NEOGENE RADIOLARIAN BIOSTRATIGRAPHY FROM ODP LEG 119, SITE 745

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ABSTRACT

Abundant, generally well preserved radiolarians were used in a stratigraphic analysis of the Neogene sequence of ODP Leg 119, Site 745. Detailed biostratigraphic analysis has been undertaken of radiolarian assemblages of the Pliocene-Pleistocene sequence. Seventy-seven radiolarian taxa were identified including three reworked forms. Twenty-one stratigraphically important species are described and illustrated from this 99.55 m long core, and allow the recognition of four radiolarian zones, i.e., Phi, Chi, Psi and Omega (from oldest to youngest) and the Plio-Pleistocene boundary. These are then correlated with the earlier established zones and boundary in the Southern Ocean.

INTRODUCTION

Leg 119 Site 745 has been chosen for the radiolarian study because it is very close to radiolarian rich ODP Legs 119 and 120, sites 744, 745, 746, 747-51. The radiolarians from the Southern Ocean region are the most diverse and often best preserved group of microfossils and therefore, useful for biostratigraphy and paleoceanography.

Detailed studies on Neogene radiolarian stratigraphy were carried out by Hays (1965); Hays and Opdyke (1967); Petrushevskaya (1967; 1975); Keany and Kennett (1972; 1975); Chen (1974; 1975a; 1975b); Keany (1976; 1979); Theyer et al. (1978). Hays (1967; 1970), Bandy and Casey (1969), Petrushevskaya (1972a; 1972b; 1973; 1978), Weaver (1975; 1983) and Weaver et al. (1976) developed a detailed Antarctic biostratigraphy and produced several paleoclimatic studies. Abelmann and Gersonde (1988) and Lazarus (1990) established Neogene biostratigraphy on cored sections of the Falkland Plateau and Weddell Sea. Gersonde et al. (1990) studied radiolarian magneto-biostratigraphy and Barron et al. (1991) produced a biochronology and magnetostratigraphy for Antarctic sediments. Caulet (1991) introduced two new genera, seventeen new species and described biostratigraphy and paleoceanography from the Neogene sediments of the Kerguelen Plateau. Lazarus and Caulet (1991) carried out work on biostratigraphy, biogeography, diversity and history of Eocene to Recent radiolarians of the Southern Ocean. Lazarus (1992) presented radiolarian stratigraphy of Middle Miocene to Holocene sediments of different sites from ODP Legs 119 and 120. McItyre and Kaczmarska (1996) worked on sections of ODP, Site 745 on the Kerguelen Plateau and placed *Stylatractus universus* Hays. Lazarus (2002) described the environmental controls on radiolarian diversity, evolutionary rates and taxa longevities of Antarctic Neogene radiolaria from ODP Leg 119. Sharma et al. (2004; 2006) carried out a detailed study on Pleistocene sediments and reported 83 radiolarian taxa, and recognized two radiolarian zones of the Tasman Sea. Stepanjants et al. (2006) discussed the bipolar distribution of Phaeodaria, Radiolaria and Medusozoa and identified 46 bipolar radiolarian species. Sharma and Takahashi (2007; 2008) 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 for the Antarctic continental margin.

In this article, radiolarian biostratigraphy and distribution in the sections is covered fully including the taxonomic description of stratigraphically key species. The present study aimed at establishing the precise placement of the Plio-Pleistocene boundary and four radiolarian zones.

AREA DESCRIPTION, METHODS AND STUDIED MATERIAL

ODP Leg 119 Site 745 is located on the southern slope of the Southern Kerguelen Plateau and lies at 59°35.71'S and 85°57.60'E in the Southern Ocean region (Fig. 1). Samples were collected at a water depth of 4082.5 meters and the total length of the studied sections is 99.55 m. The interval between the studied samples is in average 1.5 meters but varies when lithology changes.

The studied portion of the core (sections 1H to 11H) is included in one unit (Unit I), which is lithostratigraphically divided into two subunits, IA and IB. Subunit IA (0-37 meters) consists of diatom ooze along with minor amounts of radiolaria, quartz, feldspar and silt. Subunit IB is characterized by alternations of variable clay-rich diatomaceous sediments in which the clay-rich horizons contain less than 50% diatoms and minor silt, claystone, volcanic ash layers, scattered granules and small pebbles (Fig. 2).

Thirty-two samples from Leg 119, Site 745 were used for the present study. Sediment samples of about 3-4 g were disaggregated in diluted hydrogen peroxide (H2O2) for 1-2 hours followed by heating to just below the boiling point. One teaspoonful of Calgon (Hexametaphosphate) was added to further disaggregate the sediment samples and complete the treatment. The samples were sieved through a 63 micron mesh and dried. About 300 strewn slides were prepared by using an eyedropper and Canada balsam as mounting medium. Two to three slides were examined for taxonomy and stratigraphic work, depending on radiolarian abundance (i.e., on average between 1000 to 1200 individual radiolarians were observed per sample).

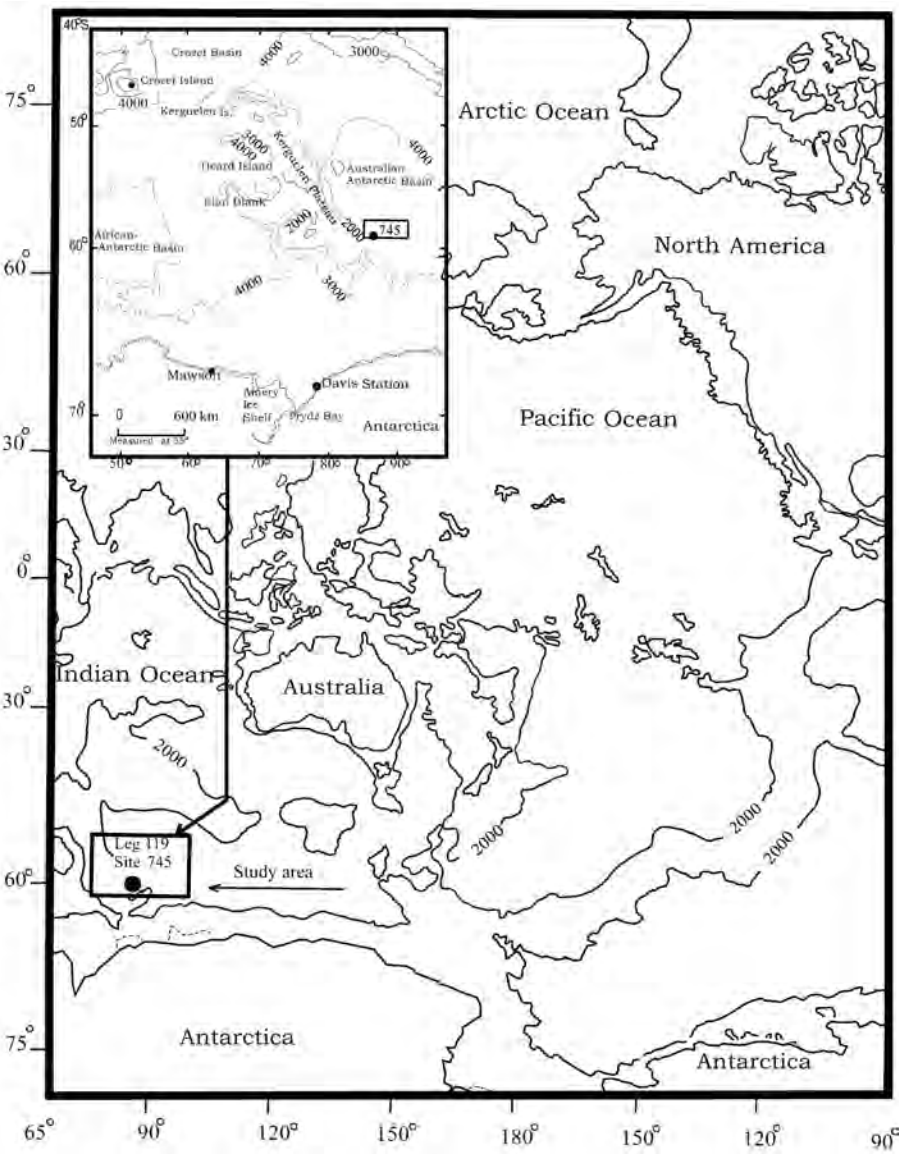

Fig. 1 - Map showing location of ODP Leg 119, Site 745.

NOMENCLATURE

Classification of the Subclass Radiolaria follows De Wever et al. (2001), Nigrini and Moore (1979), Nigrini and Lombari (1984) and Lazarus (1990). Remarks on observed morphological features and their modifications have been added for many taxa. Species within a genus, and genera within a family are arranged alphabetically. The synonymy list for each taxon is incomplete and consists of references relevant 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 (< 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 photomicrographs of stratigraphically important species are illustrated in Figs. 3 and 4.

Phylum SARCODINA Hertwig and Lesser, 1874
Class ACTINOPODA Calkins, 1909
Subclass RADIOLARIA Müller, 1858
Order POLYCYSTINA Ehrenberg, 1838, *emend.* Riedel, 1967
Suborder SPUMELLARIA Ehrenberg, 1875
Family ACTINOMMIDAE Haeckel, 1862, *emend.* Riedel, 1967
Genus *Stylatractus* Haeckel, 1887

Stylatractus universus Hays
(Figs. 5F and J)

1965 *Stylatractus* sp. - Hays, p. 167, Pl. 1, Fig. 6.

1970 *Stylatractus universus* - Hays, p. 215, Pl. 1, Figs. 1-2.

Distribution: Lazarus (1990) showed its presence in the Weddell Sea of Antarctica. Sharma and Takahashi (2008) reported its distribution from very rare to few in the Antarctic region.

Abundance: Very rare to few.

Range: Hays (1965) considered its upper limit to mark the boundary between the Omega and Chi zones in the Antarctic region. Hays and Opdyke (1967) reported its consistent presence in the Pleistocene sediments whereas Keany (1979) showed its presence in the Neogene.

Remarks: Lazarus (1992) observed the base of Omega Zone as the last appearance of *S. universus* and marked it at 0.4 Ma in the Antarctic region.

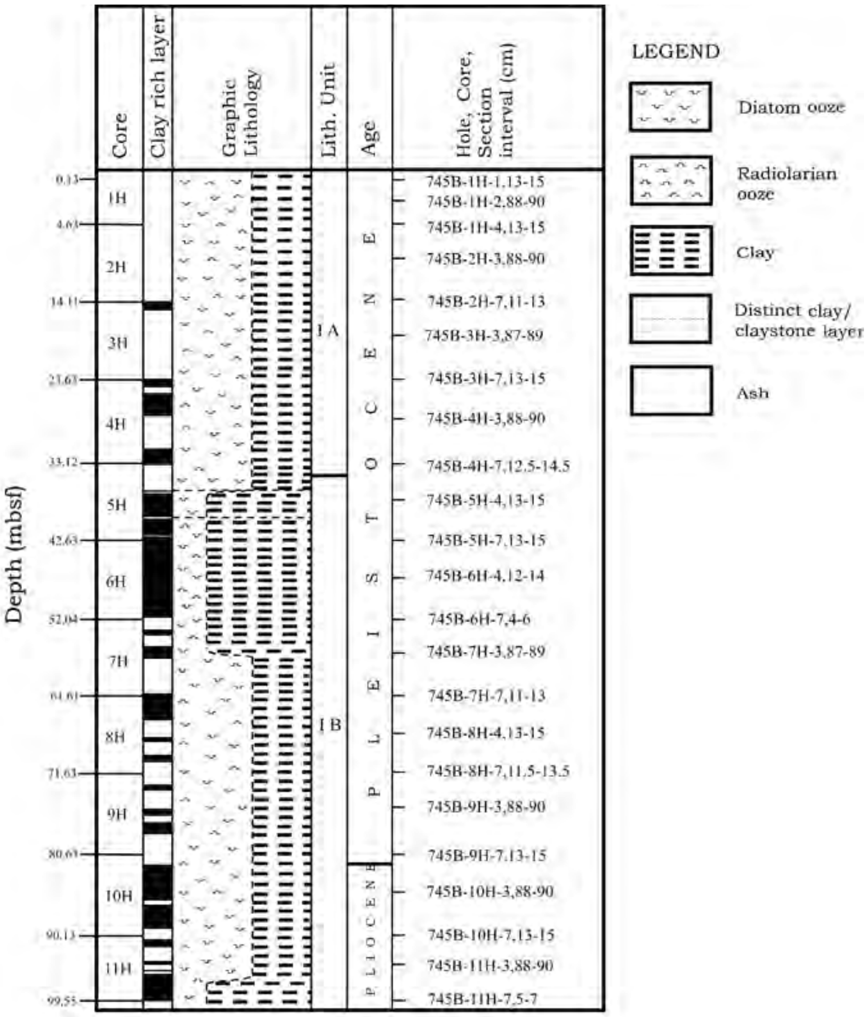

Fig. 2 - Age, position of the samples, lithostratigraphic succession and depth of ODP Leg 119, Site 745.

Family PYLONIIDAE Haeckel, 1881
Genus *Prunopyle* Dreyer, 1889

?Prunopyle antarctica Dreyer
(Figs. 4E, H)

1889 ?*Prunopyle antarctica* - Dreyer, p. 24-25, Pl. 5, Fig. 75.

1975a ?*Prunopyle antarctica* Dreyer - Chen, p. 454, Pl. 23, Fig. 5, 6.

Distribution: Riedel (1958) and Petrushevskaya (1967) reported this species from the Antarctic and subpolar region. Stepanjants et al. (2006) interpreted it as a bipolar species.

Abundance: Very rare to few.

Range: Chen (1975a) mentioned the presence of *P. antarctica* from Pleistocene to Recent. Lazarus (2002) showed its presence from 0-1.6 Ma.

Family LITHELIIDAE Haeckel, 1862
Genus *Lithelius* Haeckel, 1862

Lithelius nautiloides Popofsky
(Fig. 4A)

1908 *Lithelius nautiloides* Popofsky, p. 230-231, Pl. 27, Fig. 4.

