Sea Surface Paleoceanography

Previous Works

The taxonomy, distribution, and ecologic significance of Recent planktic foraminifera of the North Pacific have been extensively studied by many workers (Bradshaw, 1959; Parker, 1962; Coulborn *et al.*, 1980; Thompson, 1981). Based on more than 700 plankton tows conducted in the North Pacific, Bradshaw (1959) divided the North Pacific Waters into four biogeographic provinces defined by distinct planktic foraminiferal fauna: cold-water (sub-artic) fauna, transition fauna, central fauna, and the equatorial west central fauna. Parker (1962) on the other hand is credited for her taxonomic work on the planktic foraminifera occurring in Pacific sediments which has been subsequently adapted by many workers.

The introduction of Imbrie and Kipp (1971) of the transfer function method for estimating sea surface temperature from planktic foraminiferal data proved to be a milestone in the field of paleoclimatology. Imbrie and Kipp's (1971) original transfer function was calibrated using North Atlantic data base and has since been successfully used in fossil assemblages from North Atlantic cores. With the Climate Long-Range Investigation, Mapping,

and Prediction (CLIMAP, 1976, 1981) ambitious project of mapping last glacial sea surface temperatures of the world ocean, a race to develop a similar transfer function applicable for the Pacific Ocean was undertaken (*e.g.* CLIMAP, 1976; Thompson, 1976, 1977, 1981; Luz, 1977, Moore *et al.*, 1980). Results of Moore *et al.* (1980) multi-disciplinary (transfer functions based on all major microfossil group) approach to the reconstruction of the last glacial North Pacific suggest: 2-4^{0}C cooling of the equatorial region during the winter season; little or no change in central sub-tropical water temperature; 4^{0}C cooling of the sub-artic region; and greater seasonality (differrence between summer and winter sea surface temperatures) in sub-artic and transitional regions; and intensification of gyre circulation.

The southward limit of the glacial advances of the sub-artic boundary suggested in previous sea surface temperature reconstructions of the North Pacific (*e.g* CLIMAP, 1976; Thompson, 1977, 1981; Moore *et al.* 1980) was investigated by Thompson and Shackleton (1980) using intraspecific coiling variations in *Neogloboquadrina pachyderma*. They suggest that the sub-artic front migrated southward to about 35-38^{0}N latitude during glacial stage 2 and to about 32-35^{0}N latitude during the glacial stage 6.

Sedimentary core sequences from Shatsky Rise and the Hess Rise are among the very few available calcareous deep-sea sections in the north western Pacific representing the sub-tropical to temperate regions. DSDP leg 32 in the central North Pacific was able to recover 2 Neogene sections from these two respective sites (Sites 305 and 310). In a study of the carbonate and eolian flux record of core V21-146 from the Shatsky Rise, Hovan *et al.*(1991) were able to successfully link a deep marine climatic record with a continental climatic record (Chinese Loess Deposit). Higher eolian flux in the marine record during glacial periods indicated the prevalence of arid conditions in the Asian continent and possibly stronger trade winds. Kawahata *et al.* (1997), in a study of a sediment core from the Hess Rise, noted that periods of high organic carbon accumulation rates indicating high primary productivities generally coincided with high aerosol quartz and aluminum. They cited the potential role of aerosol phosphorous supply to the sea in regulating sea surface productivity. Ohkushi (1998 MS), on the other hand, studied the role of changing organic carbon flux to the deep-sea benthic fauna recorded in core NGC 102.

FP12-E SST Estimation

Full results of SST estimation using the planktic foraminiferal transfer function FP-12E for the three cores

are given in Tables 6, 7, and 8. The results are summarized in Table 9 where summer SSTs, winter SSTs, seasonalities and communalities are averaged for the different oxygen isotope stages. Core top SST estimates are remarkably similar to mean annual summer and winter SSTs derived from the marine climatological charts from the North Pacific Ocean (Figures 2 a & b). This reflects the accuracy of the transfer function in estimating modern SSTs from sediment planktic foraminiferal data. Downcore plots of summer and winter SSTs (Figure 12) follow closely $\delta^{18}O$ pattern specifically NGC 102. Estimated SSTs averaged for each of the oxygen isotope stages are comparabale to the results by previous workers using different temperature proxies (Moore et al., 1977; CLIMAP, 1981; Thompson 1981). The data suggest a maximum of $2^{0}C$ cooling below ~$35^{0}N$ latitude and > than $5^{0}C$ above $35^{0}N$ latitude during glacial times relative to the present. In addition, glacial periods are characterized by higher seasonality and steeper temperature gradients in the transition zone. Sea surface temperatures (SST) during oxygen isotope stage 5 interglacial were comparable if not warmer than the Holocene. SSTs during glacial stage 6 were lower than stage 2 resulting to steeper temperature gradients in the transition region.

Core top communalities irrespective of core depth and therefore dissolution intensities are greater than 80%. This indicates that greater than 90% of the original data is represented by the five factor model (Imbrie and Kipp, 1977). Downcore, however, distinct intervals of low communalities (< 80%) are observed. Having established at the beginning of the study that dissolution intensities have varied downcore for the three cores, the first obvious concern is the effect of selective dissolution. Surprisingly, communalities are high during periods of high carbonate dissolution. This proves that the transfer function FP-12E is relatively dissolution buffered (accounts for the effects of dissolution) having included in the calibration data set samples from a wide range of depths and states of preservation. In fact, low communalities occur during the oxygen isotope stages 2 to 4 where preservation is relatively good. Low communalities are indicative of no analog conditions (Hutson, 1976; Imbrie and Kipp, 1977). No analog conditions can be explained by a variety of factors (Hutson, 1976): a) environmental conditions in the past have no modern analogs; b) post depositional changes in the assemblage (*e.g.* dissolution); c) a change in species adaptation; or d) incomplete sampling of modern conditions. Since low communalities are observed during periods of relatively

good preservation, \dissolution as a cause of low communalities can be ruled out. A change in species adaption, on the other hand, goes against the underlying principle of paleoecological transfer functions. Further examination of the data reveals that much of the observed departures of communalites below the acceptable 80% limit is due to the relative abundances of *Neogloboquadrina pachyderma* dextral (Figure 11). Maximum observed relative abundance of this species in the core top data base used to contruct the transfer function FP12-E is 39.54% (Thompson, 1981; Table 3). The relative abundance of this particular species increases by more than two folds during the isotope stages 2 to 4. There is also the possiblility of mis-identification of this taxon. A basic requirement in using paleo-ecological transfer functions is that taxonomic classification adapted should conform with taxonomy used in the development of the transfer function. The taxonomic framework used by Thompson (1981) was strictly followed during the identification stage of the study. A conservative approach was adapted in the identification of the *Neogloboquadrina* group; only four chambered forms with distinct rim-like lip in the ultimate chamber were considered as *N. pachyderma* dextral. *N. pachyderma* dextral resembles *N. incompta*, a species not identified in the study. *N. incompta* is, however, only a minor component of

N. Pacific sediments (Thompson, 1977) and the observed maximum relative percent occurrence of this species in the calibration data set is only 0.70%. It is, in fact, not included in the transfer function FP-12E. Even if some *N. incompta* were mis-identified as *N. pachyderma* dextral, this will not sufficiently explain the observed communalities. Furthermore, high communalities in core top samples and their close agreement with actual SSTs suggest that the taxonomic scheme used is not a problem.

This leads either to no modern environmental analogs or the incomplete sampling of modern day conditions as a probable cause of the observed low communalities during glacial periods. The extreme rarity of carbonate sediments occurring north of the present sub-artic frontal boundary results to poor resolution for this area. Thompson (1981) noted that sampling sites from this region show estimates which depart widely from the observed data. This would partly explain why communalities decrease south to north in the cores studied. In addition, Coulborn *et al.* (1980) were able to observe in the North Pacific *N. pachyderma* dextral relative abundances which were higher than the maximum abundance in Thompson's (1981) core top data. The same authors reported that the faunal assemblage at Shatsky Rise were unique, forming a separate cluster distinct from the rest of their North Pacific core top samples.

The idea that there are no modern modern counterparts of glacial paleo-ecology is a more intriquing possibility with far reaching significance. Anomalous assemblages (not observed in calibration set) occurring in glacial intervals is not at all unique to the cores presently studied. Imbrie and Kipp (1977), in a study of the Carribean core V12-122, noted the anomalous combination of tropical assemblage and polar sub-polar assemblage (*G. bulloides* and *N. pachyderma* dextral) during glacial periods. *N. pachyderma* dextral are found to be abundant in areas of high productivity (Bradshaw, 1959; Parker, 1970; Coulborn *et al.*, 1980; Thompson, 1981, Deuser *et al.* 1981; Fairbanks *et al.*, 1982; Reynolds and Thunell, 1986, 1991). Greatest abundance of *N. pachyderma* dextral in the North Pacific are found off the coast of Baja California and is clearly associated with upwelling. The Transitional Water Mass represents a very narrow ecological window with a steep latitudinal temperature and productivity gradient. With increasing latitude within this narrow zone, *N. pachyderma* dextral abundances should mirror this change in productivity. Across a certain threshold of temperature and/or productivity (*e.g.* sub-artic front), however, *N. pachyderma* dextral gives way to *N. pachyderma* sinistral. During glacial periods, *N. pachyderma* dextral abundances reach levels not observed in the present Transitional

waters. This would suggest productivity levels that were much higher than modern values and more importantly, not merely in response to a southward migration of sub-artic frontal boundary. Increased productivity may have been the result of an external source of nutrients or biolimiting elements (*e.g.* phosphorous from eolian dust, Kawahata *et. al.* 1997). Alternatively, it may have been the result of a steeper temperature gradient in the transition zone. This would have lead to enhanced mixing along the gyre axis and hence higher productiviy.

Results: MAT Sea Surface Temperature Estimation

There have been so far few attempts to use the Modern Analog Technique in paleo-temperature reconstruction in the northwestern Pacific (*e.g.* Thunell *et al.*, 1994; Andersen, 1997). In this study, the CLIMAP (1981) world wide core top database was used in the search for the most similar assemblages (modern analogs). Although this represents a more complete sampling of modern ecologic settings, only well preserved samples were included in this database. Table 10 lists the full results of the analysis for core NGC 102. Included are the top 5 cores from the CLIMAP database ranked according to the degree of similarity with the sample in question, location of the 5 cores, observed summer and winter temperatures, and the similarity measure (square chord distance). Estimated summer and winter SSTs

for each sample are the weighted average of observed summer and winter SSTs of the five locations with core top assemblages most similar to the sample in question.

Time series plots of MAT vs FP-12E derived SST estimates follow the same pattern (Figure 13). Winter SSTs are remarkably the same but summer SSTs estimated using MAT are lower than FP-12E derived estimates. Closer inspection of original data (Table 10) reveals that localities from the southern hemisphere and their corresponding observed SSTs were far different from sample localities in the North Pacific. Inclusion of the former samples in the calculation of the estimated summer and winter SSTs resulted to values which departed from that derived using FP-12E. Attempts to use MAT using the CLIMAP world wide database to core NGC 108 resulted to "erroneous" estimates with the inclusion of more southern hemisphere data. This underscores the importance of using calibration data set or data base which is specific for a particular region (Thompson, 1981; Takemoto and Oda, 1997). The transfer function FP-12E was constructed specifically for the North western Pacific. Undoubtedly, SST estimates using MAT for the study area can be greatly improved by limiting search of most similar assemblage to Northern Pacific core tops. This was not attempted and MAT analysis for was discontinued.

Planktic Foraminiferal Relative Abundance Data

A total of 30 species and varieties of planktic foraminifera where identified. Species occurrence charts are presented in Tables 11, 12, and 13; relative frequency of occurrence are shown in Tables 14, 15, and 16. A Q-mode factor analysis of the planktic foraminiferal census data delineated 4 factors which together accounts for 96.3% of the observed total variance. For this analysis, the relative abundances of the species included in the transfer function FP-12E were used. The varimax factor score matrix showing the contribution of the planktic foraminiferal species to each factor is given in Table 17. Factor loadings for each of the 4 factors are shown in Tables 18, 19, and 20 for cores samples NGC 102, NGC 106, and NGC 108 respectively.

Factor 1 (75.8% of the total variance of the data), can be attributed to the most dominant species *Globorotalia inflata*. Factor 2 (9.8% of the total variance) is ascribed to *Neogloboquadrina pachyderma* dextral; factor 3 (7.4% of total variance) to *Globigerina bulloides*; and factor 4 (3.2% of total variance) to *Neogloboquadrina pachyderma* sinistral. Time series plots of the factors loadings of each of the 4 factors in the 4 factor model of the Q-mode analysis are plotted in Figure 15. Factor 1 exhibits distinct glacial-interglacial pattern and generally follows

paleotemperature/oxygen isotope curve. *G. inflata* is a characteristic species of the transitional watermass. Downcore plots of Factor 1 are identical to the transitional varimax factor assemblage plots derived from the the transfer function FP-12E (Figure 13). *N. pachyderma* dextral and *G. bulloides*, are the characteristic species of Thompson's (1981) gyre margin assemblage. This assemblage is found to be most significant along the edges of the Kuroshio gyre and is clearly associated with high productivity as a result of vertical mixing of the water column. In the Q-mode factor analysis of the present data set, these two species have been identified as representing two distinct factors (factors 2 and 3 respectively). It is the author's contention that these two species are indicative of primary productivity which are typically high during glacial periods. It has been previously shown consistently in all three cores (figures 7, 8, and 9) that abundances of *G. bulloides*, follow closely the downcore dissolution pattern. Thus, superimposed on the productivity signal of factor 3 is the dissolution signal. Both productivity and planktic foraminiferal preservation state (basis of the dissolution signal) generally increase during glacial periods. Resolution between these two independent signals from factor 3 is therefore difficult. Finally, factor 4 corresponds primarily to *N. pachyderma*

sinistral This species is characteristic of the the sub-artic water mass. Factor 4 as delineated in the Q-mode factor analysis of the planktic foraminiferal census data of this study is equivalent to the polar-subpolar assemblage of Thompson (1981).

Planktic foraminiferal abundance data

The planktic foraminiferal relative abundance data is undoubtedly biased toward the more resistant species as a result of selective dissolution. In calculating for species relative abundances, the original species count data is recalculated to 100%. In poorly preserved samples, this procedure has the effect of over-emphasizing abundances of the remaining dissolution resistant species. Absolute abundance data (# of specimens/gr), although still subject to the effects of dissolution, provides a less biased estimate of species abundances as it does not involve recalculation to 100%.

Frontal boundary migration

Absolute abundances of the dominant species as well as some remarkable species with distinct latitudinal distribution are used to trace migration of the frontal boundary. Figure 16 shows the modern distribution of some selected species with distinct geographic distribution (adapted from Bradshaw, 1959). Figures 17, 18, and 19 are

time series plots of these selected species for the three cores of the present study. Significant occurences of *Pulleniatina obliquiloculata*, although few in abundance, are observed during distinct warm events (negative $\delta^{18}O$ peaks). This in turn is mirrored by *Globortalia truncatulionoides* abundances. *P. obliquiloculata* has one of the narrowest temperature range (18°C – 30°C) and occurs most abundantly between 10°S and 10°N latitude (Be', 1977). In the northwest Pacific, this species is closely associated with the warm waters of the North Equatorial Current. Elements of the North Equatorial Current are transported north-northeastward via the Kuroshio current and its extension. *P. obliquiloculata* abundances have been used to track movements of the Kuroshio current specially off the coast of Japan. The greatest abundance of *G. truncatulionoides*, on the other hand, is observed along a narrow band associated with the sub-tropical waters of the Central Pacific. During the oxygen isotope stage 5.5 (5e to others), these two species show greatest abundances which is far greater than what is observed in the Holocene interval. This is interpreted to be a result of a more northward position of the sub-artic front and the Kuroshio Extension during this brief interval. A similar conclusion was reached by Thompson (1981) who noted a poleward expansion of sub-tropical fauna reaching as far north as

47°N latitude. Downcore distribution of the warm water calcareous nanno-fossil *Florisphaera profunda* in core NGC 102 (*in* Tanaka, 1998) exhibits a remarkably similar profile; with peak abundance occurring during the oxygen isotope stage 5.5. Southward migrations of the sub-artic front are indicated by the sudden occurrence of *N. pachyderma* sinsistral and *G. quinqueloba* and the general absence of *P. obliquiloculata* and *G. truncatulinoides*. The relative absence or rare occurrence of *N. pachyerma* sinistral and *G. quinqueloba* in core NGC 102 suggests that at no point did the sub-artic front reach NGC 102 and that this location (~32°N latitude) has remained primarily transitional to sub-tropical. Two distinct periods of southward advances of the sub-artic front can be interpreted from the downcore occurrence of *N. pachyderma* sinistral; glacial stage 2 and glacial stage 6. The greater abundance of *N. pachyderma* sinistral during stage 6 further suggest a more southward position of the front relative to stage 2. A similar conclusion was reached by Thompson and Schackleton (1980) from a study of late Quaternary coiling variations in *N. pachyderma* in the North Pacific. They estimated that the sub-artic boundary moved from its present position to 35-38°N during stage 2 glacial and to 32-35°N latitude during stage 6 glacial. In the present study, there is no evidence of the sub-artic front

reaching as far south as 32°N at any stage. In the modern oceans, the polar front overlies sediments with 10 to 20% sinistral to total *N. pachyderma* ratio (Thompson and Schackleton, 1980). In this study, using 20% as the lower limit, the polar front is estimated to have reached ~ 37°N latitude during stage 2 glacial and ~34°N during stage six The author also notes the difference in the downcore profile of the relative abundance and the absolute abundance of the transitional water species *Globorotalia inflata*. Relative abundances of this species follow closely $\delta^{18}O$ curve, increasing during the interglacials. Absolute abundances, however, show a reverse trend, generally increasing in abundances during glacial times. This seemingly contrasting results are reconciled by citing that the relative abundance is a reflection of species composition and diversity of the faunal assemblage (low during interglacials), whereas the absolute abundance is most likely linked to sea surface productivity.

Productivity signal.

In the discussion of the relative abundance data, it has been previously suggested that *N. pachyderma* dextral and *G.bulloides* abundances are related to productivity. Here presented are downcore absolute abundance curves of these two species along with *N. pachyderma* sinistral absolute abundances plotted against organic carbon data

from a study made by Kawahata *et al.* (1999) of core NGC 102 (Figure 20). Organic carbon wt% generally increases during glacial stages with distinct peaks occurring near the end of the isotope stage 2 (P2), in the middle of stage 3 (P3), within isotope six (P6), and near the termination of isotope stage 8 (P8). Among *G. bulloides* abundances, *N. pachyderma* dextral and sinistral abundances, not one strictly follow organic carbon wt% downcore pattern. The combined pattern however, show significant correlation with organic carbon wt%. *N. pachyderma* dextral abundances in all three cores show distinct maxima corresponding to organic carbon peaks P2, P3, and P8. The absence of the clear peak of *N. pachyderma* dextral during P6 can partly be explained by the sudden appearance of *N. pachyderma* sinistral specifically for the two northern cores (NGC 106 and 108). *G. bulloides* abundances on the other hand show distinct peaks corresponding to P3, P6, and to a lesser degree P8. Consistently, in all three cores, *G. bulloides* maximum abundances occur during the isotope stage 6 showing clear correlation with organic carbon wt% pattern. The absence of a *G. bulloides* abundance peak corresponding to the organic carbon peak P2 cannot be explained. Although as previously stated, *G. bulloides* abundance is also subject to the effects of dissolution, the P2 interval also corresponds to a dissolution minima.

Discussion:

Extracting a single definite paleoproductivity proxy from the planktic foraminiferal data is a difficult task. The very nature of the study area, a very narrow ecologic window with steep temperature and productivity gradients, complicates the interpretation of the individual species abundance data. Given that each species has its own temperature, nutrient, and salinity optimum (ecologic window), the ideal situation is to select samples or localities in which only one parameter has been variable through time or at least variations of the other controlling parameters are minimal. As in many cases, this is difficult to achieve and the present study is no exception. The abundance data of *N. pachyderma* dextral is a case in point. In the transition zone, *N. pachyderma* dextral abundances increases with latitude as a result of the south to north productivity gradient. Across a certain temperature or nutrient threshold, however, *N. pachyderma* dextral is replaced by *N. pachyderma* sinistral. It is believed that *N. pachyderma* dextral will change *to N. pachyderma* sinistral at sea surface temperatures between 7 and 9°C (Be' and Hamlin , 1967; Kennett, 1968; Reynolds and Thunnel, 1986). Still others suggests that upwelling and therefore nutrient conditions play an important role in the

shift from predominantly dextral to sinistral *N. pachyderma* (Ufkes and Zachariasse, 1993; Divakar and Malmgren, 1996).

Further complicating the interpretation of the abundance data is the effect of post-mortem changes in species composition and abundance as a result of carbonate dissolution. *Globigerina bulloides* abundances have been closely linked to productivity levels (Prell and Curry, 1981; Prell, 1984; Prell and Kutzbach, 1987; Divakar and Malmgren, 1996). It is, however, also a dissolution susceptible species (Berger, 1968, 1970, 1979; Berger and Parker, 1971; Coulborn *et al.*, 1980). The cold water species *G. bulloides* and *N. pachyderma* show distinctly uncoupled plankton and sediment patterns (*Boltovoskoy et al.*, 1995). Sautter and Thunell (1991), comparing sediment trap results with the underlying sediments in the upwelling region of the San Pedro Basin, noted a strong difference in faunal composition. The underlying sediment (830 m water depth), showing distinct foraminiferal fragmentation, were dominated by solution resistant species such as *N. pachyderma* and *N. dutertrei*. This was in sharp contrast to sediment trap results (500 m water depth) which were dominated by *G. bulloides*.

An alternative explantion to account for the observed differrences in the abundance profiles of the species *N. pachyderma* dextral, *N. pachyderma* sinistral, and *G.*

bulloides is differences in food requirement and or response to hydrographic properties of the overlying waters. In a study of the seasonal production and morphologic variation in *N. pachyderma* in the northeast Pacific, Reynolds and Thunell (1986) suggest that *N. pachyderma* sinistral prefers colder habitats (<8°C), waters that have little or no stratification, and higher nutrient concentrations. *N. pachyderma* dextral, on the other hand, fluorishes when the waters are warmer, well stratified, and nutrient concentrations relatively lower. In a subsequent study, Reynolds-Sautter and Thunell (1991) confirmed their earlier findings on the ecology of *N. pachyderma* dextral, noting that peak production of this species occurred during early spring when the surface waters were warming and a weak thermocline was established. In the same study, they proposed that *G. bulloides* prefer colder, less thermally stable (unstratified) waters and with less dependence on phytoplankton. This may explain the observed time series absolute abundance profiles of *N. pachyderma* dextral, *N. pachyderma* sinistral, and *G. bulloides* in the three cores of the present study. For the three cores, peak of *G. bulloides* abundances occurs during the glacial stage 6. This is accompanied by peak abundances of *N. pachyderma* sinistral in the two cores. *N. pachyderma* dextral, on the other hand, does not increase significantly for the three

cores during the oxygen isotope stage 6 glacial. These suggest that the surface waters during this period was fertile, colder, and with little or no stratification. This agrees with the previous reconstruction of the sub-artic front advancing to its most southernmost position. *N. pachyderma* dextral on the other hand show peak abundances during the oxygen isotope stages 2 to 4 where there is only a modest increase in the abundances of *G. bulloides* and *N. pachyderma* sinistral. This suggests sea surface conditions which were less colder and the existence of a more developed thermocline.

