-	-	-	-	+	+	+	-	-	+	+	R	R
42	***Lithelius nautiloides***	+	-	-	+	+	-	-	+	-	+	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
43	***Lithomelissa ehrenbergii***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	***Lithomelissa sphaerocephalis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	***Lithomelissa stigi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	***Lithomitra lineata***	R	R	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	+	-
47	***Lophocyrtis (Cyclampterium) milowi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	***Lychnocanium grande***	+	-	-	+	-	-	-	+	+	-	-	-	-	-	R	+	+	R	R	-	R	-	-	-	-
49	***Peripyramis circumtexta***	-	+	R	R	+	+	R	+	R	R	F	+	+	-	-	+	R	R	-	R	+	+	+	-	-
50	***Phormostichoartus pitomorphus***	+	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
51	***Phorticium pylonium***	-	-	+	R	-	R	+	-	+	R	F	F	R	R	R	R	R	R	R	R	R	R	R	-	+
52	***Plectopyramis dodecomma***	-	-	-	-	-	-	-	-	-	-	+	-	R	-	-	-	-	-	-	-	-	-	+	-	-
53	***Porodiscus sp.***	R	-	+	+	+	+	R	R	R	F	F	R	+	F	F	F	R	F	R	F	F	F	R	F	F
54	***?Prunopyle antarctica***	-	R	-	+	+	+	R	R	-	R	R	R	+	R	F	F	R	R	-	R	R	-	+	-	-
55	***Prunopyle tetrapila***	-	-	+	-	-	+	-	-	-	+	-	-	-	-	+	+	-	+	+	-	-	-	-	-	-
56	***Prunopyle titan***	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	+	R	+	-	+	-	-	+	-	-
57	***Pterocanium sp.***	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+
58	***Pterocorys hirundo***	-	-	-	-	+	-	R	R	+	+	R	R	+	+	+	+	-	-	-	-	+	-	-	+	-
59	***Saccospyris antarctica***	R	-	-	R	+	+	R	R	R	R	R	R	+	R	+	+	+	F	F	F	R	F	R	R	R
60	***Saccospyris preantarctica***	F	R	R	+	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F	R	R	F	R	+	+
61	***Saturnalis circularis***	-	-	-	-	-	-	-	-	-	-	-	-	-	+	R	+	-	-	-	+	-	-	-	-	-
62	***Spongocore puella***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	***Spongopyle osculosa***	-	R	R	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	F
64	***Spongotrochus glacialis***	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
65	***Stichocorys peregrina***	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	+	-	-	-	-	-	-
66	***Stichopilium bicorne ?***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
67	***Spongurus sp.***	-	-	-	+	-	R	-	-	-	-	-	-	-	+	-	-	-	-	+	+	-	R	R	R	R
68	***Spongurus pylomaticus***	+	-	+	+	R	+	+	+	-	-	-	-	-	R	-	-	+	-	+	R	+	R	-	R	R
69	***Staurolonche sp.***	-	-	R	-	-	-	-	+	-	-	+	+	+	-	-	-	-	+	-	+	+	+	R	-	-
70	***Stylatractus sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	***Stylochlamydium venustum***	+	+	+	R	R	F	+	R	+	+	R	R	R	R	R	R	R	R	-	-		-	R	R	R
72	***Stylodictya aculeata***	R	R	R	-	R	R	R	R	R	-	R	R	-	F	F	R	+	R	R	+	-	R	R	R	R
73	***Stylodictya validispina***	+	-	+	+	-	-	-	-	R	-	-	-	-	+	+	-	+	R	-	-	-	+	+	R	F
74	***Theocorys redondoensis***	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	***Triceraspyris sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	R
76	***Zygocircus piscicaudatus***	-	-	-	-	-	-	-	+	-	-	R	-	-	-	-	-	-	-	+	+	F	R	R	-	+

