Late Quaternary palaeoceanography of the eastern Indian Ocean based on benthic foraminifera

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Except where otherwise acknowledged in the text, this thesis represents original research by the author

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To:
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ABSTRACT

The distribution of the Recent benthic foraminifera from the eastern Indian Ocean and their application for the reconstruction of palaeoceanographic conditions for this region, during the Late Quaternary, are discussed herewith. The thesis is articulated in two phases: (1) the study of the distribution of the Recent benthic foraminifera and the relationships with the surrounding environment, (2) the analysis of the benthic foraminifera faunal content and $\delta^{13}C$ record of *Cibicidoides wuellerstorfi* from three deep-sea cores from the eastern Indian Ocean: *Fr10/95 GC17*, *Fr10/95 GC5*, *SHI9016* and *BAR9403*.

In order to understand the factors influencing benthic foraminiferal distribution in the eastern Indian Ocean, 57 core tops are investigated. Quantitative foraminiferal analysis (%), Detrended Correspondence Analysis (DCA), Canonical Correspondence analysis (CCA) and correlation matrix are used to define ecological structures.

Two groups of species are identified by means of the first DCA ordination axis. The first group includes three taxa: *Oridorsalis tener umbonatus*, *Epistominella exigua* and *Pyrgo murrhina* whose percentage increases with depth. These three taxa prefer a cold and well-oxygenated environment, where the carbon flux to the sea floor is low. *O. t. umbonatus* and *P. murrhina* are interpreted as indicators of reduced food availability, while *E. exigua* could be associated with periodic (seasonal) pulses of organic matter to the sea floor. The second group of taxa includes *Nummoloculina irregularis* and *Cibicidoides pseudoungerianus*, typical of shallow depths. *C. pseudoungerianus* is correlated with a warm environment characterised by high carbon-flux rate. *N. irregularis* is associated with low-salinity levels, high dissolved-oxygen concentrations and its distribution mirrors the distribution of the Antarctic Intermediate Water for this region.

Based on the second ordination-axis scores, two other species are identified as environmentally significant: *Uvigerina proboscidea* and *Bulimina aculeata*. The distribution of *U. proboscidea* is mainly limited to low latitudes, where the carbon-flux rate is high, due to higher primary productivity levels at the sea surface, and oxygen levels are low, because of the organic matter oxidation and the contemporary presence of oxygen-depleted Indonesian Intermediate Water (IIW) and North Indian Intermediate Water (NIIW). *B. aculeata* is present at low latitude in areas characterised by high phosphate concentration and where refractory phytodetritus is eventually transported down-slope from the shelf. The opportunistic behaviour of this species, indicated by high dominance levels characterising it, could relate the presence of *B. aculeata* to seasonal inputs of food.

The infaunal species are correlated with high carbon-flux rates and low dissolved-oxygen concentrations, while the porcellaneous taxa are correlated with high dissolved-oxygen and low-salinity levels.

Benthic foraminifera from the deep-sea cores are analysed by means of *Q* – mode Factor analysis. The $\delta^{13}C$ record of *C. wuellerstorfi* is measured to gather information about past intermediate- and deep-water circulations. The benthic foraminifera accumulation rate (BFAR) and the accumulation rates (AR) of *B. aculeata*, *E. exigua* and *U. proboscidea* are calculated in order to investigate episodes of increased organic-matter supply to the sea floor.

The co-variance of the organic matter supply and dissolved-oxygen levels affected the distribution of benthic foraminifera during the last 60 Kyrs. Below 1800 m, under conditions of reduced deep-water circulation (low $\delta^{13}C$ of *C. wuellerstorfi*) and increased carbon-flux rate (high BFAR and *B. aculeata*, *E. exigua* and *U. proboscidea*

AR), *B. aculeata* dominated the benthic foraminiferal assemblage. In presence of a more oligotrophic environment (low BFAR and *B. aculeata*, *E. exigua* and *U. proboscidea* AR), characterised by active deep-water circulation (high $\delta^{13}C$ of *C. wuellerstorfi*), *O. t. umbonatus* (*BAR9403*) and *C. wuellerstorfi* (*Fr10/95 GC5*, *SHI9016* and *BAR9403*) dominated the benthic foraminifera fauna. Above 1800 m and south of 20°S, the presence of strong bottom currents and the lateral advection of small amounts of organic matter, favoured the suspension feeder *C. wuellerstorfi*. Under extremely high dissolved-oxygen levels, determined by the increased influence of the Antarctic Intermediate Water (high $\delta^{13}C$ of *C. wuellerstorfi*) and reduced organic-matter supply, *N. irregularis* and *G. subglobosa* dominated the benthic foraminifera assemblage. The reduction of oxygen levels and a more stratified water column favoured the species *U. proboscidea* and *B. robusta*.

These considerations allowed the reconstruction of the palaeoceanographic evolution of the eastern Indian Ocean during the Late Quaternary:

- For *60 – 35 Kyr BP*, conditions of higher productivity (compared to the Present) at the sea surface were suggested for the Banda Sea.
- For *35 – 15 Kyr BP*, still high productivity characterised the Banda Sea. Offshore Java and Sumatra, the prevailing NW-Monsoon reduced the intensity of the South Java Upwelling System and the organic matter supply to the sea floor. Strong and oxygenated bottom currents were present offshore Western Australia. For the Last Glacial Maximum, a reduction of deep-water circulation characterised the eastern Indian Ocean, while more active circulation was recorded at intermediate depths. The enhancement of SE-Monsoon caused the South Java Upwelling System to increase its intensity, thus the amount of organic matter to the sea floor. Higher productivity offshore Java and Sumatra and in the Banda Sea favoured an increase of productivity off the north coast of Western Australia. Arid conditions over Australia, further reduced the amount of nutrients supplied to the ocean maintaining low-productivity levels off the west coast of Western Australia. At the same time the Antarctic Intermediate Water was present north of 22°S.
- For *15 – 5 Kyr BP*, increased precipitation levels led to the formation of a low-salinity water cap at the sea surface reducing productivity over the Banda Sea and offshore Java and Sumatra. Off the north coast of Western Australia, the nutrients injected into the ocean by the rivers maintained productivity levels similar to those recorded for the LGM. Off the west coast of Western Australia, freshwater injected by the rivers deepened the nutricline, preventing any increase of organic matter supply to the sea floor.
- For *5 Kyr BP – Present*, a reduction of precipitation levels led to a slight increase of South Java Upwelling System intensity. In the Banda Sea, productivity levels were like those recorded for the Present. Off the Western Australian coast an increased influence of the oxygen-depleted Indonesian Intermediate Water and the Leeuwin Current engendered a more stratified water column, characterised by low dissolved-oxygen levels.

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INTRODUCTION

The oceans' water masses play an important role in the Planet Earth System. The oceanic global circulation represents the medium through which heat, nutrients and dissolved gasses are transported for thousands of kilometres, supplying the most remote part of the globe and influencing climate and biological activity all over the world. The El Niño Southern Oscillation represents one of the most exhaustive examples to understand the links between ocean dynamics, the atmosphere and global climate. Changes in the oceanographic setting and wind regimes of Pacific Ocean have enormous repercussions all over the world, suppressing upwelling phenomena offshore Chile and Peru (Shaffer et al., 1997), causing drought over Australia and Indonesia and determining rainfall increase over central Africa (Dawson and O'Hare, 2000).

One of the principal aims of modern research is to develop instruments to assist in predicting future changes in terrestrial climate. To achieve this, the availability of long-term observations is crucial. In this sense, palaeoceanographic investigations appear to be a suitable path to follow in order to understand how, in the past, climate and oceans changed and to provide long-term data series to apply to modern climatic models.

The study of Quaternary climate revealed the presence of glacial cycles, with periods of 100 Kyrs, 43 Kyrs and 23 Kyrs in phase with Earth's orbital cycles: eccentricity, obliquity and precession (Imbrie and Shackleton, 1976; Imbrie and Imbrie, 1980). Recently it has been shown how the two shorter climatic cycles were directly driven by obliquity and precession, while the 100 Kyrs cycle was the result of orbital changes effects combined with the expansion of the global ice-sheet cover (Imbrie et al., 1993). Climatic changes during the course of the Quaternary had a great impact on the oceans. Increased or decreased polar ice-sheet cover and differences in temperature gradients between high- and low-latitudes strongly affected the production and circulation of water masses (Rahmstorf, 2002). During the Last Glacial Maximum, due to the expanded Artic ice-sheet cover, the production of North Atlantic Deep Water (NADW) diminished, leading to a global reduction of deep-water circulation (Duplessy et al., 1989). At the same time, the latitudinal shift of the Polar Front and the Subtropical Convergence (Prell et al., 1980) favoured a more vigorous circulation at intermediate depths (Duplessy et al., 1989). Computer generated models, designed to reconstruct past oceanic circulation, have indicated a similar scenario (Ganopolski et al., 1998). These changes in the ocean circulation patterns reduced the amount of heat transported from the low latitudes to the high latitudes, amplifying the temperature-reduction effect caused by diminished solar irradiance in the polar regions, during glacial phases (Williams et al., 1998).