1975 *Lithelius* (?) *nautiloides* Popofsky - Petrushevskaya, p. 572, Pl. 3, Figs. 1, 3, 5, Pl. 33, Figs. 3, 4.

Abundance: Very rare to few.

Range: Pliocene to Recent (Chen, 1975a and Keany, 1979). Hays (1965) reported *L. nautiloides* to be endemic to the present day Antarctic region of the Southern Ocean.

Suborder NASSELLARIA Ehrenberg, 1875
Family PLAGONIIDAE Haeckel, 1881, *emend.* Riedel, 1967
Genus *Antarctissa* Petrushevskaya, 1967

Antarctissa cylindrica Petrushevskaya
(Fig. 4I, J)

1972a *Antarctissa cylindrica* - Petrushevskaya, Pl. 1, Fig. 8, Pl. 2, Fig. 6.

Abundance: Rare to common.

Range: Lazarus (1990) reported *A. cylindrica* as having its last appearance in the Psi zone. Lazarus (2002) showed it to occur from 0.6 - 6.4 Ma in the Antarctic region.

Antarctissa denticulata (Ehrenberg)
(Figs. 4K, 5C)

1844 *Lithobotrys denticulata* - Ehrenberg; p. 203.

1873 *Lithopera denticulate* (Ehrenberg) - Ehrenberg; Pl. 12, Fig. 7.

1967 *Antarctissa denticulata* (Ehrenberg) - Petrushevskaya; p. 84-86, Fig. 49, 1-1V.

Abundance: Few to common.

Range: Petrushevskaya (1975) reported its range from Pleistocene to Recent, whereas Chen (1975a) considers its range to extend from Pliocene to Pleistocene. Keany (1979) reported its range from Pliocene to Recent from the Antarctic region. Lazarus (2002) showed its presence from 0 - 2.6 Ma in the Antarctic region.

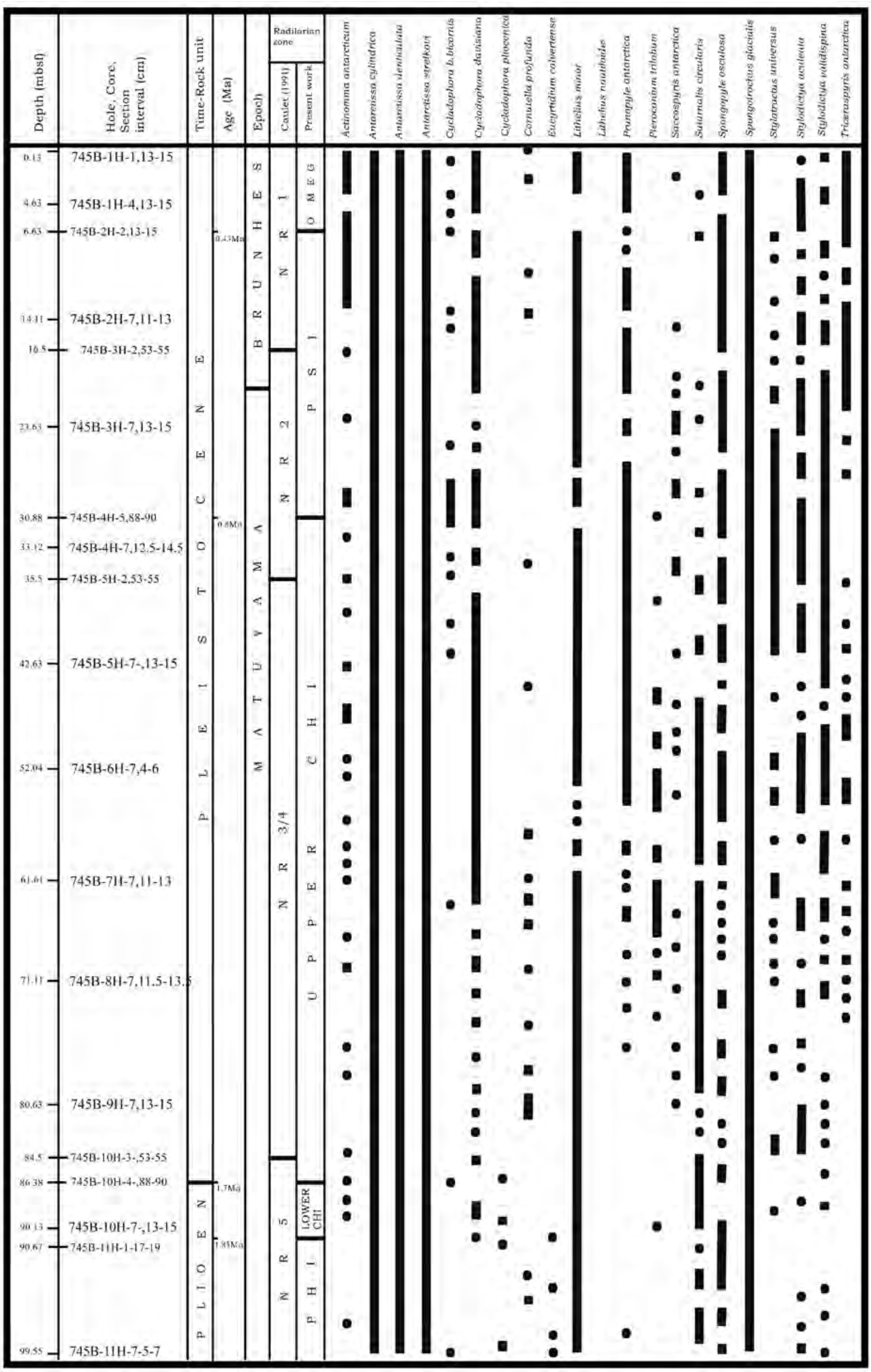

Fig. 3 - Diagram showing the observed ranges of some stratigraphically important species, radiolarian zone, and age.

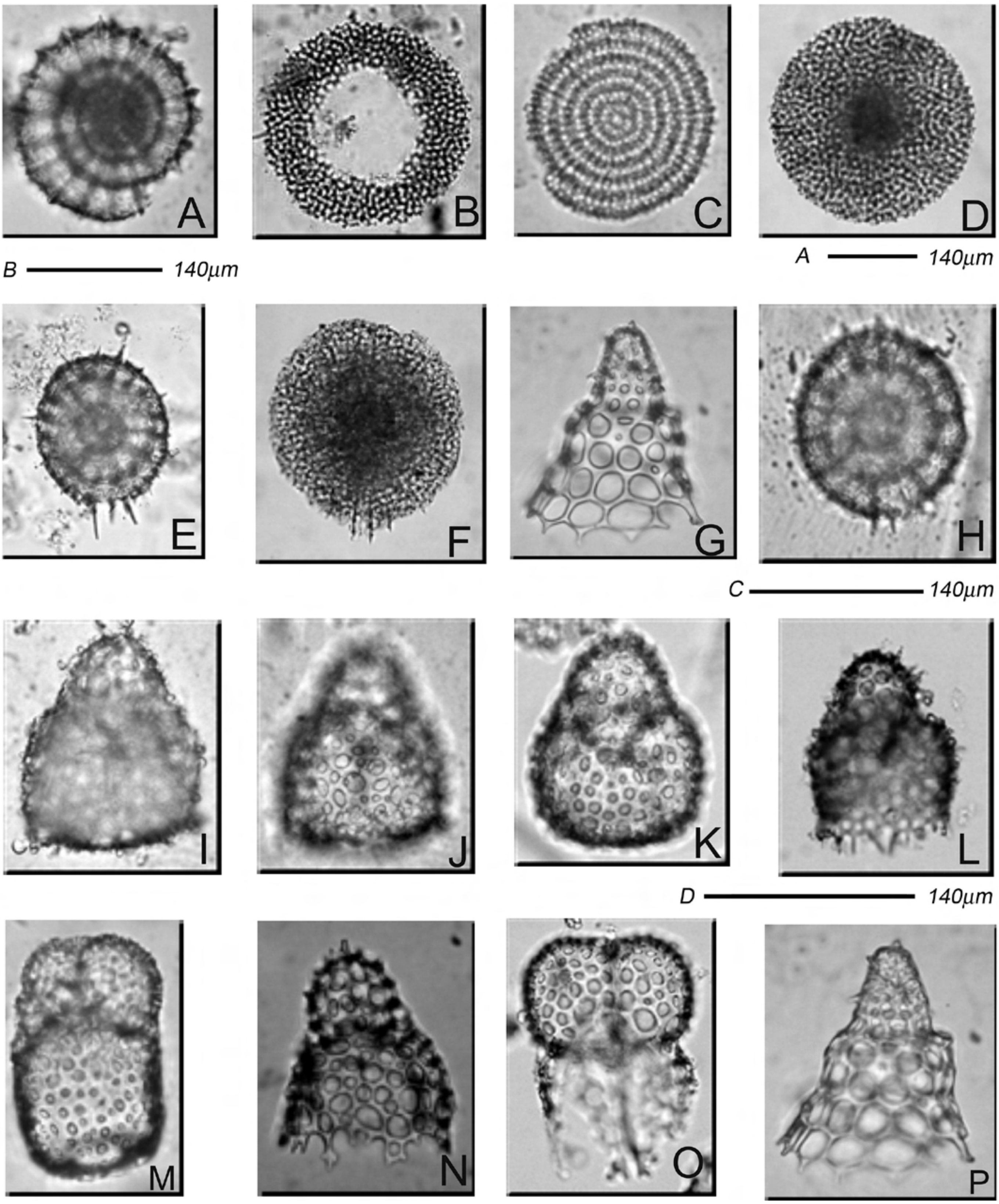

Fig. 4 - A: *Lithelius nautiloides* Popofsky, focused on cortical shell; 745B-2H-3, 88-90; scale bar C. B, D: *Spongotrochus glacialis* Popofsky, focused on cortical shell; 745B-5H-4, 13-15; scale bar B. C: *Stylodictya validispina* Jørgensen, focused on medullary shell; 745B-8H-2, 13-15; scale bar C. E, H: ?*Prunopyle antarctica* Dreyer, E- focused on cortical shell, 745B-1H-2,88-90; scale bar B; H- focused on medullary shell, 745B-1H-1,13-15; scale bar D. F: *Spongopyle osculosa* Dreyer, focused on cortical shell, 745B-6H-2, 12-14; scale bar B. G, P: *Cycladophora robusta* Lombari and Lazarus, focused on medullary and cortical shell respectively, 745B-9H-1, 88-90; scale bar C. I, J: *Antarctissa cylindrica* Petrushevskaya, focused on outer and inner portion of shell, 745B-2H-6, 13-15; scale bar D. K: *Antarctissa denticulata* (Ehrenberg), focused on cortical shell, 745B-2H-6, 13-15; scale bar B. L, N: *Antarctissa strelkovi* Petrushevskaya, L- focused on outer part, 745B-1H-3, 13-15; N- focused on inner part, 745B-7H-1,88-90; scale bar C. M: *Saccospyris antarctica* Haecker, focused on cortical shell, 745B-4H-4, 13-15; scale bar C. O: *Phormospyris stabilis* (Goll) *antarctica* (Haecker) focused on cortical shell, 745B-2H-6,13-15; scale bar B.

Antarctissa strelkovi Petrushevskaya
(Fig. 4L, N)
1908 *Helotholus histricosa* Jørgensen - Popofsky; p. 279-281, Pl. 32, Fig. 1-5, Pl. 36, Fig. 2.
1968 *Antarctissa strelkovi* - Petrushevskaya; p. 88-90, Fig. 51, 111-V1.
Abundance: Very rare to common.
Range: Petrushevskaya (1975) reported its occurrence from Miocene-Recent, whereas Chen (1975a) and Keany (1979) showed its presence from Pliocene to Recent. Lazarus (2002) showed its occurrence from 0-2.5 Ma in the Antarctic region.

Family TRISSOCYCLIDAE Haeckel, 1881, *emend.* Goll, 1968 (= ACANTHODESMIIDAE Haeckel, 1862 in Riedel, 1971)
Genus *Phormospyris* Haeckel, 1881, *emend.* Goll, 1976

Phormospyris stabilis (Goll) ***antarctica*** (Haecker)
(Fig. 4O)
1907 *Phormospyris antarctica* - Haecker, p. 124, Fig. 9.
1976 *Phormospyris stabilis antarctica* (Haecker) - Goll, p. 394, Pl. 3, Figs. 1-6, Pl. 4, Figs. 1-9, Pl. 5, Figs. 3-6.
1979 *Phormospyris stabilis* (Goll) *antarctica* (Haecker) - Nigrini and Moore, p. N17, Pl. 20, Figs. 1a-d.
Distribution: Riedel (1958) considered this species to be an exclusively Southern cold water species. Lombari and Boden (1985) showed its presence in the Southern Antarctic region.
Abundance: Very rare to rare.
Range: Early Miocene to Recent (Chen, 1975b; Cortese and Abelmann, 2002).

Genus *Triceraspyris* Haeckel, 1881

Triceraspyris antarctica (Haecker)
(Fig. 5H, Q)
1908 *Triceraspyris antarctica* (Haecker) - Haecker, p. 445, Pl. 84, Fig. 586.
1967 *Triceraspyris* (?) *antarctica* (Haecker) - Petrushevskaya, p. 62-64, Fig. 37, I-III.
Distribution: Sharma and Takahashi (2008) reported it as a rare species in the Antarctic region.
Abundance: Very rare to few.
Range: Chen (1975a) Neogene; Petrushevskaya (1975) Miocene to Recent and Neogene (Keany1979). Lazarus (2002) showed its occurrence in the Antarctic region from 0 - 1.7 Ma.