Comparing the % organic carbon data and the planktic foraminiferal data, there is an obvious difference in these commonly used productivity proxies. Using the Berger *et al.*'s (1994) terminology, the flux proxy (organic carbon) indicate higher primary productivity during the oxygen isotope stage 2 glacial in comparison with the oxygen isotope stage 6. The trophic productivity proxy (*G. bulloides* and *N. pachyderma* abundances) suggests the opposite. Although stage 2 and stage 6 glacial are periods of relatively good preservation, the effects of differential dissolution cannot be discounted given the susceptibility of *G. bulloides* to dissolution. In the three cores, the deepest core (NGC 106) shows consistently lower *G. bulloides* abundances relative to the other cores.

Organic carbon in the sediments, on the other, hand is more directly related to export productivity (the part of primary productivity which is exported from the photic zone). The amount of biogenic carbon which eventually reaches the bottom sediments is subject to the effects of depth, bottom water oxygen, and food web control. The organic carbon data is based on single core and therefore the effects of depth should be negligible. Bottom water oxygen on the other hand is not believed to be a primary factor in the preservation of organic matter (Jahnke, 1990; Kawahata *et al.*, 1998). The structure of the food web affects the amount of biogenic carbon which is recycled in the euphotic zone and the nature and composition of the biogenic carbon fluxes (Rivkin *et al.* 1996). Accordingly, lower export productivity (% organic carbon in sediments) during stage 6 may be due to a more efficient recycling of organic carbon in the euphotic layer.

Sedimentation rates, carbonate dissolution, productivity, and frontal boundary migration

The sediment distribution and composition maps of the North Pacific constructed by McCoy and Sancetta (1986) suggest that sediments in the Shatsky Rise region are mostly biogenic in origin. This region is relatively far from any large landmass and is free from turbidite influence. Paleoceanographic reconstruction maps of the

northwest Pacific constructed by Thompson and Shackleton (1980) suggest that the limit of ice rafting during glacial times was at ~42°N latitude. Mean Corg/N atomic ratio of sediments from NGC 102 is 7.2 indicating primarily marine origin (Kawahata *et al.*, *in press*). Contribution from eolian dust in this region may be significant specially during glacial periods (Hovan *et al.*, 1991; Kawahata *et al.*, 1997) but should affect sedimentation rates in three cores studied equally. Cores NGC 102, NGC 106, and NGC 108 were collected at different depths within the carbonate compensation zone along a south to north transect. Downcore changes in sedimentation rates among the three cores should primarily reflect varying response to changes in sea surface biogenic productivity and carbonate dissolution intensity

To understand how carbonate dissolution intensity and sea surface productivity have affected sedimentation rates in the three localities, the respective indices of these two factors against depth vs. age profiles and sedimentation rates for the three cores are herein presented. In calculating for the sedimentation rates (Tables 21-23), similar age tie points were used to facilitate comparison. Plots of the respective age vs. depths (Figure 21) demostrate clearly a south to north increase in average sedimentation rates. This mirrors

productivity gradient presently observed in this region (Figure 3). During the Holocene, the effects of carbonate dissolution to the sedimentation rate of the deepest core (NGC 106) is evident. It exhibits lower sedimentation rates than core NGC 102. Across the isotope stage 1 and 2 boundary, the two northern cores NGC 106 and 108 show a more than two-fold increase in sedimentation rates. The sedimentation rate of NGC 102 however remained low and in fact lower than the Holocene level. The interval from the isotope stage 2 to 4 is generally characterized by low dissolution intensity and high productivity. Enhanced sedimentation rates exhibited by NGC 106 and 108 relative to NGC 102 fits previous reconstruction of the sub-artic front reaching as far south as NGC 106 but not NGC 102 during isotope stage 2. The carbonate record of NGC 102, show lower carbonate percentages during 2 to 4 glacial stage compared to the Holocene inspite of lower dissolution intensity. This would sugggest considerable dilution by non-calcareous sediments. Biogenic opal concentrations (Kawahata *et al.*,in press), although a minor sediment component in NGC 102, are higher during this period for this core (Kawahata *et al.*, in press).

Sedimentation rates for all three cores falls sharply across isotope stage 4 and 5 boundary and remain low through-out isotope stage 5. This interval is

characterized by high dissolution intensity and low productivity. Whereas sedimentation rates of NGC 106 and 108 for this period fall within Holocene levels, the sedimentation rate in NGC 102 falls even much lower. The northward migration of the sub-artic boundary to as far as north as 45°N latitutde (Thompson, 1981) would suggest that the present position of NGC 102 would have been fully sub-tropical and under the influence of the oligotrophic waters of the central north Pacific. This would explain lower sedimentation rates, low organic carbon concentrations and the occurrence of the warm sub-tropical fauna in core NGC 102 during this period.

Summary: Paleoceanographic Reconstruction of Shatsky Rise, northwestern Pacific

Figures 22, 23, 24 and 25 are a series of time slices which summarize the carbonate preservation history and sea surface paleoceanography of the Shatsky Rise, northwestern Pacific.

During the present (Figure 22), influence of the subtropical water mass and the Kuroshio Extension is marked by the occurrence of the warm water species *Gloroborotalia truncatulinoides* and *Pulleniatina obliquiloculata*, respectively. The planktic foraminiferal assemblage is however dominated by typical transitional water mass species such as *Globorotalia inflata* and *Neogloboquadrina*

pachyderma dextral. The absence of the subpolar species *Neogloboquadrina pachyderma* sinistral and *Globigerina quinqueloba* in all three cores indicates that the subartic frontal boundary is located farther north of the study area. Temperature gradient based on average winter SST (FP-12E) a gradual south to north increase in temperature in the area. The presence of significant degree (>> 0.2 FRAG value) of fragmentation in all three cores suggests that the present foraminiferal lysocline is located above 2,612 m (depth of shallowest core). The critical FRAG value equivalent to ~0.9 is recorded in core NGC 106 (3,713 m depth). It is herein used as an arbitrary depth, in addition to the foraminiferal lysocline (FRAG value approaching 0.2), to mark temporal changes in carbonate dissolution with depth.

The Last Glacial Maximum (LGM) (Figure 23) is characterized by the steepening of the temperature gradient across this region. The appearance of the subpolar species *N. pachyderma* sinistral and *G. quinqueloba* in cores NGC 106 (~34°N latitude) and NGC 108 (~36°N latitude) marks the southward advance of the subartic front. Sinistral/total *N. pachyderma* data suggest that approximate position of this front should be between 34°N and 36°N latitude. This period is also characterized by a deepening of the foraminiferal lyscoline to a depth of ~3,390 meters.

Sea surface temperatures during the oxygen isotope stage 5.5 (figure 24) are similar if not slightly warmer than present condtions. Peak abundances of *G. truncatulinoides* and *P. obliquiloculata*, however, suggest a more northern position of the sub-artic front relative to the present. This period is also characterized by intense carbonate dissolution, with the the foraminiferal lysocline most likely shallower than the present position. The FRAG critical value ~0.9 is observed at core NGC 108 (3.390 m depth).

The oxygen isotope stage 6 (glacial) (Figure 25) is characterized by a greater steepening of the temperature gradient across this region. Sinistral/total *N. pachyderma* data suggest the subartic front migrated as far south as 34°N latitude. Depth of the foraminiferal lysocline is probably comparable to the oxygen isotope stage 2.

Conclusions

1.) Results of the sea surface temperature estimation using the transfer function FP-12E are comparable to previous sea surface reconstruction of North Pacific. The data suggest a maximum of 2°C cooling below ~35°N latitude and > than 5°C above 35°N latitude during glacial times relative to the present. In addition, glacial periods are characterized by higher seasonality and steeper temperature gradients in the transition zone. Intervals of low communalities are not associated with dissolution but are generally associated with *Neogloboquadrina pachyderma* dextral relative abundances exceeding that of calibration data set.

2) A Q-mode factor analysis of the planktic foraminiferal relative abundances identified 4 factors which could account for 96% of the total variance of the data. The 4 factors can be attributed to the occurrences of the most dominant taxa: *Globorotalia inflata*, *Neogloboquadrina pachyderma* dextral, *Globigerina bulloides*, and *Neogloboquadrina pachyderma* sinistral. The relative abundances of *G. inflata*, a transition water species, follows paleotemperature and $\delta^{18}O$ curve. The relative abundances of *N. pachyderma* dextral, *G bulloides*, and *N. pachyderma* sinistral are possibly linked to individual

species response to productivity levels, dissolution, and temperature.

3) Selective dissolution undoubtedly results to species relative abundance data that over-emphasises the dissolution resistant species. A less biased interpretation of faunal data is achieved using absolute abundances which are herein used to reconstruct sea surface conditions. The ubiquitous presence of the warm water species *Pulleniatina obliquiloculata* and *Globorotalia truncatulinoides* during peak $\delta^{18}O$ negative events (oxygen isotope stages 1 and 5.5) mark the influence of the Kuroshio Extension and the sub-tropical water mass respectively. *G. truncatulinoides* peak abundance occurring during oxygen isotope stage 5.5 (~122 kyr) not only serves as an important biostratigraphic event coincident with the disappearance of the pink pigmented *Globigerinoides ruber,* but also signals a northern retreat of the sub-polar frontal boundary relative to the present position. Southward advances of this front are marked by the appearance of *N. pachyderma* sinistral in the two northern cores (NGC 106 and NGC 108) during oxygen isotope stages 2 and 6. The general absence of this species in NGC 102 (~32^{0}N latitude) suggest that this location has remained fully sub-tropical to transitional and that the maximum southward penetration of the cold water mass was restricted to ~34^{0}N latitude. Peak abundances of *G.*

bulloides and *N. pachyderma* sinistral during stage 6 suggest sea surface conditions characterized by higher productivity and colder waters with little or no stratification relative to stage 2 glacial.

4) The effects of temporal changes in carbonate dissolution intensity and productivity are clearly reflected in the sedimentation rates constructed for the three cores. Averaged sedimentation rates, however, mirror the observed south to north productivity gradient observed in the present transition zone.

Commonly used indices to track dissolution intensity

% CACO3	Subject to the effects of: Carbonate dissolution Productivity/flux of carbonate tests Dilution by non-carbonate materials
Berger's (1968, 1971) Foraminiferal Dissolution Index (FDX)	Based from the proportion of dissolution resistant species. Formula: $FDX = \Sigma(p_i R_i)/\Sigma p_i$ where p_i = % of species i R_i = dissolution ranking of species i Subject to the effects of local ecology
Planktic Foraminiferal Fragmentation Ratio (FRAG)	Relative proportion of planktic foraminiferal fragments. Formula: $FRAG = \frac{\#\text{ of foraminiferal fragments}}{\#\text{ of foram frag} + \#\text{ of whole tests}}$
Planktic Foraminiferal Number	Number of planktic foraminiferal tests per gram sediment. Subject to the effects of: Productivity/flux of carbonate tests
Benthic Foraminiferal Number	Number of benthic foraminiferal tests per gram sediment. Subject to the effects of: Productivity/flux of carbonate tests

Table 1

Ranking of foraminiferal species in the oreder of ease of destruction by dissolution (Berger, 1971)

1.	*Hastigerina pelagica* *Hastigerinella digitata*	7.	*Globorotalia menardii* *Pulleniatina obliquiloculata* *Sphaeroidinella deshiscens* *Globorotalia crassaformis* *Neogloboquadrina dutertrei* *Turborotalia humilis* *Globorotlia truncatulinoides* *Globorotalia inflata* *Neogloboquadrina pachyderma*
2.	*Globigerina rubescens* *Globigerinoides ruber*		
3.	*Globigerinoides tenellus* *Globigerina bulloides*		
4.	*Globigerinoides sacculifer* *Globigerinoides conglolobatus*		
5.	*Globigerina siphonera* *Orbulina universa* *Globigerina falcoensis*		
6.	*Globorotalia scitula* *Globigerina digitata* *Globoquadrina conglomerata*		

Table 2

Species used in Eq. FP-12E (Thompson, 1981)	Maximum occurence (% of sample
Beela digitata (Brady)	2.752
Candeina nitida d'Orbigny	5.714
Globigerina bulloides d'Orbigny	36.294
G. falcoensis Blow	15.8
G. rubescens Hofker	7.712
Globigerinella aequilateralis (Brady)	15.426
G. calida (Parker)	11.568
Globigerinita glutinata (Egger)	83.333
Globigerinoides conglolobatus (Brady)	26.786
G. ruber (d'Orbigny)	78.571
G. sacculifer (Brady) with "sac"	11.881
G. sacculifer (Brady) without sac	13.167
G. tenellus Parker	14.239
Globoquadrina conglomerata (Schwager)	8.929
Globorotalia crassaformis (Galloway & Wissler)	13.265
G. hirsuta (d'Orbigny)	1.165
G. inflata (d'Orbigny)	100
Globorotala menardii (Parker, Jones & Brady)	28.144
G. scitula (Brady)	2.645
G. truncatulinoides (d'Orbigny) sinistral	8.667
G. truncatulinoides (d'Orbigny) dextral	12.5
G. tumida (Brady)	41.806
G. wilesi Thompson	4.348
Neogloboquadrina eggeri (Rhumbler)	26.944
N. blowi Rogl & Bolli	14.943
N. pachyderma (Ehrenberg) sinistral	100
N. pachyderma (Ehrenberg) dextral	39.554
Orbulina universa (Parker & Jones)	4.951
Pulleniatina obliquiloculata (Parker & Jones)	73.421
Spaeroidinella dehiscens (Parker & Jones)	21.05
Species counted but not included in Eq. F-12E	
Berggrenia pumilio (Parker)	0.23
Globigerinella adamsi (Banner & Blow)	0.15
Globigernita bradyi (Wiesner)	0.08
G. iota Parker	1.59
Globorotalia anfracta Parker	0.3
G. crassula Cushman & Stewart	1.44
G. fimbriata (Brady)	0.01
G. ungulata Bermudez	2.68
Globorotaloides hexagona (Natland)	0.84
Hastigerina pelagica (d'Orbigny)	0.48
Neogloboquadrina incompta (Cifelli)	0.7
Neoacarinina blowi Thompson	0.84
Turborotalia humilis (Brady)	0.64
T. quinqueloba (Natland)	5.12

Table 3

Varimax Factor Score Matrix: FP-12E

Species	Tropical dissolution resistant	Transitional	Tropical disolution susceptible	Sub-tropical	Polar /subpolar	Gyre margin
Orbulina universa (Parker & Jones)	0.011	0.012	-0.002	0.006	0.004	0.015
Globigerinoides conglolobatus (Brady)	0.137	0.019	0.016	-0.123	-0.014	0.016
G. ruber (d'Orbigny)	0.84	0.019	-0.043	-0.468	-0.005	-0.002
G. tenellus Parker	0.061	-0.002	-0.012	-0.006	0	-0.02
G. sacculifer (Brady) without sac	0.094	0.001	0.054	-0.062	-0.007	0.026
G. sacculifer (Brady) with "sac"	0.109	0.004	0.053	-0.02	-0.006	-0.033
Spaeroidinella dehiscens (Parker & Jones)	0.003	0.011	0.044	-0.019	-0.001	-0.016
Globigerinella aequilateralis (Brady)	0.123	-0.005	0.111	0.035	-0.007	-0.077
Globigerina calida (Parker)	0.078	0	0.016	0.038	-0.002	-0.075
G. bulloides d'Orbigny	0.036	0.076	-0.007	0.065	0.116	0.758
G. falcoensis Blow	0.014	0.002	-0.012	0.033	-0.003	0.09
Beela digitata (Brady)	0.009	0.011	0.006	-0.015	-0.002	0.005
Globigerinoides rubescens Hofker	0.036	-0.002	-0.005	0.032	0.001	-0.027
Neogloboquadrina pachyderma (Ehrenberg) dextral	0.013	0.009	0.01	-0.003	0.988	-0.082
N. pachyderma (Ehrenberg) sinistral	-0.034	0.235	-0.03	0.005	0.075	0.168
Globoquadrina conglomerata (Schwager)	0.007	-0.001	0.02	0.019	0.001	-0.017
Pulleniatina obliquiloculata (Parker & Jones)	0.014	0.01	0.941	0.019	0.002	-0.045
Globorotalia. inflata (d'Orbigny)	-0.03	0.957	-0.022	-0.009	-0.0029	-0.176
G. truncatulinoides (d'Orbigny) sinistral	0.006	0.006	-0.002	-0.01	0	-0.004
G. truncatulinoides (d'Orbigny) dextral	0.012	0.08	-0.007	-0.04	-0.005	0.04
G. crassaformis (Galloway & Wissler)	0	0.003	0.003	-0.022	0.01	0.05
G. hirsuta (d'Orbigny)	0.001	0.003	-0.001	-0.002	0	0.003
G. scitula (Brady)	0.004	0.005	-0.001	-0.008	0	0.008
G. menardii (Parker, Jones & Brady)	0.022	0.033	0.142	-0.044	-0.028	0.087
G. tumida (Brady)	-0.009	0.01	0.235	-0.051	0.001	-0.076
Candeina nitida d'Orbigny	0.005	0.004	0.004	-0.006	-0.001	-0.003
Globigerinita glutinata (Egger)	0.473	0.028	-0.017	0.861	-0.014	-0.031
Neogloboquadrina eggeri (Rhumbler)	0.002	0.121	0.114	-0.033	-0.04	0.557
G. wilesi Thompson	0.001	0	-0.001	-0.001	0.001	0.006
N. blowi Rogl & Bolli	0.012	-0.006	0.041	0.043	-0.003	0.063

Table 4

Parameters of equation FP-12E

Variable	Summer regression coefficient	Winter regression coefficient
Polar/ subpolar	-11.51106	-19.49652
Transitional	-0.11792	-6.42553
Tropical dissolution resistant	2.4527	4.55074
Tropical dissoultion susceptible	2.17908	3.88912
Gyre Margin	-0.96272	-8.99538
Subtropical	0.44183	0.66721
Intercept	27.01555	24.02705

Table 5

		Factor Score									
Sample No.	Age (kyr)	Tropical dissolution resistant	Transitional	Tropical dissolution susceptible	Sub-tropical	Polar /subpolar	Gyre margin	Communality	Estimated Summer SST	Estimated Winter SST	Seasonality
top	0.61	0.059791089	0.972088508	-0.00010403	-0.000658855	0.040512646	0.025816712	0.950839263	26.66	17.03	9.63
5.16	4.29	0.174255832	0.93920406	0.010112749	-0.063253705	0.014585049	-0.009363397	0.916873057	27.27	18.58	8.68
5.24	9.19	0.096508632	0.739650933	-0.003932492	-0.058337016	0.089078521	0.341528437	0.684392747	25.86	14.85	11.00
5.32	14.10	0.095306429	0.791535958	-0.008864028	-0.021725026	0.103378314	0.291103565	0.731591398	25.74	14.69	11.05
5.4	19.00	0.086773802	0.967138327	-0.016117269	0.095610783	0.050373934	0.160087719	0.980453036	26.49	15.79	10.70
5.48	25.80	0.094221983	0.903225524	-0.022041188	-0.013183381	0.087550479	0.209708403	0.876996445	25.97	14.96	11.01
5.56	32.60	0.040147314	0.862812244	-0.03013469	-0.024075479	0.09635678	0.216647039	0.803765072	25.71	14.70	11.00
5.64	39.40	0.127899077	0.813334967	-0.034035973	-0.002125383	0.099551488	0.234639851	0.744001266	25.87	15.20	10.68
5.72	46.20	0.183492945	0.842641282	-0.033020847	0.023561686	0.073588085	0.234767017	0.805890279	26.32	15.79	10.53
5.8	53.00	0.14314868	0.868784659	-0.022409081	0.065723384	0.070354803	0.151670554	0.808053813	26.38	16.32	10.06
5.88	59.00	0.299018964	0.798816393	-0.018993249	0.045315206	0.0676748	0.2231355	0.784303511	26.72	16.88	9.84
5.96	65.00	0.085361359	0.728383952	-0.0402931	0.033124983	0.114561892	0.339482675	0.668923455	25.50	14.31	11.18
6	71.33	0.084562234	0.94110761	-0.028215869	0.045176694	0.045232661	0.010904065	0.897836265	26.64	17.31	9.33
6.8	84.00	0.13653176	0.913829286	-0.013239742	-0.02186116	0.037921934	0.021885769	0.856295147	26.84	17.77	9.07
6.16	96.67	0.145630809	0.966926442	0.006625346	-0.031370537	0.041324406	0.023458163	0.959441075	26.86	17.46	9.40
6.24	109.33	0.074198998	0.928944961	-0.030088426	-0.060557521	0.057697816	0.062293993	0.880226338	26.37	16.55	9.82
6.32	122.00	0.154854073	0.734524652	0.050646826	-0.0386087	0.010882636	0.034970258	0.568903331	27.32	19.66	7.66
6.4	135.00	0.189343308	0.907158645	-0.014097291	0.070255797	0.077723698	0.282441058	0.949736231	26.30	15.00	11.31
6.48	138.20	0.171368817	0.900922488	-0.008756866	0.01146888	0.088717726	0.268211694	0.921045166	26.13	14.85	11.28
6.56	141.40	0.211314394	0.697878796	-0.024422839	-0.011741395	0.097613327	0.449484695	0.743987775	25.91	14.46	11.46
6.64	144.60	0.141363446	0.790046171	-0.019200328	0.035383733	0.089631805	0.397909804	0.81214331	25.91	14.22	11.70
6.72	147.80	0.155669528	0.888373098	-0.033179167	-0.04939444	0.077892909	0.241680975	0.88145743	26.16	15.17	10.99
6.8	151.00	0.181705627	0.90543075	-0.024224335	-0.03701839	0.046089224	0.086507227	0.864386675	26.77	17.24	9.53
6.88	156.82	0.202278615	0.866177002	-0.029114608	-0.007670445	0.06408261	0.270389733	0.869302921	26.44	15.58	10.85
6.96	162.64	0.116238122	0.929351367	-0.033841726	0.019265555	0.072398237	0.105654441	0.895126054	26.29	16.10	10.19
7	165.55	0.274280127	0.688764315	-0.03194567	0.043722916	0.113885008	0.399555899	0.7251728	25.93	14.94	10.99
7.8	171.36	0.285884091	0.457301301	-0.026989861	-0.031314475	0.127636849	0.450473826	0.511781076	25.74	15.72	10.01
7.16	177.18	0.177682088	0.714770237	-0.035103406	-0.053503034	0.115444426	0.232941298	0.614151304	25.79	15.72	10.07
7.24	183.00	0.101972894	0.743915214	-0.029791944	-0.051278593	0.101326694	0.138018155	0.596641482	25.87	16.34	9.53
7.32	198.00	0.096018346	0.934175374	-0.022469192	-0.038450404	0.043617382	0.024809733	0.886404449	26.65	17.27	9.37
7.4	213.00	0.089927212	0.821335706	0.003974095	-0.047986049	0.091393515	0.235986605	0.749040153	25.93	15.24	10.70
7.48	228.00	0.168582969	0.557708567	-0.032729038	-0.08629125	0.092645299	0.358300446	0.484938794	25.90	16.00	9.91
7.56	238.50	0.268729999	0.480813814	-0.029935613	0.010012541	0.13451095	0.403608965	0.485387521	25.67	15.80	9.87
7.64	249.00	0.163664277	0.472614367	-0.032378042	0.004587917	0.109511854	0.341992737	0.380171601	25.75	16.40	9.35
7.72	254.53	0.153090311	0.394607473	-0.028689377	-0.031353724	0.112446608	0.272683914	0.267958594	25.75	17.41	8.34
7.8	260.05	0.173553633	0.434037912	-0.034013367	-0.034133012	0.097308141	0.291438152	0.315236815	25.95	17.35	8.59
7.88	265.58	0.098683676	0.426292188	-0.037357566	0.010222847	0.150540894	0.3955139	0.372057398	25.06	15.11	9.96
7.96	271.11	0.088268197	0.403558718	-0.037318208	0.003934847	0.126646978	0.393658758	0.34306572	25.31	15.68	9.63
cc64	275.95	0.131296677	0.366307871	-0.035335271	0.053639009	0.137850188	0.499196467	0.423745785	25.21	14.99	10.22
cc72	281.47	0.065266367	0.878697119	-0.036037817	-0.036721761	0.057866696	0.081982764	0.789085265	26.33	16.65	9.68
cc80	287.00	0.155653102	0.592089778	-0.021765767	-0.037036805	0.112884473	0.24940535	0.4515896	25.79	16.38	9.41
cc88	292.53	0.08229379	0.777161819	-0.030783878	-0.045389242	0.118192554	0.243425598	0.686986093	25.53	14.76	10.76
cc96	298.05	0.067739714	0.526517984	-0.031679853	-0.023756221	0.108650598	0.172038183	0.324779916	25.68	17.15	8.53

Table 6: NGC 102 FP-12E SST.