Moved by the growing concern about the actual temperature rise, recent studies have investigated the CO_2 levels in the atmosphere during the Quaternary and their relationships with temperature changes (Barnola et al., 1987). The analysis of air bubbles trapped in the polar ice has allowed, so far, the study of the atmospheric concentration of CO_2 during the last 420 Kyrs (Petit et al., 1999). Results indicate high CO_2 concentrations during interglacial (280-300 p.p.m.v.) and low concentrations during glacial phases (180-200 p.p.m.v), suggesting the existence of a strong relationship between global temperature and CO_2 levels (Petit et al., 1999). A possible mechanism, for such CO_2 variations, is the reduction of Antarctic deep-water production during glacial periods (Francois et al., 1997; Sigman and Boyle, 2000). Another mechanism, potentially contributing to lower CO_2 levels during the past, is the increased export of organic matter to the sea floor due to increased productivity at the sea surface. Sigman and Boyle (2000) suggest that the decrease in the production of deep-waters at high latitude was also accompanied by a more efficient utilization of nutrients by the phytoplankton, which led to increased productivity in the Subantarctic Zone during glacial phases. The idea behind this model is that seawater iron concentration influences the ability of phytoplankton to exploit nutrients: the "iron hypothesis" (Martin, 1990). Laboratory experiments have shown how diatoms utilise nutrients more efficiently in presence of high iron concentrations (Takeda, 1998). According to the "iron hypothesis", increased wind strengths during the glacial periods led to an increased transport of dust from the continents to the oceans, increasing the concentration of iron at the sea surface (Petit et al., 1999). The intensification of wind regimes during the Last Glacial Maximum also strengthened the intensity of oceanic upwelling cells at low latitude, causing productivity to increase (Sarnthein et al., 1988). The real contribution of each of these processes to the reduction of CO_2 levels is still debated, as many other factors (e.g. biomass reduction over the continents, global changes in alkalinity of the oceans, sea surface temperature variations, etc.) played a role in influencing atmospheric CO_2 concentration.

The analysis of different proxies from deep-sea core sediment, collected from various parts of the world, can provide information about the evolution of oceans and climate: benthic foraminifera are one of these proxies. These microorganisms, with their good fossil preservation potential, are a reliable means through which to describe processes occurring at the sea floor as well at the surface of the oceans.

During the last decade the links between benthic foraminifera distribution, water-mass properties and productivity levels at the sea surface have been extensively investigated. The information acquired allowed the successful use of these microorganisms as palaeoceanographic proxies in order to reconstruct past sea-surface productivity levels (Mackensen et al., 1994; Kuhnt and Hess, 1999), the extension of the oxygen minimum zone (den Dulk et al., 1998) and the carbonate undersaturation of the water masses (Miao and Thunell, 1996). Most studies on benthic foraminifera have been focused on the Atlantic and the Pacific Oceans and few of the works from the Indian Ocean were related to the eastern part of this basin (Corliss, 1979a; Corliss, 1979b; Van Marle, 1988; Wells et al., 1994).

Aims of the thesis

The eastern Indian Ocean circulation is under the influence of the monsoonal climate and of the Indonesian Throughflow. The latter represents a major component of the global circulation model, as the volume of water, which moves from the Pacific to the Indian Ocean, is approximately the same of the volume of water involved in the formation of the North Atlantic Deep Water (Schmitz, 1995; Schmitz, 1996; Ganachaud and Wunsch, 2000). With the Indonesian Throughflow a considerable amount of heat absorbed from the atmosphere by Pacific Waters is transported to the Indian Ocean (Ganachaud and Wunsch, 2000). In order to understand past variations of the oceans' circulation, the investigation of the evolution of the Indo-Pacific region is crucial.

During the last decade four oceanographic cruises took place in the eastern Indian Ocean: *Shiva* (1990), *Barat* (1994), *Fr10/95* (1995) and *Fr 2/96* (1996). These scientific expeditions collected a large number of gravity and piston cores from the region. This core dataset represents a valuable source of information for improving the knowledge about the palaeoenvironmental evolution of the eastern Indian Ocean during the Late Quaternary.

This thesis will investigate the environmental variables that influence the distribution of Recent benthic foraminifera. The results obtained will be then applied to the study of fossil assemblages in order to reconstruct the palaeoceanographic evolution of the eastern Indian Ocean for the last 60 Kyrs.

1. Recent benthic foraminifera will be studied using a dataset of 57 core tops. A number of environmental variables will be measured in order to obtain information about water mass properties (temperature, salinity, dissolved-oxygen concentration) and nutrient concentrations (phosphate, nitrate). Links between benthic foraminifera distribution and processes at the sea surface will be investigated by considering the sea-surface primary-productivity levels and the carbon-flux rate at the sea floor. The relationships between foraminifera and environment will be analysed by means of statistical analyses (ordination techniques and correlation matrix).

2. The palaeoceanographic evolution of the eastern Indian Ocean will be studied by analysing the benthic foraminifera faunal content of selected cores from this region. Statistical analyses, plus the information acquired about the distribution of Recent foraminifera, will be used to interpret the faunal changes observed in the cores.

3. The $\delta^{13}C$ of *Cibicidoides wuellerstorfi* will be measured to investigate the past intermediate- and deep-water circulation and variations of organic matter supply to the sea floor.

PART I: The study of Recent benthic foraminifera foraminifera from the eastern Indian Ocean

1. Benthic foraminifera ecology and palaeoecology of application for palaeoceanographic studies.

Benthic foraminifera are abundant in marine sediments. They are present at all latitudes and also have a good fossil preservation potential. For these reasons, they represent a useful tool for oceanographic and palaeoceanographic studies. During the last thirty years much research has been conducted in order to define the links between the ecology of these microorganisms and the environment in which they live.

Several studies have successfully determined links between distribution of benthic foraminifera, water masses patterns and characteristics. Streeter (1973) used benthic foraminifera to trace water mass flow in the North Atlantic. He distinguished three major assemblages, one associated to cold and deep waters (<2°C), which he called ?*Epistominella umbonifera* assemblage, another associated to less cold waters (2-3°C) named *Epistominella exigua* – *Cibicidoides wuellerstorfi* assemblage and a third associated to warmer waters (3-4°C), the *Uvigerina hollicki* assemblage. Anderson (1975) studied benthic foraminifera from the Weddell Sea and identified six assemblages defining a relationship between their distribution and water mass characteristics, such as $CaCO_3$ saturation and salinity. In the Southern Ocean, Corliss (1979a) was able to define two major faunal assemblages for the region. The first one is dominated by *E. umbonifera*, *Planulina wuellerstorfi*, *Globocassidulina subglobosa*, *Pullenia bulloides*, *Oridorsalis tener* and is associated to Antarctic Bottom Water (AABW). The second assemblage is marked by a strong dominance of *Uvigerina* spp. and *E. exigua* and is related to Indian Bottom Water (IBW). The author showed that transition from one assemblage to another is determined by the availability of calcium carbonate in bottom waters. In the Eastern Indian Ocean, along the Ninetyeast Ridge, Peterson (1984) identified distinctive benthic foraminifera faunas, which showed defined links with the hydrology of that region. In this study, the assemblage dominated by *G. subglobosa*, *Pyrgo* spp., *Uvigerina peregrina*, *Eggerella brady*, is associated to Indian Deep Water (IDW), while the one dominated by *Nuttalides umbonifera* and *E. exigua* corresponds to Indian Bottom Water (IBW). Denne and Sen Gupta (1991) pointed out a relation between Gulf of Mexico water masses and five benthic foraminifera assemblages. These authors were also able to distinguish two other assemblages mainly related to the oxygen content of the water: one assemblage (dominated by *Nonionella opima*, *Bolivina barbata*, *Bulimina marginata*, *Bolivina alata*) is related to oxygen-depleted waters of Mississippi Delta and the other (represented by *Albaminella turgida*) is typical of oxygen-rich habitats.

Further research focused on relationships that exists between benthic foraminifera distribution and specific water masses properties. Some of these works underlined how the oxygen content of the pore water plays an important role as well as the oxygen content of the overlying water masses. Miller and Lohmann (1982), for example, found a correlation between *Globobulimina/Bulimina* assemblage and the oxygen minimum zone of the north-east United States continental slope. These authors observed also how *U. peregrina* is not influenced by the dissolved oxygen in the water column but instead is related to the amount of organic carbon content and low oxygen levels within the sediment. Moodley and Hess (1992) conducted an experiment on living benthic foraminifera. They noticed that deep-dwelling species (*Ammonia beccarii*, *Elphidium excavatum*, *Quinqueloculina seminulum*) had very low-oxygen requirements. Moodley et al. (1998) conducted laboratory experiments on specimens of *Quinqueloculina seminula* and described the capability of this species to withstand anaerobic conditions. They reported how the survival of the studied specimens appeared to be limited by the formation of H_2S within the sediment.