	a Sample Name(Hole,Core,Section,Interval(cm) 738B-	3H-1,139.5-141.5	3H-2,4.5-6.5	3H-2,15.0-17.0	3H-2,25.0-27.0	3H-2,35.0-37.0	3H-2,55.0-57.0	3H-2,65.5-67.0	3H-2,76.5-78.0	3H-2,84.5-86.0	3H-2,95.0-97.0	3H-2,106.0-108.0	3H-2,115.0-117.0	3H-2,125.0-127.0	3H-2,136.0-138.0	3H-2,145.0-147.0	3H-3,5.0-7.0	3H-3,15.0-17.0	3H-3,25.0-27.0	3H-3,35.0-37.0	3H-3,47.0-49.0	3H-3,55.0-57.0	3H-3,63.5-65.5	3H-3,75.0-77.0	3H-3,85.0-87.0	3H-3,95.0-97.0
b	**Depth (mbsf)**	14.895	15.045	15.15	15.25	15.35	15.55	15.65	15.76	15.845	15.95	16.06	16.15	16.25	16.36	16.45	16.55	16.65	16.75	16.85	16.97	17.05	17.135	17.25	17.35	17.45
c	**Total counts**	550	500	450	500	550	700	600	700	600	650	500	450	400	500	400	50	100	50	100	70	50	50	50	30	30
d	**Age**							M		I		O		C		E		N		E						
e	**Abundance**	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	R	R	R	R	R	R	R	R	R	R
f	**Preservation**	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	P	P	P	P	P	P	P	P	P	P
g	**Radiolarian Zone**									T	A	U														
	Name of Species																									
40	***Larcopyle polyacantha***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	***Lithelius minor***	R	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	***Lithelius nautiloides***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	***Lithomelissa ehrenbergii***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	***Lithomelissa sphaerocephalis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	***Lithomelissa stigi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	***Lithomitra lineata***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
47	***Lophocyrtis (Cyclampterium) milowi***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	***Lychnocanium grande***	+	-	-	-	-	R	R	R	R	F	F	F	F	F	F	R	R	R	+	-	-	-	-	-	-
49	***Peripyramis circumtexta***	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
50	***Phormostichoartus pitomorphus***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	***Phorticium pylonium***	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52	***Plectopyramis dodecomma***	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	***Porodiscus sp.***	R	R	+	+	R	F	R	R	R	R	R	R	R	R	R	-	-	+	-	-	-	-	-	-	-
54	***?Prunopyle antarctica***	+	+	-	-	-	+	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
55	***Prunopyle tetrapila***	-	-	+	+	-	+	-	+	+	+	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-
56	***Prunopyle titan***	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	***Pterocanium sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	***Pterocorys hirundo***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
59	***Saccospyris antarctica***	+	-	R	R	-	R	+	-	-	-	-	-	-	+	+	-	+	+	-	-	-	-	-	-	-
60	***Saccospyris preantarctica***	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	***Saturnalis circularis***	-	-	+	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	***Spongocore puella***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	***Spongopyle osculosa***	R	R	R	-	-	R	-	-	-	-	-	-	R	-	-	-	+	-	-	+	-	-	-	-	-
64	***Spongotrochus glacialis***	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	R	R	+	+	+	+	+	+	+
65	***Stichocorys peregrina***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	***Stichopilium bicorne ?***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
67	***Spongurus sp.***	R	R	R	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	***Spongurus pylomaticus***	F	F	F	F	F	F	F	F	R	F	F	F	R	F	R	-	-	R	-	-	-	+	-	-	-
69	***Staurolonche sp.***	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	***Stylatractus sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	***Stylochlamydium venustum***	R	R	R	R	R	R	R	R	R	R	R	R	R	F	R	-	-	+	-	-	-	-	-	-	-
72	***Stylodictya aculeata***	-	-	R	F	R	F	R	R	R	R	R	R	R	R	R	-	R	-	-	-	-	-	-	-	-
73	***Stylodictya validispina***	R	R	R	F	R	F	R	R	R	R	R	R	F	F	+	+	R	R	R	+	R	R	-	-	-
74	***Theocorys redondoensis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	***Triceraspyris sp.***	R	+	+	+	+	R	+	R	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
76	***Zygocircus piscicaudatus***	-	+	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+