		Factor Score									
Sample No.	Age (kyr)	Tropical dissolution resistant	Transitional	Tropical dissolution susceptible	Sub-tropical	Polar /subpolar	Gyre margin	Communality	Estimated Summer SST	Estimated Winter SST	Seasonality
2.00	0.00	-0.0242	0.9310	-0.0168	-0.0132	0.0388	0.0607	0.87	26.40	16.56	9.84
2.08	2.88	-0.0206	0.9685	-0.0166	0.0140	0.0441	0.0199	0.94	26.40	16.62	9.78
2.16	8.64	-0.0093	0.6538	-0.0290	-0.0028	0.1083	0.1474	0.46	25.53	16.23	9.30
2.24	14.40	0.1536	0.7312	-0.0040	0.1032	0.1647	0.2447	0.66	25.29	14.67	10.62
2.32	19.00	0.0500	0.7414	-0.0227	0.0960	0.1533	0.1263	0.60	25.24	15.34	9.89
2.40	20.09	0.0242	0.8772	-0.0172	0.0291	0.1414	0.0847	0.80	25.33	14.93	10.40
2.48	21.18	0.0499	0.8978	-0.0069	0.0761	0.1400	0.1742	0.86	25.37	14.21	11.15
2.56	21.50	0.0188	0.8183	-0.0293	0.0646	0.1558	0.1372	0.72	25.09	14.51	10.58
2.64	26.24	0.0057	0.9685	-0.0096	0.0291	0.0635	0.0389	0.94	26.24	16.22	10.02
2.72	28.91	0.0003	0.8913	-0.0356	0.0340	0.0716	0.0735	0.81	26.05	16.13	9.92
2.80	31.44	-0.0071	0.6586	-0.0315	0.0278	0.1302	0.2193	0.50	25.22	15.15	10.08
2.96	36.18	-0.0105	0.8846	-0.0160	0.0331	0.0721	0.1506	0.81	25.98	15.49	10.49
3.00	37.76	-0.0007	0.6906	-0.0023	0.0421	0.1358	0.2333	0.55	25.23	14.86	10.37
3.08	40.29	0.0071	0.8695	-0.0227	-0.0026	0.0675	0.1587	0.79	26.04	15.64	10.40
3.16	42.82	0.0462	0.6084	-0.0326	0.0450	0.0984	0.2825	0.46	25.67	15.77	9.89
3.32	47.57	0.0058	0.6457	-0.0119	0.0280	0.1070	0.2730	0.50	25.51	15.33	10.18
3.48	52.32	0.0760	0.9622	-0.0317	0.0405	0.0431	0.0495	0.94	26.60	16.81	9.79
3.56	54.69	-0.0366	0.9578	-0.0318	0.0022	0.0411	-0.0136	0.92	26.39	16.90	9.48
3.72	62.00	0.0733	0.9080	-0.0355	0.0906	0.1173	0.1220	0.87	25.68	15.06	10.62
3.88	75.75	0.0983	0.8890	-0.0236	-0.0455	0.0478	0.0043	0.80	26.62	17.67	8.95
3.96	80.75	0.0421	0.9129	-0.0195	0.0022	0.0709	0.0298	0.84	26.22	16.63	9.59
4.00	83.25	0.0885	0.7988	-0.0224	0.0153	0.0675	0.0501	0.65	26.36	17.45	8.90
4.16	92.00	-0.0040	0.9791	-0.0051	0.0351	0.0314	-0.0506	0.96	26.69	17.56	9.12
4.32	122.67	0.0527	0.9262	0.0388	-0.0544	0.0495	0.0407	0.87	26.59	17.10	9.49
4.48	130.16	0.0524	0.9392	-0.0273	0.0981	0.3178	0.0175	1.00	23.44	11.84	11.60
4.64	132.17	0.0434	0.9556	-0.0321	0.0393	0.2176	0.0506	0.97	24.50	13.29	11.22
4.80	134.18	0.1155	0.9091	0.0098	0.0356	0.1164	0.2915	0.94	25.70	13.88	11.82
4.96	137.44	0.1273	0.8700	-0.0084	0.0698	0.2668	0.2393	0.91	24.03	11.68	12.35
5.00	137.62	0.1329	0.7851	-0.0182	0.0306	0.2418	0.3677	0.83	24.17	11.52	12.65
5.16	143.34	0.0665	0.8967	-0.0273	0.0850	0.1369	0.2619	0.90	25.32	13.49	11.82
5.32	148.50	0.0787	0.9507	-0.0282	0.1454	0.1055	0.1079	0.95	25.88	15.24	10.64
5.48	152.15	0.0465	0.9156	-0.0024	0.0720	0.3754	0.0385	0.99	22.79	10.73	12.06
5.64	155.80	0.0089	0.6498	-0.0194	0.0759	0.2989	0.4198	0.69	23.18	10.26	12.91
5.72	164.04	0.1373	0.8877	0.0158	0.0890	0.1650	0.2227	0.89	25.30	13.85	11.45
5.96	170.22	0.0665	0.9496	-0.0209	0.0226	0.0891	0.0782	0.92	26.03	15.72	10.31
6.00	175.88	0.1051	0.6857	-0.0237	0.0684	0.1435	0.3264	0.61	25.28	14.32	10.96
6.16	182.06	0.0365	0.8770	-0.0171	0.0359	0.1424	0.1029	0.80	25.34	14.81	10.52
6.32	188.20	0.1366	0.7968	-0.0152	0.0482	0.0957	0.2394	0.72	26.00	15.48	10.51

Table 7: NGC 106 FP-12E SST

		Factor Score									
Sample No.	Age (kyr)	Tropical dissolution resistant	Transitional	Tropical dissolution susceptible	Sub-tropical	Polar /subpolar	Gyre margin	Communality	Estimated Summer SST	Estimated Winter SST	Seasonality
1.97	0.00	0.0009	0.5219	0.0000	0.0000	0.0174	0.0360	0.58	25.23	14.97	10.26
2.00	1.20	0.0006	0.9188	0.0001	0.0000	0.0020	0.0005	0.92	26.38	16.64	9.74
2.40	2.80	0.0015	0.6782	0.0001	0.0000	0.0106	0.0068	0.70	25.62	15.76	9.86
2.08	4.40	0.0006	0.7051	0.0002	0.0000	0.0089	0.0177	0.73	25.82	15.65	10.17
2.16	7.60	0.0000	0.6466	0.0003	0.0001	0.0133	0.0263	0.69	25.48	15.07	10.41
2.24	10.80	0.0001	0.2677	0.0004	0.0008	0.0243	0.0564	0.35	24.98	15.52	9.46
2.32	14.40	0.0092	0.1934	0.0001	0.0114	0.0310	0.0852	0.33	24.96	15.60	9.35
2.40	16.50	0.0031	0.2683	0.0007	0.0152	0.1154	0.0778	0.48	22.96	11.80	11.17
2.48	19.00	0.0056	0.2976	0.0003	0.0275	0.1154	0.0627	0.51	23.07	12.03	11.05
2.56	21.50	0.0072	0.5995	0.0001	0.0179	0.1608	0.1045	0.89	22.32	8.76	13.56
2.64	24.00	0.0023	0.9303	0.0004	0.0083	0.0158	0.0015	0.96	25.71	15.93	9.78
2.72	25.63	0.0090	0.7061	0.0004	0.0137	0.1354	0.0249	0.89	22.86	10.46	12.39
2.80	27.27	0.0177	0.7652	0.0001	0.0162	0.1044	0.0543	0.96	23.43	10.67	12.76
2.88	28.91	0.0030	0.3682	0.0005	0.0070	0.1828	0.1013	0.66	21.90	9.15	12.76
2.96	30.55	0.0089	0.3469	0.0003	0.0148	0.1084	0.1948	0.67	23.04	10.29	12.75
3.00	31.36	0.0022	0.3868	0.0005	0.0137	0.0789	0.1786	0.66	23.49	10.96	12.53
3.08	33.00	0.0002	0.3596	0.0009	0.0026	0.0380	0.1109	0.51	24.44	13.37	11.07
3.16	34.64	0.0016	0.1952	0.0006	0.0046	0.0270	0.2594	0.49	24.70	13.53	11.17
3.24	36.27	0.0033	0.0641	0.0001	0.0051	0.0302	0.4968	0.60	24.52	13.01	11.51
3.32	37.91	0.0026	0.2154	0.0004	0.0044	0.0552	0.1528	0.43	24.04	13.14	10.90
3.40	39.55	0.0003	0.3689	0.0006	0.0026	0.0612	0.2476	0.68	23.69	10.84	12.85
3.48	41.18	0.0001	0.5192	0.0009	0.0050	0.0214	0.0704	0.62	25.06	14.14	10.92
3.56	42.82	0.0150	0.3000	0.0003	0.0199	0.0275	0.2343	0.60	24.96	13.50	11.46
3.64	44.46	0.0039	0.4760	0.0002	0.0129	0.0222	0.1874	0.70	25.05	13.10	11.95
3.72	46.09	0.0001	0.3203	0.0005	0.0043	0.0165	0.0719	0.41	25.27	15.47	9.80
3.80	47.73	0.0012	0.2492	0.0006	0.0018	0.0238	0.0870	0.36	25.00	15.25	9.75
3.88	49.36	0.0023	0.2890	0.0002	0.0044	0.0270	0.2212	0.54	24.79	13.35	11.43
3.96	51.00	0.0016	0.2868	0.0000	0.0073	0.0100	0.0832	0.39	25.71	16.27	9.44
4.00	51.82	0.0016	0.2868	0.0000	0.0073	0.0100	0.0832	0.39	25.71	16.27	9.44
4.08	53.46	0.0082	0.2228	0.0006	0.0121	0.0565	0.2433	0.54	24.02	12.31	11.70
4.16	55.09	0.0177	0.3900	0.0005	0.0056	0.0359	0.3219	0.77	24.59	11.78	12.81
4.24	56.73	0.0054	0.3009	0.0006	0.0248	0.1333	0.2845	0.75	22.49	8.93	13.56
4.32	58.36	0.0106	0.2797	0.0005	0.0182	0.1005	0.3371	0.75	23.06	9.70	13.37
4.40	60.00	0.0034	0.2480	0.0001	0.0173	0.0993	0.3814	0.75	22.97	9.46	13.52
4.48	66.00	0.0088	0.3259	0.0000	0.0245	0.0503	0.3271	0.74	24.18	11.37	12.80
4.56	72.00	0.0166	0.5851	0.0000	0.0441	0.0319	0.1619	0.84	24.98	12.75	12.23
4.64	74.67	0.0099	0.3751	0.0005	0.0342	0.0530	0.1617	0.63	24.25	12.48	11.77
4.72	77.33	0.0019	0.4541	0.0004	0.0106	0.0373	0.1534	0.66	24.52	12.60	11.92
4.80	80.00	0.0000	0.7271	0.0008	0.0022	0.0119	0.0602	0.80	25.60	14.37	11.23
4.88	82.67	0.0001	0.5613	0.0000	0.0031	0.0071	0.0894	0.66	25.78	14.93	10.85
4.96	85.33	0.0170	0.8328	0.0001	0.0093	0.0036	0.0464	0.91	26.45	15.67	10.78
5.00	86.67	0.0434	0.7122	0.0002	0.0014	0.0029	0.0130	0.77	26.84	17.57	9.27
5.08	89.33	0.0599	0.7740	0.0032	0.0151	0.0023	0.0036	0.86	27.18	18.32	8.86
5.16	92.00	0.0003	0.9316	0.0003	0.0001	0.0000	0.0253	0.96	27.07	19.10	7.97
5.24	94.67	0.0137	0.8435	0.0000	0.0182	0.0773	0.0049	0.96	24.21	13.94	10.27

Table 8.1 : Species Relative Abundance NGC 102.

		Factor Score									
Sample No.	Age (kyr)	Tropical dissolution resistant	Transitional	Tropical dissolution susceptible	Sub-tropical	Polar /subpolar	Gyre margin	Communality	Estimated Summer SST	Estimated Winter SST	Seasonality
5.32	97.33	0.0002	0.7388	0.0073	0.0003	0.0012	0.0429	0.79	26.57	16.25	10.32
5.40	100.00	0.0002	0.4483	0.0003	0.0016	0.0103	0.0303	0.49	25.69	16.21	9.48
5.48	102.67	0.0003	0.5834	0.0005	0.0011	0.0052	0.0496	0.64	25.99	15.75	10.24
5.56	105.33	0.0001	0.8798	0.0003	0.0000	0.0006	0.0116	0.89	26.64	16.58	10.06
5.64	108.00	0.0000	0.9115	0.0000	0.0001	0.0008	0.0012	0.91	26.66	17.06	9.60
5.72	110.67	0.0001	0.8037	0.0021	0.0000	0.0025	0.0775	0.89	26.29	15.02	11.27
5.80	113.33	0.0008	0.6425	0.0001	0.0001	0.0120	0.0398	0.70	25.46	14.78	10.68
5.88	116.00	0.0006	0.7827	0.0002	0.0045	0.0032	0.0336	0.82	26.30	15.81	10.49
5.96	118.67	0.0004	0.7142	0.0001	0.0000	0.0066	0.0864	0.81	25.87	14.51	11.35
6.00	120.00	0.0000	0.6764	0.0050	0.0000	0.0011	0.0792	0.76	26.49	15.80	10.69
6.80	122.67	0.0000	0.8362	0.0058	0.0002	0.0047	0.0193	0.87	26.25	15.86	10.39
6.16	125.33	0.0061	0.8440	0.0052	0.0002	0.0308	0.0195	0.91	25.21	14.09	11.11
6.24	128.00	0.0014	0.8579	0.0054	0.0002	0.0292	0.0090	0.90	25.20	14.35	10.85
6.32	130.06	0.0087	0.6024	0.0005	0.0200	0.2033	0.0167	0.85	21.94	9.52	12.41
6.40	132.12	0.0184	0.3112	0.0000	0.0159	0.4084	0.1286	0.88	19.69	5.45	14.24
6.48	134.18	0.0063	0.5732	0.0000	0.0082	0.2685	0.0788	0.93	21.00	6.94	14.06
6.56	136.24	0.0035	0.5065	0.0005	0.0036	0.4857	0.0039	1.00	19.05	5.53	13.52
6.64	138.30	0.0118	0.4096	0.0002	0.0178	0.3759	0.0978	0.91	19.95	5.68	14.27
6.72	140.36	0.0210	0.1317	0.0000	0.0116	0.2021	0.3817	0.75	21.63	8.08	13.55
6.08	142.42	0.0049	0.3870	0.0003	0.0224	0.1637	0.1999	0.78	22.12	8.47	13.63
6.88	144.48	0.0087	0.3974	0.0000	0.0030	0.1036	0.3060	0.82	23.01	9.17	13.85
6.96	146.53	0.0215	0.4647	0.0000	0.0272	0.0992	0.2367	0.85	23.33	9.88	13.45
7.00	147.56	0.0075	0.3744	0.0000	0.0084	0.2970	0.1713	0.86	20.59	6.20	14.39
7.80	149.62	0.0154	0.5704	0.0001	0.0042	0.2652	0.0590	0.91	21.16	7.52	13.64
7.16	151.68	0.0111	0.6746	0.0004	0.0199	0.1898	0.0665	0.96	22.02	8.43	13.59
7.24	153.74	0.0061	0.3689	0.0002	0.0246	0.4448	0.0807	0.93	19.29	4.98	14.31
7.32	155.80	0.0030	0.4572	0.0000	0.0083	0.4892	0.0147	0.97	19.02	5.27	13.75
7.40	157.86	0.0263	0.3155	0.0006	0.0412	0.3782	0.1468	0.91	20.00	5.76	14.24
7.48	159.92	0.0064	0.1653	0.0004	0.0198	0.2764	0.3129	0.78	20.64	6.52	14.12
7.56	161.98	0.0047	0.1915	0.0003	0.0176	0.4911	0.1768	0.88	18.73	4.10	14.63
7.64	164.04	0.0081	0.3924	0.0001	0.0280	0.1859	0.2113	0.83	21.87	7.93	13.94
7.72	166.10	0.0074	0.4522	0.0004	0.0247	0.3891	0.0119	0.89	19.96	6.98	12.98
7.80	168.16	0.0060	0.5820	0.0001	0.0065	0.2587	0.0115	0.86	21.25	8.61	12.64
7.88	170.22	0.0093	0.5527	0.0002	0.0080	0.3879	0.0026	0.96	20.13	8.01	12.12
7.96	172.28	0.0005	0.2383	0.0000	0.0032	0.7311	0.0029	0.98	17.29	4.84	12.46
cc 60	173.82	0.0114	0.3822	0.0004	0.0379	0.5227	0.0007	0.96	18.96	6.26	12.70
cc 68	175.88	0.0145	0.2281	0.0002	0.0225	0.4153	0.0508	0.73	19.71	6.96	12.75
cc 76		0.0197	0.3387	0.0001	0.0245	0.2146	0.0910	0.69	21.78	9.24	12.53
cc 84	180.00	0.0069	0.4524	0.0007	0.0162	0.2270	0.0266	0.73	21.57	9.31	12.26
cc 92	182.06	0.0022	0.4156	0.0003	0.0075	0.4519	0.0207	0.90	19.25	5.69	13.56

Table 8.2 : Species Relative Abundance NGC 102.

NGC 102	Modern SST (C)	Estimated SST (C)	Seasonal contrast (C)	Communality	% Fraction of Original Data	FDX	FRAG
core top	~26.50/17.00	26.76/17.19	9.56	0.96	98.03	6.36	0.69
Stage 1		26.93/17.72	9.21	0.93	96.58	6.06	0.49
Stage 2		26.26/15.77	10.50	0.87	93.21	5.96	0.33
Stage 3		26.20/15.67	10.53	0.85	92.05	5.72	0.30
Stage 4		26.15/15.56	10.58	0.74	85.74	5.39	0.42
Stage 5		26.44/16.27	10.17	0.84	91.83	5.55	0.40
Stage 6		26.27/16.23	10.03	0.73	85.55	5.20	0.34
Stage 7		26.12/16.32	9.80	0.62	78.81	5.72	0.54
Stage 8		25.73/16.26	9.47	0.46	67.48	5.76	0.54

NGC 106	Modern SST (C)	Estimated SST (C)	Seasonal contrast (C)	Communality	% Fraction of Original Data	FDX	FRAG
core top	~26.0/15.0	26.40/15.56	9.84	0.87	93.27	6.84	0.83
Stage 1		26.11/16.47	9.64	0.76	87.18	6.76	0.83
Stage 2		25.26/14.73	10.52	0.73	85.44	6.30	0.59
Stage 3		25.89/15.83	10.06	0.72	84.85	6.36	0.60
Stage 4		25.68/15.06	10.62	0.87	93.27	6.12	0.70
Stage 5		26.49/17.28	9.21	0.83	91.10	6.55	0.73
Stage 6		24.78/13.29	11.49	0.86	92.74	5.83	0.51

NGC 108	Modern SST (C)	Estimated SST (C)	Seasonal contrast (C)	Communality	% Fraction of Original Data	FDX	FRAG
core top	~24.0/13.00	25.23/14.97	10.26	0.58	75.91	6.71	0.74
Stage 1		25.18/15.13	10.05	0.60	77.26	6.36	0.56
Stage 2		22.70/10.33	12.31	0.70	83.64	5.96	0.52
Stage 3		24.39/13.09	11.30	0.61	77.91	5.68	0.39
Stage 4		23.55/10.59	12.96	0.72	84.63	4.96	0.46
Stage 5		25.91/15.27	10.64	0.79	88.68	6.33	0.60
Stage 6		20.55/07.09	13.47	0.87	93.30	5.34	0.33

Modern SST values from the Marine Climatological Charts of the North Pacific Ocean for a 30 yr period (1961-1990), Japan Meteorolocial Agency, March 1993.

Table 9: Summary SST estimation: NGC 102, 106, and 108.

Table 10.1: Results Modern Analog Technique, NGC 102.