Factors such as the level of tolerance to low-oxygen conditions or the food availability concur to define specific microhabitats within the sediment for different species. Corliss (1985) was able to put in evidence a vertical stratification of the taxa within the samples studied. He distinguished epifaunal species found living close to the sediment/water interface. These taxa showed a preference for an oxygenated environment (*Hoeglundina elegans*, *P. wullerstorfi*, *Cibicidoides* spp.). Species like *Chilostomella oolina*, *Globobulimina affinis*, *Melonis barleeanum* were found preferentially in the deeper part (5-8 cm) of the sediment and were referred as infaunal species. These kinds of taxa seem to be well adapted to low-oxygen levels. Jorissen et al. (1995) studied benthic foraminifera from the Adriatic Sea and developed a conceptual model to explain microhabitat preferences in term of organic flux to the seafloor and depth of the redox front in the sediment: the TROX model. In this model, under oligotrophic conditions, the vertical distribution of the species is controlled by the availability of food. Under eutrophic conditions, the maximum depth at which fauna can survive is determined by the thickness of the oxygenated layer in the sediment. In regions where bottom water oxygenation, salinity and temperature are uniform the study of benthic foraminifera shows how the sediment organic carbon content is the main factor that controls faunal patterns (Rathburn et al., 1996). Other studies from the Arabian Sea point out that under a pronounced OMZ oxygen is no more a limiting factor because many of the species present in that region are already adapted to withstand low oxygen conditions (Jannik et al., 1998). This study of samples collected in and below the OMZ, shows how, within this severely oxygen-depleted environment, benthic foraminifera position in the sediment is mainly related to the amount or type of food that reaches the sea floor. Some species, such as *B. dilatata*, *Bulimina exilis*, *U. peregrina*, seem to prefer unaltered organic matter. Below the OMZ, where the organic matter appears to be reduced and altered, opportunistic species (*E. exigua*, *Bulimina aculeata*, *M. barleeanum*, *Rotalinopsis semiinvoluta*) are abundant.

The existing data allow to distinguish four major patterns in the vertical distribution of benthic foraminifera (Jorissen, 1999). A "type A", representing epifaunal-shallow infaunal species, includes those species showing highest abundance in the top-most level of the sediment (0-2 cm). A "type B", representing shallow infaunal-transitional species, is composed by the taxa that can live in the upper part as well as deeper in the sediment (0-4 cm). A "type C", which includes the species presenting mainly downcore maxima (4-5 cm), and the "type D", which is typical of those species showing high abundance at the surface (0-1 cm) and in the deeper part of the sediment (6-7 cm).

The preference of foraminifera for certain microhabitats determines differences in the morphology of their test. The epifaunal species are usually characterised by a plano-convex, biconvex test, without large pores (but if found they only occur on one side) and trochospiral or milioline coiling (Corliss and Chen, 1988). Such test shape can result advantageous in order to remain attached to the substrate in presence of current and the position of the aperture is well suited for feeding and locomotion (Corliss, 1991). The shallow infaunal species have pores all over their test and are characterised by uniserial, triserial or planispiral coiling (Corliss and Fois, 1991). In this group the test is also characterised by ornamentation which could represent a useful way of remaining in the top-most level of the sediment or for mantaining the same orientation within the sediment (Corliss, 1991). Intermediate infaunal species have generally planispiral coiling, rounded periphery and pores over the entire test. It appears that these pores can enhance gas exchange especially in a low-oxygen environment (Corliss, 1985). Deep-infaunal taxa characterised by planispiral or triserial coiling and ovate or cylindrical test.

The amount of organic matter sinking from the sea surface controls the patterns of some species (Lutze and Coulbourn, 1983; Mackensen et al., 1985). Organic matter availability is an important factor linking benthic foraminifera to productivity level at the sea surface. Some benthic foraminifera species bloom when phytodetritus reaches the sea floor (Gooday, 1988; Gooday, 1993). For example, Gustafsson and Nordberg (2001) reported a seven-fold increase of *Stainforthia fusiformis* population size as a consequence of spring phytoplankton bloom. Laboratory experiments have also shown how *Cribrostomoides subglobosum* increases individual bodymass in the presence of a food pulse (Altenbach, 1992). In the Norwegian Sea, Altenbach and Sarnthein (1989) found a positive correlation between the distribution of *C. wuellerstorfi* and *E. exigua* and the amount of organic matter in the sediment. Loubere (1991), who studied assemblages from the equatorial Pacific Ocean, focused on a set of samples from an area where productivity at the sea surface was apparently the only variable affecting the sea-floor community. This author identified an assemblage dominated by *U. peregrina*, *M. barleeanum* and *C. wuellerstorfi* associated to higher productivity and another assemblage dominated by *E. umbonifera* related to lower productivity.

The presence of organic matter at the sea floor and its subsequent oxidation causes depletion in oxygen in sediment pore-water, thus low-oxygen tolerant species have been observed. Under eutrophic conditions, infaunal taxa are the most abundant, while under oligotrophic conditions and higher oxygen levels, opportunistic epifaunal species dominate the faunas (Gooday and Rathburn, 1999). In areas of coastal upwelling along the western African coasts, Schmiedl et al. (1997) found that benthic foraminifera assemblages were dominated by elevated standing stocks, low diversities and a large number of infaunal taxa, such as: *Uvigerina*, *Melonis*, *Bolivina*, *Bulimina*, *Globobulimina* and *Cassidulina*. On the other hand, offshore, under more oligotrophic conditions, the assemblages were dominated by epifaunal species, such as: *E. exigua*, *N. umbonifera*. Futher, Kuhnt et al. (1999) determined the relationship existing between benthic foraminifera from South China Sea and organic flux down to the sea floor. This study showed how the species related to food supply occupied infaunal microhabitat (*U. peregrina*, *Bolivina robusta*, *Bolivina pacifica*, *Trifarina bradyi*, *Rosalina concinna*, *Cassidulina crassa*, *Epistominella rugosa* and *G. affinis*).

The rate of organic matter oxidation is reduced under disoxic condition and its burial within the sediment is therefore more efficient. Under these conditions, k-strategist/deep-infaunal species, which rely on refractory phytodetritus, find optimal conditions and consequently their abundance increases (Jannik et al., 1998). Already, Rathburn and Corliss (1994) described a positive correlation between the abundance of deep-dwelling/low-oxygen tolerant species and high nutrient flux to the sea floor. These authors noticed how *C. oolina*, *Chilosomella ovoidea*, *Globobulimina* spp. and *Valvulineria mexicana* take advantage of the sediment subsurface accumulations of organic carbon. A similar trend between the abundance of deep-infaunal taxa (*B. alata*, *Chilostomella* spp., *Globobulimina* spp.) and mineralised organic matter was described also for the Mediterranean Sea by De Rijk et al. (2000). In the Arabian Sea, Kurbjeweit et al. (2000) interpreted the positive correlation between Chloroplastic Pigment Equivalents in the sediment and the taxa *G. affinis*, *Lagenammina difflugiformis*, *B. aculeata* and *M. barleeanum* as an indication for their preference for altered phytodetritus.

The study of modern assemblages is therefore necessary to acquire a better understanding of the factors that influence the distribution of benthic foraminifera. This is a fundamental procedure for using the remains of these microorganisms as a proxy of past oceanographic conditions.

The eastern Indian Ocean is characterised by complex circulation systems at the sea surface and at intermediate depth. As a consequence, environmental variables present strong latitudinal gradients in the water column. The monsoonal climate is responsible for the strong seasonality of the South Java Upwelling System and, together with the Indonesian Throughflow, for a significant difference in primary productivity between Indonesia and Australia. In this first part, fifty-seven core tops collected offshore Western Australia and offshore Java and Sumatra Islands have been analysed in order to investigate eventual links that may relate benthic foraminifera to the oceanographic processes in these regions. Statistical analyses have been performed to define the relationships between the distribution of benthic foraminifera species and the environmental parameters measured for the studied area.

2. Materials and Methods

A total of 57 core tops was utilised for this study (figure 2.1). 44 gravity cores were collected during two cruises offshore Western Australia: *Fr 10/95* in 1995 and *Fr 2/96* in 1996, using the *RV Franklin*. The remaining 13 core tops were sampled from trigger cores collected during two other cruises offshore Java and Sumatra: *Shiva* in 1990, *Barat* in 1994, using the *RV Baruna Jaya*.

While short trigger cores (60cm) minimize the loss of surface material when collecting samples from the sea floor, gravity cores may not return samples at the sediment-water interface. However, the set of core tops utilised for this study is the same used by Martinez et al. (1998a), who sampled the cores on board of the *RV Franklin* soon after recovery, in order to avoid contamination and mixing.

The cores were collected from the upper-bathyal (≈ 700 m b.s.l.) to the abyssal zone (≈ 4500 m b.s.l.), within a depth ranges of the water masses similar to those signalled for the water masses present in this region (figure 2.2).

Samples used for this study were obtained from the first 1 to 2 cm of each core. About 3 cc. of material from each sample was soaked in a dilute (3%) hydrogen peroxide solution until clays had fully disaggregated, then washed with a gentle water jet through a 63 μm sieve and the coarse fraction was then dried at 40°C.

All the benthic foraminifera of the total assemblage from the fraction >150 μm of each sample were counted. When the number of specimens in the sediment was less than 70 individuals, more material was washed and added for counting.