Family THEOPERIDAE Haeckel, 1881**,** *emend.* Riedel, 1967
Genus *Cycladophora* Ehrenberg, 1872, *emend.* Lombari and Lazarus, 1988

Cycladophora davisiana Ehrenberg
(Figs. 5A, N)
1861 *Cycladophora davisiana* - Ehrenberg, p. 297.
1958 *Theocalyptra davisiana* (Ehrenberg) - Riedel, p. 239, Pl. 4, Figs. 2, 3, text-Fig. 10.
1967 *Cycladophora davisiana* Ehrenberg - Petrushevskaya, p. 122, Pl. 69, Fig. 1- V11.
Distribution: Riedel (1958) considered *C. davisiana* as a cosmopolitan species and showed its higher abundances in high latitudes compared to lower latitudes. Lombari and Boden (1985) showed its presence throughout the Southern Ocean region and also considered it as a cosmopolitan species. Stepanjants et al. (2006) reported it as a bipolar species.
Abundance: Very rare to few.
Range: Pliocene to Recent (Keany, 1979); Lazarus (2002) showed its range from 0 - 2.7 Ma

Cycladophora pliocenica (Hays)
(Figs. 5O, P)
1965 *Clathrocyclas bicornis* Hays, p. 179, Pl. 3, Fig.3.
1988 *Cycladophora pliocenica* (Hays) Lombari and Lazarus, p. 104.
Distribution: Keany and Kennett (1975) reported *C. bicornis* occurrences from Pliocene to Pleistocene sediments.
Abundance: Very rare.
Range: The last appearance of *Clathrocyclas bicornis* (Hays) (renamed *Cycladophora pliocenica* by Lombari and Lazarus, 1988) was noted by Hays and Opdyke (1967) within the Chi zone. Lazarus (1990) also reported its presence in the Chi zone.

Cycladophora robusta Lombari and Lazarus
(Figs. 4G, P)
1988 *Cycladophora robusta* - Lombari and Lazarus, p. 105, Pl. 2, Figs. 1-14.
Abundance: Very rare to common.
Range: Miocene (Lombari and Lazarus, 1988)

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

Eucyrtidium calvertense Martin
(Fig. 5I, K)
1904 *Eucyrtidium calvertense* - Martin, p. 450, Pl. 80, Fig. 5.
1990 *Eucyrtidium calvertense* Martin - Lazarus, p.716, Pl. 6, Figs. 4-6.
Distribution: Hays (1965) and Lazarus (1990) reported its presence in the Antarctic region.
Abundance: Very rare to rare.
Range: Pliocene (Chen, 1975a; Keany, 1979)

Genus *Pterocanium* Ehrenberg, 1847

Pterocanium trilobum (Haeckel)
(Fig. 5B, D, E)
1862 *Dictyopodium trilobum* - Haeckel, p. 340; Pl. 8, Figs. 6-10.
1887 *Pterocanium trilobum* - Haeckel, p. 1333.
1965 *Pterocanium trilobum* Haeckel - Hays, p. 177, Pl. 3, Fig. 10.
Distribution: *P. trilobum* was reported by Hays (1965) to be a cosmopolitan species.
Abundance: Very rare to rare.
Range: Hays (1965) showed its presence in the Phi zone.
Remarks: Popofsky (1913) and Nigrini and Moore (1979) reported this species from higher latitudes and mentioned the absence of spines on the thorax, whereas, in the studied material the species are dominantly with spines on the thorax.

Family CANNOBOTRYIDAE Haeckel, 1881
Genus *Saccospyris* Haecker, 1908

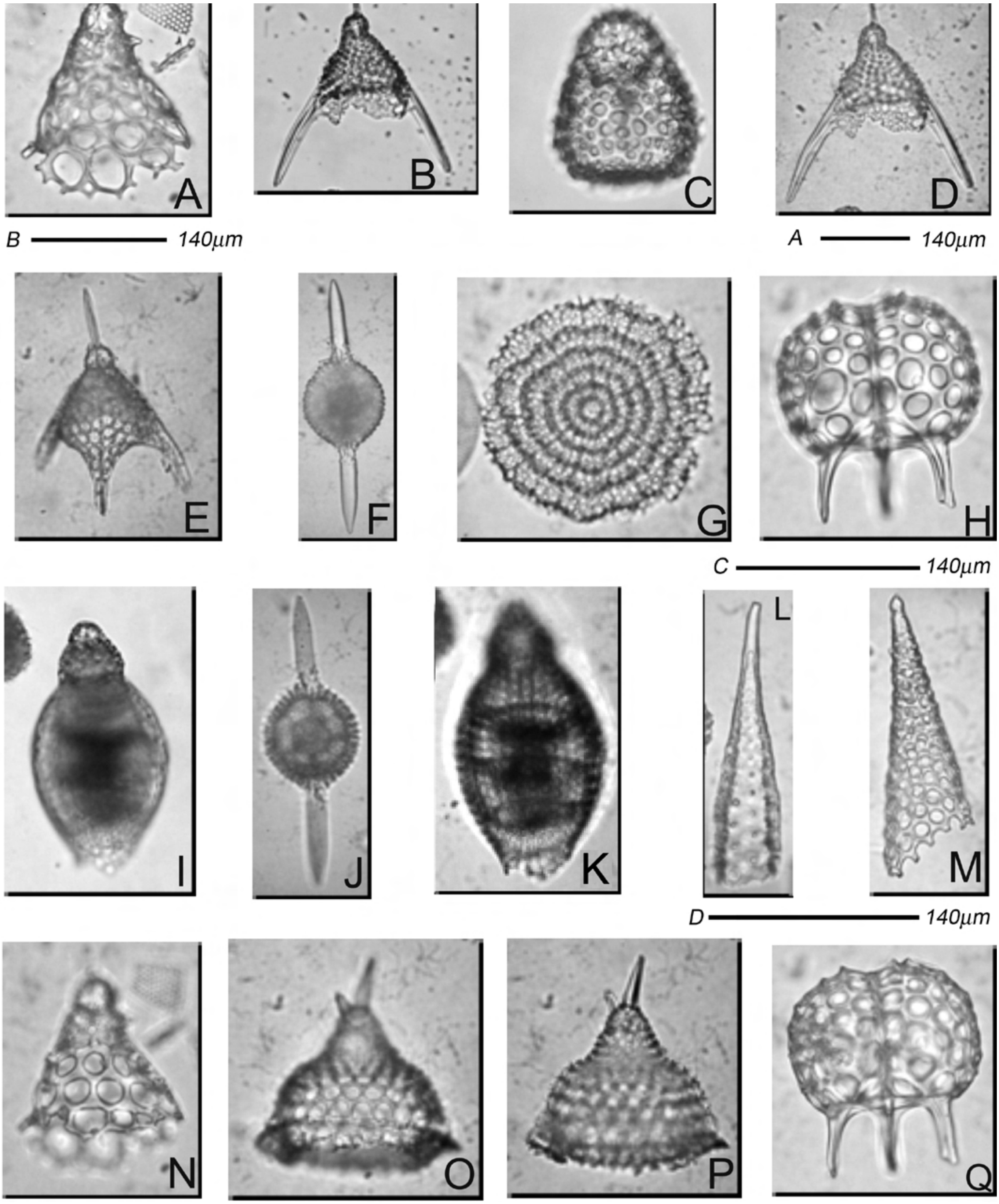

Fig. 5 - A, N: *Cycladophora davisiana* Ehrenberg, focused on outer and inner shell respectively, 745B-1H-2, 88-90; scale bar C. B, D, E: *Pterocanium trilobum* (Haeckel) B,D. focused on outer portion of the shell and inner shell portion respectively, 745B-7H-1, 88-90; scale bar C and A; E. focused on outer shell; 745B-8H-1, 85-87; scale bar C. C: *Antarctissa denticulata* (Ehrenberg), focused on outer portion, 745B-2H-6, 13-15; scale bar B. F, J: *Stylatractus universus* Hays, focused on cortical and medullary shell respectively, 745B-5H-3,13-15; scale bar C. G: *Stylodictya aculeata* Jørgensen, focused on medullary shell, 745B-8H-2, 88-90; scale bar C. H, Q: *Triceraspyris antarctica* (Haecker), focused on outer and inner shell respectively; 745B-7H-1, 88-90; scale bar C. I, K: *Eucyrtidium calvertense* Martin, focused on outer and inner portion respectively; 745B-11H-7, 5-7; scale bar C. L, M: *Cornutella profunda* Ehrenberg, L- focused on cortical shell, 745B-8H-2, 88-90; scale bar C; M- focused on cortical shell, 745B-6H-2, 88-90; scale bar C. O, P: *Cycladophora pliocenica* (Hays) focused on outer and inner shell portions respectively,745B-10H-6, 88-90; scale bar C.

Saccospyris antarctica Haecker
(Fig. 4M)

1908 *Saccospyris antarctica* - Haecker, p. 447, Pl. 84, Figs. 584, 589, 590.

1975 *Saccospyris antarctica* Haecker - Petrushevskaya, p. 589, Pl. 13, Figs. 21, 28.

Abundance: Very rare to rare.

Range: Pliocene-Pleistocene (Petrushevskaya, 1975). Lazarus (2002) showed its range from 0 - 1.7 Ma.

RADIOLARIAN BIOSTRATIGRAPHY

Four radiolarian zones, namely Phi (Φ), the older, Chi (X), Psi (Ψ) and Omega (Ω), the younger, have been recognized (Fig. 3) on the basis of their last appearance, consistent appearance and highest common occurrences of radiolarian species.

Phi (Φ) Zone

Lazarus (1992) defined the base of the Phi Zone (2.3 - 1.85 Ma) as the last occurrence of *Helotholus vema* Lazarus and its top as the last presence of *Eucyrtidium calvertense* Martin. In the studied sequence, the top of this zone is placed at sample 745B-11H-1, 17-19 (90.67 m), on the basis of the last occurrence of *E. calvertense*, with its abundance being from very rare to rare. This sample therefore also marks the boundary between the Phi and Chi Zones, and hence it is assigned the age of 1.85 Ma.

However, Caulet (1991) considered this Zone as equivalent to the NR5 Zone = *Eucyrtidium calvertense* Zone.

Chi (X) Zone

The base of the Chi Zone (1.85 - 0.8 Ma) was defined as the last appearance of *Eucyrtidium calvertense* Martin and its top as the last appearance of *Pterocanium charybdeum trilobum* (Haeckel). Furthermore, this Zone was divided into two subzones (Lower and Upper) by the last appearance of *Cycladophora pliocenica* (Hays) Lombari and Lazarus at 1.7 Ma. The first appearance of *Triceraspyris antarctica* (Haecker) however, occurs within or at the base of this zone at ~ 1.8 Ma. In the studied sequence, the base of the Chi Zone is marked at 745B-11H-1, 17-19 (90.67 m) on the basis of the last appearance of *E. calvertense*, while its top is placed at sample 745B-4H-5, 88-90 (30.88 m), on the basis of the last appearance of *P.c. trilobum*.

P.c. trilobum shows its abundance from very rare to rare from sample 745B-10H-7, 13-15 (90.13 m) to sample 745B-4H-5, 88-90 (30.88 m). The Chi Zone is further subdivided into a lower and upper part based on the last appearance of *C. pliocenica* in sample 745B-10H-4, 13-15 (85.63 m). This species abundance is very rare from 745B-11H-7,5-7 (99.55 m) to 745B-10H-4, 13-15 (85.63 m), whereas the upper part of this zone starts from 745B-10H-4, 13-15 (85.63 m) to 745B-4H-5, 88-90 (30.88 m). However, *T. antarctica* makes its first appearance within or near the base of the Chi Zone in sample 745B-10H-7, 13-15 (90.13 m) at 1.8 Ma. *T. antarctica* is rare to few. The base of the Chi Zone occurs in sample 745B-10H-4, 13-15 (85.63 m) and its age is 1.85 Ma, whereas the upper part of this Zone is observed in sample 745B-4H-5, 88-90 (30.88 m) and its age is 0.8 Ma.

Caulet (1991) named this zone as NR3/4, which is equivalent to the *Saturnalis circularis* Zone of Chen (1975a) in part.

Psi (Ψ) Zone

Lazarus (1992) defined the base of the Psi Zone (0.8 - 0.4 Ma) on the basis of the last appearance of *Pterocanium charybdeum trilobum* (Haeckel) and its top as the last occurrence of *Stylatractus universus* Hays. In the studied core, the base of Psi Zone is identified at sample 745B-4H-5, 88-90 (30.88 m) on the basis of the last appearance of *P. c. trilobum*, whose abundance varied from very rare to rare in sample 745B-10H-7, 13-15 (90.13 m) to 745B-4H-5, 88-90 (30.88 m). The top of the Psi Zone is assigned to sample 745B-2H-2,13-15 (6.63 m), and *S. universus* occurs as very rare to few.

However, Caulet (1991) mentioned this Zone as corresponding in part to NR2, and in part to the *Stylatractus universus* Zone of Chen (1975a).

Omega (Ω) Zone

The base of the Omega Zone (0.4 - 0 Ma) is defined by Lazarus (1992) as corresponding to the last appearance of *Stylatractus universes* Hays. In the studied samples, its last appearance is in sample 745B-2H-2,13-15 (6.63 m), where this species is very rare. In the older portion of the section, this species sporadically occurs as rare to few.

Furthermore, Petrushevskaya (1986) marked the last appearance of the Omega Zone as corresponding to the last common occurrence of the species *Antarctissa cylindrica* Petrushevskaya at ~ 0.6 Ma, and considered it as a very useful marker for the Late Pleistocene. In the upper part of the section its presence is common to rare.

Caulet (1991) named this zone *Antarctissa denticulata* Zone (Chen). However, he marked the boundary between the NR1 and NR2 Zones in sample 745B-3H-2, 53-55 (16.5 m), whereas in the studied section it lies at 6.63 mbsf in sample 745B-2H-2, 13-15.

Reworking

Minor reworking is observed throughout the sequence, and is responsible for bringing older species into the younger Pliocene and Pleistocene part of the sequence. One specie (*Cycladophora robusta*), is present.

Pliocene-Pleistocene Boundary

Caulet (1991) identified the Pliocene - Pleistocene boundary between NR4/NR5 on the basis of the last appearance of *Cycladophora pliocenica* (Hays) between sample 119-745B-10H-3, 53-55 at a depth of 84.5 mbsf and sample 119-745B-10H-4, 53-55 at a depth of 86 mbsf, and estimated the age to be between 1.71-1.75 Ma. In the studied sequence, the boundary is identified in sample 745B-10H-4, 13-15, at a depth of 85.63 mbsf, due to the total absence of *C. pliocenica* in younger samples (Fig. 3).