	a Sample Name(Hole,Core,Section,Interval(cm) 738B-	3H-3,105.0-107.0	3H-3,115.0-117.0	3H-3,125.0-127.0	3H-3,135.0-137.0	3H-3,143.0-145.0	3H-4,4.0-6.0	3H-4,13.0-15.0	3H-4,24.0-26.0	3H-4,34.5-36.5	3H-4,44.0-46.0	3H-4,53.0-55.0	3H-4,61.0-63.0	3H-4,68.0-70.0	3H-4,76.0-78.0	3H-4,84.5-85.5	3H-4,95.5-97.5	3H-4,105.5-107.5	3H-4,113.5-115.5	3H-4,125.5-127.5	3H-4,137.5-139.5	3H-4,146.5-148.5
	b Depth (mbsf)	17.55	17.65	17.75	17.85	17.93	18.04	18.13	18.24	18.345	18.44	18.53	18.61	18.68	18.76	18.845	18.955	19.055	19.135	19.255	19.375	19.465
	c Total counts	20	20	20	10	10	100	150	200	100	100	100	500	550	600	600	550	600	600	700	550	600
	d Age						L	A	T	E		O	L	I	G	O	C	E	N	E		
	e Abundance	R	R	R	R	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
	f Preservation	P	P	P	P	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
	g Radiolarian Zone					*A.*		*a*	*u*	*s*	*t*	*r*	*a*	*l*	*i*	*s*						
	Name of Species																					
40	***Larcopyle polyacantha***	-	-	+	-	-	-	-	-	-	-	-	+	+	+	R	+	R	R	+	R	R
41	***Lithelius minor***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	***Lithelius nautiloides***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	***Lithomelissa ehrenbergii***	-	-	-	-	-	R	+	+	R	R	R	+	+	+	+	-	-	-	-	-	R
44	***Lithomelissa sphaerocephalis***	-	-	-	-	-	R	R	+	R	R	R	+	-	R	+	-	-	-	+	-	+
45	***Lithomelissa stigi***	-	-	-	-	-	+	-	-	-	R	-	+	-	+	+	-	-	+	-	-	-
46	***Lithomitra lineata***	-	-	+	+	-	R	+	-	+	+	R	R	R	R	R	R	R	R	+	R	R
47	***Lophocyrtis (Cyclampterium) milowi***	-	-	-	-	-	F	+	-	R	R	+	+	+	+	+	-	-	-	R	+	R
48	***Lychnocanium grande***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	***Peripyramis circumtexta***	-	-	-	-	-	R	R	-	-	+	+	-	+	-	+	+	+	+	+	R	+
50	***Phormostichoartus pitomorphus***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	***Phorticium pylonium***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52	***Plectopyramis dodecomma***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	***Porodiscus sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	***?Prunopyle antarctica***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	***Prunopyle tetrapila***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	***Prunopyle titan***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	***Pterocanium sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
58	***Pterocorys hirundo***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	R	+	+
59	***Saccospyris antarctica***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	***Saccospyris preantarctica***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	***Saturnalis circularis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	***Spongocore puella***	-	-	-	-	-	R	R	-	R	R	R	R	R	R	R	R	R	R	R	+	R
63	***Spongopyle osculosa***	-	-	-	-	-	+	-	+	+	+	-	-	+	-	-	+	-	-	+	+	+
64	***Spongotrochus glacialis***	+	-	-	-	-	F	+	+	+	+	+	+	F	F	F	R	F	R	F	F	R
65	***Stichocorys peregrina***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	***Stichopilium bicorne ?***	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
67	***Spongurus sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	***Spongurus pylomaticus***	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
69	***Staurolonche sp.***	-	-	-	-	+	-	+	-	-	R	-	+	+	R	R	+	R	+	R	+	R
70	***Stylatractus sp.***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	***Stylochlamydium venustum***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	***Stylodictya aculeata***	+	-	-	-	-	-	-	+	+	+	-	+	R	-	-	-	-	-	R	+	-
73	***Stylodictya validispina***	-	-	-	-	-	-	+	-	-	F	F	R	F	F	F	F	F	F	F	F	F
74	***Theocorys redondoensis***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	***Triceraspyris sp.***	-	-	+	-	-	-	+	-	+	-	+	+	+	+	+	+	+	+	+	-	-
76	***Zygocircus piscicaudatus***	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