Benthic foraminifera were identified and mounted on a slide and the absolute number of specimens for each species was recorded. Fragments of *Rhabdammina* sp., *Rhizammina* sp., and the other tubular-shaped species were considered to indicate the presence of at least one specimen in the sample. An average of 241 specimens per sample was identified and counted. The fraction >150 μm was selected in order to allow a comparison with previous works such as those of Corliss (1979a) and Peterson (1984).

301 species were identified (see Appendix A1 and Taxonomic references). The samples from cruises *Fr10/95* and *Fr2/96*, were those utilised by Martinez et al. (1998a), who studied planktonic foraminifera. While the volume of sediment taken

was recovered, the lack of records related to the dry weight of sediment did not allow to express the abundance (n/g) of each species.

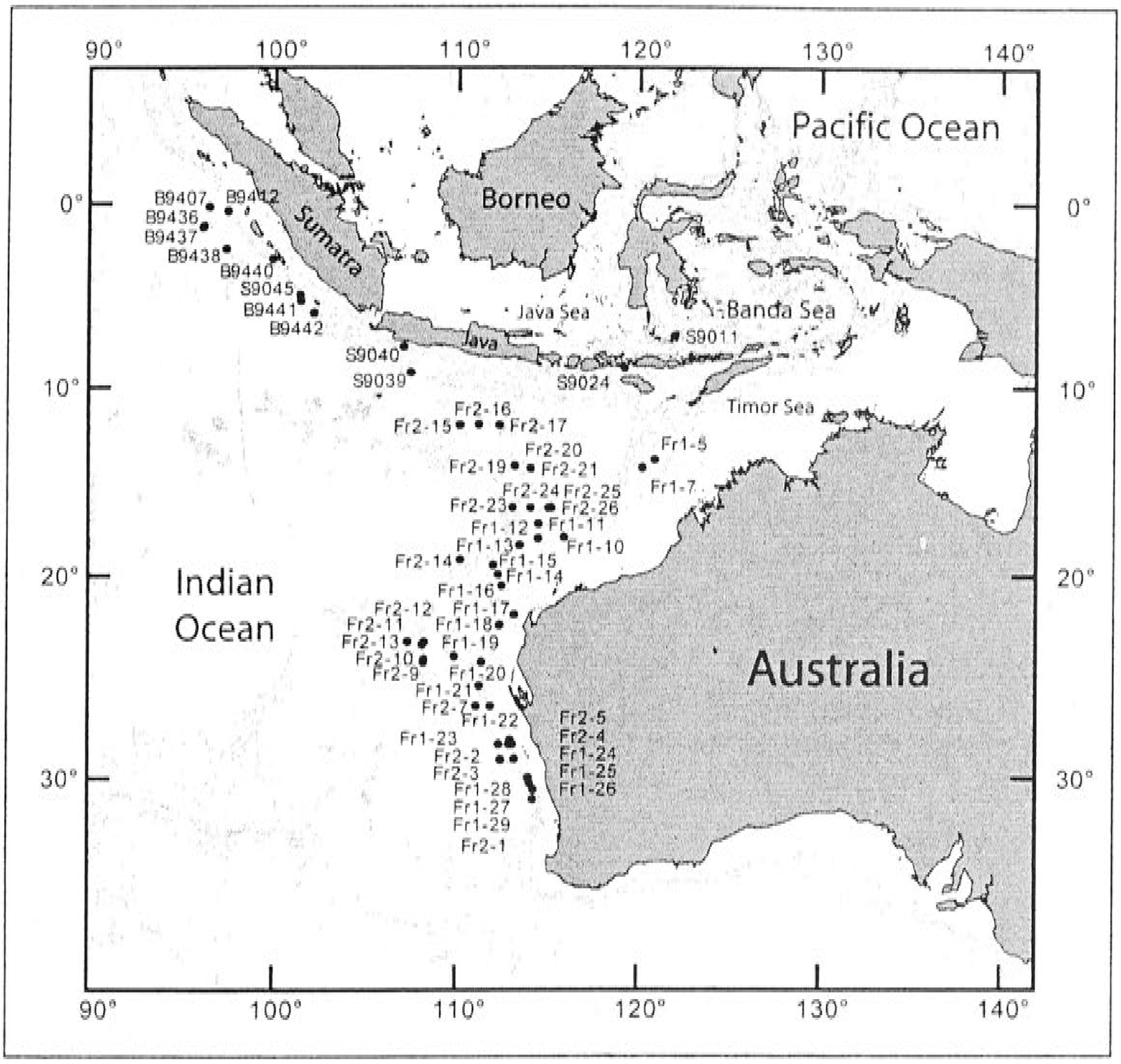

Fig. 2.1 – **Map of the eastern Indian Ocean and location of the cores studied.**
The abbreviations beside each core location indicate the cruise during which the each core was collected (prefixes Fr1 = *Fr10/95*, Fr2 = *Fr2/96*, B = *Barat*, S = *Shiva*). The number after each abbreviation indicates the number of the core top.

For this reason, the absolute number of specimens for each species was converted as the percentage of total foraminifera present in each sample. Those species present with a percentage >2% in at least 1 sample were used for statistical analyses. In order to acquire useful information for application to palaeoenvironmental and palaeoecological studies, agglutinated taxa, which presented poor preservation potential and were not found when analysing the fossil faunas from selected cores from the same area (see sections 8, 9 and 10), were eliminated from the database. Note that the genera *Fissurina*, *Lagena*, *Lenticulina*, *Oolina* and *Parafissurina* were present in many samples with high species diversity.

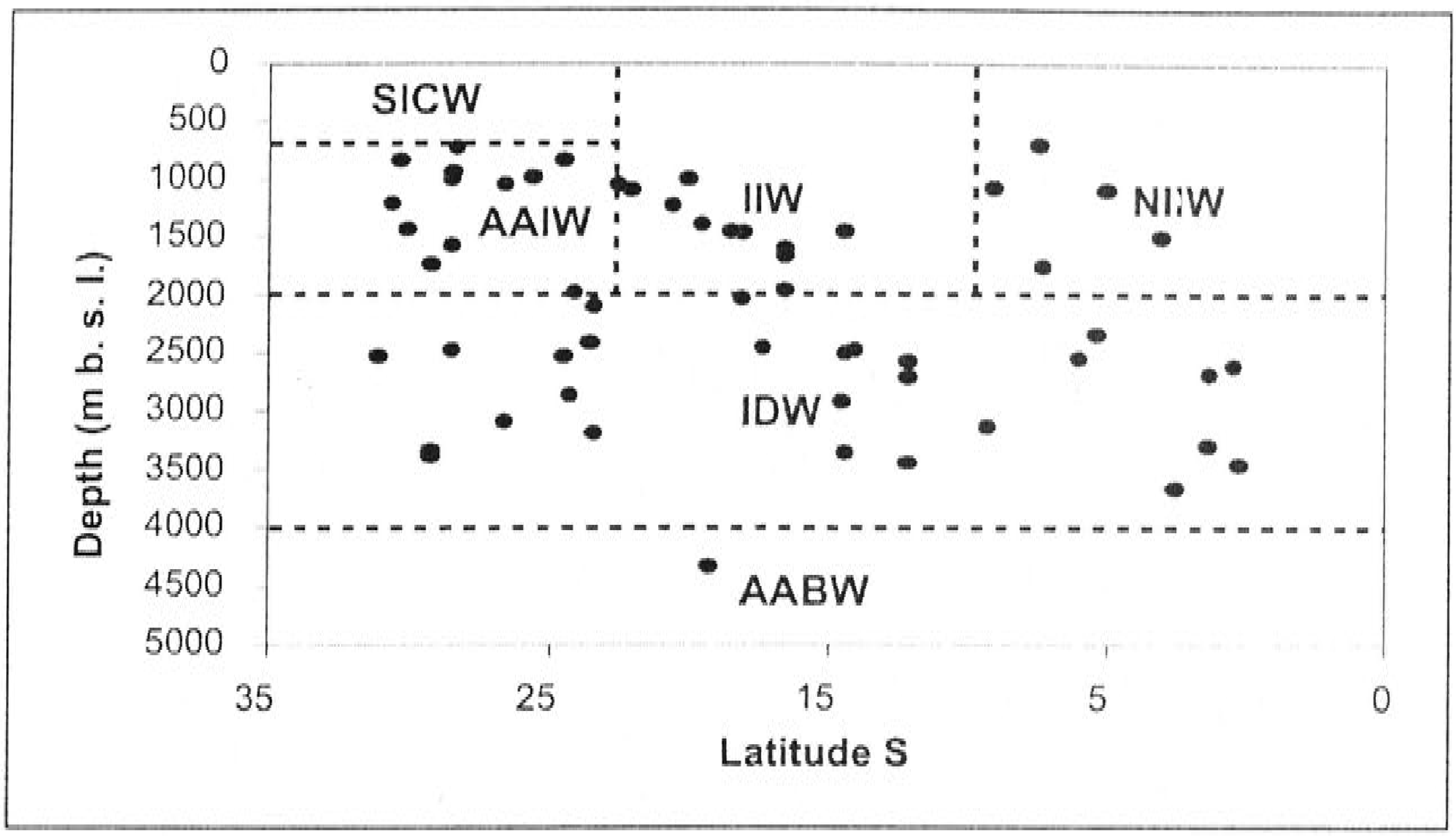

Fig. 2.2 – **Location of the cores studied and water masses distribution for this region.** SICW = South Indian Central Water; AAIW = Antarctic Intermediate Water; IIW = Indonesian Intermediate Water; NIIW = North Indian Intermediate Water; IDW = Indian Deep Water; AABW = Antarctic Bottom Water.