DISCUSSION AND CONCLUSION

A comparison of the radiolarian zones recognized at ODP Leg119 Site 745 with the same sample setas Caulet (1991) has been made (Table 2). The top of the NR5 Zone and the base of NR3/4 are identified in sample 745B-10H-4, 13-15 at a depth of 85.63 mbsf whereas the top of NR3/NR4 and the base of the NR2 Zone are placed at sample 745B-4H-5, 88-90, at a depth of 30.88 mbsf. The top of NR2 Zone

Table 2 - A Comparison of the radiolarian zonal scheme of the present work from ODP Leg 119, Site 745, with Caulet (1991).

Epoch	Caulet (1991)			Present work (Leg 119, Site 745)		
	Radiolarian Zone	Hole,Core, Section, Interval	Depth (mbsf)	Radiolarian Zone after Lazarus(1992) of Antarctic region	Hole,Core, Section, Interval	Depth (mbsf)
Pleistocene	NR 1			OMEGA		
	Stylatractus universus	745B-3H-2, 53-55	16.5 (mbsf)	*Stylatractus universus*	745B-2H-2, 13-15	6.63 (mbsf)
	NR 2			PSI		
	Phormostichoartus pitomorphus	745B-5H-2, 53-55	35.5 (mbsf)	*Pterocanium charybdeum trilobum*	745B-4H-5, 88-90	30.88 (mbsf)
	NR3/4			CHI: UPPER CHI		
	Cycladophora pliocenica	745B-10H-3, 52-55	84.5 (mbsf)	*Cycladophora pliocenica*	745B-10H-4, 13-15	85.63 (mbsf)
Pliocene	NR 5			CHI: LOWER CHI		
				Eucyrtidium calvertense	745B-11H-1, 17-19	90.67 (mbsf)
				PHI		

and the base of the NR1 are recognized at sample 745B-2H-2, 13-15 at a depth of 6.63 mbsf.

Sections 1H to11H from ODP Leg 119, Site 745 are found to range in age from ~ 0 to 1.85 Ma. The Pliocene - Pleistocene boundary in the sequence is found in sample 745B-10H-4, 13-15, at a depth of 85.63 mbsf, which is slightly younger than what found by Caulet (1991).

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Table 1 - Occurrences of radiolarian species in the studied samples (ODP Leg 119, Site 745).

	Serial no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Sample Name(Hole,Core,Section,Interval(cm)745B	1H-1,13-15	1H-1,88-90	1H-2,13-15	1H-2,88-90	1H-3,13-15	1H-3,89-91	1H-4,13-15	2H-1,43-45	2H-1,96-98	2H-2,13-15	2H-2,88-90	2H-3,13-15	2H-3,88-90	2H-4,13-15	2H-4,88-90	2H-5,13-15	2H-5,88-90	2H-6,13-15
B	Depth (mbsf)	0.13	0.88	1.63	2.38	3.13	3.89	4.63	5.43	5.96	6.63	7.38	8.13	8.88	9.63	10.38	11.13	11.88	12.63
C	Total counts	883	1091	955	1041	1099	1024	630	1064	1000	1021	1006	1100	1044	1013	1145	1043	1006	1066
D	Age				P	L	E	I	S	T	O	C	E	N	E				
E	Radiolarian Zone			O	M	E	G	A						P	S	I			
F	Percentage	42.69	42.68	28.69	31.7	31.21	34.66	19.68	22.46	11.6	20.17	23.45	38.09	31.22	20.63	31.09	19.07	22.16	26.54
G	Abundance	A	A	A	A	A	A	C	A	C	A	A	A	A	A	A	C	A	A
H	Preservation	P	G	M	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
	Name of Species																		
1	*Acanthosphaera* sp.	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
2	*Acrosphaera* sp. cf. *A. spinosa echinoides*	F	F	+	-	R	+	+	R	-	-	F	F	F	+	F	F	R	F
3	*Acrosphaera* sp. A.	F	F	+	R	R	R	+	-	R	+	-	R	-	R	+	-	-	+
4	*Acrosphaera* sp. B.	R	-	+	R	R	R	+	-	-	+	-	+	-	-	-	+	-	-
5	*Actinomma antarcticum*	F	F	F	R	F	F	-	F	F	R	R	+	F	F	F	F	F	+
6	*Actinomma leptodermum*	-	+	R	R	R	+	-	+	-	-	R	-	+	+	R	-	-	-
7	*Antarctissa cylindrical*	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	C	F	C
8	*Antarctissa denticulate*	C	C	F	F	C	C	F	F	F	F	F	F	F	F	C	C	C	C
9	*Antarctissa strelkovi*	F	C	F	C	C	C	F	F	+	F	F	F	C	F	C	F	F	C
10	*Artostrobus annulatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	*Bathropyramis* sp.	-	-	R	+	-	R	-	+	-	-	-	+	R	-	-	-	-	+
12	*Botryostrobus aquilonaris*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
13	*Botryostrobus auritus-australis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	*Botryostrobus* sp. cf. *B. auritus-australis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	*Botryostrobus* sp. A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
16	*Botryostrobus* sp. B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
17	*Cenosphaera cristata*	R	-	-	-	-	+	-	-	-	-	R	-	-	-	R	+	+	+
18	*Cenosphaera* sp. 1	+	+	+	R	-	+	-	R	-	-	+	+	+	-	+	-	-	-
19	*Cenosphaera* sp. 2	-	R	R	-	+	+	-	R	F	R	-	-	+	+	R	-	R	+
20	*Cornutella profunda*	+	-	-	R	+	-	-	-	-	-	-	-	-	-	+	-	-	-
21	*Cycladophora bicornis amphora*	F	F	R	-	-	F	-	R	-	R	+	-	+	+	+	-	-	+
22	*Cycladophora bicornis bicornis*	-	F	-	-	-	+	-	+	-	R	-	-	-	-	-	-	-	-
23	*Cycladophora* sp.cf. *C. cabrilloensis subhumerus*	-	R	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
24	*Cycladophora* sp.cf. *C. cosma irregularis*	-	-	R	R	-	-	-	+	+	-	+	-	+	-	-	-	+	-
25	*Cycladophora davisiana*	+	F	R	F	F	F	F	+	-	+	+	F	R	-	R	+	R	+

Table 1 *(continued)*

	Serial no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Sample Name(Hole,Core,Section,Interval(cm)745B	1H-1,13-15	1H-1,88-90	1H-2,13-15	1H-2,88-90	1H-3,13-15	1H-3,89-91	1H-4,13-15	2H-1,43-45	2H-1,96-98	2H-2,13-15	2H-2,88-90	2H-3,13-15	2H-3,88-90	2H-4,13-15	2H-4,88-90	2H-5,13-15	2H-5,88-90	2H-6,13-15
B	Depth (mbsf)	0.13	0.88	1.63	2.38	3.13	3.89	4.63	5.43	5.96	6.63	7.38	8.13	8.88	9.63	10.38	11.13	11.88	12.63
C	Total counts	883	1091	955	1041	1099	1024	630	1064	1000	1021	1006	1100	1044	1013	1145	1043	1006	1066
D	Age				**P**	**L**	**E**	**I**	**S**	**T**	**O**	**C**	**E**	**N**	**E**				
E	Radiolarian Zone			**O**	**M**	**E**	**G**	**A**						**P**	**S**	**I**			
F	Percentage	42.69	42.68	28.69	31.7	31.21	34.66	19.68	22.46	11.6	20.17	23.45	38.09	31.22	20.63	31.09	19.07	22.16	26.54
G	Abundance	A	A	A	A	A	A	C	A	C	A	A	A	A	A	A	C	A	A
H	Preservation	P	G	M	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
26	*Cycladophora pliocenica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	*Cycladophora robusta*	F	F	F	F	F	F	F	F	-	F	F	F	F	-	F	F	R	F
28	*Cyrtopera laguncula*	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	*Dictyophimus mawsoni*	-	-	-	-	-	-	-	-	-	-	+	-	R	-	-	+	-	+
30	*Eucyrtidium calvertense*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	*E. acuminatum octocolum*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	*Haliommetta miocenica*	-	-	F	F	F	R	-	R	R	-	R	F	F	F	F	R	+	+
33	*Heliosoma* sp.	-	+	-	+	-	R	-	-	-	+	-	+	+	-	-	-	-	-
34	*Hymeniastrum* sp.	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
35	*Litharachnium* sp. aff. *L. tentorium*	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	*Lithelius minor*	R	F	F	F	F	F	-	-	-	+	F	F	F	R	F	F	F	F
37	*Lithelius nautiloides*	F	F	F	F	F	F	R	F	-	F	F	F	F	F	F	F	F	F
38	*Lithocampe platycephala*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	*Lithomitra arachnea*	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
40	*Mitrocalpis araneafera*	-	-	-	-	-	-	-	-	-	+	+	+	R	-	R	-	-	-
41	*Octopyle stenozona*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	*Perichlamydium limbatum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	*Peripyramis circumtexta*	R	R	+	F	F	R	+	+	-	+	F	F	R	-	R	-	-	-
44	*Phormospyris stabilis antarctica*	R	R	+	-	-	+	-	R	-	-	-	+	-	-	+	+	R	R
45	*Phormostichoartus* sp. cf. *P. fistula*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-
46	*Phorticium clevei*	F	R	-	-	-	R	-	R	-	-	+	R	-	-	-	-	-	+
47	*Phorticium pylonium (clevei)*	F	F	-	-	+	R	+	R	-	R	R	F	R	+	R	R	R	R
48	*Plectacantha oikiskos*	-	-	-	+	-	+	+	-	-	-	-	-	-	-	+	-	-	-
49	*Plectopyramis dodecomma*	-	-	-	-	-	R	-	-	-	-	-	+	-	-	-	-	-	-
50	*Porodiscus* sp.	+	+	-	+	+	R	+	+	-	+	-	-	-	-	+	+	+	-
51	*Prunopyle antarctica*	F	F	F	F	F	F	R	R	-	+	-	+	-	+	R	F	R	+

Table 1 *(continued)*

	Serial no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	Sample Name(Hole,Core,Section,Interval(cm)745B	1H-1,13-15	1H-1,88-90	1H-2,13-15	1H-2,88-90	1H-3,13-15	1H-3,89-91	1H-4,13-15	2H-1,43-45	2H-1,96-98	2H-2,13-15	2H-2,88-90	2H-3,13-15	2H-3,88-90	2H-4,13-15	2H-4,88-90	2H-5,13-15	2H-5,88-90	2H-6,13-15
B	Depth (mbsf)	0.13	0.88	1.63	2.38	3.13	3.89	4.63	5.43	5.96	6.63	7.38	8.13	8.88	9.63	10.38	11.13	11.88	12.63
C	Total counts	883	1091	955	1041	1099	1024	630	1064	1000	1021	1006	1100	1044	1013	1145	1043	1006	1066
D	Age				**P**	**L**	**E**	**I**	**S**	**T**	**O**	**C**	**E**	**N**	**E**				
E	Radiolarian Zone			**O**	**M**	**E**	**G**	**A**						**P**	**S**	**I**			
F	Percentage	42.69	42.68	28.69	31.7	31.21	34.66	19.68	22.46	11.6	20.17	23.45	38.09	31.22	20.63	31.09	19.07	22.16	26.54
G	Abundance	A	A	A	A	A	A	C	A	C	A	A	A	A	A	A	C	A	A
H	Preservation	P	G	M	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
52	*Prunopyle* sp.	F	F	+	R	F	F	F	-	-	+	+	R	F	+	F	F	R	+
53	*Pterocanium* sp. cf. *P. praetextum eucolpum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	*Pterocanium* sp. cf. *P. praetextum. praetextum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	*Pterocanium trilobum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	*Saccospyris antarctica*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	*Saccospyris preantarctica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	*Saturnalis circularis*	-	-	-	-	-	+	-	-	-	+	+	-	-	-	-	-	-	-
59	*Saturnalis* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	*Spongaster tetras irregularis*	R	F	R	F	F	F	F	-	-	-	+	R	R	+	+	+	R	+
61	*Spongocore* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-
62	*Spongopyle osculosa*	F	F	+	R	+	R	-	F	+	R	F	F	F	+	F	F	F	R
63	*Spongotrochus glacialis*	C	C	C	F	C	F	F	C	F	F	C	C	C	F	C	F	F	F
64	*Spongurus* ? sp.	+	R	+	R	R	R	R	-	-	-	+	F	+	+	F	+	R	+
65	*Spongurus pylomaticus*	F	F	F	F	F	F	F	F	-	-	F	F	F	+	F	F	R	R
66	*Spongurus* sp.	F	R	R	R	F	F	R	F	+	-	R	F	R	+	R	R	R	F
67	*Stylatractus* sp.	+	+	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
68	*Stylatractus* spp.	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
69	*Stylatractus universes*	-	-	-	-	-	-	-	-	-	+	R	-	+	-	-	-	-	+
70	*Stylochlamydium venustum*	+	+	-	-	-	+	-	-	-	-	-	-	R	+	-	-	+	R
71	*Stylodictya aculeate*	-	F	-	R	R	R	R	+	+	R	-	R	R	-	+	+	R	-
72	*Stylodictya validispina*	R	F	-	-	F	R	+	-	-	-	+	R	R	-	R	-	R	+
73	*Tetrapyle octacantha*	-	-	-	+	-	-	-	+	-	-	+	+	-	-	-	-	-	-
74	*Theoconus zancleus*	-	-	+	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-
75	*Triceraspyris Antarctica*	+	+	R	F	R	R	R	+	+	+	+	R	-	+	R	+	-	R
76	*Zygocircus* sp. cf. *Z. productus capulosus*	+	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
77	*Zygocircus* sp.	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-

Table 1 (continued)