Sample ID	Rank	Analog ID	Distance	Core ID	Latitude (degrees)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	SST cool	SST warm
NGC 102 TOP	0	V32-126	0.179613	V32-126	35	19	177	54	15.8	24.4
NGC 102 TOP	1	RC10-172	0.207618	RC10-172	32	8	154	38	18.06	26.95
NGC 102 TOP	2	RC10-161	0.209968	RC10-161	33	5	158	0	17.4	26.6
NGC 102 TOP	3	V32-139	0.213743	V32-139	31	34	151	6	18.3	27.2
NGC 102 TOP	4	RC 12303	0.220315	RC 12303	-30	-28	11	32	15.6	20.2
NGC 102 5.16	0	V 27206	0.172861	V 27206	-31	-21	-1	-41	16.3	21
NGC 102 5.16	1	V16-95	0.202139	V16-95	-28	-1	95	11	17.4	22.3
NGC 102 5.16	2	V16-86	0.204671	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 5.16	3	V28-292	0.219586	V28-292	27	7	140	9	21	28.5
NGC 102 5.16	4	RC 12300	0.223454	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 5.24	0	V16-67	0.16079	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.24	1	V 27137	0.177255	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 5.24	2	RC 11 86	0.187094	RC 11 86	-35	-47	18	27	15.2	20
NGC 102 5.24	3	RC10-175	0.196258	RC10-175	34	35	159	10	16.94	26.11
NGC 102 5.24	4	RC14-97	0.202667	RC14-97	33	28	137	59	15.56	26.39
NGC 102 5.32	0	RC10-175	0.154403	RC10-175	34	35	159	10	16.94	26.11
NGC 102 5.32	1	V16-67	0.157972	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.32	2	V 23 13	0.182306	V 23 13	41	31	-45	-8	14	21.8
NGC 102 5.32	3	RC14-97	0.185762	RC14-97	33	28	137	59	15.56	26.39
NGC 102 5.32	4	AR4-63	0.185908	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.40	0	V16-67	0.128392	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.40	1	AR4-63	0.150194	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.40	2	RC10-175	0.17248	RC10-175	34	35	159	10	16.94	26.11
NGC 102 5.40	3	RC10-161	0.175665	RC10-161	33	5	158	0	17.4	26.6
NGC 102 5.40	4	V 18182	0.192166	V 18182	-32	-20	15	1	14.8	19.8
NGC 102 5.48	0	V16-67	0.123609	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.48	1	AR4-63	0.15794	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.48	2	AR3-25	0.164804	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 5.48	3	RC 12300	0.183659	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 5.48	4	RC 12299	0.1907	RC 12299	-34	-4	1	0	15	19.3
NGC 102 5.56	0	AR4-63	0.121351	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.56	1	V16-67	0.123484	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.56	2	AR3-25	0.15174	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 5.56	3	RC10-175	0.17306	RC10-175	34	35	159	10	16.94	26.11
NGC 102 5.56	4	V 27137	0.175136	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 5.64	0	AR4-63	0.097411	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.64	1	V16-67	0.125544	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.64	2	V 27137	0.157785	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 5.64	3	AR3-25	0.163676	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 5.64	4	RC 12300	0.171669	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 5.72	0	AR4-63	0.101523	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.72	1	V16-67	0.123591	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.72	2	V 29135	0.169935	V 29135	-19	-42	8	53	16.1	22.1
NGC 102 5.72	3	V 30 64	0.170612	V 30 64	25	53	-17	-33	18.5	22.2
NGC 102 5.72	4	AR3-25	0.17717	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 5.80	0	V 27137	0.091268	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 5.80	1	AR4-63	0.107254	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.80	2	V16-67	0.110042	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.80	3	V 23 84	0.169287	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 5.80	4	V16-88	0.191972	V16-88	-32	-23	84	51	14.6	21.1
NGC 102 5.88	0	V 27137	0.118681	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 5.88	1	V16-67	0.134284	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.88	2	AR4-63	0.167523	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 5.88	3	V 29134	0.207862	V 29134	-24	-13	7	25	17.3	21.4
NGC 102 5.88	4	V 30 61	0.21827	V 30 61	25	34	-16	-50	18.2	22
NGC 102 5.96	0	AR3-25	0.08867	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 5.96	1	RC 12297	0.128605	RC 12297	-36	-9	-6	-43	13.4	18.9
NGC 102 5.96	2	V16-67	0.156797	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 5.96	3	RC 12266	0.156829	RC 12266	-39	-49	-24	-47	12.3	17.8
NGC 102 5.96	4	RC11-117	0.167784	RC11-117	-36	-29	69	33	14.2	19.7
NGC 102 6.0	0	RC 12300	0.09301	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 6.0	1	RC 12303	0.112326	RC 12303	-30	-28	11	32	15.6	20.2
NGC 102 6.0	2	V16-67	0.113656	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.0	3	AR3-25	0.118159	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 6.0	4	RC 12299	0.121261	RC 12299	-34	-4	1	0	15	19.3

Table 10.2: Results Modern Analog Technique, NGC 102.

Sample ID	Rank	Analog ID	Distance	Core ID	Latitude (degrees)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	SST cool	SST warm
NGC 102 6.8	0	RC 12300	0.115005	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 6.8	1	V16-86	0.151186	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 6.8	2	RC 12303	0.171232	RC 12303	-30	-28	11	32	15.6	20.2
NGC 102 6.8	3	RC 12299	0.171901	RC 12299	-34	-4	1	0	15	19.3
NGC 102 6.8	4	V16-67	0.180761	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.16	0	RC 12300	0.111727	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 6.16	1	V16-67	0.127954	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.16	2	V16-86	0.139963	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 6.16	3	V 19240	0.152057	V 19240	-30	-35	13	17	15.4	20
NGC 102 6.16	4	V 27206	0.153786	V 27206	-31	-21	-1	-41	16.3	21
NGC 102 6.24	0	RC 12300	0.106232	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 6.24	1	RC 12303	0.106409	RC 12303	-30	-28	11	32	15.6	20.2
NGC 102 6.24	2	V16-67	0.132555	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.24	3	V16-86	0.154203	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 6.24	4	RC 12299	0.15456	RC 12299	-34	-4	1	0	15	19.3
NGC 102 6.32	0	V28-292	0.23098	V28-292	27	7	140	9	21	28.5
NGC 102 6.32	1	V28-296A	0.248659	V28-296A	30	50	139	52	18.3	28.06
NGC 102 6.32	2	RC12-143	0.285504	RC12-143	29	46	133	17	19	28.3
NGC 102 6.32	3	V 27206	0.318151	V 27206	-31	-21	-1	-41	16.3	21
NGC 102 6.32	4	AR4-63	0.318738	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.40	0	AR4-63	0.095353	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.40	1	V16-67	0.112686	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.40	2	V 23 13	0.127494	V 23 13	41	31	-45	-8	14	21.8
NGC 102 6.40	3	V 29135	0.141864	V 29135	-19	-42	8	53	16.1	22.1
NGC 102 6.40	4	V 28 90	0.156309	V 28 90	42	10	-42	-6	14	22.5
NGC 102 6.48	0	AR4-63	0.109712	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.48	1	V 23 13	0.135682	V 23 13	41	31	-45	-8	14	21.8
NGC 102 6.48	2	V16-67	0.13807	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.48	3	V 18182	0.166251	V 18182	-32	-20	15	1	14.8	19.8
NGC 102 6.48	4	V 29135	0.166862	V 29135	-19	-42	8	53	16.1	22.1
NGC 102 6.56	0	AR4-63	0.207496	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.56	1	V 23 13	0.240772	V 23 13	41	31	-45	-8	14	21.8
NGC 102 6.56	2	A180 15	0.251698	A180 15	39	16	-36	-42	15.3	23.6
NGC 102 6.56	3	V 12 56	0.252124	V 12 56	-36	-30	8	5	12.8	18
NGC 102 6.56	4	RC11-134	0.252568	RC11-134	-33	-4	110	33	16.2	19.7
NGC 102 6.64	0	AR4-63	0.172141	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.64	1	V16-67	0.180342	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.64	2	V 23 13	0.183815	V 23 13	41	31	-45	-8	14	21.8
NGC 102 6.64	3	V 29135	0.201286	V 29135	-19	-42	8	53	16.1	22.1
NGC 102 6.64	4	V 12 56	0.214028	V 12 56	-36	-30	8	5	12.8	18
NGC 102 6.72	0	AR4-63	0.116576	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.72	1	V16-67	0.157826	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.72	2	V 27137	0.190293	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 6.72	3	V16-88	0.198904	V16-88	-32	-23	84	51	14.6	21.1
NGC 102 6.72	4	RC 12298	0.203539	RC 12298	-34	-57	-4	-45	14.1	19.4
NGC 102 6.80	0	AR4-63	0.151958	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.80	1	V16-67	0.18349	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.80	2	V16-86	0.225641	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 6.80	3	V 27137	0.230751	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 6.80	4	V 27206	0.238975	V 27206	-31	-21	-1	-41	16.3	21
NGC 102 6.88	0	AR4-63	0.154596	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.88	1	V 29135	0.214888	V 29135	-19	-42	8	53	16.1	22.1
NGC 102 6.88	2	V16-67	0.215706	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.88	3	V 23 13	0.232777	V 23 13	41	31	-45	-8	14	21.8
NGC 102 6.88	4	RC11-134	0.233288	RC11-134	-33	-4	110	33	16.2	19.7
NGC 102 6.96	0	AR4-63	0.17787	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 6.96	1	V16-86	0.194122	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 6.96	2	V16-88	0.211547	V16-88	-32	-23	84	51	14.6	21.1
NGC 102 6.96	3	V16-67	0.222603	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 6.96	4	V16-87	0.231517	V16-87	-31	-38	83	49	15.3	21.8
NGC 102 7.0	0	AR4-63	0.142397	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.0	1	V 29178	0.18797	V 29178	42	50	-25	-9	13.4	20.3
NGC 102 7.0	2	V 23 13	0.188202	V 23 13	41	31	-45	-8	14	21.8
NGC 102 7.0	3	V 27143	0.19834	V 27143	39	42	-20	-9	14	21.2

Table 10.3: Results Modern Analog Technique, NGC 102.

Sample ID	Rank	Analog ID	Distance	Core ID	Latitude (degrees)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	SST cool	SST warm
NGC 102 7.0	4	V 29176	0.200147	V 29176	40	33	-26	0	14.3	21.4
NGC 102 7.8	0	V 23 13	0.192135	V 23 13	41	31	-45	-8	14	21.8
NGC 102 7.8	1	V 27137	0.231927	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.8	2	V 27 15	0.232412	V 27 15	42	44	-43	-13	13.2	21.9
NGC 102 7.8	3	V 28 90	0.242087	V 28 90	42	10	-42	-6	14	22.5
NGC 102 7.8	4	AR4-63	0.25543	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.16	0	V 27137	0.165309	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.16	1	V16-67	0.175225	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 7.16	2	AR4-63	0.183037	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.16	3	RC 12299	0.202763	RC 12299	-34	-4	1	0	15	19.3
NGC 102 7.16	4	V 23 13	0.228947	V 23 13	41	31	-45	-8	14	21.8
NGC 102 7.24	0	V16-67	0.203705	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 7.24	1	V 27126	0.255281	V 27126	43	47	-14	-41	12.4	18.9
NGC 102 7.24	2	V32-126	0.279758	V32-126	35	19	177	54	15.8	24.4
NGC 102 7.24	3	RC 12300	0.281749	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 7.24	4	RC 12299	0.284468	RC 12299	-34	-4	1	0	15	19.3
NGC 102 7.32	0	V16-67	0.157733	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 7.32	1	V 27206	0.184746	V 27206	-31	-21	-1	-41	16.3	21
NGC 102 7.32	2	RC 12300	0.192631	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 7.32	3	RC 12299	0.194315	RC 12299	-34	-4	1	0	15	19.3
NGC 102 7.32	4	V16-86	0.208348	V16-86	-31	-3	82	57	15.7	22.2
NGC 102 7.40	0	AR4-63	0.181232	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.40	1	V16-67	0.199635	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 7.40	2	RC 12299	0.211825	RC 12299	-34	-4	1	0	15	19.3
NGC 102 7.40	3	V 23 13	0.220995	V 23 13	41	31	-45	-8	14	21.8
NGC 102 7.40	4	V32-126	0.231434	V32-126	35	19	177	54	15.8	24.4
NGC 102 7.48	0	AR4-63	0.21032	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.48	1	V 27137	0.221696	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.48	2	V16-67	0.251226	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 7.48	3	RC12-143	0.260516	RC12-143	29	46	133	17	19	28.3
NGC 102 7.48	4	V 23 84	0.260574	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 7.56	0	V 27137	0.148202	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.56	1	AR4-63	0.1785	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.56	2	V 23 84	0.200033	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 7.56	3	V32-130	0.231309	V32-130	35	17	171	54	16	24.5
NGC 102 7.56	4	V 27 15	0.234005	V 27 15	42	44	-43	-13	13.2	21.9
NGC 102 7.64	0	V 27137	0.198622	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.64	1	AR4-63	0.204185	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.64	2	V32-130	0.213904	V32-130	35	17	171	54	16	24.5
NGC 102 7.64	3	V 23 84	0.215974	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 7.64	4	V 27144	0.23239	V 27144	39	35	-13	-33	13.7	20.4
NGC 102 7.72	0	V 27137	0.211287	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.72	1	V 27144	0.272083	V 27144	39	35	-13	-33	13.7	20.4
NGC 102 7.72	2	V32-130	0.279916	V32-130	35	17	171	54	16	24.5
NGC 102 7.72	3	AR4-63	0.28743	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 7.72	4	V 23 84	0.294172	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 7.80	0	V 27137	0.222999	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.80	1	RC12-143	0.26621	RC12-143	29	46	133	17	19	28.3
NGC 102 7.80	2	V32-130	0.268363	V32-130	35	17	171	54	16	24.5
NGC 102 7.80	3	V 27144	0.303972	V 27144	39	35	-13	-33	13.7	20.4
NGC 102 7.80	4	V 23 84	0.311918	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 7.88	0	V32-130	0.176713	V32-130	35	17	171	54	16	24.5
NGC 102 7.88	1	V 27144	0.217308	V 27144	39	35	-13	-33	13.7	20.4
NGC 102 7.88	2	V 27137	0.22304	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.88	3	V 29189	0.239322	V 29189	52	22	-17	-32	10.3	15.3
NGC 102 7.88	4	RC 12299	0.256765	RC 12299	-34	-4	1	0	15	19.3
NGC 102 7.96	0	V32-130	0.220312	V32-130	35	17	171	54	16	24.5
NGC 102 7.96	1	V 27144	0.251985	V 27144	39	35	-13	-33	13.7	20.4
NGC 102 7.96	2	RC 12268	0.266282	RC 12268	-37	-52	-28	-52	13.6	19.2
NGC 102 7.96	3	V 27137	0.277797	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 7.96	4	RC 12299	0.279576	RC 12299	-34	-4	1	0	15	19.3
NGC 102 cc64	0	V32-130	0.182172	V32-130	35	17	171	54	16	24.5
NGC 102 cc64	1	V 29189	0.240078	V 29189	52	22	-17	-32	10.3	15.3
NGC 102 cc64	2	V 27144	0.242706	V 27144	39	35	-13	-33	13.7	20.4

Table 10.4: Results Modern Analog Technique, NGC 102.

Sample ID	Rank	Analog ID	Distance	Core ID	Latitude (degrees)	Latitude (minutes)	Longitude (degrees)	Longitude (minutes)	SST cool	SST warm
NGC 102 cc64	3	V 23 84	0.252497	V 23 84	46	0	-16	-55	11.8	18.2
NGC 102 cc64	4	V 29180	0.253813	V 29180	45	18	-23	-52	12.6	19
NGC 102 cc72	0	V32-126	0.167996	V32-126	35	19	177	54	15.8	24.4
NGC 102 cc72	1	RC 12299	0.184706	RC 12299	-34	-4	1	0	15	19.3
NGC 102 cc72	2	V20-103	0.198432	V20-103	33	59	-177	-50	16.11	25
NGC 102 cc72	3	RC 12303	0.213484	RC 12303	-30	-28	11	32	15.6	20.2
NGC 102 cc72	4	RC 12300	0.220238	RC 12300	-32	-53	2	50	15.6	19.6
NGC 102 cc80	0	V32-130	0.22918	V32-130	35	17	171	54	16	24.5
NGC 102 cc80	1	V 27137	0.24505	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 cc80	2	V 27144	0.252241	V 27144	39	35	-13	-33	13.7	20.4
NGC 102 cc80	3	AR4-63	0.257922	AR4-63	-39	-50	75	3	12.4	16.4
NGC 102 cc80	4	V16-67	0.288951	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 cc88	0	V16-67	0.169312	V16-67	-37	-9	43	30	16.1	19.9
NGC 102 cc88	1	RC 12299	0.182629	RC 12299	-34	-4	1	0	15	19.3
NGC 102 cc88	2	AR3-25	0.196703	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 cc88	3	RC 12297	0.201421	RC 12297	-36	-9	-6	-43	13.4	18.9
NGC 102 cc88	4	RC 12268	0.206036	RC 12268	-37	-52	-28	-52	13.6	19.2
NGC 102 cc96	0	AR3-25	0.257611	AR3-25	-39	-44	67	53	13.2	17.3
NGC 102 cc96	1	V32-130	0.264749	V32-130	35	17	171	54	16	24.5
NGC 102 cc96	2	RC 12299	0.265216	RC 12299	-34	-4	1	0	15	19.3
NGC 102 cc96	3	V 27137	0.277636	V 27137	42	41	-17	-4	12.8	20.1
NGC 102 cc96	4	V16-67	0.284694	V16-67	-37	-9	43	30	16.1	19.9

Species \ Sample #	NGC 102 TOP	NGC 102 5.16	NGC 102 5.24	NGC 102 5.32	NGC 102 5.40	NGC 102 5.48	NGC 102 5.56	NGC 102 5.64	NGC 102 5.72	NGC 102 5.80	NGC 102 5.88	NGC 102 5.96	NGC 102 6.0	NGC 102 6.8	NGC 102 6.16	NGC 102 6.24	NGC 102 6.32	NGC 102 6.40	NGC 102 6.48	NGC 102 6.56	NGC 102 6.64	NGC 102 6.72	NGC 102 6.80	NGC 102 6.88	NGC 102 6.96	NGC 102 7.0
Globigerina. bulloides	13		19	44	34	21	29	30	35	26	22	27	67	17	10	7	22	17	59	86	106	92	48	39	54	38
G. calida			1		1				2																	
G. digitata			1	1							1			1					5	1	2	2			1	
G. falcoensis			8	11	13	8	12	7	22	7	12	4	5	7	6	8	2	2	17	25	30	33	16	18	15	4
G. rubescens																										
G. quinqueloba				1	1			1			1		1	1			1		2		1					
G. sp.			2	12	18	3	3	10	11	3	9	7	12	2	4	1	6		25	17	15	23	13	21	4	14
Globigerinella aequilateralis	2		9	9	2	4	4	2	3	3	12	10	2	3	4	4	4	3	9	7	7	6	5	12	6	
Globigerinita glutinata	4			12	7	13	5	4	11	6	16	9	10	21	6	8	2	9	17	12	7	9	7	9	9	11
Globigerinoides conglobatus			3	1											3	2									1	
G. ruber	9		28	33	30	7	17	11	27	15	17	20	17	19	19	28	30	20	22	32	31	18	28	34	21	49
G. ruber (pink)																			1		2	2	1		1	
G.sacculifer w/o				11	4	1	2				3	3		1		2		12	1	9	2	3		5	3	3
G. sacculifer w/	1			1	2						1	3			2			1		2		1	2		1	
G. tenellus																			1						1	
G. sp	4																							1		
Goborotalia crassaformis																										
G. hirsuta	2		10		3									16	26	10	3	6	4	4	22	10	2		1	
G. inflata	107		134	126	133	114	105	90	105	60	94	52	106	177	106	147	169	91	120	152	100	113	110	148	93	131
G. menardii			1		1													1	1			1		1		
G. puncticulata																				1					1	
G. scitula				4	1	2		3	2		2	7	1	1		1	1			1			2	4		
G. truncatulinoides (left)				2	1				2		4	1	4	7	9	2	8	0								
G. truncatulinoides (right)	25		49	8	6	4	8	8	6	6	14	3	0	0	0	4	10	100	6	8	1	1	5	10	8	3
G. tumida	2		1														1									
G. wilesi							2																			
G. sp.									1	1										2		1				
Globorotaloides hexagona																										
Neogloboquadrina eggeri	7		5	44	46	14	9	7	9	4	3	3	1	6	7	18	17	9	20	16	2	4	1	4	2	2
N. blowi	6		14	16	11	8	15	12	26	15	9	11	10	16	10	34	22	10	22	14	5	6	5	7	2	4
N. incompta																										
N. pachyderma (left)				8	8	1	1	3	2	2	2		1	2	0	3	3		3	6	3	4	3	2		2
N. pachyderma (right)	40		24	156	147	37	69	61	89	38	70	41	126	114	53	50	83	6	39	39	14	37	52	43	19	61
Orbulina univera			5		4	8		6	14	5	18	18	4	3	5	11	2	19	11	19	30	27	15	57	15	18
Pulleniatina obliquiloculata	3		4	2	1	1	1				1		1		2	2		10		2		1				
Spaeroidinella dehiscens			1													1										
unidentified				1	3	1	1			1		3				1										1

Table 11.1: NGC 102 Species Count

Species \ Sample #	NGC 102 7.8	NGC 102 7.16	NGC 102 7.24	NGC 102 7.32	NGC 102 7.40	NGC 102 7.48	NGC 102 7.56	NGC 102 7.64	NGC 102 7.72	NGC 102 7.80	NGC 102 7.88	NGC 102 7.96	NGC 102 cc64	NGC 102 cc72	NGC 102 cc80	NGC 102 cc88	NGC 102 cc96
Globigerina, bulloides	51	47	38	19	8	41	34	39	42	53	23	65	74	73	11	30	35
G. calida	2					1											
G. digitata					2	1		1	2	2						1	
G. falcoensis	24	11	7	7	2	9	5	11	13	8	2	3	5	6		3	4
G. rubescens				1													
G. quinqueloba	1	3			1		1			1	3	1		1		3	
G. sp.	18	16	16	4	2	2	17	8	12	10	7	15	12	3	2	1	4
Globigerinella aequilateralis	3	12	9	8	5	8	4	5	5	2	1					2	1
Globigerinita glutinata	15	10	5		3	3	2	13	15	10	7	9	7	8	2	8	
Globigerinoides conglobatus		3		2				1									
G. ruber	28	34	34	21	14	16	30	32	32	55	25	23	32	18	11	29	16
G. ruber (pink)		1	0				2	1		1	1						
G.sacculifer w/o	2	3	4	1	2	3	2	4	1	4	5					1	1
G. sacculifer w/	2	2	1	1				1		2	4	1					
G. tenellus				1						2							
G. sp																	
Goborotalia crassaformis			1	4												1	
G. hirsuta	33	15	17		8	6				1		4	8	5	1		2
G. inflata	64	29	78	84	88	86	48	30	44	44	22	33	35	20	75	57	72
G. menardii		4		2	6	5	3						1	1	2	7	4
G. puncticulata																	
G. scitula			1		1		2	1		2				1			
G. truncatulinoides (left)																	2
G. truncatulinoides (right)	5	2	4	1	6	32	36	16	12	19	9	12	4	10	12	25	4
G. tumida	2				2	2				2					1	1	1
G. wilesi										5			6	1			
G. sp.				3					1			1		2			
Globorotaloides hexagona			1													1	
Neogloboquadrina eggeri	1	5	6	7	2	3	8	5	20	4	3	0			1		
N. blowi	4	7	7	5	6	5	13	16	17	21	5	15	15	11	6	5	6
N. incompta																	
N. pachyderma (left)	3	1	3	4		3	2	2	1			2	1	1	1	4	1
N. pachyderma (right)	50	89	111	113	44	78	113	101	138	253	105	167	176	117	58	133	83
Orbulina univera	20	20	20	17	5	3	8	6	23	45	19	17	16	15	4	15	9
Pulleniatina obliquiloculata						3				2	1					1	
Spaeroidinella dehiscens																	
unidentified		1					1		2	1	2			2		2	