The percentage of each species was generally low (<2.5%). Therefore, all the species belonging to these genera and used for statistical analyses were grouped together as *Fissurina* spp., *Lagena* spp., *Lenticulina* spp., *Oolina* spp. and *Parafissurina* spp.

A total of 75 taxa was utilised for Detrended Correspondence Analysis (DCA) and Canonical Correspondence Analysis (CCA). The DCA is a type of ordination particularly suitable for databases with many zeros and for unimodal response models in which the abundance of any species follows a normal distribution (Jongman et al., 1987). DCA algorithm generates axes that maximise the dispersion of the species scores and that are constrained to be uncorrelated with each other (Jongman et al., 1987). The axes are calculated in such a way that at any point, on the *i*th axes, the mean value of the site scores on the subsequent axes is zero, avoiding in this way the "horseshoe effect" (Jongman et al., 1987). Canonical Correspondence Analysis (CCA) was then performed in order to explore the relationship between environmental variables and benthic foraminifera distribution. CCA is a direct gradient analysis, which generates axes that maximise the dispersion of the species scores and that are constrained to be a linear combination of the measured environmental variables (ter Braak, 1986). As for DCA, these axes have to be uncorrelated with each other. CCA ordination axes were assessed using the Monte Carlo Permutation test (190 unrestricted permutation: $p < 0.05$) (ter Braak and Smilauer, 1998). Statistical analyses were performed utilizing the software package CANOCO 4.0 (ter Braak and Smilauer, 1998).

The environmental variables for each core depth were the annual means available in the World Ocean Atlas 94 (Table 2.1). These data can be downloaded from the NOAA web site at http://ferret.wrc.noaa.gov/las/decompress/mainDecompress.html. Organic carbon flux rates were calculated using the annual productivity data, derived from the Coastal Zone Colour Scanner (CZCS) archive by Antoine et al. (1996) for the interval years 1978-1986, applied to the formula (1) by Berger and Wefer (1990) and to the formula (2) by Suess (1980).

In the first formula the portion (*Jz*) of primary production (PP) which leaves the photic zone and reaches the depth *z* is calculated as follows:

$$Jz = k \, PP / z \qquad (1)$$

where $k = 2 \, PP^{0.5}$, PP is the annual primary productivity (g C m^{-2} y^{-1}) and z is the depth in metres.

The second function is calculated as follows:

$$C.\ flux(z) = C_{prod} / (0.0238\, z + 0.212) \qquad (2)$$

where C_{prod} is the primary production rate at the sea surface, C. flux(z) is the organic carbon flux at depth z ($z \geq 50$m).

In order to investigate the relationships between faunal structures and benthic foraminifera species distribution, faunal characteristics were calculated and expressed using the Fisher's Alpha index, Shannon-Weaver diversity index, equitability and dominance.

The species richness, represented by the Fisher's Alpha Index α was calculated following the formula:

$$\alpha = (N*(1-x))/x$$

where N is the number of taxa and x is a constant related to the ratio N/S (S = number of species) (Williams, 1964)

The grade of heterogeneity of each sample has been assessed calculating the Shannon-Weaver Index [H(S)] with the following formula:

$$H(S) = -\sum_{i=1}^{S} p_i \ln p_i$$

where S is the number of species present in the sample and p_i is the percentage of the *i*th species divided by 100. The higher is the value of the index, the higher is the grade of differentiation of the species in the sample (Murray, 1991).

The H(S) index was then used to calculate the equitability [E] of each sample (Murray, 1991):

$$E = e^{H(S)}$$

The dominance [D] was calculated as the percentage of the most abundant species of each sample (den Dulk, 2000).

In order to investigate eventual relationships between faunal groups and the environment, the percentages of the species belonging to the agglutinated taxa, the presumed calcareous-infaunal species and to the porcellaneous species, were summed separately. The total percentage of each group (Table 2.1) was then correlated with the environmental variables considered in this research.

The selection of the species belonging to the calcareous infaunal group was made on the basis of the results of researches conducted in different parts of the world (Appendix B).

2.1 The use of total assemblages and the problems related to taphonomic processes, which occur within the mixed sediment layer.

When studying Recent benthic foraminifera, the use of total assemblages implies analysing a combination of living plus dead specimens, collected, as in this case, from the first centimetres of the sediment. Within this interval, the scarcely compacted sediment undergoes continuous mixing. This situation has repercussion on the composition of the total assemblage, since the foraminifera tests are produced and deposited in a non-steady environment. The micropalaeontological "signal", recovered from a sediment sample, represents the result of a *time – average*, which is the process through which fossils of different ages are mixed into a single assemblage (Martin, 1999). This phenomenon is caused by the fact that a foraminiferal generation time is much shorter than the rate of sediment accumulation. "*The total assemblage represents an average, with the advantage of eliminating short-term noise*" (Martin, 1999), but, since the total-assemblage includes living plus dead specimens, it is important to define the similarity degree between the dead- and the living-assemblage and understand the processes responsible for the eventual differences observed between the two.

The dead-assemblage is produced by the living species, within the upper centimetres of the sediment (Loubere, 1990) and should reflect the composition of the living-assemblage at the site where it is found (De Stigter et al., 1999). The duration of the permanence within the mixed layer by an empty test, will determine higher or lower exposure to all the taphonomic processes. These can cause the compositional differentiation between the dead-assemblage and the living-assemblage. For example, bottom currents can transport allochthonous tests from elsewhere, or specimens from the living-assemblage can be carried away in the same way (De Stigter et al., 1999). Deep-borrowing macrobenthos activity can cause mixing of older material with younger material or vice versa (Rathburn and Miao, 1995). Another factor which can differentiate the living- from the dead-assemblage is the selective destruction of tests (Murray and Alve, 2002). In environments characterised by active carbonate dissolution, assemblages dominated by agglutinated species can result from assemblages initially dominated by calcareous species, after selective dissolution of calcareous tests (Murray and Alve, 1999). Preservation of calcareous tests can also be favoured by bacterial sulfate-reduction consequently resulting in an alkalinity increase

(Martin, 1999). In condition of normal carbonate concentration, soft- or iron oxide-cemented agglutinated taxa are more subjected to destruction rather than calcite-cemented agglutinated taxa or calcareous species (De Stigter et al., 1999; Murray and Alve, 1999). In areas characterised by low sedimentation rate, long permanence-time within the mixed layer can cause the loss of shallow-dwelling species, determining an over-representation of infaunal taxa in the dead-assemblage (Loubere, 1990). Test-production rate may also play a role in the process of differentiation between the living- and the dead-assemblage (Edelman-Furstenberg et al., 2001). Where the selective loss of shallow dwelling species is minimized, their high test-production rate, compared to infaunal species with lower turn-over rate, may cause the opposite situation (De Stigter et al., 1999). The processes, which can take place within the mixed layer and take part in the creation of the fossil assemblage (long-term) and of the total assemblage (short-term), are illustrated in figure 2.3.