REFERENCES

[1] C.G. Ehrenberg,"Einige vorlaufige Resultate seiner Untersuchungen der ihm von der Sudpolreise des Capitain Ross, so wie von den Herren Schayer und Darwin zugekommenen Materialien uber das Verhalten des kleinsten Lebens in den Oceanen und den grossten bisher zuganglichen Tiefen des Weltmeeres" Monatsber. Konigliche Preussischen Akademie der Wissenschaften zu Berlin Jahre, Vol. 1844, 1844, pp. 182-207.

[2] E. Haeckel, "Report on the Radiolaria collected by H.M.S. Challenger during the years 1873-1876, Reports of Scientific Results," Voyage H.M.S. Challenger, Zoology, Vol. 18, 1887, pp. 1-1803.

[3] V. Haecker, "Tiefsee Radiolarien. Spezieller Teil," Wissensch Erqeb, Deutsche Teifsee Expedition. Jena, Vol. 14, 1908, pp. 337-476.

[4] A. Popofsky, " Die Radiolarien des Antarktis (mit Ausnahme der Tripyleen)," Deutsche Südpolar-Expedition 1901-1903, Part 10, Zoology, Vol. 2, No. 3, 1908, pp. 183-305.

[5] W.R. Riedel, "Radiolaria in Antarctic Sediments," Reports B.A.N.Z. Antarctic Research Expedition, Vol. 6, No. 10, 1958, pp. 217-255.

[6] K. Nakaseko, "On Superfamily Liosphaericae (Radiolaria) from sediments in the sea near Antarctica, Part 1. On Radiolaria from sediments in the sea near Antarctica," special publication from the Seto Marine Biology Laboratory, Biological Results of the Japanese Antarctic Expedition Vol. 2, 1959, pp. 1-21.

[7] J.D. Hays, "Radiolaria and late Tertiary and Quaternary history of Antarctic seas," In: Llano, G.A. (Ed.), Biology of Antarctic Seas II. American Geophysical Union, Antarctic Research Series, Vol. 5, 1965, pp. 125-184.

[8] J.D. Hays, and N.D. Opdyke, "Antarctic Radiolaria, magnetic reversals and climatic change," Science, Vol. 158, 1967, pp. 1001-1011.

[9] M.G. Petrushevskaya, "Cenozoic radiolarians of the Antarctic, DSDP Leg 29," In: J.P. Kennett, R.E. Houtz, et al.,(Eds.), Initial Reports of Deep Sea Drilling Project, U.S. Government Printing Office,Washington DC, Vol. 29, 1975, pp. 541-675.

[10] P.H. Chen, "Post Paleocene radiolarian: Their taxonomy, boistratigraphy and phylogeny and the development of late Neogene cold water faunas," Ph.D. Dissertation, Columbia University, New York, 1975, pp. 475.

[11] J. Keany,"Early Pliocene radiolarian taxonomy and biostratigraphy in the Antarctic region," Micropaleontology, Vol. 25, No. 1, 1979, pp. 50-74.

[12] F. Theyer, C.Y. Mato, S.R. Hammond, "Paleomagnetic and geochronologic calibration of latest Oligocene to Pliocene radiolarian events," Equatorial Pacific Marine Micropaleontology Vol. 3, 1978, pp. 377-395.

[13] J.D. Hays, "Quaternary sediments of Antarctic Ocean," Progress in Oceanography, Vol. 4, 1967, pp. 117-131.