Table 11.2: NGC 102 Species Count

Species \ Sample #	NGC 106 2-0	NGC 106 2-8	NGC 106 2-16	NGC 106 2-24	NGC 106 2-32	NGC 106 2-40	NGC 106 2-48	NGC 106 2-56	NGC 106 2-64	NGC 106 2-72	NGC 106 2-80	NGC 106 2-96	NGC 106 3-0	NGC 106 3-8	NGC 106 3-16	NGC 106 3-32	NGC 106 3-48	NGC 106 3-56	NGC 106 3-72	NGC 106 3-88	NGC 106 3-96	NGC 106 4-0	NGC 106 4-16
Globigerina. bulloides	7	13	17	23	14	17	26	22	17	17	34	20	29	23	100	40	24	10	32	5	11	3	
G. calida								1															
G. digitata			1						1														
G. falcoensis				11	3	6	3	11	9	7	2	2	2	2	8	8	7	2	7	1	1		1
G. rubescens																							
G. quinqueloba				10		4	2		2		3		1	2	4								
G. sp.																							
Globigerinella aequilateralis		2		5		2	2	2	2		3		2	3	3	6	2	1	1				
Globigerinita glutinata		3	2	24	24	9	12	10	9	6	5	3	5	2	25	4	14		17	3	5	11	6
Globigerinoides conglobatus									1											1			
G. ruber	3	1	8	16	7	7	5	3	4	3	3	1	2	6	23	4	13		8	16	10	16	1
G. ruber (pink)																							
G.sacculifer w/o			1	3		3								1		1	2						1
G.sacculifer w/			1	2	1			1						1		1	1						
Goborotalia crassaformis																							
G. hirsuta			2															1	2	6	4	2	1
G. inflata	132	135	117	74	113	126	94	95	167	107	85	78	66	108	159	72	145	110	113	83	107	91	111
G. menardii	2											1		1					1				
G. puncticulata														1									
G. scitula				1	4		1					1		3		1	2						
G. truncatulinoides (left)					1												1		4	3	3	1	3
G. truncatulinoides (right)	8	5	1	3	2	2	1		7	3	4	6	2	7	3	2						1	
G. tumida																							
G. wilesi																							
G. sp.					3	5	2	2	2			1							1			2	1
G. wilesi																							
Neogloboquadrina eggeri	20	9	13	22	14	10	12	4	16	1	6	4	4	14	11	6	6				2	5	12
N. blowi	14	11	17	9	40	7	11	16	3	8	6	17	10	8	16	5	2	4	9	4	13	11	17
N. pachyderma (left)		1	10	14	19	15	10	13	5	2	9	1	7	1	3	3			8		3	2	2
N. pachyderma (right)	91	68	228	108	156	112	72	102	87	88	163	63	112	101	356	142	70	57	77	66	77	107	36
Orbulina universa				1	1	1		1	5	1		4	3	7	3	1	14	10	6	3	2		1
Pulleniatina obliquiloculata		1		2		2	2		3			1	4		1	3				2	2	2	1
Spaeroidinella dehiscens		1	1																				

Table12.1 NGC 106 Species Count.

Species \ Sample #	NGC 106 4-32	NGC 106 4-48	NGC 106 4-64	NGC 106 4-80	NGC 106 4-96	NGC 106 5-0	NGC 106 5-16	NGC 106 5-32	NGC 106 5-48	NGC 106 5-64	NGC 106 5-72	NGC 106 5-96	NGC 106 6-0	NGC 106 6-16	NGC 106 6-32
Globigerina. bulloides	7	28	32	58	36	97	78	51	26	71	42	21	43	22	22
G. calida															
G. digitata						1							1		
G. falcoensis		5	10	7	11	11	15	8	2	5	5		10	1	6
G. rubescens															
G. quinqueloba		2	4	5	6	8	3	1	4	9	3		2		5
G. sp.															
Globigerinella aequilateralis	1			5	3			3		2	7		2	5	6
Globigerinita glutinata		21	10	10	8	9	15	28	13	7	15	6	11	7	9
Globigerinoides conglobatus							1								
G. ruber	11	4	8	15	8	19	7	4	4		11	8	10	6	6
G. ruber (pink)											1				5
G.sacculifer w/o				1				1			1		2		
G.sacculifer w/				1		2		1			1	1			3
Goborotalia crassaformis															5
G. hirsuta				8	3	2	6					14	37	12	
G. inflata	86	148	143	115	66	114	139	153	122	66	89	87	57	93	55
G. menardii		1		1				1	2			2			
G. puncticulata															
G. scitula									1	5	2				3
G. truncatulinoides (left)															
G. truncatulinoides (right)	22	11	2	5			2	1	10				1	1	2
G. tumida	2												1		2
G. wilesi															
G. sp.			1	2	4			3			1		2		2
G. wilesi															
Neogloboquadrina eggeri	7	3	1	17	3	3	4	1	6	5	3	1	2	1	6
N. blowi	10	5	5	20	7	8	8	3	20	9	10	5	3	4	13
N. pachyderma (left)	1	48	28	8	17	26	12	10	49	28	11	4	6	10	2
N. pachyderma (right)	56	56	58	40	14	17	36	41	38	101	52	40	74	78	60
Orbulina universa		1	6	9	6	6	12	12	2	8	5	13	17	23	6
Pulleniatina obliquiloculata	7			3	1	1			2	1	5	1	1	2	
Spaeroidinella dehiscens															

Table12.2 NGC 106 Species Count.

Species \ Sample #	NGC 108 1.37	NGC 108 2.0	NGC 108 2.04	NGC 108 2.08	NGC 108 2.16	NGC 108 2.24	NGC 108 2.32	NGC 108 2.4	NGC 108 2.48	NGC 108 2.56	NGC 108 2.64	NGC 108 2.72	NGC 108 2.08	NGC 108 2.88	NGC 108 2.96	NGC 108 3.0	NGC 108 3.08	NGC 108 3.16	NGC 108 3.24	NGC 108 3.32	NGC 108 3.4	NGC 108 3.48	NGC 108 3.56	NGC 108 3.64	NGC 108 3.72	NGC 108 3.8	NGC 108 3.88	NGC 108 3.96	NGC 108 4.0	NGC 108 4.08	NGC 108 4.16
Globigerina, bulloides	10	8	13	22	33	30	32	35	22	39	8	35	51	43	54	59	82	76	56	63	55	43	48	80	41	36	63	50	65	60	95
G. calida																															
G. digitata						1																									
G. falcoensis	1	2	1	3	4	7	6	2	2	7	7	6	12	8	8	8	6	4	5	2	6	5	3	9	6	3	3	4	13	8	8
G. rubescens																												1	1		
G. quinqueloba	2		1	1		2	13	6	4	14	8	9	7	5	3	1	3	4	1	2	2		2	1	4	4			4	2	1
G. sp.	3	1	2		3	14	21	18	6	9	8	13	18	18	15	11	31	6	1	17	10	14	8	19	22	20	15	12	29	16	24
Globigerinella aequilateralis						1						1	4		3	1	1		2				2	3	1		1	1	4	2	2
Globigerinita glutinata		2		5		7	23	17	21	16	13	24	23	11	14	13	10	7	3	10	3	9	15	17	11	8	8	18	21	12	10
Globigerinoides conglobatus			1		1																										
G. ruber	1	2		10	8	7	12	3	2	4	3	9	11	5	6	2	6	5	3	8	2	2	7	5	2	8	6	6	7	6	13
G. ruber (pink)																															
G.sacculifer w/o				1		1			1			1												2	3					3	
G. sacculifer w/						1					1													1						1	
G. tenellus				1																											
G. sp																															
Globorotalia crassaformis												1																			
G. hirsuta							1		1				6				3	1				2						4	2	2	
G. inflata	73	165	155	121	127	66	36	41	39	67	105	113	110	53	44	54	96	32	3	42	41	81	33	83	64	46	44	62	55	29	62
G. menardii		4	3	5																											
G. puncticulata					1																										
G. scitula				1								2							4					2	1		1				1
G. truncatulinoides (left)																											1	1			1
G. truncatulinoides (right)	12	16	19	16	13	2		1		1	4	2	8	1	1	2	4	3	1	5							1				
G. tumida		2			1																										
G. wilesi				1	1					1	5	2		2		2	1			1			2								
G. sp.						1		4	1						3				1	2	2				1						
Globorotaloides hexagona																															
Neogloboquadrina eggeri	21	18	12	10	7	11	9	1	8	16	4	12	13	6	7	6	3	3	13	2	8	2	7	9	2	6	10		5	1	3
N. blowi	20	6	15	15	14	33	40	24	24	18	21	23	23	22	22	21	32	27	30	52	2	25	24	31	14	34	27	9	42	18	16
N. incompta																															
N. pachyderma (left)	10	2	11	6	9	17	16	34	31	36	12	50	38	44	26	23	24	7	5	23	14	9	6	8	7	11	8	1	20	14	10
N. pachyderma (right)	114	96	173	127	150	209	157	115	98	59	30	87	45	96	80	93	208	118	54	141	73	116	72	109	166	152	111	180	120	87	42
Orbulina univera			3		2						1			1			1	2	7	1		2	1	3	1		2	3	2	3	2
Pulleniatina obliquiloculata	2	2	4	2	3	1	2						1											1	2		1	7	5		
Spaeroidinella dehiscens				1	2																										
unidentified					1	2					1	2											2								

Table 13.1: NGC 108 Species count.

Species \ Sample #	NGC 108 4.24	NGC 108 4.32	NGC 108 4.40	NGC 108 4.48	NGC 108 4.56	NGC 108 4.64	NGC 108 4.72	NGC 108 4.80	NGC 108 4.88	NGC 108 4.96	NGC 108 5.0	NGC 108 5.08	NGC 108 5.16	NGC 108 5.24	NGC 108 5.32	NGC 108 5.40	NGC 108 5.48	NGC 108 5.56	NGC 108 5.64	NGC 108 5.72	NGC 108 5.8	NGC 108 5.88	NGC 108 5.96	NGC 108 6.0	NGC 108 6.08	NGC 108 6.16	NGC 108 6.24	NGC 108 6.32	NGC 108 6.4	NGC 108 6.48	NGC 108 6.56
Globigerina, bulloides	102	184	80	83	56	53	67	39	38	26	13	17		12			3	4	5	11	21	12	22	9	6	20	19	20	80	103	23
G. calida																															
G. digitata							1	1			3															1	1	2			
G. falcoensis	10	7	5	5	10	9	8	5	4	1	3	5		3		3				6	2		4	2		2		10	2	5	4
G. rubescens					1							1																			
G. quinqueloba	11	13	4	6	3	4	3			1		2			1	2	1	1					2	3		2	2	2	8	8	2
G. sp.	34	36	12	7	12	14	13	5	3	2	7	4		8	1	2	1		2		1	1	2	2		2	3	7	15	20	21
Globigerinella aequilateralis		3		2	1	1					3	2	1	1				1												1	
Globigerinita glutinata	21	31	10	14	22	22	12	5	6	13	12	32		29	3	3	4	2	1	3	1	8	2	1	2	5	5	16	23	19	8
Globigerinoides conglobatus												1		2	1					1							1				
G. ruber	2	12	1	3	4	3	3	2	2	9	18	26	1	8				3	4	3	1	2	5	2	5	7	5	2	10	8	4
G. ruber (pink)																															
G.sacculifer w/o						2		1				5												1	1					1	
G. sacculifer w/						1	2		1																						
G. tenellus						2						1																			
G. sp																															
Globorotalia crassaformis																													1		
G. hirsuta	3			1	6	14	13	5	6	8	5	9	1	19			3	1	1	2	3			1				1	3		
G. inflata	57	90	35	47	64	48	73	96	73	74	63	111	67	139	74	53	73	131	105	78	111	70	68	77	122	72	89	59	63	138	64
G. menardii					1		1		1	2	1	4	1	3					1	1		1			3	1	3			1	
G. puncticulata																															
G. scitula	1		2	1	1			3	1		2		1	2					1											1	
G. truncatulinoides (left)				1	3		1			1	2	3	1	2	1			2	2									1		2	
G. truncatulinoides (right)						1									2				1		5	8	8	18	26	27	31	37	37	8	2
G. tumida				1					1																						
G. wilesi		14	6	3					3	1	3								2			3									
G. sp.																										1	1	2		2	2
Globorotaloides hexagona																						1									
Neogloboquadrina eggeri	4	6	5		3	2	2	10	9	11	3	7		12	47	24	41	47	22	46	28	18	23	48	43	8	6	4	1	5	
N. blowi	12	21	17	20	14	11	42	25	21	22	20	42	6	10	28	54	47	37	31	14	32	21	14	38	33	16	11	8	11	11	2
N. incompta																															
N. pachyderma (left)	39	50	21	12	9	15	14	5		1		2		42	3	7	5	2	2	3	9	1	2	1	7	12	14	37	84	91	66
N. pachyderma (right)	89	127	52	41	45	85	94	82	96	32	52	56	4	8	36	64	72	49	27	41	129	55	66	56	73	26	47	31	52	37	31
Orbulina universa	1	2	1	1	1	2	3		2	3	2	2	0	2	1			1	4		1						2		2	3	
Pulleniatina obliquiloculata			1	2	3	1		7	2		4	11		1	5					2		2	2	5	11	8	11		3	3	
Sphaeroidinella dehiscens																															
unidentified																									2						

Table 13.2: NGC 108 Species count.

Species \ Sample #	NGC 108 6.64	NGC 108 6.72	NGC 108 6.8	NGC 108 6.88	NGC 108 6.96	NGC 108 7.0	NGC 108 7.08	NGC 108 7.16	NGC 108 7.24	NGC 108 7.32	NGC 108 7.4	NGC 108 7.48	NGC 108 7.56	NGC 108 7.64	NGC 108 7.72	NGC 108 7.80	NGC 108 7.88	NGC 108 7.96	NGC 108 cc 60	NGC 108 cc 68	NGC 108 cc 76	NGC 108 cc 84	NGC 108 cc 92
Globigerina bulloides	54	152	68	82	68	76	71	39	55	54	66	83	67	89	17	24	14	7	17	18	31	15	39
G. calida																							
G. digitata																2							
G. falconensis	8	8	8	5	6	5	7	6	7	5	7	4	5	8	2	8		2	3	10	8	4	6
G. rubescens																				1			1
G. quinqueloba	26	54	17	14	9	21	25	6	6	8	17	20	32	28	17	27	12	16	18	14	12	9	24
G. sp.	19	49	12	13	14	15	24	18	16	29	16	10	34	17	7	19	2	17	7	16	16	10	23
Globigerinella aequilateralis		1		1		2	5			2					1	2	3			1	5	1	4
Globigerinita glutinata	14	18	11	5	17	9	13	14	15	15	26	13	13	23	16	16	21	11	28	14	19	12	15
Globigerinoides conglobatus																							
G. ruber	4	14		7	6	5	13	4		2	7	2	1	3	2	8	9		2	4	7	3	3
G. ruber (pink)																							
G.sacculifer w/o				1	2	1	1					1					1	1					
G. sacculifer w/									1					1						2			
G. tenellus																							
G. sp																							
Globorotalia crassaformis																							
G. hirsuta	10	6	4		7	4	7					3	3				35	22	12	16	15	15	13
G. inflata	58	49	53	59	57	62	102	65	57	107	50	28	34	68	48	89	110	68	64	24	38	39	85
G. menardii							1		1							1							
G. puncticulata																							
G. scitula				5						2				5							1		
G. truncatulinoides (left)																							
G. truncatulinoides (right)			1			1			2		1							2	1		1	1	1
G. tumida																							
G. wilesi												2		3	1								
G. sp.							3	4	3		4		3					2	1	3	5		4
Globorotaloides hexagona																							
Neogloboquadrina eggeri	5	6		12	7	2	2	5		6	1		1	4	2	6	3	1		5	7	3	4
N. blowi	2	6	7	6	2	18	8	4	7	19	3	9	5	8	8	9	14	4	6	9	6	3	15
N. incompta																							
N. pachyderma (left)	55	61	30	25	22	54	66	33	63	111	61	47	70	48	51	65	96	136	85	46	38	32	102
N. pachyderma (right)	9	10	5	9	15	20	17	24	13	16	42	52	48	74	49	84	40	49	51	50	71	53	86
Orbulina universa		3	2	2	6	5	5	6	3	7	1	2	4	3				4	5	1	6		7
Pulleniatina obliquiloculata		1			1	1	1			1				2		2		1			1		
Sphaeroidinella dehiscens																							
unidentified																	1				2		3

Table 13.3: NGC 108 Species count.

Species \ Sample #	NGC 102 TOP	NGC 102 5.16	NGC 102 5.24	NGC 102 5.32	NGC 102 5.40	NGC 102 5.48	NGC 102 5.56	NGC 102 5.64	NGC 102 5.72	NGC 102 5.80	NGC 102 5.88	NGC 102 5.96	NGC 102 6.0	NGC 102 6.8	NGC 102 6.16	NGC 102 6.24	NGC 102 6.32	NGC 102 6.40	NGC 102 6.48	NGC 102 6.56	NGC 102 6.64	NGC 102 6.72	NGC 102 6.80	NGC 102 6.88
Globigerina. bulloides	5.78		5.96	8.75	7.13	8.5	10.2	11.8	9.54	13.5	7.07	12.2	18.2	4.11	3.68	2.03	5.7	5.38	15.3	18.9	27.9	23.4	15.2	9.4
G. calida	0		0.31	0	0.21	0	0	0	0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0		0.31	0.2	0	0	0	0	0	0	0.32	0	0	0.24	0	0	0	0	1.3	0.22	0.53	0.51	0	0
G. falcoensis	0		2.51	2.19	2.73	3.24	4.24	2.75	5.99	3.65	3.86	1.8	1.36	1.69	2.21	2.33	0.52	0.63	4.42	5.49	7.89	8.38	5.08	4.34
G. rubescens	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. quinqueloba	0		0	0.2	0.21	0	0	0.39	0	0	0.32	0	0.27	0.24	0	0	0.26	0	0.52	0	0.26	0	0	0
G. sp.	0		0.63	2.39	3.77	1.21	1.06	3.92	3	1.56	2.89	3.15	3.26	0.48	1.47	0.29	1.55	0	6.49	3.74	3.95	5.84	4.13	5.06
Globigerinella aequilateralis	0.89		2.82	1.79	0.42	1.62	1.41	0.78	0.82	1.56	3.86	4.5	0.54	0.72	1.47	1.16	1.04	0.95	2.34	1.54	1.84	1.52	1.59	2.89
Globigerinita glutinata	1.78		0	2.39	1.47	5.26	1.77	1.57	3	3.13	5.14	4.05	2.72	5.07	2.21	2.33	0.52	2.85	4.42	2.64	1.84	2.28	2.22	2.17
Globigerinoides conglobatus	0		0.94	0.2	0	0	0	0	0	0	0	0	0	0	1.1	0.58	0	0	0	0	0	0	0	0
G. ruber	4		8.78	6.56	6.29	2.83	6.01	4.31	7.36	7.81	5.47	9.01	4.62	4.59	6.99	8.14	7.77	6.33	5.71	7.03	8.16	4.57	8.89	8.19
G. ruber (pink)	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0.53	0.51	0.32	0
G.sacculifer w/o	0		0	2.19	0.84	0.4	0.71	0	0	0	0.96	1.35	0	0.24	0	0.58	0	3.8	0.26	1.98	0.53	0.76	0	1.2
G. sacculifer w/	0.44		0	0.2	0.42	0	0	0	0	0	0.32	1.35	0	0	0.74	0	0	0.32	0	0.44	0	0.25	0.63	0
G. tenellus	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0
G. sp	1.78		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.24
Goborotalia crassaformis	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. hirsuta	0.89		3.13	0	0.63	0	0	0	0	0	0	0	0	3.86	9.56	2.91	0.78	1.9	1.04	0.88	5.79	2.54	0.63	0
G. inflata	47.6		42	25	27.9	46.2	37.1	35.3	28.6	31.3	30.2	23.4	28.8	42.8	39	42.7	43.8	28.8	31.2	33.4	26.3	28.7	34.9	35.7
G. menardii	0		0.31	0	0.21	0	0	0	0	0	0	0	0	0	0	0	0	0.32	0.26	0	0	0.25	0	0.24
G. puncticulata	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.22	0	0	0	0
G. scitula	0		0	0.8	0.21	0.81	0	1.18	0.54	0	0.64	3.15	0.27	0.24	0	0.29	0.26	0	0	0.22	0	0	0.63	0.96
G. truncatulinoides (left)	0		0	0.4	0.21	0	0	0	0.54	0	1.29	0.45	1.09	1.69	3.31	0.58	2.07	0	0	0	0	0	0	0
G. truncatulinoides (right)	11.1		15.4	1.59	1.26	1.62	2.83	3.14	1.63	3.13	4.5	1.35	0	0	0	1.16	2.59	31.6	1.56	1.76	0.26	0.25	1.59	2.41
G. tumida	0.89		0.31	0	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0	0
G. wilesi	0		0	0	0	0	0.71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 14.1 : Species Relative Abundance NGC 102.