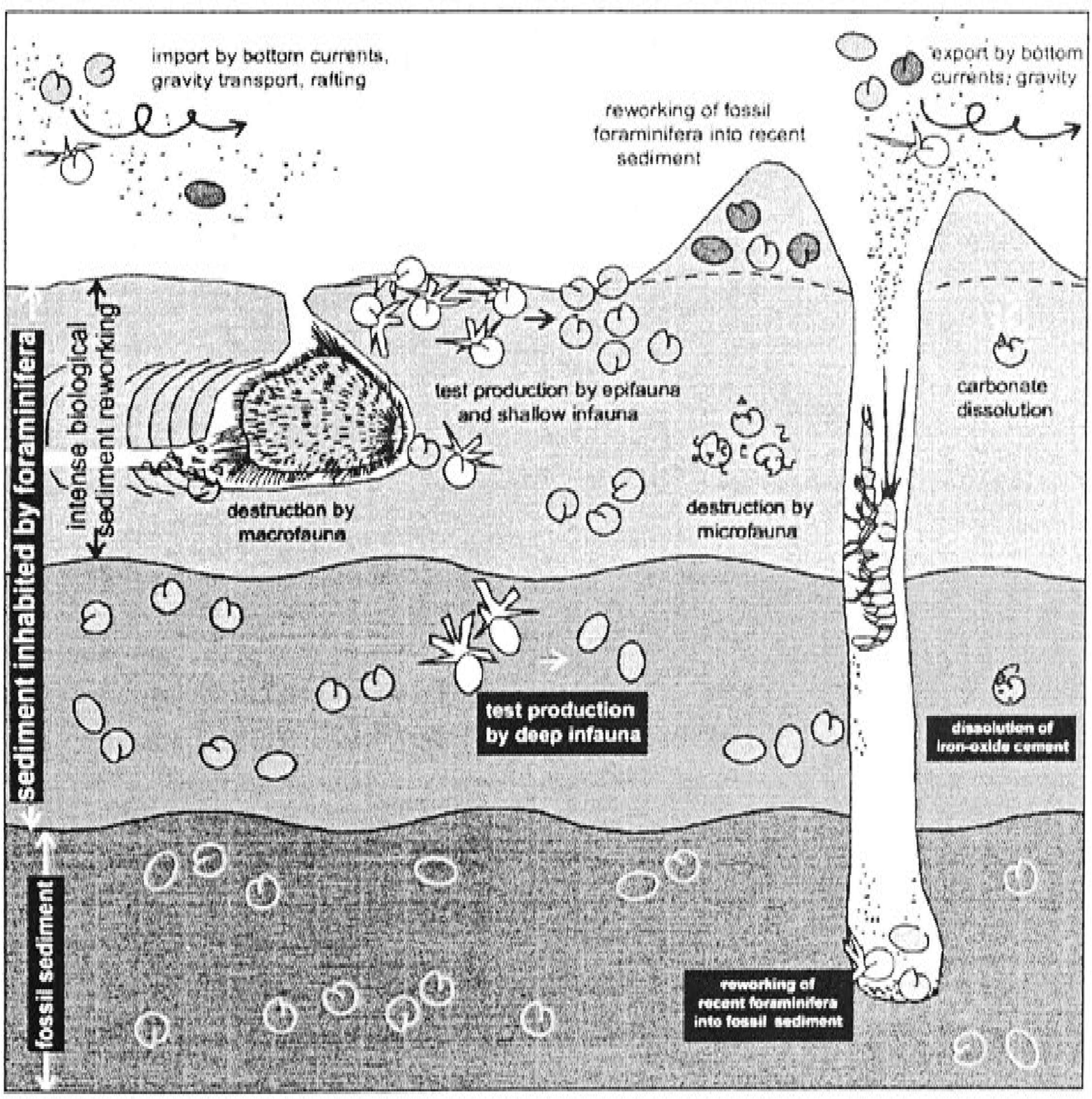

Fig. 2.3 – **Overview of the processes affecting the generation of the benthic foraminifera assemblage** (copied from De Sigter et al., 1999).

Table 2.1 – **List of studied sample giving coordinates for each core, depth, environmental variables measured or calculated and the faunal characteristics at each site.**
(* = g C m^{-2} y^{-1}; # = pressure calculated for the site's depth)

Sample	Latitude (S)	Longitude (E)	Depth (m)	Salinity ‰	Temperature °C	Oxygen (ml/l)	Pressure dbar#	Phosphate (μmol/l)
Fr1-5	14°00.55' S	121°01.58' E	2472	34.73	1.96	3.44	2552.34	2.05
Fr1-7	14°42.58' S	120°32.74' E	1445	34.67	3.41	2.55	1491.96	2.35
Fr1-10	18°08.93' S	116°01.29' E	1462	34.69	3.36	2.84	1509.52	2.55
Fr1-11	17°38.57' S	114°59.93' E	2458	34.73	1.92	3.45	2537.89	2.13
Fr1-12	18°14.7' S	114°59.63' E	2034	34.73	2.43	3.17	2100.11	2.16
Fr1-13	18°49.26' S	113°58.26' E	1454	34.67	3.39	2.74	1501.26	2.69
Fr1-14	20°02.71' S	112°39.73' E	997	34.64	5.07	2.32	1029.40	2.24
Fr1-15	19°53.75' S	112°13.37' E	1393	34.66	3.81	2.62	1438.27	2.35
Fr1-16	20°59.83' S	112°59.35' E	1221	34.65	4.43	2.35	1260.68	2.30
Fr1-17	22°07.74' S	113°30.11' E	1093	34.63	4.65	2.37	1128.52	2.17
Fr1-18	22°59.64' S	112°49.86' E	1055	34.63	4.69	2.73	1089.29	2.17
Fr1-19	24°14.11' S	110°00.18' E	1974	34.72	2.41	3.37	2038.16	2.20
Fr1-20	24°44.67' S	111°49.75' E	841	34.54	5.49	3.63	868.33	1.85
Fr1-21	25°59.78' S	111°38.09' E	982	34.54	4.49	3.30	1013.92	2.03
Fr1-22	26°59.52' S	112°00.31' E	1049	34.53	4.24	3.47	1083.09	2.05
Fr1-23	28°44.7' S	112°46.97' E	2470	34.74	1.94	3.80	2550.28	1.99
Fr1-24	28°45.04' S	113°03.87' E	1577	34.61	3.07	3.34	1628.25	2.02
Fr1-25	28°43.93' S	113°22.08' E	1010	34.48	4.36	3.74	1042.83	1.93
Fr1-26	29°14.42' S	113°33.48' E	1738	34.68	2.57	3.49	1794.49	2.15
Fr1-27	30°30.14' S	114°16.64' E	843	34.45	5.38	4.33	870.40	1.77
Fr1-28	30°04.88' S	114°08.51' E	1440	34.62	2.99	3.86	1486.80	2.01
Fr1-29	30°59.51' S	114°35.37' E	1220	34.53	3.46	3.51	1259.65	2.04
Fr2-1	31°06.64' S	114°32.89' E	2530	34.72	1.92	3.82	2612.23	2.15
Fr2-2	29°20.95' S	112°56.91' E	3377	34.73	1.60	4.30	3486.75	1.97
Fr2-3	29°17.78' S	112°56.58' E	3343	34.73	1.57	4.30	3451.65	2.03
Fr2-4	28°43.02' S	113°23.32' E	936	34.48	4.73	3.95	966.42	1.89
Fr2-5	28°23.55' S	113°09.57' E	735	34.52	6.55	4.83	758.89	1.47
Fr2-7	26°58.76' S	111°20.13' E	3090	34.73	1.65	3.98	3190.43	2.09
Fr2-9	24°44.83' S	108°29.26' E	2534	34.74	1.98	3.70	2616.36	2.05

Table 2.1 – *(continued)*.

Sample	Latitude (S)	Longitude (E)	Depth (m)	Salinity ‰	Temperature °C	Oxygen (ml/l)	Pressure dbar[#]	Phosphate (μmol/l)
Fr2-10	24°27.85' S	108°30.61' E	2852	34.74	1.81	3.85	2944.69	2.01
Fr2-11	23°57.16' S	108°22.14' E	2404	34.74	1.97	3.67	2482.13	2.06
Fr2-12	23°44.23' S	108°31.91' E	2100	34.72	2.39	3.42	2168.25	2.13
Fr2-13	23°43.75' S	107°42.71' E	3189	34.73	1.65	3.94	3292.64	1.96
Fr2-14	19°24.64' S	110°30.4' E	4335	34.72	1.21	4.33	4475.89	2.01
Fr2-15	12°14.41' S	110°25.7' E	3446	34.72	1.35	4.02	3558.00	2.00
Fr2-16	12°11.29' S	111°30.45' E	2714	34.74	1.79	3.64	2802.21	2.06
Fr2-17	12°14.8' S	112°44.27' E	2571	34.74	1.96	3.47	2654.56	2.12
Fr2-19	14°34.95' S	113°30.49' E	3355	34.73	1.47	4.02	3464.04	2.00
Fr2-20	14°34.95'S	113°30.49'E	2497	34.74	1.95	3.46	2577.29	2.10
Fr2-21	14°48.68' S	114°16.37' E	2919	34.73	1.61	3.75	3013.87	2.03
Fr2-23	16°54.81' S	113°20.14' E	1967	34.73	2.43	3.17	2030.93	2.22
Fr2-24	16°55.61' S	114°15.46' E	1603	34.70	3.39	2.84	1655.10	2.55
Fr2-25	16°54.65' S	115°15.9' E	1666	34.70	3.39	2.73	1720.15	2.45
Fr2-26	16°54.0' S	115°31.0' E	1958	34.73	2.43	3.17	2021.64	2.15
B9407	0°26.22' S	96°49.5' E	3460	34.71	1.40	3.80	3572.45	2.13
B9412	0°49.38' S	97°54.06' E	2602	34.74	2.07	3.25	2686.57	2.29
B9436	1°38.04' S	96°16.38' E	3295	34.72	1.58	3.59	3402.09	2.17
B9437	1°31.08' S	96°21.12' E	2680	34.74	2.06	3.22	2767.10	2.30
B9438	2°54.42' S	97°44.4' E	3668	34.71	1.44	3.44	3787.21	2.02
B9440	3°10.14' S	100°01.38' E	1495	34.85	4.12	2.18	1543.59	2.23
B9441	5°06.66' S	101°51.12' E	1099	34.77	5.19	1.63	1134.72	2.44
B9442	6°04.56' S	102°25.08' E	2542	34.75	1.99	3.23	2624.62	2.35
S9011	7°26.917' S	122°09.833' E	1750	34.59	3.54	2.17	1806.88	1.78
S9024	9°03.352' S	119°31.321' E	1075	34.57	4.25	2.27	1109.94	2.37
S9039	9°26.2' S	107°55.8' E	3130	34.72	1.41	3.53	3231.73	2.22
S9040	7°41.2' S	107°27.3' E	700	34.76	6.91	1.59	722.75	2.18
S9045	5°39.26' S	101°54.2' E	2340	34.75	2.21	2.99	2416.05	2.44

Table 2.1 – *(continued)*.