[14] J.D. Hays,1970. "Stratigraphy and evolutionary trends of Radiolaria in North Pacific deep-sea sediments," In: J.D. Hays, Ed., Geological investigations of the North Pacific, Geological Society of America, Memoir, Vol. 126, pp. 185-218.

[15] M.G. Petrushevskaya, 1978. "Radiolarian biostratigraphy of Neogene deep-sea sediments of Antarctica," In: A.P. Zhuze, Ed., Marine Micropaleonotology (diatoms, radiolarians, silicoflagellates, foraminifers and calcareous nannoplanktons). Nauka, Moscow, 1978, pp. 82-90.

[16] F.M. Weaver, 1983. "Cenozoic radiolarians from the Southwest Atlantic, Falkland Plateau region, DSDP Leg 71," In: W.J. Ludwig, V.A. Krasheninikov, I.A. Basov, U. Bayer, J. Bloemendal, B. Bornhold, P.F. Ciesielski, E.H. Goldstein, C. Robert, J. Salloway, J.L. Usher, H. Von der Dick, F.M. Weaver, and S.W. Wise jr. Eds., Initial Reports of Deep Sea Drilling Project, 71. U.S. Govt. Printing Office, Washington DC, 1983, pp. 667-686.

[17] F.M. Weaver, M.G. Dinkelman, S.V. Margolis and R.G. Blank, "Pliocene climatic and glacial history of Antarctica as revealed by Southeast Indian Ocean deep-Sea cores," Geological Society America Bulletin Vol. 87 No. 10, 1976, pp. 1529-1532.

[18] A. Abelmann, and R. Gersonde, "*Cycladophora davisiana* stratigraphy in Pliocene-Pleistocene cores from the Antarctic Ocean (Atlantic Sector)," Micropaleontology Vol. 3 No.34, 1988, pp. 268-276.

[19] D. Lazarus, "Middle Miocene to Recent radiolarians from the Weddell Sea, Antarctica, ODP Leg 113," In: P.F. Barkar, J.P. Kennett, Eds., Proceedings of Ocean Drilling Program Scientific Results. College Station, XT (Ocean Drilling Programme), 1990, pp. 709-728.

[20] R. Gersonde, A. Abelmann, L.H. Burckle, N. Hamilton, D. Lazarus, K. MC Cartney, P. O'Brien, V. Spiess, S.W. Wise Jr., "Biostratigraphic synthesis of Neogene siliceous microfossils from the Antarctic Ocean, ODP Leg 113 (Weddell Sea)," In: P.F. Barker, J.P. Kennett, S. O'Connell, S. Berkowitz, W.R. Bryant, L.H. Burckle, P.K. Egeberg, D.K. Fiitterer, R.E. Qersonde, X. Qolovchenko, N. Hamilton, L. Lawver, D.B. Lazarus, M. Lonsdale, B. Mohr, T. Nagao, C.P.Q. Pereira, C.J. Pudsey, C.M. Robert, E. Schandl, V. Spiej, L.D. Stott, E. Thomas, K.F.M. Thompson, S.W. Wise Jr. Eds., Proceedings of the Ocean Drilling Program, Scientific Results. College Station, TX (Ocean Drilling Program), 1990, pp. 915-936.

[21] J. Barron, B. Larsen, J.G. Baldauf, C. Alibert, S. Berkowitz, J.P. Caulet, S. Chambers, A. Cooper, R. Cranston, W. Dron, W. Ehrmann, R. Fox, G. Fryxell, M. Hambrey, B. Huber, C.

Jenkins, S. Kang, B. Keating, K. Mehl, I. Noh, G. Ollier, A. Pittenger, H. Sakai, C. Schroder, A. Solheim, D. Stockwell, H. Thierstein, B. Tocher, B. Turner, W. Wie, "Biochronologic and Magnetographic synthesis of Leg 119 sediments from the Kerguelen Plateau and Prydz Bay, Antarctica," In: J.A. Barron, B. Larsen, J. Baldauf, J.P. Caulet, A. Cooper, D. Wolfgang, H. Theirsten, C. Schroder, Eds., Proceedings of the Ocean Drilling Program (ODP), Scientific Results. College Station, TX (Ocean Drilling Program), 1991, pp. 813-847.