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
A	2H-6,93-95	2H-7,11-13	3H-1,33-35	3H-1,91-93	3H-2,13-15	3H-2,88-90	3H-3,13-15	3H-3,87-89	3H-4,13-15	3H-4,88-90	3H-5,13-15	3H-5,88-90	3H-6,13-15	3H-6,87-89	3H-7,13-15	4H-1,60-62	4H-1,121-123	4H-2,13-15	4H-2,95-97	4H-3,13-15	4H-3,88-90	4H-4,13-15	4H-4,93-95
B	13.43	14.11	14.83	15.41	16.13	16.88	17.63	18.37	19.13	19.88	20.63	21.38	22.13	22.88	23.63	24.6	25.21	25.63	26.45	27.13	27.88	28.63	29.43
C	1055	1009	1017	1100	1050	1015	1216	1065	1011	1040	1121	995	1228	1075	1170	1070	994	1200	1100	1046	1012	1200	1150
D							P	L	E	I	S	T	O	C	E	N	E						
E											P	S	I										
F	21.42	22.89	13.07	17.81	16.47	11.42	10.03	9.85	18.49	19.51	15.61	15.77	10.99	10.51	11.88	12.8	11.46	10.16	11.36	15.25	12.74	13.58	14.6
G	A	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	G	G	M	G	G	G	G	M	G	G	G	G	G	G
1	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
2	-	-	R	R	R	R	-	-	-	R	R	R	R	R	R	-	R	R	+	R	+	+	R
3	+	-	-	+	-	+	+	-	-	-	-	-	-	+	-	+	-	-	+	-	-	-	-
4	-	-	-	+	+	-	+	+	-	+	-	+	-	-	+	-	-	-	-	-	-	-	-
5	F	-	-	-	-	R	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	R	R
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	F	C	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
8	F	F	F	F	C	F	F	F	C	F	F	C	F	F	F	F	F	F	F	F	F	F	F
9	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	+	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	R	+
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	R	R	-	-	R	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	R	-	-	+	-	-	-	-	-	-	-	-	R	+	-	+	-	-	-	-	-	-
20	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	R	+	-	R	+	+	-	-	-	+	-	+	-	+	-	-	+	-	+	R	-	R	+
22	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	+	+
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
24	-	+	+	+	-	-	-	-	-	R	-	+	-	-	-	-	+	-	-	+	-	+	R
25	+	R	R	R	+	+	+	+	F	R	+	-	-	-	+	-	R	+	-	+	+	R	R

Table 1 *(continued)*

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
A	2H-6,93-95	2H-7,11-13	3H-1,33-35	3H-1,91-93	3H-2,13-15	3H-2,88-90	3H-3,13-15	3H-3,87-89	3H-4,13-15	3H-4,88-90	3H-5,13-15	3H-5,88-90	3H-6,13-15	3H-6,87-89	3H-7,13-15	4H-1,60-62	4H-1,121-123	4H-2,13-15	4H-2,95-97	4H-3,13-15	4H-3,88-90	4H-4,13-15	4H-4,93-95
B	13.43	14.11	14.83	15.41	16.13	16.88	17.63	18.37	19.13	19.88	20.63	21.38	22.13	22.88	23.63	24.6	25.21	25.63	26.45	27.13	27.88	28.63	29.43
C	1055	1009	1017	1100	1050	1015	1216	1065	1011	1040	1121	995	1228	1075	1170	1070	994	1200	1100	1046	1012	1200	1150
D							P	L	E	I	S	T	O	C	E	N	E						
E											P	S	I										
F	21.42	22.89	13.07	17.81	16.47	11.42	10.03	9.85	18.49	19.51	15.61	15.77	10.99	10.51	11.88	12.8	11.46	10.16	11.36	15.25	12.74	13.58	14.6
G	A	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	G	G	M	G	G	G	G	M	G	G	G	G	G	G
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	R	F	F	F	F	R	R	F	F	F	F	F	R	+	R	F	F	F	F	F	F	F	F
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	+	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	+	-	-	-	-	-	-	+	-	-	-	+	-	-	R	+	-	-	-	-	-	-	R
33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	F	F	+	+	R	R	+	R	+	R	R	R	R	R	R	R	R	+	+	-	R	R	R
37	F	F	R	F	R	R	R	F	+	R	R	R	+	F	R	R	F	R	+	F	F	F	R
38	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	R	+	+	+	-	+	-	-	-	+	-	-	-	R	-	+	-	+	R	R
41	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
43	-	-	+	R	R	R	R	-	R	R	R	R	-	-	-	-	-	-	-	+	-	-	+
44	-	-	-	-	R	-	R	+	-	R	-	-	-	-	-	-	+	+	-	+	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	+	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	+	-	-	-
47	R	+	-	+	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	+	+	+	+	+	-	+	-	+	-	-	-	-	-	-	-	-	+	+	-
49	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	+	+	-	-	-	-	-	+	-	-	-	-	-	-	+	-	+	-	-	-
51	+	-	R	R	R	R	+	R	+	R	+	-	-	R	R	+	-	-	+	R	+	R	R

Table 1 *(continued)*

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
A	2H-6,93-95	2H-7,11-13	3H-1,33-35	3H-1,91-93	3H-2,13-15	3H-2,88-90	3H-3,13-15	3H-3,87-89	3H-4,13-15	3H-4,88-90	3H-5,13-15	3H-5,88-90	3H-6,13-15	3H-6,87-89	3H-7,13-15	4H-1,60-62	4H-1,121-123	4H-2,13-15	4H-2,95-97	4H-3,13-15	4H-3,88-90	4H-4,13-15	4H-4,93-95
B	13.43	14.11	14.83	15.41	16.13	16.88	17.63	18.37	19.13	19.88	20.63	21.38	22.13	22.88	23.63	24.6	25.21	25.63	26.45	27.13	27.88	28.63	29.43
C	1055	1009	1017	1100	1050	1015	1216	1065	1011	1040	1121	995	1228	1075	1170	1070	994	1200	1100	1046	1012	1200	1150
D							**P**	**L**	**E**	**I**	**S**	**T**	**O**	**C**	**E**	**N**	**E**						
E											**P**	**S**	**I**										
F	21.42	22.89	13.07	17.81	16.47	11.42	10.03	9.85	18.49	19.51	15.61	15.77	10.99	10.51	11.88	12.8	11.46	10.16	11.36	15.25	12.74	13.58	14.6
G	A	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	G	G	M	G	G	G	G	M	G	G	G	G	G	G
52	R	R	+	R	+	R	+	-	+	-	-	-	-	+	-	-	+	+	+	+	R	+	R
53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	-	-	+	-	-	-	-	-	+	-	R	-	+	+	+	+	-	R	-	-	+	+	+
57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	+	+
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	R	-	+	+	-	-	-	+	+		-	-	-	+	-	+	R	R	R	-	-	R
61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	F	F	R	F	R	R	-	R	R	R	F	F	R	F	F	R	+	+	-	R	R	R	R
63	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
64	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	F	R	R	F	R	+	+	R	+	R	R	+	-	-	-	F	R	-	+	R	R	+	R
66	R	+	+	R	R	R	-	-	+	-	R	+	R	-	+	R	+	R	R	R	R	+	R
67	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
68	-	-	-	-	-	+	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-
69	-	-	-	+	-	-	R	-	-	+	+	+	-	-	+	F	R	F	F	R	R	R	F
70	R	-	-	-	-	+	-	-	-	+	-	-	+	-	-	-	R	-	R	R	+	F	R
71	+	R	+	R	+	-	+	-	R	R	R	F	R	+	+	+	-	R	R	R	R	-	R
72	-	+	+	+	+	-	-	+	R	R	R	F	R	+	R	+	+	R	R	R	R	R	R
73	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	+	+	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	+	R	R	+	R	+	R	F	R	R	R	+	+	-	-	+	R	-	-	+	R	-	-
76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1 *(continued)*

	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
A	4H-5,13.5-15.5	4H-5,88-90	4H-6,13-15	4H-6,88-90	4H-7,12.5-14.5	5H-1,88-90	5H-2,13-15	5H-2,85-87	5H-3,13-15	5H-3,87-89	5H-4,13-15	5H-4,84.5-86.5	5H-5,13-15	5H-5,88-90,	5H-6,13-15	5H-6,88-90	5H-7,13-15	6H-1,88-90	6H-2,12-14	6H-2,88-90	6H-3,13-15	6H-3,88-90	6H-4,12-14	6H-4,88-90
B	30.14	30.88	31.63	32.38	33.12	34.38	35.13	35.85	36.63	37.37	38.13	38.85	39.63	40.38	41.13	41.88	42.63	43.88	44.62	45.38	46.13	46.88	47.62	48.38
C	1000	1000	1014	1044	943	1100	1050	1094	1096	1019	1068	1031	1129	1100	1000	1065	905	876	1075	1100	1017	1040	1000	1021
D							**P**	**L**	**E**	**I**	**S**	**T**	**O**	**C**	**E**	**N**	**E**							
E	**PSI**							**U**	**P**	**P**	**E**	**R**		**C**	**H**	**I**								
F	13.9	12.3	12.62	14.94	12.3	20	18.85	18.55	23.26	22.57	21.06	23.47	25.33	19.18	17.9	20.93	19.22	14.8	16.74	12.45	16.91	20.38	16.2	15.86
G	C	C	C	C	C	A	C	C	A	A	A	A	A	C	C	A	C	C	C	C	C	A	C	C
H	G	G	G	G	M	G	G	G	G	G	G	G	G	G	G	G	M	P	G	G	G	G	G	G
1	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-
2	-	+	-	-	-	R	R	-	R	R	+	-	+	R	+	R	-	-	+	-	+	F	R	R
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+
4	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	+	-
5	R	-	-	F	-	-	-	+	R	-	-	+	-	-	-	-	+	R	-	-	-	+	+	+
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	F	F	F
8	F	F	F	F	F	F	F	C	F	F	C	F	F	F	F	F	F	F	F	F	F	F	F	F
9	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
10	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	R	+	-	+	-	+	R	-	+	+	+	+	+	-	+	-	-	-	-	+	-	R	+	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
17	+	-	-	-	+	+	R	-	+	-	-	+	-	-	R	+	+	R	R	+	-	R	R	+
18	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-
19	-	-	-	-	-	+	-	+	R	-	-	-	-	-	-	-	-	R	+	+	-	+	-	-
20	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-
21	-	R	R	+	R	-	+	R	R	+	+	-	R	R	-	R	+	-	-	-	+	-	+	R
22	+	+	+	-	-	+	-	+	-	-	-	-	+	-	-	R	-	-	-	-	-	-	-	-
23	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
24	R	+	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	+	+	+	-	-
25	R	R	+	-	R	R	R	-	-	R	R	R	F	R	F	F	F	R	F	R	R	R	R	R

Table 1 *(continued)*

	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
A	4H-5,13.5-15.5	4H-5,88-90	4H-6,13-15	4H-6,88-90	4H-7,12.5-14.5	5H-1,88-90	5H-2,13-15	5H-2,85-87	5H-3,13-15	5H-3,87-89	5H-4,13-15	5H-4,84.5-86.5	5H-5,13-15	5H-5,88-90,	5H-6,13-15	5H-6,88-90	5H-7,13-15	6H-1,88-90	6H-2,12-14	6H-2,88-90	6H-3,13-15	6H-3,88-90	6H-4,12-14	6H-4,88-90
B	30.14	30.88	31.63	32.38	33.12	34.38	35.13	35.85	36.63	37.37	38.13	38.85	39.63	40.38	41.13	41.88	42.63	43.88	44.62	45.38	46.13	46.88	47.62	48.38
C	1000	1000	1014	1044	943	1100	1050	1094	1096	1019	1068	1031	1129	1100	1000	1065	905	876	1075	1100	1017	1040	1000	1021
D							P	L	E	I	S	T	O	C	E	N	E							
E	PSI							U	P	P	E	R		C	H	I								
F	13.9	12.3	12.62	14.94	12.3	20	18.85	18.55	23.26	22.57	21.06	23.47	25.33	19.18	17.9	20.93	19.22	14.8	16.74	12.45	16.91	20.38	16.2	15.86
G	C	C	C	C	C	A	C	C	A	A	A	A	A	C	C	A	C	C	C	C	C	A	C	C
H	G	G	G	G	M	G	G	G	G	G	G	G	G	G	G	G	M	P	G	G	G	G	G	G
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	F	F	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
28	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	+	-	R	+	+	R	+	+	R	+	+	+	R	+	R	R	R	+	+
33	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	+
34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	R	-	+	F	F	+	R	R	R	R	R	F	F	F	F	F	F	F	F	F	R	R	R	R
37	R	R	R	F	+	+	R	R	R	F	+	R	R	-	+	R	F	-	R	+	F	R	R	R
38	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
40	R	R	-	+	-	R	-	-	-	-	+	-	-	+	-	-	-	-	-	+	+	+	R	R
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
42	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	+	+	-	+	-	+	+	+	+	R	R	-	+	+	R	-	-	-	-	+	+	R	-	+
44	-	-	-	-	-	+	-	-	+	-	-	+	+	-	-	-	-	-	-	-	+	R	+	+
45	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	+	-	-	R	+	+	+	+	-	+	+	-	-	-	-	R	R	-	+	-	R	R
47	-	-	-	-	-	+	-	+	R	+	+	-	R	-	+	-	+	R	R	+	-	R	R	R
48	-	-	-	-	-	+	-	-	+	R	R	+	-	-	-	-	-	R	-	-	+	R	R	R
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
50	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	+	-	-
51	R	R	R	R	+	+	R	R	R	R	R	R	R	R	R	+	+	R	R	R	F	+	R	R