Sample	Nitrate (μmol/l)	PP*	Jz*	C. flux(*z*) *	H(S)	E	D (%)	α	Agglutinated %	Infaunal %	Porcellaneous %	No. of specimens
Fr1-5	29.81	150	1.49	2.54	2.89	18.02	11.32	32.57	5.66	33.96	10.06	159
Fr1-7	26.74	125	1.93	3.61	3.11	22.32	8.44	26.29	5.37	35.29	21.48	391
Fr1-10	36.59	100	1.37	2.86	2.63	13.93	12.64	32.12	12.09	38.46	10.71	182
Fr1-11	35.15	100	0.81	1.70	2.86	17.38	11.76	33.21	4.90	46.08	19.73	204
Fr1-12	35.14	100	0.98	2.06	2.80	16.48	11.16	33.47	5.36	41.96	21.98	224
Fr1-13	32.51	100	1.38	2.87	3.01	20.29	6.62	45.10	13.91	33.11	5.66	151
Fr1-14	32.59	100	2.01	4.18	3.11	22.50	11.26	34.77	7.79	43.29	8.20	462
Fr1-15	32.70	100	1.44	3.00	3.18	24.01	9.19	31.95	7.95	35.75	12.93	881
Fr1-16	34.33	100	1.64	3.42	3.13	22.88	7.16	29.43	14.07	32.74	5.38	391
Fr1-17	33.32	100	1.83	3.81	3.03	20.69	15.11	34.56	10.93	46.62	3.96	311
Fr1-18	34.54	100	1.90	3.95	2.94	18.88	9.86	30.43	11.27	45.07	16.48	71
Fr1-19	32.17	100	1.01	2.12	3.04	21.00	8.91	24.92	5.28	44.55	8.21	303
Fr1-20	27.01	100	2.38	4.94	3.06	21.38	7.95	34.22	10.23	42.05	11.76	88
Fr1-21	31.11	100	2.04	4.24	2.65	14.17	20.22	28.98	12.36	42.70	8.77	178
Fr1-22	33.63	100	1.91	3.97	3.13	22.77	8.89	27.65	8.89	25.93	15.00	135
Fr1-23	35.45	100	0.81	1.69	2.73	15.38	9.47	35.14	16.84	35.79	11.43	95
Fr1-24	36.40	100	1.27	2.65	2.54	12.63	19.18	31.29	9.59	28.77	13.48	73
Fr1-25	32.84	100	1.98	4.12	3.18	24.03	8.03	40.77	10.37	26.76	10.26	299
Fr1-26	33.26	100	1.15	2.41	3.09	21.92	9.36	36.41	5.99	32.21	4.11	267
Fr1-27	23.98	100	2.37	4.93	2.88	17.86	8.98	30.86	6.17	32.10	5.92	162
Fr1-28	36.06	100	1.39	2.90	2.85	17.37	8.08	38.50	8.08	45.45	5.76	99
Fr1-29	33.83	100	1.64	3.42	2.98	19.68	6.76	41.68	7.90	29.12	8.76	443
Fr2-1	33.41	100	0.79	1.65	2.80	16.51	10.53	41.51	15.79	28.20	14.29	266
Fr2-2	30.63	100	0.59	1.24	2.57	13.01	19.51	24.51	10.37	34.15	25.28	164
Fr2-3	31.91	100	0.60	1.25	2.43	11.40	8.04	33.26	21.43	27.68	6.86	112
Fr2-4	32.59	100	2.14	4.45	3.29	26.72	7.13	29.61	2.43	32.02	8.48	659
Fr2-5	24.31	100	2.72	5.65	3.08	21.71	7.39	45.30	7.39	33.66	9.27	514
Fr2-7	32.27	100	0.65	1.36	2.56	13.00	9.43	39.75	25.16	27.67	5.41	159

Table 2.1 – *(continued)*.

Sample	Nitrate (μmol/l)	PP*	Jz*	C. flux(*z*) *	H(S)	E	D (%)	α	Agglutinated %	Infaunal %	Porcellaneous %	No. of specimens
Fr2-9	31.99	100	0.79	1.65	2.71	15.04	19.67	25.19	3.83	37.16	8.85	183
Fr2-10	34.78	100	0.70	1.47	2.87	17.59	7.48	28.00	8.84	29.25	12.93	147
Fr2-11	31.89	100	0.83	1.74	2.58	13.18	21.15	25.09	5.38	37.69	5.38	260
Fr2-12	32.51	100	0.95	1.99	2.55	12.80	35.74	18.02	3.41	32.20	3.96	733
Fr2-13	31.62	100	0.54	1.31	2.85	17.30	10.99	22.75	4.40	31.87	16.48	91
Fr2-14	32.10	100	0.46	0.97	2.11	8.23	33.21	10.26	2.50	16.79	8.21	560
Fr2-15	32.45	150	1.07	1.82	2.52	12.47	24.71	21.25	11.76	21.18	11.76	85
Fr2-16	33.49	150	1.35	2.31	2.61	13.58	16.67	20.12	11.40	27.19	8.77	114
Fr2-17	33.35	150	1.43	2.44	2.67	14.50	16.00	26.58	10.00	40.00	15.00	100
Fr2-19	34.10	150	1.10	1.87	2.07	7.96	11.43	41.11	20.00	22.86	11.43	70
Fr2-20	35.18	125	1.12	2.10	2.41	11.15	29.49	15.61	5.62	30.90	13.48	356
Fr2-21	33.05	125	0.96	1.79	2.86	17.38	7.69	24.65	10.26	26.50	10.26	117
Fr2-23	34.97	100	1.02	2.13	2.85	17.34	9.46	20.59	4.11	42.47	4.11	73
Fr2-24	35.72	100	1.25	2.61	2.93	18.73	9.94	28.59	5.71	45.45	5.92	473
Fr2-25	32.69	100	1.20	2.51	2.66	14.35	28.80	22.17	5.76	27.75	5.76	191
Fr2-26	35.09	100	1.02	2.14	2.68	14.65	10.95	26.10	4.38	39.42	8.76	137
B9407	32.37	150	1.06	1.82	0.87	2.39	79.61	8.73	2.46	5.41	0.00	407
B9412	33.66	150	1.41	2.41	2.61	13.55	10.39	41.46	24.68	22.08	0.00	77
B9436	34.32	150	1.12	1.91	2.52	12.39	32.53	20.08	5.91	23.15	0.00	203
B9437	33.53	150	1.37	2.34	2.38	10.77	22.82	20.42	3.46	26.30	0.00	289
B9438	36.44	150	1.00	1.71	2.97	19.48	13.33	11.61	3.02	18.46	0.00	298
B9440	39.92	150	2.46	4.19	2.62	13.75	7.83	21.11	2.22	25.56	0.00	90
B9441	36.43	150	3.34	5.69	1.79	6.01	50.96	42.53	5.22	46.09	0.00	115
B9442	34.56	150	1.45	2.47	2.68	14.59	20.00	9.66	7.69	68.27	0.00	104
S9011	37.84	150	2.10	3.58	2.74	15.45	10.59	29.12	9.09	56.97	1.82	165
S9024	32.42	150	3.42	5.81	2.39	10.94	17.11	28.33	5.49	68.63	3.53	255
S9039	33.24	150	1.17	2.01	2.71	14.99	12.00	29.56	21.05	23.68	5.26	76
S9040	34.58	150	5.25	8.89	2.68	14.51	10.31	16.96	6.40	71.20	0.00	125
S9045	36.45	150	1.57	2.68	3.32	27.69	10.31	24.25	16.49	37.11	14.43	97

3. Oceanography of the eastern Indian Ocean

The oceanography of the eastern Indian Ocean is complex because of the contemporary influence of the monsoonal climate, which causes periodical reversal of the flow direction of surface currents, and of the influence of the Indonesian Passageway, which connects Indian and Pacific Oceans (Tomczak and Godfrey, 1994; Schmitz, 1996).

During January-February (boreal winter), the high-pressure system present over Asia, combined with the low-pressure system over the Indian Ocean, generates northeastern winds blowing from SE Asia to NW Western Australia (Northwestern Monsoon). Conversely, during July-August (boreal summer), the intense warming over Southeast Asia creates a zone of low pressure centred on Arabia, Pakistan and NE India. In consequence of this gradient pressure, a southwesterly wind system blows over SE Asia (Southeastern Monsoon) (Tchernia, 1980) (figure 3.1).