[22] J.P. Caulet, "Radiolaria from the Kerguelen Plateau, Leg119," In: J. Barron, B. Larsen, et al., (Eds.), Proceedings of the Ocean Drilling Program Scientific Results. College Station, TX (Ocean Drilling Programme), 1991, pp. 513-542.

[23] D. Lazarus, J.P. Caulet, "Eocene to Recent radiolaria biostratigraphy, biogeography, diversity, and history of the Southern Oceans," International Conference on the Role of the Southern Ocean and Antarctica in Global Change: an ocean drilling perspective, Santa Barbara, 1991, Abstract, 30.

[24] D. Lazarus, "Antarctic Neogene radiolarians from the Kerguelen Plateau, ODP Legs 119 and 120," In: S.W. Wise, R. Schlich, Eds., Proceedings of Ocean Drilling Program Scientific Results. College Station, TX (Ocean Drilling Programme), 1992, pp. 785-810.

[25] L. McIntyre, I. Kaczmarska,"Improved resolution of the Pleistocene extinction level of Stylatractus universus (Hays) in ODP Hole 75B, Kerguelen Plateau," Micropaleontology, Vol. 42 No. 4, 1996, pp. 375-379.

[26] D. Lazarus, "Environmental control of diversity, evolutionary rates and taxa longevities in Antarctic Neogene radiolarian," Paleontologica Electronica, Vol. 5 No. 1, 2002, p. 32.

[27] G.K. Sharma, K. Takahashi, V.S. Dalakoti, "Taxonomy and distribution of Pleistocene Radiolarians from the Tasman region," Neues Jahrbuch Für Geologie und Palaontologie Vol. 231 No. 3, 2004, pp. 297-347.

[28] G.K. Sharma, K. Takahashi and V.S. Dalakoti, "Pleistocene Biostratigraphy of Radiolarians from the South Tasman region," Acta Micropalentologica Sinica Vol. 23 No. 1, 2006, pp. 31-50.

[29] S.D. Stepanjants, G. Cortese, S.B. Kruglikova, K.R. Bjorklund, "A review of bipolarity concept: history and examples from Radiolaria and Medusozoa (Cnidaria)," Marine Biology Research Vol. 2, 2006, pp. 200-241.

[30] G.K. Sharma, K. Takahashi, "Pleistocene radiolarian from the Antarctic Continental margin: distribution and biostratigraphy," J. Geol. Soc. India Vol. 69, 2007, pp. 813-826.

[31] G.K. Sharma, K. Takahashi, "Distribution and Taxonomy of Pleistocene Radiolarians from KH94-4-AMR-2PC core of the Southern Ocean region," Palaeoworld, Vol. 17, 2008, pp. 57-82.

[32] P. De Weaver, P. Dumitrica, J.P. Caulet, C. Nigrini, M. Caridroit, "Radiolarians in the sedimentary record," Tylor and Francis, The Netherlands, 2001, pp. 533.

[33] C.A. Nigrini, T.C. Moore Jr., "A Guide to Modern Radiolaria," Cushman Foundation for Foraminiferal Research, Special Publication 1979, pp. S1- 142, N1-106.

[34] C.A. Nigrini, G. Lombari, "Miocene Radiolaria," Cushman Foundation for Foraminiferal Research, Special Publication, 1984, pp. S1- 102, N1- 206.

[35] D. Dayal, "Miocene-Pliocene Radiolaria From The Kerguelen Plateau,Site 745,Southern Ocean Region : Biostratigraphy and Paleoceanography," (*Unpublished thesis,* 2014, pp. 120.