Table 1 *(continued)*

	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
A	4H-5,13.5-15.5	4H-5,88-90	4H-6,13-15	4H-6,88-90	4H-7,12.5-14.5	5H-1,88-90	5H-2,13-15	5H-2,85-87	5H-3,13-15	5H-3,87-89	5H-4,13-15	5H-4,84.5-86.5	5H-5,13-15	5H-5,88-90,	5H-6,13-15	5H-6,88-90	5H-7,13-15	6H-1,88-90	6H-2,12-14	6H-2,88-90	6H-3,13-15	6H-3,88-90	6H-4,12-14	6H-4,88-90
B	30.14	30.88	31.63	32.38	33.12	34.38	35.13	35.85	36.63	37.37	38.13	38.85	39.63	40.38	41.13	41.88	42.63	43.88	44.62	45.38	46.13	46.88	47.62	48.38
C	1000	1000	1014	1044	943	1100	1050	1094	1096	1019	1068	1031	1129	1100	1000	1065	905	876	1075	1100	1017	1040	1000	1021
D							**P**	**L**	**E**	**I**	**S**	**T**	**O**	**C**	**E**	**N**	**E**							
E	**PSI**							**U**	**P**	**P**	**E**	**R**		**C**	**H**	**I**								
F	13.9	12.3	12.62	14.94	12.3	20	18.85	18.55	23.26	22.57	21.06	23.47	25.33	19.18	17.9	20.93	19.22	14.8	16.74	12.45	16.91	20.38	16.2	15.86
G	C	C	C	C	C	A	C	C	A	A	A	A	A	C	C	A	C	C	C	C	C	A	C	C
H	G	G	G	G	M	G	G	G	G	G	G	G	G	G	G	G	M	P	G	G	G	G	G	G
52	R	+	-	R	+	-	R	-	-	-	-	-	+	-	-	-	-	-	-	+	R	R	R	-
53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
55	-	+	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	+	+	+	-	-
56	-	-	-	-	-	+	R	R	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-
57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	-	-	R	R	-	-	-	+	R	+	-	-	-	+	+	+	-	-	-	-	R	F	F	R
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
60	R	+	+	+	R	R	R	R	R	R	F	F	F	R	R	R	F	R	F	R	-	F	R	R
61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	+	R	+	+	-	F	R	R	R	R	+	-	R	R	+	F	+	-	R	R	-	+	+	+
63	F	F	F	F	F	F	F	F	C	C	F	F	C	F	F	F	C	F	F	F	C	C	F	F
64	-	-	R	-	R	R	R	R	R	R	R	R	-	R	+	+	R	-	-	-	R	-	-	+
65	+	+	+	R	+	F	F	F	F	F	F	F	F	F	F	F	F	R	+	-	R	R	R	R
66	+	-	-	+	-	R	R	+	-	R	R	R	R	+	R	R	+	R	-	R	+	R	R	R
67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	R	-	-	-	-	-
68	-	-	-	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-
69	R	F	R	F	+	F	F	F	F	F	R	R	R	F	R	R	-	-	-	-	+	-	-	-
70	R	R	R	R	+	R	+	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	R	R	R	R	R	R	R	R	R	-	R	R	F	R	+	R	-	-	-	R	-	-	R	-
72	R	F	R	F	F	F	R	R	R	R	F	R	F	R	R	+	R	R	R	R	-	R	-	+
73	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	R	-	-	-	+	R	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	R	-	-	-	+	-	+	R	-	-	+	-	+	-	+	R
76	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-
77	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1 (continued)

	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
A	6H-5,13-15	6H-5,88-90	6H-6,13-15	6H-6,88-90	6H-7,4-6	7H-1,12-14	7H-1,88-90	7H-2,12-14	7H-2,87-89	7H-3,13-15	7H-3,87-89	7H-4,13-15	7H-4,88-90	7H-5,13-15	7H-5,87-89	7H-6,13-15	7H-6,88-90	7H-7,11-13	8H-1,85-87	8H-2,13-15	8H-2,88-90	8H-3,13-15	8H-3,86.5-88.5
B	49.13	49.88	50.63	51.38	52.04	52.62	53.38	54.12	54.87	55.63	56.37	57.13	57.88	58.63	59.37	60.13	60.88	61.61	62.85	63.63	64.38	65.13	65.86
C	1060	1015	1027	1010	1030	1094	1080	1000	1064	1005	897	812	1030	1042	1011	1000	1000	1081	1018	1066	1026	798	1068
D							P	L	E	I	S	T	O	C	E	N	E						
E								U	P	P	E	R		C	H	I							
F	14.71	15.04	17.52	17.72	25.24	14.44	17.77	16.9	18.13	15.42	14.8	13.05	15.33	15.93	17.6	13	13.6	15.35	16.79	13.97	16.47	18.92	20.22
G	C	C	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A
H	G	G	G	G	G	G	G	G	G	G	P	P	G	G	G	G	G	G	G	G	G	P	G
1	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
2	F	R	R	R	F	F	F	R	R	+	-	+	R	-	F	R	R	R	R	R	R	-	R
3	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
5	-	-	-	+	-	R	-	-	-	-	R	-	-	+	-	+	-	R	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
8	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
9	F	F	F	F	F	F	F	F	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F
10	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	+	R	-	-	-	-	-	+
11	-	-	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-	+	R	-	-	-	+
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
17	-	-	-	R	+	R	R	+	R	+	R	-	-	-	-	-	-	-	+	-	-	-	-
18	-	-	-	-	-	-	+	-	+	+	R	+	+	-	-	-	-	-	+	+	-	+	+
19	R	+	R	+	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
20	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	R	-	R	R	-	+
21	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	R	-	-	R	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	+	-	-	-	+	+	-	+	-	-	-	-	R	-	+	+	+	R	+	-	+	-	-
25	R	R	R	R	R	F	F	F	F	F	F	F	F	F	F	R	R	R	R	+	R	-	-

Table 1 *(continues)*

	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
A	6H-5,13-15	6H-5,88-90	6H-6,13-15	6H-6,88-90	6H-7,4-6	7H-1,12-14	7H-1,88-90	7H-2,12-14	7H-2,87-89	7H-3,13-15	7H-3,87-89	7H-4,13-15	7H-4,88-90	7H-5,13-15	7H-5,87-89	7H-6,13-15	7H-6,88-90	7H-7,11-13	8H-1,85-87	8H-2,13-15	8H-2,88-90	8H-3,13-15	8H-3,86.5-88.5
B	49.13	49.88	50.63	51.38	52.04	52.62	53.38	54.12	54.87	55.63	56.37	57.13	57.88	58.63	59.37	60.13	60.88	61.61	62.85	63.63	64.38	65.13	65.86
C	1060	1015	1027	1010	1030	1094	1080	1000	1064	1005	897	812	1030	1042	1011	1000	1000	1081	1018	1066	1026	798	1068
D							P	L	E	I	S	T	O	C	E	N	E						
E								U	P	P	E	R		C	H	I							
F	14.71	15.04	17.52	17.72	25.24	14.44	17.77	16.9	18.13	15.42	14.8	13.05	15.33	15.93	17.6	13	13.6	15.35	16.79	13.97	16.47	18.92	20.22
G	C	C	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A
H	G	G	G	G	G	G	G	G	G	G	P	P	G	G	G	G	G	G	G	G	G	P	G
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
28	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	-	+	-	+	+	-	-	+	+	-	R	R	R	-	+	+	+	-	-	-	-	-	R
33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
34	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	R	R	R	R	R	R	+	-	+	-	+	-	R	+	+	-	+	R	R	R	R	R	+
37	R	R	F	R	R	R	+	R	+	R	R	-	R	R	R	+	R	R	R	-	R	R	R
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	+	-	-	-	-	-	R	R	R	+	+	-	-	-	-
40	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	R	-	-	-	-	-
42	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-
43	-	-	R	+	+	-	-	+	+	R	-	R	-	+	R	R	+	-	R	R	R	R	-
44	+	-	R	-	+	+	R	-	+	-	-	+	-	-	-	-	+	-	-	-	+	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	+	-	-	R	-	+	R	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-
47	R	R	-	+	R	R	F	+	R	+	R	-	-	+	-	-	+	R	-	+	-	-	-
48	R	+	F	R	F	R	F	R	R	R	R	R	+	+	-	-	-	-	-	-	-	-	+
49	-	-	-	-	-	-	-	-	-	-	-	-	R	-	F	+	-	+	-	-	-	-	-
50	+	-	-	-	R	-	+	+	-	-	-	-	-	+	-	+	-	-	-	+	-	-	+
51	R	+	+	R	R	+	+	R	+	-	-	-	+	R	F	-	+	-	R	-	R	F	+

Table 1 *(continues)*

	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
A	6H-5,13-15	6H-5,88-90	6H-6,13-15	6H-6,88-90	6H-7,4-6	7H-1,12-14	7H-1,88-90	7H-2,12-14	7H-2,87-89	7H-3,13-15	7H-3,87-89	7H-4,13-15	7H-4,88-90	7H-5,13-15	7H-5,87-89	7H-6,13-15	7H-6,88-90	7H-7,11-13	8H-1,85-87	8H-2,13-15	8H-2,88-90	8H-3,13-15	8H-3,86.5-88.5
B	49.13	49.88	50.63	51.38	52.04	52.62	53.38	54.12	54.87	55.63	56.37	57.13	57.88	58.63	59.37	60.13	60.88	61.61	62.85	63.63	64.38	65.13	65.86
C	1060	1015	1027	1010	1030	1094	1080	1000	1064	1005	897	812	1030	1042	1011	1000	1000	1081	1018	1066	1026	798	1068
D							P	L	E	I	S	T	O	C	E	N	E						
E								U	P	P	E	R		C	H	I							
F	14.71	15.04	17.52	17.72	25.24	14.44	17.77	16.9	18.13	15.42	14.8	13.05	15.33	15.93	17.6	13	13.6	15.35	16.79	13.97	16.47	18.92	20.22
G	C	C	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A
H	G	G	G	G	G	G	G	G	G	G	P	P	G	G	G	G	G	G	G	G	G	P	G
52	-	R	+	+	R	-	+	+	R	-	+	-	-	-	F	-	-	-	-	-	-	-	-
53		+	+	-	R	-	+	+	+	-	-	-	-	-	+	-	-	-	+	-	+	-	+
54	+	+	+	-	+	-	-	+	-	-	-	-	-	+	+	-	+	-	-	-	R	-	+
55	+	+	+	-	+	+	+	R	+	R	-	-	-	+	+	+	-	R	R	+	+	R	R
56	+	-	R	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-
57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-
58	R	R	R	R	R	R	R	R	R	+	+	R	R	R	F	+	-	R	F	R	F	F	F
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	R	R	R	R	R	R	+	R	R	+	-	-	-	-	-	-	-	+	-	R	R	R	R
61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	+	-	+	+	R	R	F	R	R	+	R	-	R	R	+	R	-	R	R	-	+	-	+
63	F	F	F	F	C	F	F	F	F	F	F	F	F	F	C	F	F	F	F	F	F	C	C
64	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	R	-	-	R	-
65	F	R	R	R	F	R	+	R	R	-	-	-	-	-	-	-	+	R	R	+	R	R	R
66	R	R	+	+	R	R	R	F	R	R	R	R	-	-	+	-	+	+	-	-	-	-	-
67	+	-	+	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	+
69	-	-	R	+	R	-	R	R	+	-	-	-	+	-	-	-	R	+	+	+	-	-	+
70	+	R	+	-	R	+	R	+	-	-	-	-	+	-	+	+	R	+	-	-	-	-	-
71	+	R	R	R	R	R	F	F	R	+	-	-	+	-	-	-	-	-	-	+	+	R	+
72	R	R	R	R	R	R	F	+	+	-	-	R	+	+	+	+	+	-	-	R	+	R	R
73	+	+	-	-	-	-	+	-	-	+	-	-	+	-	-	-	+	+	-	+	-	+	+
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	+	+	-	-	-	+	R	+	+	-	-	-	+	-	-	-	-	+	R	-	+	R	-
76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
77	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1 *(continues)*

	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
A	8H-4,13-15	8H-4,88-90	8H-5,13-15	8H-5,87.5-89.5	8H-6,13-15	8H-6,88-90	8H-7,11.5-13.5	9H-1,13-15	9H-1,88-90	9H-2,10-12	9H-2,85-87	9H-3,13-15	9H-3,88-90	9H-4,13-15	9H-4,88-90	9H-5,13-15	9H-5,88-90	9H-6,7-9	9H-6,82-84	9H-7,13-15	10H-1,12-14	10H-1,87.5-89.5	10H-2,8-10
B	66.63	67.38	68.13	68.88	69.63	70.38	71.11	71.63	72.38	73.1	73.85	74.63	75.38	76.13	76.88	77.63	78.38	79.07	79.82	80.63	81.12	81.88	82.58
C	1044	1062	1065	1034	1100	1037	1040	1050	1063	1016	1014	1070	1000	1048	1069	1077	1042	1072	946	1056	1071	1074	1065
D							P	L	E	I	S	T	O	C	E	N	E						
E								U	P	P	E	R		C	H	I							
F	15.7	15.91	17.27	17.6	17.72	17.55	21.05	16.57	15.99	16.04	18.54	19.9	16.5	18.12	18.33	18.19	23.32	20.05	16.17	16.66	18.86	15.82	14.17
G	C	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	A	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	M	G	G	G	G
1	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	R	-	R	F	F	R	F	F	R	-	R	R	+	+	+	R	+	R	R	+	R	+	-
3	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-
4	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
5	-	+	-	-	+	+	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	F	F	F	F	F	F	F	F	F	F	R	F	F	F	F	F	F	F	R	F	F	F	F
8	F	F	F	F	F	F	F	F	F	F	F	F	F	C	F	F	F	F	F	F	F	F	F
9	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
10	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	+	-	-	-
11	+	+	R	-	R	R	+	-	R	-	R	+	R	-	+	+	-	-	-	+	+	-	+
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	+	+	-	-	-	-	-	-	+	R	-	-	-	R	-	-	+	+	-	+	-	-	+
18	-	R	R	+	-	-	+	+	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-
19	-	-	-	-	+	+	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-
20	+	-	-	-	-	+	-	-	-	-	-	R	-	-	-	F	+	-	+	+	R	+	-
21	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	+	+	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	+	R
25	+	+	-	+	R	+	-	R	+	-	+	+	-	-	R	-	-	R	R	-	+	-	+