Species \ Sample #	NGC 102 6.96	NGC 102 7.0	NGC 102 7.8	NGC 102 7.16	NGC 102 7.24	NGC 102 7.32	NGC 102 7.40	NGC 102 7.48	NGC 102 7.56	NGC 102 7.64	NGC 102 7.72	NGC 102 7.80	NGC 102 7.88	NGC 102 7.96	NGC 102 cc64	NGC 102 cc72	NGC 102 cc80	NGC 102 cc88	NGC 102 cc96
Globigerina. bulloides	20.9	11.8	15.5	14.9	10.5	6.23	3.86	13.2	10.3	13.3	11.1	9.65	9.43	17.7	18.9	24.9	5.88	9.09	14.3
G. calida	0	0	0.61	0	0	0	0	0.32	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0.39	0	0	0	0	0	0.97	0.32	0	0.34	0.53	0.36	0	0	0	0	0	0.3	0
G. falcoensis	5.81	1.24	7.32	3.49	1.93	2.3	0.97	2.9	1.51	3.75	3.42	1.46	0.82	0.82	1.28	2.05	0	0.91	1.63
G. rubescens	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0
G. quinqueloba	0	0	0.3	0.95	0	0	0.48	0	0.3	0	0	0.18	1.23	0.27	0	0.34	0	0.91	0
G. sp.	1.55	4.33	5.49	5.08	4.41	1.31	0.97	0.65	5.14	2.73	3.16	1.82	2.87	4.08	3.06	1.02	1.07	0.3	1.63
Globigerinella aequilateralis	2.33	0	0.91	3.81	2.48	2.62	2.42	2.58	1.21	1.71	1.32	0.36	0.41	0	0	0	0	0.61	0.41
Globigerinita glutinata	3.49	3.41	4.57	3.17	1.38	0	1.45	0.97	0.6	4.44	3.95	1.82	2.87	2.45	1.79	2.73	1.07	2.42	0
Globigerinoides conglobatus	0.39	0	0	0.95	0	0.66	0	0	0	0.34	0	0	0	0	0	0	0	0	0
G. ruber	8.14	15.2	8.54	10.8	9.37	6.89	6.76	5.16	9.06	10.9	8.42	10	10.2	6.25	8.16	6.14	5.88	8.79	6.53
G. ruber (pink)	0.39	0	0	0.32	0	0	0	0	0.6	0.34	0	0.18	0.41	0	0	0	0	0	0
G.sacculifer w/o	1.16	0.93	0.61	0.95	1.1	0.33	0.97	0.97	0.6	1.37	0.26	0.73	2.05	0	0	0	0	0.3	0.41
G. sacculifer w/	0.39	0	0.61	0.63	0.28	0.33	0	0	0	0.34	0	0.36	1.64	0.27	0	0	0	0	0
G. tenellus	0.39	0	0	0	0	0.33	0	0	0	0	0	0.36	0	0	0	0	0	0	0
G. sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goborotalia crassaformis	0	0	0	0	0.28	1.31	0	0	0	0	0	0	0	0	0	0	0	0.3	0
G. hirsuta	0.39	0	10.1	4.76	4.68	0	3.86	1.94	0	0	0	0.18	0	1.09	2.04	1.71	0.53	0	0.82
G. inflata	36	40.6	19.5	9.21	21.5	27.5	42.5	27.7	14.5	10.2	11.6	8.01	9.02	8.97	8.93	6.83	40.1	17.3	29.4
G. menardii	0	0	0	1.27	0	0.66	2.9	1.61	0.91	0	0	0	0	0	0.26	0.34	1.07	2.12	1.63
G. puncticulata	0.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. scitula	0	0	0	0	0.28	0	0.48	0	0.6	0.34	0	0.36	0	0	0	0.34	0	0	0
G. truncatulinoides (left)	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	0	0	0	0.82
G. truncatulinoides (right)	3.1	0.93	1.52	0.63	1.1	0.33	2.9	10.3	10.9	5.46	3.16	3.46	3.69	3.26	1.02	3.41	6.42	7.58	1.63
G. tumida	0	0	0.61	0	0	0	0.97	0.65	0	0	0	0.36	0	0	0	0	0.53	0.3	0.41
G. wilesi	0	0	0	0	0	0	0	0	0	0	0	0.91	0	0	1.53	0.34	0	0	0

Table 14.2: Species Relative Abundance NGC 102.

Species \ Sample #	NGC 106 2-0	NGC 106 2-8	NGC 106 2-16	NGC 106 2-24	NGC 106 2-32	NGC 106 2-40	NGC 106 2-48	NGC 106 2-56	NGC 106 2-64	NGC 106 2-72	NGC 106 2-80	NGC 106 2-96	NGC 106 3-0	NGC 106 3-8	NGC 106 3-16	NGC 106 3-32	NGC 106 3-48	NGC 106 3-56	NGC 106 3-72	NGC 106 3-88	NGC 106 3-96	NGC 106 4-0	NGC 106 4-16
Globigerina. bulloides	2.53	5.2	4.06	7.01	3.48	5.18	10.2	7.77	5	7	10.5	9.85	11.6	7.9	14	13.4	7.92	5.13	11.2	2.59	4.58	1.18	0
G. calida	0	0	0	0	0	0	0	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0	0	0.24	0	0	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. falcoensis	0	0	0	3.35	0.75	1.83	1.18	3.89	2.65	2.88	0.62	0.99	0.8	0.69	1.12	2.68	2.31	1.03	2.45	0.52	0.42	0	0.52
G. rubescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. quinqueloba	0	0	0	3.05	0	1.22	0.78	0	0.59	0	0.93	0	0.4	0.69	0.56	0	0	0	0	0	0	0	0
G. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Globigerinella aequilateralis	0	0.8	0	1.52	0	0.61	0.78	0.71	0.59	0	0.93	0	0.8	1.03	0.42	2.01	0.66	0.51	0.35	0	0	0	0
Globigerinita glutinata	0	1.2	0.48	7.32	5.97	2.74	4.71	3.53	2.65	2.47	1.55	1.48	2.01	0.69	3.5	1.34	4.62	0	5.94	1.55	2.08	4.33	3.09
Globigerinoides conglobatus	0	0	0	0	0	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0.52	0	0	0
G. ruber	1.08	0.4	1.91	4.88	1.74	2.13	1.96	1.06	1.18	1.23	0.93	0.49	0.8	2.06	3.22	1.34	4.29	0	2.8	8.29	4.17	6.3	0.52
G. ruber (pink)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.sacculifer w/o	0	0	0.24	0.91	0	0.91	0	0	0	0	0	0	0	0.34	0	0.33	0.66	0	0	0	0	0	0.52
G.sacculifer w/	0	0	0.24	0.61	0.25	0	0	0.35	0	0	0	0	0	0.34	0	0.33	0.33	0	0	0	0	0	0
Goborotalia crassaformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. hirsuta	0	0	0.48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.51	0.7	3.11	1.67	0.79	0.52
G. inflata	47.7	54	27.9	22.6	28.1	38.4	36.9	33.6	49.1	44	26.3	38.4	26.5	37.1	22.2	24.1	47.9	56.4	39.5	43	44.6	35.8	57.2
G. menardii	0.72	0	0	0	0	0	0	0	0	0	0	0.49	0	0.34	0	0	0	0	0.35	0	0	0	0
G. puncticulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0.34	0	0	0	0	0	0	0	0	0
G. scitula	0	0	0	0.3	1	0	0.39	0	0	0	0	0.49	0	1.03	0	0.33	0.66	0	0	0	0	0	0
G. truncatulinoides (left)	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0.33	0	1.4	1.55	1.25	0.39	1.55
G. truncatulinoides (right)	2.89	2	0.24	0.91	0.5	0.61	0.39	0	2.06	1.23	1.24	2.96	0.8	2.41	0.42	0.67	0	0	0	0	0	0.39	0
G. tumida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. wilesi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. sp.	0	0	0	0	0.75	1.52	0.78	0.71	0.59	0	0	0.49	0	0	0	0	0	0	0.35	0	0	0.79	0.52
G. wilesi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neogloboquadrina eggeri	7.22	3.6	3.1	6.71	3.48	3.05	4.71	1.41	4.71	0.41	1.86	1.97	1.61	4.81	1.54	2.01	1.98	0	0	0	0.83	1.97	6.19
N. blowi	5.05	4.4	4.06	2.74	9.95	2.13	4.31	5.65	0.88	3.29	1.86	8.37	4.02	2.75	2.24	1.67	0.66	2.05	3.15	2.07	5.42	4.33	8.76
N. pachyderma (left)	0	0.4	2.39	4.27	4.73	4.57	3.92	4.59	1.47	0.82	2.79	0.49	2.81	0.34	0.42	1	0	0	2.8	0	1.25	0.79	1.03
N. pachyderma (right)	32.9	27.2	54.4	32.9	38.8	34.1	28.2	36	25.6	36.2	50.5	31	45	34.7	49.8	47.5	23.1	29.2	26.9	34.2	32.1	42.1	18.6
Orbulina universa	0	0	0	0.3	0.25	0.3	0	0.35	1.47	0.41	0	1.97	1.2	2.41	0.42	0.33	4.62	5.13	2.1	1.55	0.83	0	0.52
Pulleniatina obliquiloculata	0	0.4	0	0.61	0	0.61	0.78	0	0.88	0	0	0.49	1.61	0	0.14	1	0	0	0	1.04	0.83	0.79	0.52
Spaeroidinella dehiscens	0	0.4	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 15.1: Species Relative Abundance NGC 106.

Species \ Sample #	NGC 106 4-32	NGC 106 4-48	NGC 106 4-64	NGC 106 4-80	NGC 106 4-96	NGC 106 5-0	NGC 106 5-16	NGC 106 5-32	NGC 106 5-48	NGC 106 5-64	NGC 106 5-72	NGC 106 5-96	NGC 106 6-0	NGC 106 6-16	NGC 106 6-32
Globigerina. bulloides	3.33	8.41	10.4	17.6	18.7	29.9	23.1	15.8	8.64	22.4	15.9	10.3	15.2	8.3	10.1
G. calida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0	0	0	0	0	0.31	0	0	0	0	0	0	0.35	0	0
G. falcoensis	0	1.5	3.25	2.12	5.7	3.4	4.44	2.48	0.66	1.58	1.89	0	3.55	0.38	2.75
G. rubescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. quinqueloba	0	0.6	1.3	1.52	3.11	2.47	0.89	0.31	1.33	2.84	1.14	0	0.71	0	2.29
G. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Globigerinella aequilateralis	0.48	0	0	1.52	1.55	0	0	0.93	0	0.63	2.65	0	0.71	1.89	2.75
Globigerinita glutinata	0	6.31	3.25	3.03	4.15	2.78	4.44	8.7	4.32	2.21	5.68	2.96	3.9	2.64	4.13
Globigerinoides conglobatus	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0	0
G. ruber	5.24	1.2	2.6	4.55	4.15	5.86	2.07	1.24	1.33	0	4.17	3.94	3.55	2.26	2.75
G. ruber (pink)	0	0	0	0	0	0	0	0	0	0	0.38	0	0	0	2.29
G.sacculifer w/o	0	0	0	0.3	0	0	0	0.31	0	0	0.38	0	0.71	0	0
G.sacculifer w/	0	0	0	0.3	0	0.62	0	0.31	0	0	0.38	0.49	0	0	1.38
Goborotalia crassaformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.29
G. hirsuta	0	0	0	2.42	1.55	0.62	1.78	0	0	0	0	6.9	13.1	4.53	0
G. inflata	41	44.4	46.4	34.8	34.2	35.2	41.1	47.5	40.5	20.8	33.7	42.9	20.2	35.1	25.2
G. menardii	0	0.3	0	0.3	0	0	0	0.31	0.66	0	0	0.99	0	0	0
G. puncticulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. scitula	0	0	0	0	0	0	0	0	0.33	1.58	0.76	0	0	0	1.38
G. truncatulinoides (left)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. truncatulinoides (right)	10.5	3.3	0.65	1.52	0	0	0.59	0.31	3.32	0	0	0	0.35	0.38	0.92
G. tumida	0.95	0	0	0	0	0	0	0	0	0	0	0	0.35	0	0.92
G. wilesi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. sp.	0	0	0.32	0.61	2.07	0	0	0.93	0	0	0.38	0	0.71	0	0.92
G. wilesi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neogloboquadrina eggeri	3.33	0.9	0.32	5.15	1.55	0.93	1.18	0.31	1.99	1.58	1.14	0.49	0.71	0.38	2.75
N. blowi	4.76	1.5	1.62	6.06	3.63	2.47	2.37	0.93	6.64	2.84	3.79	2.46	1.06	1.51	5.96
N. pachyderma (left)	0.48	14.4	9.09	2.42	8.81	8.02	3.55	3.11	16.3	8.83	4.17	1.97	2.13	3.77	0.92
N. pachyderma (right)	26.7	16.8	18.8	12.1	7.25	5.25	10.7	12.7	12.6	31.9	19.7	19.7	26.2	29.4	27.5
Orbulina universa	0	0.3	1.95	2.73	3.11	1.85	3.55	3.73	0.66	2.52	1.89	6.4	6.03	8.68	2.75
Pulleniatina obliquiloculata	3.33	0	0	0.91	0.52	0.31	0	0	0.66	0.32	1.89	0.49	0.35	0.75	0
Spaeroidinella dehiscens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 15.2: Species Relative Abundance NGC 106.

Species \ Sample #	NGC 108 1.37	NGC 108 2	NGC 108 2.04	NGC 108 20.8	NGC 108 2.16	NGC 108 2.24	NGC 108 2.32	NGC 108 2.4	NGC 108 2.48	NGC 108 2.56	NGC 108 2.64	NGC 108 2.72	NGC 108 2.08	NGC 108 2.88	NGC 108 2.96	NGC 108 3.0	NGC 108 3.08	NGC 108 3.16	NGC 108 3.24	NGC 108 3.32	NGC 108 3.4	NGC 108 3.48	NGC 108 3.56	NGC 108 3.64	NGC 108 3.72	NGC 108 3.8	NGC 108 3.88	NGC 108 3.96	NGC 108 4.0	NGC 108 4.08	NGC 108 4.16
Globigerina, bulloides	3.72	2.45	3.15	6.32	8.68	7.26	8.7	11.6	8.46	13.6	3.46	8.93	13.8	13.7	18.9	19.9	16	25.8	25.9	17	25.2	13.9	20.7	20.9	11.8	11	20.9	13.9	16.5	22.7	32.8
G. calida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0	0	0	0	0	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.28	0.25	0	0
G. falcoensis	0.37	0.61	0.24	0.86	1.05	1.69	1.63	0.66	0.77	2.44	3.03	1.53	3.24	2.54	2.8	2.7	1.17	1.36	2.31	0.54	2.75	1.61	1.29	2.35	1.72	0.91	0.99	1.11	3.29	3.03	2.76
G. rubescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. quinqueloba	0.74	0	0.24	0.29	0	0.48	3.53	1.99	1.54	4.88	3.46	2.3	1.89	1.59	1.05	0.34	0.59	1.36	0.46	0.54	0.92	0	0.86	0.26	1.15	1.22	0	0	1.01	0.76	0.34
G. sp.	1.12	0.31	0.48	0	0.79	3.39	5.71	5.98	2.31	3.14	3.46	3.32	4.86	5.71	5.24	3.72	6.07	2.03	0.46	4.58	4.59	4.52	3.45	4.96	6.32	6.1	4.97	3.34	7.34	6.06	8.28
Globigerinella aequilateralis	0	0	0	0	0	0.24	0	0	0	0	0	0.26	1.08	0	1.05	0.34	0.2	0	0.93	0	0	0	0.86	0.78	0.29	0	0.33	0.28	1.01	0.76	0.69
Globigerinita glutinata	0	0.61	0	1.44	0	1.69	6.25	5.65	8.08	5.57	5.63	6.12	6.22	3.49	4.9	4.39	1.96	2.37	1.39	2.7	1.38	2.9	6.47	4.44	3.16	2.44	2.65	5.01	5.32	4.55	3.45
Globigerinoides conglobatus	0	0	0.24	0	0.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. ruber	0.37	0.61	0	2.87	2.11	1.69	3.26	1	0.77	1.39	1.3	2.3	2.97	1.59	2.1	0.68	1.17	1.69	1.39	2.16	0.92	0.65	3.02	1.31	0.57	2.44	1.99	1.67	1.77	2.27	4.48
G. ruber (pink)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.sacculifer w/o	0	0	0	0.29	0	0.24	0	0	0.38	0	0	0.26	0	0	0	0	0	0	0	0	0	0	0	0.52	0.86	0	0	0	0	1.14	0
G. sacculifer w/	0	0	0	0	0	0.24	0	0	0	0	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0.38	0
G. tenellus	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goborotalia crassaforms	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. hirsuta	0	0	0	0	0	0	0.27	0	0.38	0	0	0	1.62	0	0	0	0.59	0.34	0	0	0	0.65	0	0	0	0	0	1.11	0.51	0.76	0
G. inflata	27.1	50.6	37.5	34.8	33.4	16	9.78	13.6	15	23.3	45.5	28.8	29.7	16.8	15.4	18.2	18.8	10.8	13.9	11.3	18.8	26.1	14.2	21.7	18.4	14	14.6	17.3	13.9	11	21.4
G. menardii	0	1.23	0.73	1.44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. puncticulata	0	0	0	0	0.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. scitula	0	0	0	0.29	0	0	0	0	0	0	0	0.51	0	0	0	0	0	0	1.85	0	0	0	0	0.52	0.29	0	0.33	0	0	0	0.34
G. truncatulinoides (left)	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.28	0	0	0.34
G. truncatulinoides (right)	4.46	4.91	4.6	4.6	3.42	0.48	0	0.33	0	0.35	1.73	0.51	2.16	0.32	0.35	0.68	0.78	1.02	0.46	1.35	0	0	0	0	0	0	0.33	0	0	0	0
G. tumida	0	0.61	0	0	0.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. wilesi	0	0	0	0.29	0.26	0	0	0	0	0.35	2.16	0.51	0	0.63	0	0.68	0.2	0	0	0.27	0	0	0.86	0	0	0	0	0	0	0	0
G. sp.	0	0	0	0	0	0.24	0	1.33	0.38	0	0	0	0	0	1.05	0	0	0	0.46	0.54	0.92	0	0	0	0.29	0	0	0	0	0	0
Globorotaloides hexagona	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neogloboquadrina eggeri	7.81	5.52	2.91	2.87	1.84	2.66	2.45	0.33	3.08	5.57	1.73	3.06	3.51	1.9	2.45	2.03	0.59	1.02	6.02	0.54	3.67	0.65	3.02	2.35	0.57	1.83	3.31	0	1.27	0.38	1.03
N. blowi	7.43	1.84	3.63	4.31	3.68	7.99	10.9	7.97	9.23	6.27	9.09	5.87	6.22	6.98	7.69	7.09	6.26	9.15	13.9	14	0.92	8.06	10.3	8.09	4.02	10.4	8.94	2.51	10.6	6.82	5.52
N. incompta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. pachyderma (left)	3.72	0.61	2.66	1.72	2.37	4.12	4.35	11.3	11.9	12.5	5.19	12.8	10.3	14	9.09	7.77	4.7	2.37	2.31	6.2	6.42	2.9	2.59	2.09	2.01	3.35	2.65	0.28	5.06	5.3	3.45
N. pachyderma (right)	42.4	29.4	41.9	36.5	39.5	50.6	42.7	38.2	37.7	20.6	13	22.2	12.2	30.5	28	31.4	40.7	40	25	38	33.5	37.4	31	28.5	47.7	46.3	36.8	50.1	30.4	33	14.5
Orbulina univera	0	0	0.73	0	0.53	0	0	0	0	0	0.43	0	0	0.32	0	0	0.2	0.68	3.24	0.27	0	0.65	0.43	0.78	0.29	0	0.66	0.84	0.51	1.14	0.69
Pulleniatina obliquiloculata	0.74	0.61	0.97	0.57	0.79	0.24	0.54	0	0	0	0	0	0.27	0	0	0	0	0	0	0	0	0	0	0.26	0.57	0	0.33	1.95	1.27	0	0
Spaeroidinella dehiscens	0	0	0	0.29	0.53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unidentified	0	0	0	0	0.26	0.48	0	0	0	0	0.43	0.51	0	0	0	0	0	0	0	0	0	0	0.86	0	0	0	0	0	0	0	0

Table 16.1: Species Relative Abundance NGC 108.