[36] G. Lombari, G. Boden, "Modern Radiolarian Global Distribution," Cushman Foundation for Foraminiferal Research (Special Publication), Vol. 16A, 1985, pp. 1-125.

[37] G.K. Sharma and D. Dayal, "Distribution of Pliocene Radiolaria at Site 745 (Section 14-15 H,Leg 119, from the Kergulean Plateau and Biostratigraphy," *Stratigrafica*, Vol. 23, No. 7, 2015, pp. 56-66.

[38] A. Popofsky, "Die Sphaerellarien des Warmwassergebietes. Deutsche Südpolar-Expedition," *Zoology*, part 2, Vol. 13, No. 5, 1912, pp. 73-159.

[39] J. Renaudie and D. B. Lazarus, "New species of Neogene radiolarians from the Southern Ocean- Part III," Journal of Micropalaeontology, Vol. 34, 2015, pp. 181-209.

[40] J. Keany and J.P. Kennett, "Pliocene-Pleistocene radiolarian biostratigraphy and paleoclimatology at DSDP site 278 on the Antarctic convergence," In: J.P. Kennett, R.E. Houtz, et al. Eds., *Initial Reports of Deep Sea Drilling Project*, U.S. Government Printing Office, Washington Vol. 29, 1975, pp. 757-767.

[41] J.A. Lozano, "Antarctic sedimentary, faunal and sea surface temperature responses during the last 230,000 years with emphasis in comparison between 18,000 years ago and today. *Ph.D. dissertation*," Columbia University, New York, 1974, pp. 400.

[42] R.N. Benson, "Recent Radiolaria from the Gulf of California (*Ph.D. dissertation*)," Minnesota University, 1966, pp. 577.

[43] M.G. Petrushevskaya, "Radiolaria of the orders Spumellaria and Nassellaria pf the Antarctic region," *Issledovaniya Fauny Morey*, Vol. 4 No. 12, 1967, pp. 1-186.

[44] D.B. Lazarus, K. Faust and I. Popova-Goll, "New species of prunoid radiolarians from the Antarctic Neogene," *Micropaleontology*, Vol. 24 No. 2, 2005, pp. 97-121.

[45] G.K. Sharma and S. Kanojia, "Pleistocene radiolaria from Leg 119 Site 738B Section (1H1-1H2): Systematics and Biostratigraphy,"*Open Journal of Geology*, USA, Vol. 3, 2013, pp. 427-438.

[46] G. Lombari, and D.B. Lazarus, "Neogene Cycladophorid Radiolaria from North Atlantic, Antarctic and North Pacific Deep Sea sediments," *Micropaleontology*, Vol. 34 No. 2, 1988, pp. 97-135.

[47] R. Vigour and D. Lazarus, "Biostratigraphy of late Miocene–early Pliocene radiolarians from ODP Leg 183 Site 1138," In: F.A. Frey, M.F. Coffin, P.J. Wallace, P.G. Quilty, Eds., *Proceedings of the Ocean Drilling Program, Scientific Results*. College Station, TX (Ocean Drilling Program), 2002, pp. 1–17.

[48] M.J. Westberg-Smith and W.R. Riedel, "Radiolarians from the western margin of the Rockall Plateau," DSDP Leg 81. In: D.G. Roberts, D. Schnitker, et al. Eds., *Initial Reports of the Deep Sea Drilling Project 81,* U.S. Govt. Printing Office, Washington, 1985, pp. 477-501.

[49] A.S. Campbell, and B.L. Clark, "Miocene radiolarian faunas from Southern California," *Geological Society of America* (Special Paper) Vol. 51, 1944, pp. 1-76.

[50] C.A. Nigrini, "Tropical Cenozoic Artostrobiidae (Radiolaria)," *Micropaleontology* Vol. 23 No. 3, 1977, pp. 241-269.

[51] S. Kanojia, "Qaternary Radiolaria from Leg119 Site 738B, Southern Antarctic Region: Biostratigraphy and Paleoceanography" (Unpublished Ph.D.thesis), 2016, pp. 106.