Table 1 *(continues)*

	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
A	8H-4,13-15	8H-4,88-90	8H-5,13-15	8H-5,87.5-89.5	8H-6,13-15	8H-6,88-90	8H-7,11.5-13.5	9H-1,13-15	9H-1,88-90	9H-2,10-12	9H-2,85-87	9H-3,13-15	9H-3,88-90	9H-4,13-15	9H-4,88-90	9H-5,13-15	9H-5,88-90	9H-6,7-9	9H-6,82-84	9H-7,13-15	10H-1,12-14	10H-1,87.5-89.5	10H-2,8-10
B	66.63	67.38	68.13	68.88	69.63	70.38	71.11	71.63	72.38	73.1	73.85	74.63	75.38	76.13	76.88	77.63	78.38	79.07	79.82	80.63	81.12	81.88	82.58
C	1044	1062	1065	1034	1100	1037	1040	1050	1063	1016	1014	1070	1000	1048	1069	1077	1042	1072	946	1056	1071	1074	1065
D							P	L	E	I	S	T	O	C	E	N	E						
E								U	P	P	E	R		C	H	I							
F	15.7	15.91	17.27	17.6	17.72	17.55	21.05	16.57	15.99	16.04	18.54	19.9	16.5	18.12	18.33	18.19	23.32	20.05	16.17	16.66	18.86	15.82	14.17
G	C	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	A	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	M	G	G	G	G
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	F	F	R	F	F	F	F	F	F	R	F	F	F	R	F	C	F	F	C	F	F	F	F
28	-	-	-	-	-	-	-	-	-	-	-	R	-	-	+	R	+	-	-	R	+	-	-
29	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
32	+	+	F	F	R	R	R	F	R	+	+	R	R	+	-	+	R	+	+	+	+	-	R
33	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	R	R	R	R	R	R	R	R	R	+	R	R	R	+	R	R	R	R	R	R	R	R	R
37	R	R	R	R	R	R	R	+	+	R	+	+	R	F	R	R	R	R	+	R	R	R	R
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	R	+	+	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	R	R	+	R	R	R	R	+	R	+	-	R	R	R	R	R	R	R	R	R	R	+	+
44	-	-	+	-	-	+	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
50	+	-	+	+	-	-	R	-	+	-	+	+	-	-	-	+	+	R	R	+	+	+	+
51	-	-	-	+	-	-	+	-	-	+	-	-	-	R	-	-	-	-	-	-	-	-	-

Table 1 *(continued)*

	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
A	8H-4,13-15	8H-4,88-90	8H-5,13-15	8H-5,87.5-89.5	8H-6,13-15	8H-6,88-90	8H-7,11.5-13.5	9H-1,13-15	9H-1,88-90	9H-2,10-12	9H-2,85-87	9H-3,13-15	9H-3,88-90	9H-4,13-15	9H-4,88-90	9H-5,13-15	9H-5,88-90	9H-6,7-9	9H-6,82-84	9H-7,13-15	10H-1,12-14	10H-1,87.5-89.5	10H-2,8-10
B	66.63	67.38	68.13	68.88	69.63	70.38	71.11	71.63	72.38	73.1	73.85	74.63	75.38	76.13	76.88	77.63	78.38	79.07	79.82	80.63	81.12	81.88	82.58
C	1044	1062	1065	1034	1100	1037	1040	1050	1063	1016	1014	1070	1000	1048	1069	1077	1042	1072	946	1056	1071	1074	1065
D							P	L	E	I	S	T	O	C	E	N	E						
E								U	P	P	E	R		C	H	I							
F	15.7	15.91	17.27	17.6	17.72	17.55	21.05	16.57	15.99	16.04	18.54	19.9	16.5	18.12	18.33	18.19	23.32	20.05	16.17	16.66	18.86	15.82	14.17
G	C	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	A	A	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	M	G	G	G	G
52	-	-	+	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
53	+	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	+	+	-	+	-	R	R	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
56	-	-	+	-	-	-	-	+	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-
57	+	-	-	-	-	-	-	-	-	-	R	R	R	-	R	-	+	-	R	+	R	+	R
58	R	F	R	F	F	F	R	R	R	R	F	F	R	R	R	R	R	+	R	-	+	-	R
59	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
60	+	+	R	R	-	+	+	+	-	R	R	+	-	+	+	-	+	+	-	-	R	R	+
61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
62	-	R	-	+	-	-	-	R	+	F	-	-	R	R	+	-	R	R	+	-	-	+	-
63	F	F	C	C	C	C	C	C	F	C	F	F	F	C	C	F	C	C	F	C	F	F	F
64	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-
65	R	R	F	R	R	R	R	F	R	R	F	R	F	+	R	R	R	R	-	-	R	R	R
66	-	-	-	-	-	-	-	R	+	-	-	-	-	-	-	-	-	+	-	-	R	+	+
67	-	-	-	-	-	R	-	-	+	-	-	-	-	-	-	-	+	-	-	-	+	-	-
68	-	-	-	-	-	+	-	-	+	+	-	-	-	R	+	-	-	-	-	-	-	-	-
69	-	R	-	-	+	-	+	-	-	-	-	-	-	R	-	-	+	-	-	-	-	-	+
70	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	+	-	-	-	+	-	-	+	+	+	-	-	+	+	-	+	-	-	-	+	R	+	R
72	-	R	-	+	+	-	+	R	R	-	-	-	-	-	-	-	+	-	-	+	-	+	-
73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
75	+	-	-	+	+	-	+	-	+	-	R	-	-	-	-	-	-	-	+	R	-	+	-
76	-	-	-	-	R	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
77	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-

Table 1 *(continued)*

	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134
A	10H-2,83-85	10H-3,13-15	10H-3,88-90	10H-4,13-15	10H-4,88-90	10H-5,13-15	10H-5,88-90	10H-6,13-15	10H-6,88-90	10H-7,13-15	11H-1,17-19	11H-1,92-94	11H-2,13-15	11H-2,88-90	11H-3,13-15	11H-3,88-90	11H-4,13-15	11H-4,88-90	11H-5,13-15	11H-5,88-90	11H-6,13-15	11H-6,88-90	11H-7,5-7
B	83.33	84.13	84.88	85.63	86.38	87.13	87.88	88.63	89.38	90.13	90.67	91.42	92.13	92.88	93.63	94.38	95.13	95.88	96.63	97.38	98.13	98.88	99.55
C	1062	1000	1000	1021	1022	1019	1014	1014	1010	837	962	1074	1001	1052	1056	1028	1050	1010	1036	1064	853	1000	1010
D	P L E I S T O C E N E										P L I O C E N E												
E		UPPER CHI				LOWER C H I								P H I									
F	14.21	15.1	20.2	13.71	14.38	12.85	15.97	15.68	13.56	17.08	11.33	15.08	11.58	10.74	15.43	14.59	11.42	12.87	11.38	17.01	17.7	10.3	16.63
G	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	P	M	G	G	G	G	G	G	G	G	G	P	G	G
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	R	R	R	+	+	-	R	R	R	R	-	R	R	-	R	R	R	-	+	R	R	+	+
3	-	-	+	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	R	+	-
4	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	R	-	-	+	-	R	-	-	-	-	+	-	-	-	-	-	-	-	R	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
8	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
9	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
11	-	-	+	+	+	-	+	-	-	-	-	+	-	+	-	-	+	+	-	R	-	+	+
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	F	R	R	+	-	R	R	R	R	+	-	-	R	R	+	R	R	R	+	+	R	+	R
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	+
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-
21	-	-	-	-	-	+	R	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-
22	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	R	-	-
25	-	+	+	-	-	-	+	+	R	-	+	-	-	-	-	-	-	-	-	-	-	-	-

Table 1 (continued)

	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	131	133	134
A	10H-2,83-85	10H-3,13-15	10H-3,88-90	10H-4,13-15	10H-4,88-90	10H-5,13-15	10H-5,88-90	10H-6,13-15	10H-6,88-90	10H-7,13-15	11H-1,17-19	11H-1,92-94	11H-2,13-15	11H-2,88-90	11H-3,13-15	11H-3,88-90	11H-4,13-15	11H-4,88-90	11H-5,13-15	11H-5,88-90	11H-6,13-15	11H-6,88-90	11H-7,5-7
B	83.33	84.13	84.88	85.63	86.38	87.13	87.88	88.63	89.38	90.13	90.67	91.42	92.13	92.88	93.63	94.38	95.13	95.88	96.63	97.38	98.13	98.88	99.55
C	1062	1000	1000	1021	1022	1019	1014	1014	1010	837	962	1074	1001	1052	1056	1028	1050	1010	1036	1064	853	1000	1010
D	PLEISTOCENE				PLIOCENE																		
E	UPPER CHI				LOWER CHI						PHI												
F	14.21	15.1	20.2	13.71	14.38	12.85	15.97	15.68	13.56	17.08	11.33	15.08	11.58	10.74	15.43	14.59	11.42	12.87	11.38	17.01	17.7	10.3	16.63
G	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	P	M	G	G	G	G	G	G	G	G	G	P	G	G
26	-	-	-	+	+	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	+	+
27	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	F	R	F
28	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	R	-	R
31	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	+	+	-	R	R	-	-	-	R	+	-	-	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	R	R	R	R	R	R	R	R	+	R	R	R	R	+	R	R	R	R	R	R	R	+	R
37	R	R	R	R	R	R	+	+	R	R	R	R	+	-	R	R	+	R	+	R	R	+	+
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	R	-	-	+	+	-	+	-	+	-	-	+	-	-	-
43	-	-	-	+	+	-	+	+	+	-	-	-	-	+	-	+	-	-	-	+	+	+	-
44	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
47	+	-	+	-	+	-	-	-	-	-	+	+	-	+	-	+	-	-	+	-	-	+	-
48	-	-	-	-	-	+	R	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
50	+	+	R	-	-	R	+	R	+	+	-	+	+	-	+	R	-	-	-	-	+	-	-
51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-

Table 1 *(continued)*

	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	131	133	134
A	10H-2,83-85	10H-3,13-15	10H-3,88-90	10H-4,13-15	10H-4,88-90	10H-5,13-15	10H-5,88-90	10H-6,13-15	10H-6,88-90	10H-7,13-15	11H-1,17-19	11H-1,92-94	11H-2,13-15	11H-2,88-90	11H-3,13-15	11H-3,88-90	11H-4,13-15	11H-4,88-90	11H-5,13-15	11H-5,88-90	11H-6,13-15	11H-6,88-90	11H-7,5-7
B	83.33	84.13	84.88	85.63	86.38	87.13	87.88	88.63	89.38	90.13	90.67	91.42	92.13	92.88	93.63	94.38	95.13	95.88	96.63	97.38	98.13	98.88	99.55
C	1062	1000	1000	1021	1022	1019	1014	1014	1010	837	962	1074	1001	1052	1056	1028	1050	1010	1036	1064	853	1000	1010
D	**P L E I S T O C E N E**										**P**	**L**	**I**	**O**	**C**	**E**	**N**	**E**					
E		**UPPER**	**CHI**			**LOWER**	**C**	**H**	**I**					**P**		**H**		**I**					
F	14.21	15.1	20.2	13.71	14.38	12.85	15.97	15.68	13.56	17.08	11.33	15.08	11.58	10.74	15.43	14.59	11.42	12.87	11.38	17.01	17.7	10.3	16.63
G	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
H	G	G	G	G	G	G	G	G	G	P	M	G	G	G	G	G	G	G	G	G	P	G	G
52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	+	R	R	+	-	-	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	-
58	-	R	R	R	F	R	R	R	R	R	-	R	-	R	+	R	-	R	R	+	R	+	-
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	+	R	-	+	R	-	R	+	+	R	R	-	+	-	+	-	-	-	R	+	-	-
61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	R	-	R	+	R	-	-	-	+	+	+	+	+	+	+	R	-	+	+	+	-	+	R
63	F	F	C	F	F	F	F	F	C	C	F	F	F	F	F	F	F	F	F	C	F	F	C
64	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	-	R	R	R	-	+	R	+	R	-	R	+	R	+	+	-	R	-	-	-	-	+	+
66	R	-	R	-	-	-	+	+	R	-	+	R	-	-	-	+	R	-	+	-	+	+	-
67	+	+	+	+	-	-	-	-	-	+	-	-	-	+	-	+	-	-	-	+	-	+	-
68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-
69	+	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	-	-	-	-	-	-	-	-	+	-	-	+	+	-	R	+	+	-	-	+	-	-	-
71	R	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	+
72	R	-	-	+	-	-	+	+	-	-	-	-	-	-	-	+	-	-	+	-	-	-	+
73	+	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-
76	-	-	+	-	-	-	R	-	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-
77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-

REFERENCES

Abelmann A. and Gersonde R., 1988. *Cycladophora davisiana* stratigraphy in Pliocene- Pleistocene cores from the Antarctic Ocean (Atlantic Sector). Micropaleontology, 34: 268-276.

Bandy O.L. and Casey R.E., 1969. Major Late Cenozoic planktonic datum planes, Antarctic to the Tropics. Antarctica, 5 (4): 170-171.

Barron J., Larsen B., Baldauf J.G., Alibert C., Berkowitz S., Caulet J.P., Chambers S., Cooper A., Cranston R., Dron W., Ehrmann W., Fox R., Fryxell G., Hambrey M., Huber B., Jenkins C., Kang S., Keating B., Mehl K., Noh I., Ollier G., Pittenger A., Sakai H., Schroder C., Solheim A., Stockwell D., Thierstein H., Tocher B., Turner B. and Wie W., 1991. Proceed. ODP, Sci. Results, 119: 1003 pp.

Calkins G.N., 1909. Protozoology. Lea and Febiger Company, 349 pp.

Caulet J.P., 1991. Radiolaria from the Kerguelen Plateau. Leg119. In: J. Barron, B. Larsen, J. Baldauf, C Alibert, S. Berkowitz, J.P. Caulet, S. Chambers, A. Cooper, R. Cranston, W. Dom, W. Ehrmann, R. Fox, G. Pyrell, 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 and W. Wie (Eds.), Proceed. ODP, Sci. Results, 119: 513-542.

Chen P.H., 1974. Some new Tertiary radiolaria from Antarctic deep sea sediments. Micropaleontology, 204: 480-492.

Chen P.H., 1975a. Antarctic radiolaria. In: D.E. Hayes, L.A. Frakes, P.J. Barrett, D.A. Burns, P.H. Chen, A.B. Ford, A.G. Kaneps, E.M. Kemp, D.W. McCollum, D.J.W. Piper, R.E. Wall and P.N. Webb (Eds.), Init. Rep. Deep Sea Drilling Project, 28: 437-513.