Species \ Sample #	NGC 108 4.24	NGC 108 4.32	NGC 108 4.40	NGC 108 4.48	NGC 108 4.56	NGC 108 4.64	NGC 108 4.72	NGC 108 4.80	NGC 108 4.88	NGC 108 4.96	NGC 108 5.0	NGC 108 5.08	NGC 108 5.16	NGC 108 5.24	NGC 108 5.32	NGC 108 5.40	NGC 108 5.48	NGC 108 5.56	NGC 108 5.64	NGC 108 5.72	NGC 108 5.8	NGC 108 5.88	NGC 108 5.96	NGC 108 6.0	NGC 108 6.08	NGC 108 6.16	NGC 108 6.24	NGC 108 6.32	NGC 108 6.4	NGC 108 6.48	NGC 108 6.56
Globigerina, bulloides	26.4	30.9	31.7	33.2	21.6	18.3	19	13.4	14.1	12.6	6.02	4.96	0	3.96	0	0	1.2	1.42	2.37	5.21	6.1	5.91	10	3.41	1.8	9.52	7.57	8.37	20.3	22.1	10
G. calida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0	0	0	0	0	0	0.28	0.34	0	0	1.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.48	0.4	0.84	0	0	0
G. falcoensis	2.59	1.17	1.98	2	3.86	3.1	2.27	1.72	1.49	0.48	1.39	1.46	0	0.99	0	1.42	0	0	0	2.84	0.58	0	1.82	0.76	0	0.95	0	4.18	0.51	1.07	1.75
G. rubescens	0	0	0	0	0.39	0	0	0	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. quinqueloba	2.85	2.18	1.59	2.4	1.16	1.38	0.85	0	0	0.48	0	0.58	0	0	0.49	0.94	0.4	0.36	0	0	0	0	0.91	1.14	0	0.95	0.8	0.84	2.03	1.71	0.87
G. sp.	8.81	6.04	4.76	2.8	4.63	4.83	3.69	1.72	1.12	0.97	3.24	1.17	0	2.64	0.49	0.94	0.4	0	0.95	0	0.29	0.49	0.91	0.76	0	0.95	1.2	2.93	3.8	4.28	9.17
Globigerinella aequilateralis	0	0.5	0	0.8	0.39	0.34	0	0	0	0	1.39	0.58	1.2	0.33	0	0	0	0.36	0	0	0	0	0	0	0	0	0	0	0	0.21	0
Globigerinita glutinata	5.44	5.2	3.97	5.6	8.49	7.59	3.41	1.72	2.23	6.28	5.56	9.33	0	9.57	1.48	1.42	1.6	0.71	0.47	1.42	0.29	3.94	0.91	0.38	0.6	2.38	1.99	6.69	5.82	4.07	3.49
Globigerinoides conglobatus	0	0	0	0	0	0	0	0	0	0	0	0.29	0	0.66	0.49	0	0	0	0	0.47	0	0	0	0	0	0	0.4	0	0	0	0
G. ruber	0.52	2.01	0.4	1.2	1.54	1.03	0.85	0.69	0.74	4.35	8.33	7.58	1.2	2.64	0	0	0	1.07	1.9	1.42	0.29	0.99	2.27	0.76	1.5	3.33	1.99	0.84	2.53	1.71	1.75
G. ruber (pink)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.sacculifer w/o	0	0	0	0	0	0.69	0	0.34	0	0	0	1.46	0	0	0	0	0	0	0	0	0	0	0	0.38	0.3	0	0	0	0	0.21	0
G. sacculifer w/	0	0	0	0	0	0.34	0.57	0	0.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. tenellus	0	0	0	0	0	0.69	0	0	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Globorotalia crassaformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0
G. hirsuta	0.78	0	0	0.4	2.32	4.83	3.69	1.72	2.23	3.86	2.31	2.62	1.2	6.27	0	0	1.2	0.36	0.47	0.95	0.87	0	0	0.38	0	0	0	0.42	0.76	0	0
G. inflata	14.8	15.1	13.9	18.8	24.7	16.6	20.7	33	27.1	35.7	29.2	32.4	80.7	45.9	36.5	25	29.2	46.6	49.8	37	32.3	34.5	30.9	29.2	36.5	34.3	35.5	24.7	15.9	29.6	27.9
G. menardii	0	0	0	0	0.39	0	0.28	0	0.37	0.97	0.46	1.17	1.2	0.99	0	0	0	0	0.47	0.47	0	0.49	0	0	0.9	0.48	1.2	0	0	0.21	0
G. puncticulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. scitula	0.26	0	0.79	0.4	0.39	0	0	1.03	0.37	0	0.93	0	1.2	0.66	0	0	0	0	0.47	0	0	0	0	0	0	0	0	0	0	0.21	0
G. truncatulinoides (left)	0	0	0	0.4	1.16	0	0.28	0	0	0.48	0.93	0.87	1.2	0.66	0.49	0	0	0.71	0.95	0	0	0	0	0	0	0	0	0.42	0	0.43	0
G. truncatulinoides (right)	0	0	0	0	0	0.34	0	0	0	0	0	0	0	0	0.99	0	0	0	0.47	0	1.45	3.94	3.64	6.82	7.78	12.9	12.4	15.5	9.37	1.71	0.87
G. tumida	0	0	0	0.4	0	0	0	0	0.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. wilesi	0	2.35	2.38	1.2	0	0	0	0	1.12	0.48	1.39	0	0	0	0	0	0	0	0.95	0	0	1.48	0	0	0	0	0	0	0	0	0
G. sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.48	0.4	0.84	0	0.43	0.87
Globorotaloides hexagona	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.49	0	0	0	0	0	0	0	0	0
Neogloboquadrina eggeri	1.04	1.01	1.98	0	1.16	0.69	0.57	3.44	3.35	5.31	1.39	2.04	0	3.96	23.2	11.3	16.4	16.7	10.4	21.8	8.14	8.87	10.5	18.2	12.9	3.81	2.39	1.67	0.25	1.07	0
N. blowi	3.11	3.52	6.75	8	5.41	3.79	11.9	8.59	7.81	10.6	9.26	12.2	7.23	3.3	13.8	25.5	18.8	13.2	14.7	6.64	9.3	10.3	6.36	14.4	9.88	7.62	4.38	3.35	2.78	2.36	0.87
N. incompta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. pachyderma (left)	10.1	8.39	8.33	4.8	3.47	5.17	3.98	1.72	0	0.48	0	0.58	0	13.9	1.48	3.3	2	0.71	0.95	1.42	2.62	0.49	0.91	0.38	2.1	5.71	5.58	15.5	21.3	19.5	28.8
N. pachyderma (right)	23.1	21.3	20.6	16.4	17.4	29.3	26.7	28.2	35.7	15.5	24.1	16.3	4.82	2.64	17.7	30.2	28.8	17.4	12.8	19.4	37.5	27.1	30	21.2	21.9	12.4	18.7	13	13.2	7.92	13.5
Orbulina universa	0.26	0.34	0.4	0.4	0.39	0.69	0.85	0	0.74	1.45	0.93	0.58	0	0.66	0.49	0	0	0.36	1.9	0	0.29	0	0	0	0	0	0.8	0	0.51	0.64	0
Pulleniatina obliquiloculata	0	0	0.4	0.8	1.16	0.34	0	2.41	0.74	0	1.85	3.21	0	0.33	2.46	0	0	0	0	0.95	0	0.99	0.91	1.89	3.29	3.81	4.38	0	0.76	0.64	0
Sphaeroidinella dehiscens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0

Table 16.2: Species Relative Abundance NGC 108.

Species \ Sample #	NGC 108 6.64	NGC 108 6.72	NGC 108 6.8	NGC 108 6.88	NGC 108 6.96	NGC 108 7.0	NGC 108 7.08	NGC 108 7.16	NGC 108 7.24	NGC 108 7.32	NGC 108 7.4	NGC 108 7.48	NGC 108 7.56	NGC 108 7.64	NGC 108 7.72	NGC 108 7.80	NGC 108 7.88	NGC 108 7.96	NGC 108 cc 60	NGC 108 cc 68	NGC 108 cc 76	NGC 108 cc 84	NGC 108 cc 92
Globigerina, bulloides	20.5	34.7	31.2	33.3	28.5	25.2	19.1	17.1	22.1	14.1	21.9	30.1	20.9	23.2	7.69	6.63	3.88	2.04	5.67	7.69	10.7	7.5	8.97
G. calida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. digitata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.55	0	0	0	0	0	0	0
G. falconensis	3.03	1.83	3.67	2.03	2.51	1.66	1.89	2.63	2.81	1.3	2.32	1.45	1.56	2.08	0.9	2.21	0	0.58	1	4.27	2.77	2	1.38
G. rubescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.43	0	0	0.23
G. quinqueloba	9.85	12.3	7.8	5.69	3.77	6.98	6.74	2.63	2.41	2.08	5.63	7.25	10	7.29	7.69	7.46	3.32	4.66	6	5.98	4.15	4.5	5.52
G. sp.	7.2	11.2	5.5	5.28	5.86	4.98	6.47	7.89	6.43	7.55	5.3	3.62	10.6	4.43	3.17	5.25	0.55	4.96	2.33	6.84	5.54	5	5.29
Globigerinella aequilateralis	0	0.23	0	0.41	0	0.66	1.35	0	0	0.52	0	0	0	0	0.45	0.55	0.83	0	0	0.43	1.73	0.5	0.92
Globigerinita glutinata	5.3	4.11	5.05	2.03	7.11	2.99	3.5	6.14	6.02	3.91	8.61	4.71	4.06	5.99	7.24	4.42	5.82	3.21	9.33	5.98	6.57	6	3.45
Globigerinoides conglobatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. ruber	1.52	3.2	0	2.85	2.51	1.66	3.5	1.75	0	0.52	2.32	0.72	0.31	0.78	0.9	2.21	2.49	0	0.67	1.71	2.42	1.5	0.69
G. ruber (pink)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.sacculifer w/o	0	0	0	0.41	0.84	0.33	0.27	0	0	0	0	0.36	0	0	0	0	0.28	0.29	0	0	0	0	0
G. sacculifer w/	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0.26	0	0	0	0	0	0.85	0	0	0
G. tenellus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Globorotalia crassaformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. hirsuta	3.79	1.37	1.83	0	2.93	1.33	1.89	0	0	0	0	1.09	0.94	0	0	0	9.7	6.41	4	6.84	5.19	7.5	2.99
G. inflata	22	11.2	24.3	24	23.8	20.6	27.5	28.5	22.9	27.9	16.6	10.1	10.6	17.7	21.7	24.6	30.5	19.8	21.3	10.3	13.1	19.5	19.5
G. menardii	0	0	0	0	0	0	0.27	0	0.4	0	0	0	0	0	0	0.28	0	0	0	0	0	0	0
G. puncticulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. scitula	0	0	0	2.03	0	0	0	0	0	0.52	0	0	0	1.3	0	0	0	0	0	0	0.35	0	0
G. truncatulinoides (left)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. truncatulinoides (right)	0	0	0.46	0	0	0.33	0	0	0.8	0	0.33	0	0	0	0	0	0	0.58	0.33	0	0.35	0.5	0.23
G. tumida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. wilesi	0	0	0	0	0	0	0	0	0	0	0	0.72	0	0.78	0.45	0	0	0	0	0	0	0	0
G. sp.	0	0	0	0	0	0	0.81	1.75	1.2	0	1.32	0	0.94	0	0	0	0	0.58	0.33	1.28	1.73	0	0.92
Globorotaloides hexagona	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neogloboquadrina eggeri	1.89	1.37	0	4.88	2.93	0.66	0.54	2.19	0	1.56	0.33	0	0.31	1.04	0.9	1.66	0.83	0.29	0	2.14	2.42	1.5	0.92
N. blowi	0.76	1.37	3.21	2.44	0.84	5.98	2.16	1.75	2.81	4.95	0.99	3.26	1.56	2.08	3.62	2.49	3.88	1.17	2	3.85	2.08	1.5	3.45
N. incompta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. pachyderma (left)	20.8	13.9	13.8	10.2	9.21	17.9	17.8	14.5	25.3	28.9	20.2	17	21.9	12.5	23.1	18	26.6	39.7	28.3	19.7	13.1	16	23.4
N. pachyderma (right)	3.41	2.28	2.29	3.66	6.28	6.64	4.58	10.5	5.22	4.17	13.9	18.8	15	19.3	22.2	23.2	11.1	14.3	17	21.4	24.6	26.5	19.8
Orbulina universa	0	0.68	0.92	0.81	2.51	1.66	1.35	2.63	1.2	1.82	0.33	0.72	1.25	0.78	0	0	0	1.17	1.67	0.43	2.08	0	1.61
Pulleniatina obliquiloculata	0	0.23	0	0	0.42	0.33	0.27	0	0	0.26	0	0	0	0.52	0	0.55	0	0.29	0	0	0.35	0	0
Spaeroidinella dehiscens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.28	0	0	0	0.69	0	0.69

Table 16.3: Species Relative Abundance NGC 108.

Varimax Score Matrix

Species	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
Orbulina universa	0.03880	-0.06962	0.00897	-0.55927
Globigerinoides conglolobatus	-0.19922	-0.25403	-0.33011	-0.17823
G. ruber	0.22579	0.16814	0.02180	-0.69383
G. teneallus	-0.21859	-0.24820	-0.32391	-0.17555
G. sacculifer (w/o sac)	-0.17707	-0.22285	-0.28438	-0.24147
G. sacculifer (w/ sac)	-0.19460	-0.23729	-0.31755	-0.18883
Spaeroidinella dehiscens	-0.21698	-0.25449	-0.32593	-0.17140
Globigerinella aequilateralis	-0.10122	-0.18554	-0.22018	-0.31341
Globigerina calida	-0.21600	-0.25247	-0.32079	-0.17781
Globigerina bulloides	-1.10140	0.92146	4.86195	-1.20178
G. falcoensis	-0.17690	-0.13538	0.18728	-0.22541
G. digitata	-0.20615	-0.24675	-0.31837	-0.18069
G. rubescens	-0.22105	-0.25422	-0.32367	-0.16344
N. pachyderma (left)	-1.18959	-0.53392	0.84930	4.91098
N. pachyderma (right)	0.36753	5.12996	-0.98403	0.64801
Globoquadrina conglomerata	-0.21990	-0.25542	-0.32298	-0.17182
Pulleniatina obliquiloculata	-0.10205	-0.26470	-0.32898	-0.20110
Globorotalia inflata	5.01791	-0.46169	1.18762	0.82320
G. truncatulinoides (left)	-0.16120	-0.26319	-0.33266	-0.19074
G. truncatulinoides (right)	0.28082	-0.21391	-0.44999	-0.11566
G. crassaformios	-0.21777	-0.24749	-0.32752	-0.17128
G. hirsuta	-0.12995	-0.21710	-0.18669	0.21492
G. scitula	-0.20035	-0.23362	-0.26438	-0.23295
G. menardii	-0.16753	-0.25467	-0.33576	-0.17948
G. tumida	-0.20966	-0.23417	-0.32827	-0.18608
Candeina nitida	-0.22181	-0.25384	-0.32274	-0.17181
Globigerina glutinata	-0.22693	-0.08380	0.33578	0.58061
Neogloboquadrina eggeri	0.35732	-0.26594	-0.32920	-0.48053
G. wilesi	-0.22955	-0.24530	-0.27129	-0.19476
N. blowi	0.01733	0.17005	0.09669	-0.41042

Table 17: Varimax Factor Score Matrix

Sample #	FACTOR	FACTOR 2	FACTOR 3	FACTOR 4
NGC 102 TOP	0.89975	0.30947	0.20377	0.15827
NGC 102 5.16	0.91411	0.10965	0.21086	0.10265
NGC 102 5.24	0.5518	0.77027	0.21017	0.09043
NGC 102 5.32	0.52614	0.54717	0.46859	0.40842
NGC 102 5.40	0.6191	0.7199	0.1962	0.13649
NGC 102 5.48	0.85943	0.30242	0.36697	0.12073
NGC 102 5.56	0.75576	0.53534	0.34092	0.12327
NGC 102 5.64	0.70512	0.6283	0.28896	0.12876
NGC 102 5.72	0.6465	0.69211	0.2783	0.11967
NGC 102 5.80	0.69653	0.58919	0.37883	0.0719
NGC 102 5.88	0.74634	0.56988	0.27478	0.11323
NGC 102 5.96	0.67465	0.54402	0.38439	0.02791
NGC 102 6.0	0.50513	0.75444	0.39712	0.08449
NGC 102 6.8	0.85268	0.43806	0.17261	0.18008
NGC 102 6.16	0.84132	0.43733	0.14273	0.1575
NGC 102 6.24	0.91707	0.29694	0.17149	0.1556
NGC 102 6.32	0.83073	0.49473	0.1747	0.1554
NGC 102 6.40	0.6993	-0.00039	0.18984	0.03328
NGC 102 6.48	0.7776	0.35948	0.49169	0.06842
NGC 102 6.56	0.76859	0.29751	0.55295	0.05111
NGC 102 6.64	0.49838	0.19022	0.81199	-0.08455
NGC 102 6.72	0.60408	0.30149	0.71733	-0.03371
NGC 102 6.80	0.74736	0.36874	0.52759	0.03766
NGC 102 6.88	0.83887	0.21303	0.37803	0.04936
NGC 102 6.96	0.72994	0.19033	0.63704	-0.008
NGC 102 7.0	0.82429	0.38378	0.34315	0.1328
NGC 102 7.8	0.49025	0.4884	0.62074	-0.00307
NGC 102 7.16	0.19787	0.86644	0.35909	-0.00905
NGC 102 7.24	0.53832	0.78079	0.22753	0.11057
NGC 102 7.32	0.59532	0.76983	0.07722	0.1603
NGC 102 7.40	0.84803	0.45023	0.1844	0.14873
NGC 102 7.48	0.66086	0.63293	0.3058	0.09139
NGC 102 7.56	0.34824	0.86692	0.21123	0.02226
NGC 102 7.64	0.23696	0.91253	0.24439	0.05154
NGC 102 7.72	0.25021	0.94654	0.14295	0.05921
NGC 102 7.80	0.18701	0.96186	0.02061	0.08021
NGC 102 7.88	0.2259	0.95081	0.06053	0.05692
NGC 102 7.96	0.16718	0.9522	0.22325	0.07534
NGC 102 cc64	0.14993	0.96148	0.20284	0.05604
NGC 102 cc72	0.07652	0.92384	0.35312	0.00558
NGC 102 cc80	0.75804	0.60143	0.15038	0.15053
NGC 102 cc88	0.39081	0.87904	0.12841	0.10361
NGC 102 cc96	0.5904	0.73315	0.28376	0.1223

Table 18: Factor Loadings NGC 102

Sample #	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
NGC 106 2-0	0.83904	0.49	0.11036	0.16887
NGC 106 2-8	0.88138	0.37692	0.19555	0.17241
NGC 106 2-16	0.48656	0.84757	0.00142	0.19187
NGC 106 2-24	0.54547	0.76903	0.1532	0.22546
NGC 106 2-32	0.58433	0.74724	0.07	0.25256
NGC 106 2-40	0.73725	0.60038	0.15429	0.25202
NGC 106 2-48	0.74434	0.55276	0.28451	0.21549
NGC 106 2-56	0.65416	0.68124	0.18721	0.23959
NGC 106 2-64	0.87456	0.38463	0.19997	0.1897
NGC 106 2-72	0.76463	0.58096	0.17779	0.18103
NGC 106 2-80	0.45908	0.85587	0.11647	0.17982
NGC 106 2-96	0.75119	0.5806	0.24211	0.14134
NGC 106 3-0	0.48963	0.8319	0.16811	0.17385
NGC 106 3-8	0.73305	0.6336	0.17495	0.1458
NGC 106 3-16	0.39638	0.89285	0.16152	0.11529
NGC 106 3-32	0.43675	0.86671	0.16737	0.12755
NGC 106 3-48	0.86931	0.37116	0.26607	0.14344
NGC 106 3-56	0.87226	0.3884	0.19193	0.1672
NGC 106 3-72	0.76451	0.51231	0.3171	0.19392
NGC 106 3-88	0.79601	0.55576	0.10356	0.16835
NGC 106 3-96	0.80988	0.52191	0.15841	0.18794
NGC 106 4-0	0.67939	0.70204	0.02854	0.19093
NGC 106 4-16	0.93367	0.21289	0.15755	0.18499
NGC 106 4-32	0.84519	0.46231	0.12629	0.15632
NGC 106 4-48	0.79054	0.25161	0.35136	0.42533
NGC 106 4-64	0.82151	0.30063	0.36432	0.30222
NGC 106 4-80	0.76821	0.2859	0.55802	0.08934
NGC 106 4-96	0.69637	0.15979	0.65096	0.23304
NGC 106 5-0	0.56927	0.14157	0.79464	0.12529
NGC 106 5-16	0.7304	0.21796	0.63018	0.11104
NGC 106 5-32	0.82432	0.20546	0.47353	0.1652
NGC 106 5-48	0.7666	0.18968	0.38826	0.4593
NGC 106 5-64	0.35839	0.75071	0.48924	0.22791
NGC 106 5-72	0.72015	0.45533	0.48104	0.17339
NGC 106 5-96	0.83839	0.3548	0.3335	0.16346
NGC 106 6-0	0.46806	0.70081	0.38044	0.11921
NGC 106 6-16	0.72465	0.58044	0.23352	0.21347
NGC 106 6-32	0.63859	0.70172	0.26518	0.1123

Table 19: Factor Loadings NGC 106.

Table 20.1: Factor Loadings NGC 108.

Sample #	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
NGC 108 1.97	0.34314	0.9215	-0.01313	0.15687
NGC 108 2.0	0.56133	0.77855	0.02946	0.2125
NGC 108 2.04	0.87215	0.41844	0.12956	0.18539
NGC 108 2.08	0.68728	0.68079	0.06091	0.21767
NGC 108 2.16	0.69805	0.67334	0.13355	0.18313
NGC 108 2.24	0.64101	0.72098	0.16025	0.18358
NGC 108 2.32	0.31174	0.9245	0.02965	0.18703
NGC 108 2.4	0.21239	0.93767	0.07685	0.17796
NGC 108 2.48	0.24693	0.8712	0.21095	0.34116
NGC 108 2.56	0.29129	0.84205	0.15497	0.37603
NGC 108 2.64	0.89469	0.1831	0.25686	0.25529
NGC 108 2.72	0.64228	0.50965	0.34152	0.43924
NGC 108 2.08	0.69154	0.29757	0.54466	0.34155
NGC 108 2.88	0.31905	0.7683	0.348	0.40987
NGC 108 2.96	0.2899	0.7744	0.47866	0.25381
NGC 108 3.0	0.3365	0.78518	0.45096	0.22076
NGC 108 3.08	0.35299	0.87362	0.26694	0.1751
NGC 108 3.16	0.1527	0.89045	0.40602	0.0429
NGC 108 3.24	-0.06863	0.76888	0.53594	-0.07337
NGC 108 3.32	0.19726	0.88956	0.28529	0.16379
NGC 108 3.4	0.30786	0.77731	0.50197	0.15311
NGC 108 3.48	0.51437	0.78514	0.26961	0.1653
NGC 108 3.56	0.27546	0.82636	0.44162	0.07094
NGC 108 3.64	0.444	0.73255	0.48766	0.0814
NGC 108 3.72	0.34713	0.91156	0.12958	0.14936
NGC 108 3.8	0.27798	0.93026	0.11085	0.1515
NGC 108 3.88	0.26827	0.8726	0.37198	0.07732
NGC 108 3.96	0.31261	0.92671	0.14274	0.11004
NGC 108 4.0	0.28815	0.83661	0.37791	0.16311
NGC 108 4.08	0.16374	0.85923	0.46053	0.12024
NGC 108 4.16	0.34223	0.44008	0.82631	-0.00326
NGC 108 4.24	0.20385	0.65847	0.68016	0.23029
NGC 108 4.32	0.18621	0.6074	0.75128	0.13996
NGC 108 4.40	0.15126	0.59589	0.76444	0.11822
NGC 108 4.48	0.26473	0.48657	0.81785	0.03504
NGC 108 4.56	0.52961	0.49833	0.6496	0.11874
NGC 108 4.64	0.33315	0.79375	0.43929	0.19113
NGC 108 4.72	0.4324	0.71178	0.47611	0.13332
NGC 108 4.80	0.68792	0.60365	0.33328	0.13923
NGC 108 4.88	0.55867	0.76274	0.27214	0.09839
NGC 108 4.96	0.80349	0.34319	0.41704	0.0937

Table 20.2: Factor Loadings NGC 108.

Sample #	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
NGC 108 5.0	0.74475	0.57849	0.20175	0.11683
NGC 108 5.08	0.81685	0.36658	0.24345	0.13433
NGC 108 5.16	0.95308	-0.02933	0.21167	0.1523
NGC 108 5.24	0.83139	-0.05848	0.3311	0.41149
NGC 108 5.32	0.80175	0.27965	0.08082	0.13011
NGC 108 5.40	0.56587	0.59091	0.00939	0.16979
NGC 108 5.48	0.66286	0.55313	0.04419	0.1528
NGC 108 5.56	0.8879	0.24166	0.15057	0.1358
NGC 108 5.64	0.91758	0.15607	0.20142	0.13484
NGC 108 5.72	0.80342	0.33868	0.18825	0.12365
NGC 108 5.8	0.65257	0.6966	0.11938	0.1865
NGC 108 5.88	0.77292	0.54316	0.17349	0.14378
NGC 108 5.96	0.69346	0.6363	0.22933	0.12068
NGC 108 6.0	0.73905	0.43792	0.10501	0.08975
NGC 108 6.08	0.84017	0.397	0.10581	0.17213
NGC 108 6.16	0.8119	0.24734	0.36103	0.21965
NGC 108 6.24	0.80886	0.3712	0.27011	0.2487
NGC 108 6.32	0.57985	0.27976	0.3679	0.52002
NGC 108 6.4	0.21516	0.36031	0.66297	0.55523
NGC 108 6.48	0.4902	0.17003	0.71509	0.45934
NGC 108 6.56	0.45434	0.22911	0.43144	0.73672
NGC 108 6.64	0.34114	0.07189	0.76372	0.53601
NGC 108 6.72	0.00987	0.15278	0.96662	0.17913
NGC 108 6.8	0.33032	0.09869	0.9027	0.24532
NGC 108 6.88	0.34465	0.1464	0.90623	0.12207
NGC 108 6.96	0.40294	0.20574	0.86649	0.17247
NGC 108 7.0	0.29823	0.20236	0.83231	0.40009
NGC 108 7.08	0.50792	0.09576	0.71874	0.45662
NGC 108 7.16	0.58372	0.25306	0.64035	0.41971
NGC 108 7.24	0.29444	0.10773	0.74319	0.58592
NGC 108 7.32	0.42211	0.02611	0.57105	0.68722
NGC 108 7.4	0.20785	0.39091	0.71602	0.52729
NGC 108 7.48	0.01477	0.54169	0.76669	0.33554
NGC 108 7.56	0.04921	0.44798	0.6788	0.57369
NGC 108 7.64	0.29278	0.56528	0.68917	0.3296
NGC 108 7.72	0.40228	0.49415	0.31954	0.693
NGC 108 7.80	0.53007	0.53386	0.28344	0.58721
NGC 108 7.88	0.55069	0.13942	0.30822	0.7369
NGC 108 7.96	0.22611	0.17985	0.22089	0.92069
NGC 108 cc 60	0.35022	0.32578	0.31064	0.81386
NGC 108 cc 68	0.1584	0.61681	0.28693	0.68114
NGC 108 cc 76	0.2849	0.7404	0.3404	0.47529
NGC 108 cc 84	0.41695	0.65155	0.25185	0.55618
NGC 108 cc 92	0.35934	0.46943	0.36546	0.71168

Sample #	Core depth	Age	Oxygen Isotope	Sedimentation rate	Planktonic Foraminiferal Number	FDX	FRAG	%Caco3	%Organic Carbon
Top	0	0.61	0.52	1.63	1440	6.36	0.68838		
5,12	4	1.84	0.22	1.63			0.51181		
5,16	7	4.29	0.21	1.63	2150.7	6	0.32014	68.45	0.41843
5,24	15	9.19	1.08	1.63	4669.2	5.88	0.45918	60.31	0.55249
5,32	23	14.10	1.59	1.63	6751	5.88	0.40183	53.51	0.73316
5,40	31	19.00	1.69	1.63	2959.5	6.04	0.25424	50.8	0.55542
5,48	39	25.80	1.66	1.18	6184.7	5.92	0.31361	53.25	0.48826
5,56	47	32.60	1.59	1.18	5027	5.8	0.32065	56.56	0.39725
5,64	55	39.40	1.60	1.18	3147.3	5.63	0.25228	57.15	0.38873
5,72	63	46.20	1.40	1.18	8306.2	5.59	0.36562	55.34	0.46127
5,80	71	53.00	1.06	1.18	5729	5.67	0.23596	64.1	0.32743
5,88	79	59.00	1.36	1.33	2548.5	5.12	0.39721	59.31	0.41513
5,96	87	65.00	1.43	1.33	3521.3	5.65	0.44625	50.34	0.39
6,0	91	71.33	0.94	0.63	2540.7	6.32	0.52235	59.37	0.34596
6,8	99	84.00	0.88	0.63	3697.5	6	0.4824	60.6	0.30352
6,16	107	96.67	1.08	0.63	2299.1	6.16	0.7128	49.16	0.38516
6,24	115	109.33	0.91	0.63	2291.3	6.18	0.69103	59.85	0.33967
6,32	123	122.00	0.34	0.63	4172.3	6.04	0.32866	64.07	0.30882
6,40	131	135.00	1.57	0.62	6493.6	5.19	0.26885		
6,48	139	138.20	1.58	2.50	10586	5.11	0.30032	51.28	0.66583
6,56	147	141.40	1.44	2.50	8807.6	4.52	0.245	59.03	0.41896
6,64	155	144.60	1.54	2.50	7687.8	4.78	0.18444	59.67	0.53079
6,72	163	147.80	1.60	2.50	6768.5	5.22	0.30085	51.92	0.61712
6,80	171	151.00	1.72	2.50	6154.6	5.13	0.22581	56.44	0.43666
6,88	179	156.82	1.38	1.37	8911.6	5.03	0.22884	57.05	0.54075
6,96	187	162.64	1.38	1.37	2651.6	5.31	0.38967	51.43	0.46644
7,0	191	165.55	1.29	1.37	5252.9	4.88	0.30796	60.63	0.39767
7,8	199	171.36	1.51	1.37	4012.5	4.83	0.26734	45.47	0.35584
7,16	207	177.18	1.66	1.37	2580.8	5.37	0.43688	47.97	0.49241
7,24	215	183.00	1.72	1.37	2107.5	5.86	0.55752	38	0.39866
7,32	223	198.00	1.39	0.53	791.49	6.14	0.59504	35.78	0.44424
7,40	231	213.00	1.19	0.53	1362.3	5.9	0.62423	37.89	0.43699
7,48	239	228.00	1.68	0.53	2381.6	5.52	0.59657	42.14	0.3297
7,56	247	238.50	1.48	0.76	2132.6	5.33	0.34177		
7,64	255	249.00	1.85	0.76	6229.9	5.44	0.42361	38.19	0.57857
7,72	263	254.53	1.73	1.45	6001	5.5	0.27671	58.61	0.46505
7,80	271	260.05	1.81	1.45	5385.3	5.34	0.35306	60.79	0.5172
7,88	279	265.58	2.12	1.45	3394.3	5.79	0.41021	55.19	0.42887
7,96	287	271.11	2.13	1.45	3291.4	5.75	0.55652	54.44	0.33696
cc64	294	275.95	2.16	1.45	3344.9	5.55	0.44818		
cc72	302	281.47	1.78	1.45	513.65	6.3	0.6835	46.4	0.34427
cc80	310	287.00	1.52	1.45	1797.4	5.83	0.69366		
cc88	318	292.53	1.60	1.45	1308	5.8	0.70862	65.66	0.2535
cc96	326	298.05	1.52	1.45	1301.8	6.27	0.82		

Table 21: NGC 102 Sedimentation Rates

Sample #	Core depth	Age	Oxygen Isotope	Sedimentation rate	Planktonic Foraminiferal Number	FDX	FRAG
2.00	1.00	0.00		1.36	142.23	6.84	0.93
2.08	5.00	2.88		1.36	224.72	6.72	0.88
2.16	13.00	8.64		1.36	851.84	6.71	0.68
2.24	21.00	14.40		1.36	2382.75	6.00	0.45
2.32	29.00	19.00		1.36	1154.76	6.55	0.55
2.40	37.00	20.09		3.29	1163.64	6.37	0.59
2.48	45.00	21.18		3.29	2101.74	6.25	0.62
2.56	53.00	21.50		3.29	1174.58	6.35	0.76
2.64	61.00	26.24		3.29	1402.06	6.47	0.67
2.72	69.00	28.91		3.29	923.52	6.51	0.68
2.80	77.00	31.44		3.29	1910.54	6.42	0.63
2.96	92.00	36.18		3.29	2919.55	6.42	0.70
3.00	97.00	37.76		3.29	1860.60	6.35	0.67
3.08	105.00	40.29		3.29	3018.48	6.36	0.51
3.16	113.00	42.82		3.29	3177.78	6.13	0.44
3.32	129.00	47.57		3.29	1770.21	6.20	0.49
3.48	145.00	52.32		2.86	1431.14	6.11	0.57
3.56	153.00	54.69		2.86	1306.81	6.59	0.63
3.72	169.00	62.00		2.86	1778.81	6.12	0.70
3.88	185.00	75.75		1.05	1317.55	6.34	0.51
3.96	193.00	80.75		1.05	538.95	6.51	0.70
4.00	197.00	83.25		1.05	607.47	6.49	0.78
4.08						0.00	
4.16	213.00	92.00		1.05	605.66	6.82	0.85
4.24						0.00	
4.32	229.00	122.67		1.05	660.12	6.59	0.80
4.40						0.00	
4.48	245.00	130.16		1.02	439.60	6.40	0.52
4.56						0.00	
4.64	261.00	132.17		3.41	1925.00	6.16	0.45
4.72						0.00	
4.80	277.00	134.18		3.41	1142.86	5.67	0.39
4.88						0.00	
4.96	293.00	137.44		3.41	1708.44	5.37	0.51
5.00	297.00	137.62		2.12	1807.85	5.17	0.47
5.08						0.00	
5.16	313.00	143.34		2.12	4296.33	5.58	0.38
5.24						0.00	
5.32	329.00	148.50		2.12	3469.36	5.82	0.42
5.40						0.00	
5.48	345.00	152.15		2.12	812.14	6.41	0.54
5.56						0.00	
5.64	361.00	155.80		2.12	2375.64	5.79	0.59
5.72	369.00	164.04		3.12	944.97	5.73	0.48
5.80						0.00	
5.88						0.00	
5.96	393.00	170.22		3.12	1027.85	6.05	0.55
6.00	397.00	175.88		3.12	1267.42	5.59	0.47
6.08						0.00	
6.16	413.00	182.06		3.12	671.95	6.13	0.61
6.24						0.00	
6.32	429.00	188.20		3.12	120.36	5.80	0.71

Table 22: NGC 106 Sedimentation Rates.

Sample #	Core Depth	Age	Oxygen Isotope	Sedimentation rate	Planktonic Foraminiferal Number	FDX	FRAG
1.97	0.00	0.00	-1.40	2.68	1294.60	671.00	0.74
2.00	3.00	1.20	-1.22	2.68	684.07	682.00	0.67
2.04	7.00	2.80	-1.05	2.68	668.89	679.00	0.70
2.08	11.00	4.40	-1.16	2.68	1279.30	649.00	0.63
2.12	15.00	6.00	-1.14	2.68			
2.16	19.00	7.60	-1.26	2.68	3203.80	638.00	0.64
2.24	27.00	10.80	-1.43	4.64	3836.30	621.00	0.43
2.32	35.00	14.40	-1.75	4.64	4826.20	577.00	0.28
2.40	43.00	16.50	-2.44	4.64	4600.90	576.00	0.37
2.48	51.00	19.00	-2.43	4.64	2665.80	617.00	0.49
2.56	59.00	21.50	-2.14	4.64	2101.80	576.00	0.55
2.64	67.00	24.00	-2.22	4.64	1399.50	600.00	0.53
2.72	75.00	25.63	-2.24	4.64	1667.90	594.00	0.56
2.80	83.00	27.27	-2.21	4.64	977.22	561.00	0.46
2.88	91.00	28.91	-2.31	4.64	1324.70	571.00	0.58
2.96	99.00	30.55	-2.15	4.64	2230.00	544.00	0.51
3.00	103.00	31.36	-2.22	4.64	2130.70	567.00	0.49
3.08	111.00	33.00	-2.02	4.64	6508.90	575.00	0.39
3.16	119.00	34.64	-2.02	4.64	3656.90	558.00	0.36
3.24	127.00	36.27	-1.87	4.64	3721.60	537.00	0.34
3.32	135.00	37.91	-2.03	4.64	2834.10	574.00	0.37
3.40	143.00	39.55	-1.81	4.64	3410.40	541.00	0.44
3.48	151.00	41.18	-1.93	4.64	4763.50	596.00	0.39
3.56	159.00	42.82	-1.59	4.64	4548.00	542.00	0.19
3.64	167.00	44.46	-1.64	4.64	2153.80	551.00	0.26
3.72	175.00	46.09	-1.52	4.64	1908.20	583.00	0.37
3.80	183.00	47.73	-1.66	4.64	4606.00	589.00	0.33
3.88	191.00	49.36	-1.70	4.64	5983.40	560.00	0.27
3.96	199.00	51.00	-1.52	4.64	27058.00	594.00	0.30
4.00	203.00	51.82	-1.81	4.64	8227.20	544.00	0.29
4.08	211.00	53.46	-1.95	4.64	2835.60	523.00	0.39
4.16	219.00	55.09	-1.43	3.19	4351.70	468.00	0.36
4.24	227.00	56.73	-1.58	3.19	1446.50	498.00	0.46
4.32	235.00	58.36	-1.79	3.19	1980.10	483.00	0.42
4.40	243.00	60.00	-1.87	3.19	787.35	499.00	0.56
4.48	251.00	66.00	-2.15	3.19	966.26	502.00	0.58
4.56	259.00	72.00	-1.56	2.82	1702.00	533.00	0.56
4.64	267.00	74.67	-1.52	2.82	1542.30	544.00	0.48
4.72	275.00	77.33	-1.38	2.82	1647.90	568.00	0.53
4.80	283.00	80.00	-1.39	2.82	1072.10	618.00	0.59
4.88	291.00	82.67	-1.45	2.82	909.46	609.00	0.66
4.96	299.00	85.33	-1.48	2.82	1253.00	594.00	0.61
5.00	303.00	86.67	-1.48	2.82	1548.00	575.00	0.46
5.08	311.00	89.33	-1.40	2.82	957.77	595.00	0.57
5.16	319.00	92.00	-1.80	2.82	33.13	688.00	0.95
5.24	327.00	94.67	-1.85	2.82	113.59	618.00	0.76
5.32	335.00	97.33	-1.52	2.82	1027.00	689.00	0.66
5.40	343.00	100.00	-1.38	2.82	1244.80	683.00	0.61
5.48	351.00	102.67	-1.52	2.82	641.54	686.00	0.77
5.56	359.00	105.33	-1.26	2.82	1551.70	684.00	0.58
5.64	367.00	108.00	-1.28	2.82	1001.80	660.00	0.48
5.72	375.00	110.67	-1.34	2.82	1038.00	658.00	0.63
5.80	383.00	113.33	-1.36	2.82	1960.50	668.00	0.47
5.88	391.00	116.00	-1.28	2.82	2200.20	646.00	0.46
5.96	399.00	118.67	-1.26	2.82	1242.70	631.00	0.62
6.00	403.00	120.00	-1.04	2.82	1213.80	668.00	0.64
6.08	411.00	122.67	-0.56	2.82	1912.00	679.00	0.63
6.16	419.00	125.33	-0.92	3.48	1939.40	623.00	0.54
6.24	427.00	128.00	-1.02	3.48	2570.20	637.00	0.49
6.32	435.00	130.06	-2.01	3.48	1270.40	605.00	
6.40	443.00	132.12	-1.76	3.48			
6.48	451.00	134.18	-1.89	3.48	3631.60	549.00	0.25
6.56	459.00	136.24	-1.69	3.89	5509.80	565.00	0.31
6.64	467.00	138.30	-1.76	3.89	7602.30	497.00	0.23
6.72	475.00	140.36	-1.80	3.89	6955.80	400.00	0.21
6.80	483.00	142.42	-1.54	3.89	6588.90	480.00	0.30
6.88	491.00	144.48	-1.36	3.89	4950.90	476.00	0.29
6.96	499.00	146.53	-1.78	3.89	4020.00	483.00	0.26
7.00	503.00	147.56	-1.83	3.89	4532.70	508.00	0.29
7.08	511.00	149.62	-1.80	3.89	3441.20	505.00	0.32
7.16	519.00	151.68	-1.88	3.89	3949.10	517.00	0.29
7.24	527.00	153.74	-1.64	3.88	2945.70	523.00	0.39
7.32	535.00	155.80	-2.07	3.88	3072.00	561.00	0.43
7.40	543.00	157.86	-2.03	3.88	4510.60	507.00	0.24
7.48	551.00	159.92	-2.02	3.88	4906.70	499.00	0.28
7.56	559.00	161.98	-1.81	3.88	7529.40	476.00	0.37
7.64	567.00	164.04	-1.48	3.88	4068.90	515.00	0.33
7.72	575.00	166.10	-1.56	3.88	1759.20	590.00	
7.80	583.00	168.16	-1.34	3.88	2123.60	578.00	0.42
7.88	591.00	170.22	-1.32	3.88	1182.40	628.00	0.46
7.96	599.00	172.28	-1.72	3.88	1930.70	615.00	0.39
cc 60	605.00	173.82	-1.76	3.88		601.00	0.38
cc 68	613.00	175.88	-1.64	3.88	2487.70	541.00	0.29
cc 76	621.00			3.88	2064.30	534.00	0.38
cc 84	629.00	180.00	-2.02	3.88		583.00	0.36
cc 92	637.00	182.06	-2.14		1829.20	568.00	0.41

Table 23: NGC 108 Sedimenation Rates.

Figure 1: Location of cores used in the present study (NGC 102, NGC 106, and NGC 108) and a nearby core V21-146 (Hovan*et. al.*, 1991) used for comparison.

Figure 2a: Sea Surface Temperature (C°) August. Based from the marine climatological charts of the North Pacific Ocean for a 30 year period (1961 -1990), Japan Meteorological Agency.

Figure 2b: Sea Surface Temperature (C°) February. Based from the marine climatological charts of the North Pacific Ocean for a 30 year period (1961 -1990), Japan Meteorological Agency.

Figure 3 : Contoured phosphate (PO_4) concentration (annual average). (World Ocean Atlas CD-ROM, Levitus et al., 1994)

Figure 4a : Salinity (annual average) profile at 154.5 ^{o} E longitude (World Ocean Atlas CD-ROM, Levitus et al., 1994)

Figure 4b : Dissolved oxygen content (annual average) profile at 154.5 ^{o} E longitude (World Ocean Atlas CD-ROM, Levitus et al., 1994).

Figure 5: Lithologic descriptions of cores NGC 102, NGC 106, and NGC 108; from Ioka et al. (1997).

Figure 6: Chronology and oxygen isotope stratigraphy of cores NGC 102 and 108. Additional biostratigraphic age control provided by the last appearance datum (LAD) of the pink pigmented *Globigerinoides ruber* (~122 kyr), first appearance datum (FAD) of the calcareous nanno-fossil *Emiliania huxleyi* (~260 kyr) (from Tanaka, 1997), coiling changes in *Globorotalia truncatulinoides* and *Neogloboquadrina pachyderma*.

Figure 6b: Age model for core NGC 106 is based from graphic correlation of FRAG and estimated SST profile with FRAG record of NGC 108 and SPEC MAP.

Figure 7: Downcore plots of relative degree of fragmentation (FRAG) (a), foraminiferal dissolution index (FDX) (b), planktic foraminiferal no. (c), and *G. bulloides* absolute abundance (d) for core NGC 102. FRAG and FDX are tightly coupled (e) showing significant correlation (f).

Figure 8: Downcore plots of relative degree of fragmentation (FRAG) (a), foraminiferal dissolution index (FDX) (b), planktic foraminiferal no. (c), and *G. bulloides* absolute abundance (d) for core NGC 106. FRAG and FDX are tightly coupled (e) showing significant correlation (f).

Figure 9: Downcore plots of relative degree of fragmentation (FRAG) (a), foraminiferal dissolution index (FDX) (b), planktic foraminiferal no. (c), and *G. bulloides* absolute abundance (d) for core NGC 108. FRAG and FDX are tightly coupled (e) showing significant correlation (f).

Figure 10: Carbonate dissolution record (FRAG) of the three cores compared with %CaCO3 of NGC 102 (Kawahata et al. in press) and V21-146. Dissolution record follows the carbonate event scale of Farell and Prell (1989) constructed for the central equatorial Pacific.

Figure 11 : Cross spectral analysis between d18O and FRAG. The interplolated time interval for the spectral analysis is 3 kyr. Confidence interval of phase estimates is at 80 % significance level. Spectra for both d18O and FRAG dominated by the 100 kyr cycle where significant coherency also occur. FRAG lags behind d18O in the order 26 deg (~7 kyr) at the 100 kyr cycle.

Figure 12: Time series plots of estimate summer SSTs, winter SSTs, seasonality, and communality. SST profiles follow closely $\delta^{18}O$ profiles. Plotted together with communalities are relative abundances of *N. pacyderma* dextral (green). Solid dark line marks 80% acceptable limit for communality. Green dashed line marks ~39% level of relative abundance. Intervals of low communality are primarily the result of *N. pachyderma* dextral abundances approaching or exceeding maximum observed in calibratin data set of Thompson (1981).

Figure 13: Downcore plots of varimax factor assemblages derived from the five factor model of FP-12E.

FP-12E SST ESTIMATE VS. MODERN ANAIOGUE TECHNIQUE

Figure 14: Comparison between FP-12E derived SST estimates and Modern Analogue Technique SST estimates.

Figure 15: Downcore plots of the factor loadings of the 4 factor model derived from a Q-mode factor analysis of planktic foraminiferal census data.

Figure 16: Modern distribution of some remarkable planktic foraminiferal species and typical core top assemblage (top) in Shatsky Rise.

Figure 17: Absolute abundance plots of key planktic species of NGC 102.

Figure 18: Absolute abundance plots of key planktic species of NGC 106.

Figure 19: Absolute abundance plots of key planktic species of NGC 108.

Figure 20: Absolute abundance data of *G, bulloides*, *N. pachyderma* (R) , and *N. pachyderma* (L) are compared with % organic carbon record of NGC 102.

Figure 21: Sedimentation rates in the three cores as a function of changing dissolution rates and productivity.

Figure 22: Present oceanographic setting in the core localities (Shatsky Rise). Illustrated planktic species represent typical assemblage. Influence of the subtropical , transitional and subartic watermasses represented by areas shaded in red, green, and blue, respectively. Temperature gradient across the three core localities are based on average winter SSTs (FP-12E). Top of gray shaded area represents approximate position of foraminiferal lysocline; bottom represents arbitrary depth representing carbonate dissolution equivalent to a relative degree of fragmentation (FRAG) approaching ~0.90.

Figure 23: Last Glacial Maximum (LGM) paleoceanographic reconstruction. Illustrated planktic species represent typical assemblage. Influence of the subtropical , transitional and subartic watermasses represented by areas shaded in red, green, and blue, respectively. Temperature gradient across the three core localities are based on average winter SSTs (FP-12E). Top of gray shaded area represents approximate position of foraminiferal lysocline; bottom represents arbitrary depth representing carbonate dissolution equivalent to a relative degree of fragmentation (FRAG) approaching ~0.90.

Figure 24: Paleoceanographic reconstruction for the oxygen isotope stage 5.5. Illustrated planktic species represent typical assemblage. Influence of the subtropical , transitional and subartic watermasses represented by areas shaded in red, green, and blue, respectively. Temperature gradient across the three core localities are based on winter SSTs (FP-12E). Top of gray shaded area represents approximate position of foraminiferal lysocline; bottom represents arbitrary depth representing carbonate dissolution equivalent to a relative degree of fragmentation (FRAG) approaching ~0.90.

Figure 25: Paleoceanographic reconstruction for the oxygen isotope stage 6 (glacial). Illustrated planktic species represent typical assemblage. Influence of the subtropical , transitional and subartic watermasses represented by areas shaded in red, green, and blue, respectively. Temperature gradient across the three core localities are based on average winter SSTs (FP-12E). Top of gray shaded area represents approximate position of foraminiferal lysocline; bottom represents arbitrary depth representing carbonate dissolution equivalent to a relative degree of fragmentation (FRAG) approaching ~0.90.