Chen P.H., 1975b. Post Paleocene radiolaria: their taxonomy, biostratigraphy and phylogeny and the development of late Neogene cold water faunas. Ph.D. Dissert., Columbia Univ., New York, 475 pp.

Cortese G. and Abelmann A., 2002. Radiolarian-based paleotemperatures during the last 160 kyr at ODP Site 1089 (Southern Ocean, Atlantic sector). Palaeo. Palaeo. Palaeo., 182 (3/4): 259-286.

De Wever P., Dumitrica A.P., Caulet J.P., Nigrini C. and Caridroit M., 2001. Radiolarians in the sedimentary record. Taylor and Francis, The Netherlands, 533 pp.

Dreyer F., 1889. Morphologische Radiolarien studien. I. Die Pylombildungen in vergleichend- anatomischer und entwicklungs geschichtlicher Beziehung bei Radiolarien und bei Protisten uberhaupt, nebst System und Beschreibung neuer und des bis jetzt bekannten pylomatischen Spumellarien. Jeina. Zeitschr. Naturwiss., 23: 1-138.

Ehrenberg C.G., 1838. Uber die Bildung der Kreidefelsen und des Kreidemergels durch unsichtbare Organismen. Konigl. Preuss. Akad. Wissen. Berlin, Abhandl., Jahrg., 1838, p. 59-147.

Ehrenberg C.G., 1844. Vorläufige Resultate seiner Untersuchungen der ihm von der Südpolreise des Capitain Ross, so wie von den Herren Schayer und Darwin zugekommenen Materialien über das Verhalten des kleinsten Lebens in den Oceanen und den grössten bisher zugänglichen Tiefen des Weltmeers vor. Bericht über die zur Bekanntmachung geeigneten. Verhandl. Königl. Akad. Wissen. Berlin, Jahrg., 1844, p. 182-207.

Ehrenberg C.G., 1847. Über die mikroskopischen kieselschaligen Polycystinen als mächtige Gebirgmasse von Barbados. Monatsber. Konigl. Preuss. Akad. Wissen. Berlin, Jahrg., 1847, p. 40-60.

Ehrenberg, C.G., 1861. Über die Tiefgrund-Verhaltnisse des Oceans am Eingange der Davisstrasse und bei Island. König. Preuss. Akad. Wissens. Berlin, Monatsb., p. 275-315.

Ehrenberg C.G., 1872. Mikrogeologische Studien uber das Kleinste Leben der Meeres- Tiefgrunde aller Zonen und dessen geologischen Einfluss. Konig. Preuss. Akad. Wissen. Berlin Abhandl., Jahre, 1872, p. 131-399.

Ehrenberg, C.G., 1873. Mikrogeologische Studien fiber das kleinste Leben der Meeres-Tiefgriinde aller Zonen und dessen Geologischen Einfluss. Konigl. Akad. Wissen. Berlin, Abhandl., Jahre, 1873, p. 131-399.

Ehrenberg C.G., 1875. Fortsetzung der mikrogeolgischen Studien als Gesammt-Uebersicht der mikroscopischen Palaontologie gleichartig analysierter Gebirgsartender Erde, mit specieller Rucksicht auf den Polycystinen Mergel von Barbados. Konig. Preuss. Akad. Wissen. Berlin Abhandl., Jahre, 1875, p. 1-225.

Gersonde R., Abelmann A., Burckle L.H., Hamilton N., Lazarus D., Mc Cartney K., O'Brien P., Spiess V. and Wise S.W., Jr., 1990. 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. Fitterer, 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 and S.W. Wise Jr. (Eds.), Proceed. ODP Sci. Results, 113: 915-936.

Goll R.M., 1968. Classification and phylogeny of Cenozoic Trissocyclidae (Radiolaria) in the Pacific and Caribbean Basins. Part 1. Palaeontology, 42 (2): 1409-1432.

Goll R.M., 1976. Morphological intergradation between modern populations of *Lophospyris* and *Phormospyris* (Trissocyclidae, Radiolaria). Micropaleontology, 22 (4): 379-418.

Haeckel E., 1862. Die Radiolarien (Rhizopoda Radiolaria), eine Monographie. Reimer, Berlin, 572 pp.

Haeckel E., 1881. Entwurf eines Radiolarien-System auf Grund von Studien der Challenger Radiolarien. Jenais. Zeitschr. Naturwiss., 15 (8): 418-472.

Haeckel E., 1887. 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, 18: 1-1803.

Haecker V., 1907. Alterümliche Sphärellarien und Cyrtellarien aus grossen meerestiefen, Arch. Protist., 10: 114-126.

Haecker V., 1908. Tiefsee Radiolarien. Spezieller Teil: Wissensch Ergeb. Deutsche Tiefsee Expedition, Jena, 14: 337-476.

Hays J.D., 1965. Radiolaria and late Tertiary and Quaternary history of Antarctic seas. In: G.A. Llano, (Ed.), Biology of Antarctic Seas II. Am. Geophys., Antarctic Res. Series, 5: 125-184.

Hays J.D., 1967. Quaternary sediments of Antarctic Ocean. In: J.D. Hays, (Ed.), Progress in oceanography, 4: 117-131.

Hays J.D., 1970. Stratigraphy and evolutionary trends of Radiolaria in North Pacific deep-sea sediments. In: J.D. Hays (Ed.), Geological investigations of the North Pacific. Geol. Soc. Am. Mem., 126: 185-218.

Hays J.D. and Opdyke N.D., 1967. Antarctic Radiolaria, magnetic reversals and climatic change. Science, 15: 1001-1011.

Hertwig R. and Lesser E., 1874. Ueber Rhizopoden und denselben nahestenden Organismen. Arch. Mikr. Anat., 10 (Suppl.), 35 pp.

Keany, J., 1976. Early Pliocene paleoclimatology and radiolarian biostratigraphy of the Southern Ocean. Antarctic Res., 11: 171-173.

Keany J., 1979. Early Pliocene radiolarian taxonomy and biostratigraphy in the Antarctic region. Micropaleontology, 25 (1): 50-74.

Keany J. and Kennett J.P., 1972. Pliocene-Early Pleistocene paleoclimatic history recorded in Antarctic-Subantarctic deep-sea cores. Deep-Sea Res., 19: 529-548.

Keany J, and Kennett J.P., 1975. Pliocene-Pleistocene radiolarian biostratigraphy and paleoclimatology at DSDP site 278 on the Antarctic convergence. In: J.P, Kennett, R.E. Houtz, P.B. Andrews, A.R. Edwards, V.A. Gostin, M. Hajos, M.A. Hampton, J.D. Graham, S.V. Margolis, O.A. Thomas and K. Perch-Nielsen (Eds.), Init. Rep. Deep Sea Drilling Project, 29: 757-767.

Lazarus D., 1990. Middle Miocene to Recent radiolarians from the Weddell Sea, Antarctica, ODP Leg 113, In: P.F. Barker and J.P. Kennett (Eds.), Proceed. ODP. Sci. Results, 113: 709-728.

Lazarus D., 1992. Antarctic Neogene radiolarians from the Kerguelen Plateau, ODP Legs 119 and 120. In: S.W. Wise and R. Schlich (Eds.), Proceed. ODP. Sci. Results, 120: 785-810.

Lazarus D., 2002. Environmental control of diversity, evolutionary rates and taxa longevities in Antarctic Neogene radiolaria. Paleontol. Electron., 5 (1): 32

Lazarus D. and Caulet J.P., 1991. Eocene to Recent radiolarian biostratigraphy, biogeography, diversity, and history of the Southern Oceans. Intern. Conf. on the role of the Southern Ocean and Antarctica in global change: an ocean drilling perspective, Santa Barbara. Abstr., p. 30.

Lombari G. and Boden G., 1985. Modern radiolarian global distribution. Cushman Found. Foram. Res., Spec. Publ., 16A: 1-125.

Lombari G. and Lazarus D.B., 1988. Neogene Cycladophorid radiolaria from North Atlantic, Antarctic and North Pacific deep sea sediments. Micropaleontology, 34: 97-135.

Martin G.C , 1904. Radiolaria. Maryland Geol. Surv. (Miocene), Gen. Ser.: 447-459.

McIntyre L. and Kaczmarska I., 1996. Improved resolution of the Pleistocene extinction level of *Stylatractus universus* (Hays) in ODP Hole 75B, Kerguelen Plateau. Micropaleontology, 42: 375-379.

Müller J., 1858. Über die Thalasscollen, Polycystinen und Acanthometren des Mittelmeers. Wissens. Berlin, Abhandl., Jahre Fur. 1858, p. 1-62.

Nigrini C.A., 1967. Radiolaria in pelagic sediments from the Indian and Atlantic Oceans: Scripps Inst. Oceanogr., Univ. California Bull., 11: 1-25.

Nigrini, CA. and Lombari G., 1984. A guide to Miocene Radiolaria. Cushman Found. Foram. Res., Spec. Publ., 22: S1-S102, N1-N206.

Nigrini C.A. and Moore T.C. Jr., 1979. A Guide to modern radiolaria. Cushman Found. Foram. Res., Spec. Publ., 16: S1-S142, N1-N106.

Petrushevskaya M.G., 1967. Radiolyarii otryadov Spumellaria i Nassellaria antarkticheskoi oblasti. In: Issledovaniya Fauny Morei, t. IV (XII). Resultaty Biologicheskikh Issledovanii Sovetskoi Antarkticheskoi, Ekspeditsii 1955-1958, 3: 5-186.

Petrushevskaya M.G., 1972a. Biostratigraphy of deep-sea Quaternary sediments on the radiolarian data. Okeanologia, 12: 71-86.

Petrushevskaya M.G., 1972b. Some aspects of paleogeography based on the radiolarian analysis of the deep sea bottom sediments. Okeanologia, 12: 640-653.

Petrushevskaya M.G., 1973. Radiolyarii v donnykh otlozhenniyakh yuzhnogo polushchariya, Okeanologia, 13: 1041-1051.

Petrushevskaya M.G., 1975. Cenozoic radiolarians of the Antarctic, Leg 29, DSDP. In: J.P. Kennett, R.E. Houtz, P.B. Andrews, A.R. Edwards, V.A. Gostin, M. Hojos, M.A. Hampton, D. Graham Jenkins, S.V. Margolis, A. Thomas Ovenshine and K. Perch-Nielsen (Eds.), Initial Rep. Deep Sea Drilling Project, 29: 541-675.

Petrushevskaya M.G., 1978. Biostratigrafiya neogenovykh donnykh oltozhenii Antarctiki po radiolyaryam (Radiolarian biostratigraphy of Neogene deep-sea sediments of Antarctica). In: A.P. Zhuze (Ed.), Morskaya Mikropaleontologiya (diatomei, radiolyarii, silikoflyagellyaty, foraminifery i izvestkovyi nannoplankton) (Marine Micropaleontology diatoms, radiolarians, silicoflagellates, foraminifers and calcareous nannoplankton). Nauka, Moscow, USSR, p. 82-90.

Petrushevskaya M.G., 1986. Evolution of the Antarctissa group. Mar. Micropal., 11: 185-195.

Popofsky A., 1908. Die Radiolarien der Antarktis. Deutsche Südpolar-Expedition (1901-1903). Zoologie, 10 (3): 184-305.

Popofsky A., 1913. Die Nassellarien des Warmwassergebietes. Deutsche Südpolar-Expedition, Zoology, 14 (6): 217-416.

Riedel W.R., 1958. Radiolaria in Antarctic sediments. Rep. B.A.N.Z. Antarctic Res. Expedition, 6: 217-255.

Riedel W.R., 1967. Subclass Radiolaria. In: W.B. Harland, C.H. Holland, M.R. House, N.F. Hughes, A.B. Reynolds, M.J.S. Rudwick, G.E. Satterthwaite, L.B.H. Tarlo and E.C. Wiley (Eds.), The fossil record. Geol. Soc. London, p. 291-298.

Riedel W.R., 1971. Systematic classification of Polycystine Radiolaria. In: B.M. Funnell and W.R.Riedel (Eds.), Micropaleontology of oceans, Cambridge Univ. Press, p. 649-661.

Sharma G.K. and Takahashi K., 2007. Pleistocene radiolarian from the Antarctic continental margin: distribution and biostratigraphy. J. Geol. Soc. India, 69: 813-826.

Sharma G.K. and Takahashi K., 2008. Distribution and taxonomy of Pleistocene radiolarians from KH94-4-AMR-2PC core of the Southern Ocean region. Palaeoworld, 17: 57-82

Sharma G.K., Takahashi K. and Dalakoti V.S., 2004. Taxonomy and distribution of Pleistocene radiolarians from the Tasman region. N. Jahrb. Geol. Paläontol., 231: 297-347.

Sharma G.K, Takahashi K. and Dalakoti V.S., 2006. Biostratigraphy and distribution of Pleistocene radiolaria from the South Tasman sea. Acta Micropal. Sinica, 23 (1): 31-50.

Stepanjants S.D., Cortese G., Kruglikova S.B. and Bjørklund K.R., 2006. A review of bipolarity concept: history and examples from Radiolaria and Medusozoa (Cnidaria). Marine Biol. Res., 2: 200-241.

Theyer F., Mato C.Y. and Hammond S.R., 1978. Paleomagnetic and geochronologic calibration of latest Oligocene to Pliocene radiolarian events, Equatorial Pacific. Marine Micropal., 3: 377-395.

Weaver F.M., 1975. Correlation of Late Miocene-Early Pliocene radiolarian zone to the paleomagnetic time scale. Antarctica, U.S., 10 (5): 270-271.

Weaver F.M., 1983. Cenozoic radiolarians from the Southwest Atlantic, Falkland Plateau region, DSDP leg 71. In: W.J. Ludwig, V.A. Krashenninikov, I.A. Basov, U. Bayer, J. Bolemendal, 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.), Init. Rep. Deep Sea Drilling Project, 71: 667-686.

Weaver F.M., Dinkelman M.G., Margolis S.V. and Blank R.G., 1976. Pliocene climatic and glacial history of Antarctica as revealed by Southeast Indian Ocean deep-Sea cores. Geol. Soc. Am. Bull., 87 (10): 1529-1532.

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