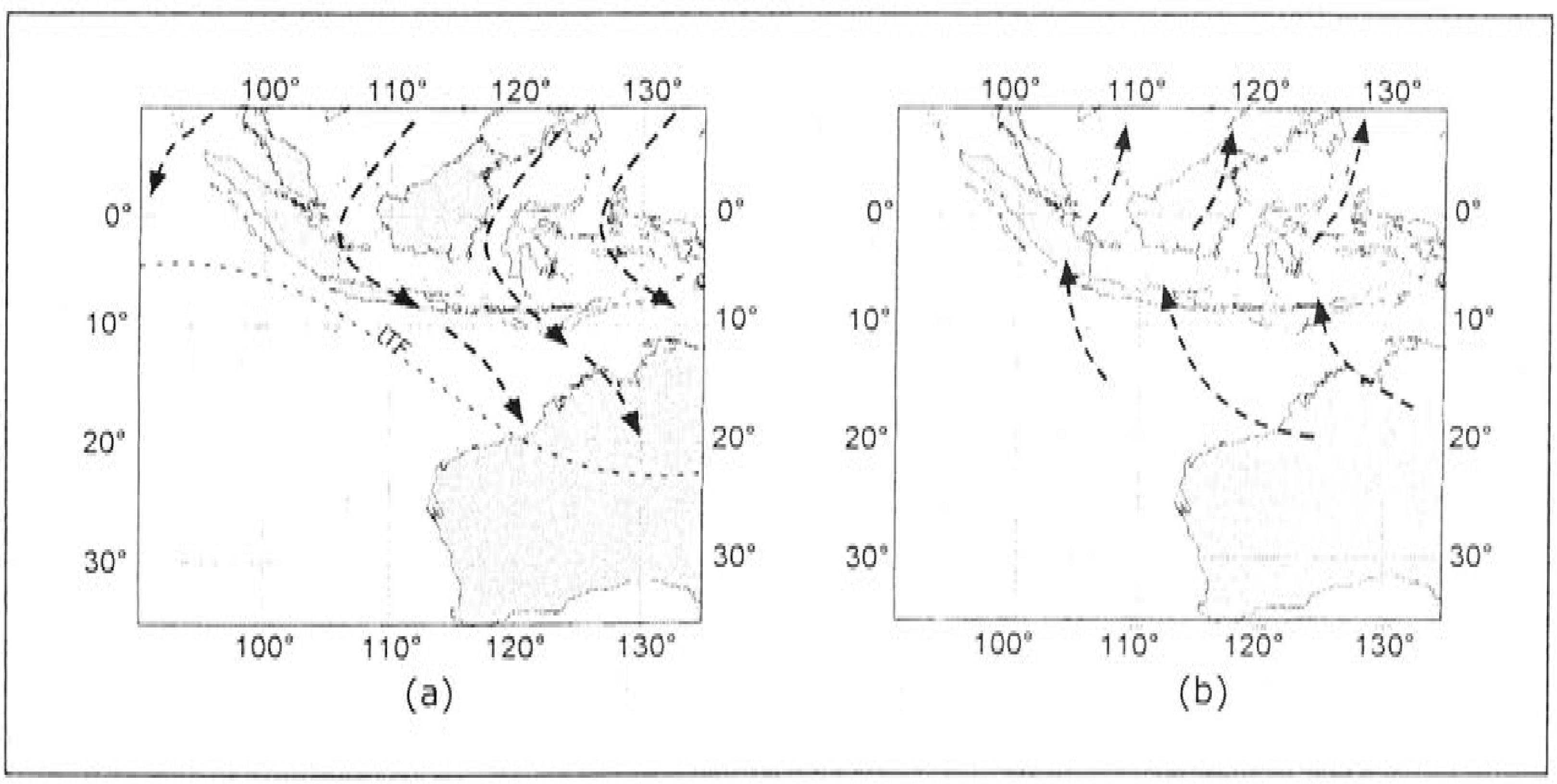

Fig. 3.1 – **Monsoon winds direction** (after Tchernia, 1980)

ITF = Inter-Tropical Front
a) Northwestern Monsoon (January-February), with winds blowing from Asia over the Indian Ocean.
b) Southeastern Monsoon (July-August), with winds blowing from the Indian Ocean towards Asia.

3.1 The Indonesian Throughflow

The higher steric height in the Pacific Ocean, compared to that in the Indian Ocean, generates a flow that moves from the former to the latter ocean passing through the Indonesia Archipelago: this is the **Indonesian Throughflow** (ITF). The bottom topography of the area surrounding the many Indonesian islands is complicated. It is characterised by a series of deep basins connected by limited and shallow sills (Tomczak and Godfrey, 1994). The Indonesian seas are acting as a "dilution" basin: rain occurs at all times of the year and for this reason, in these basins, water that enters from the Pacific is progressively diluted and becomes fresher. In the global circulation the main source for the Indonesian Throughflow is the upwelled deep water from the Pacific Ocean (Schmitz, 1995; Zhang et al., 1998; Ganachaud and Wunsch, 2000). The inflow and the outflow affects the entire water column: from the North Pacific (Godfrey et al., 1993) and, in a reduced amount, from the South pacific waters enter the Indonesian Archipelago passing trough the Sulawesi Sea and the Halamera Sea respectively (Gordon and Fine, 1995) (figure 3.2).

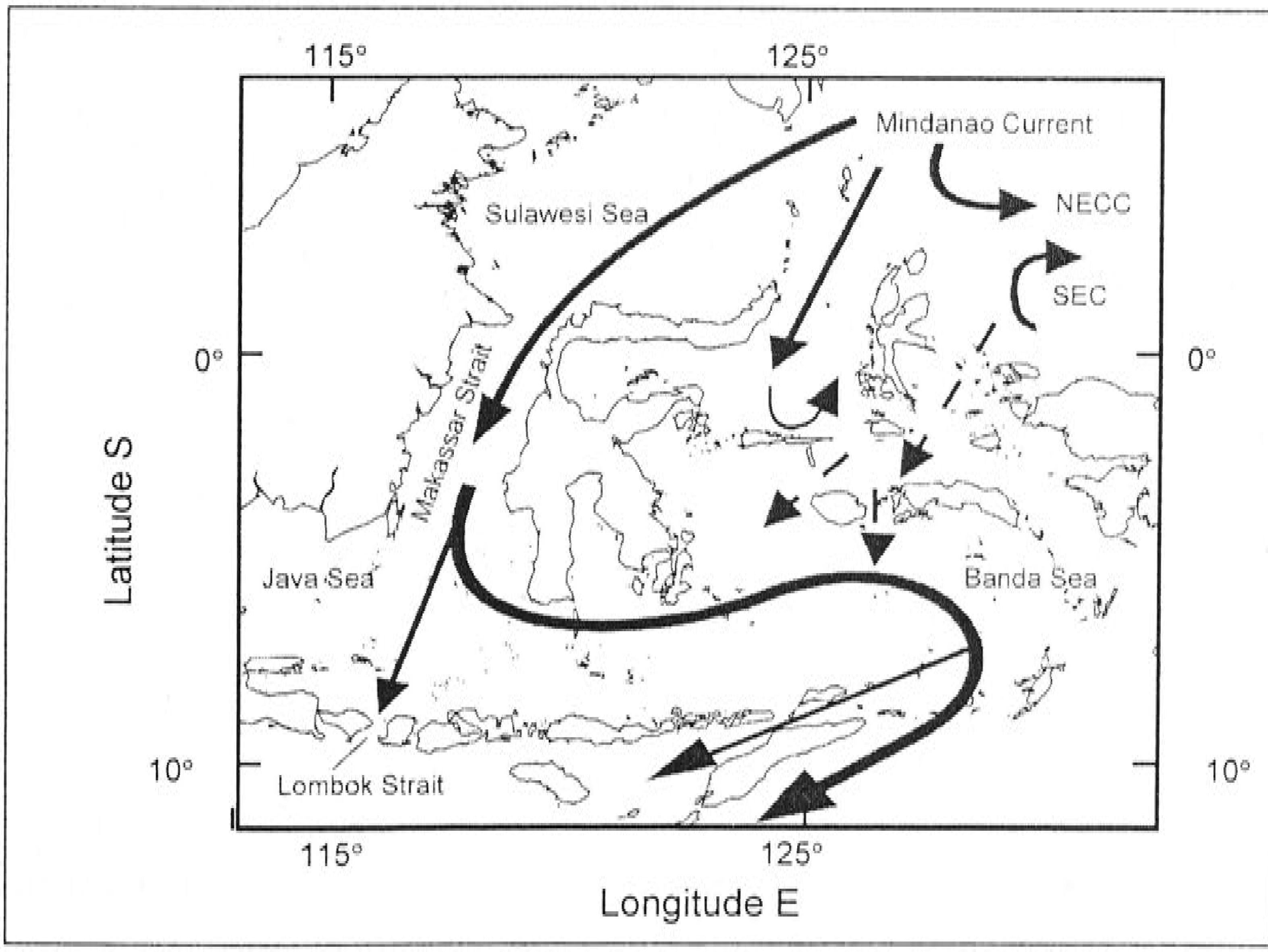

Fig. 3.2 – **Thermocline circulation for the Indonesian Archipelago** (after Gordon and Fine, 1995). For the Pacific Ocean: NECC = North Equatorial Counter Current; SEC = South Equatorial Current.

Once they enter the Indonesian Seas, tidal currents produce strong mixing which preserves the temperature stratification and causes complete homogenisation of the salinity field (Van Aken et al., 1988) (figure 3.3). After this process, the Pacific's characteristics tend to disappear originating the Indonesian Water (IW), at sea surface, and the Indonesian Intermediate Water (IIW), at intermediate depth (Fieux et al., 1996a).

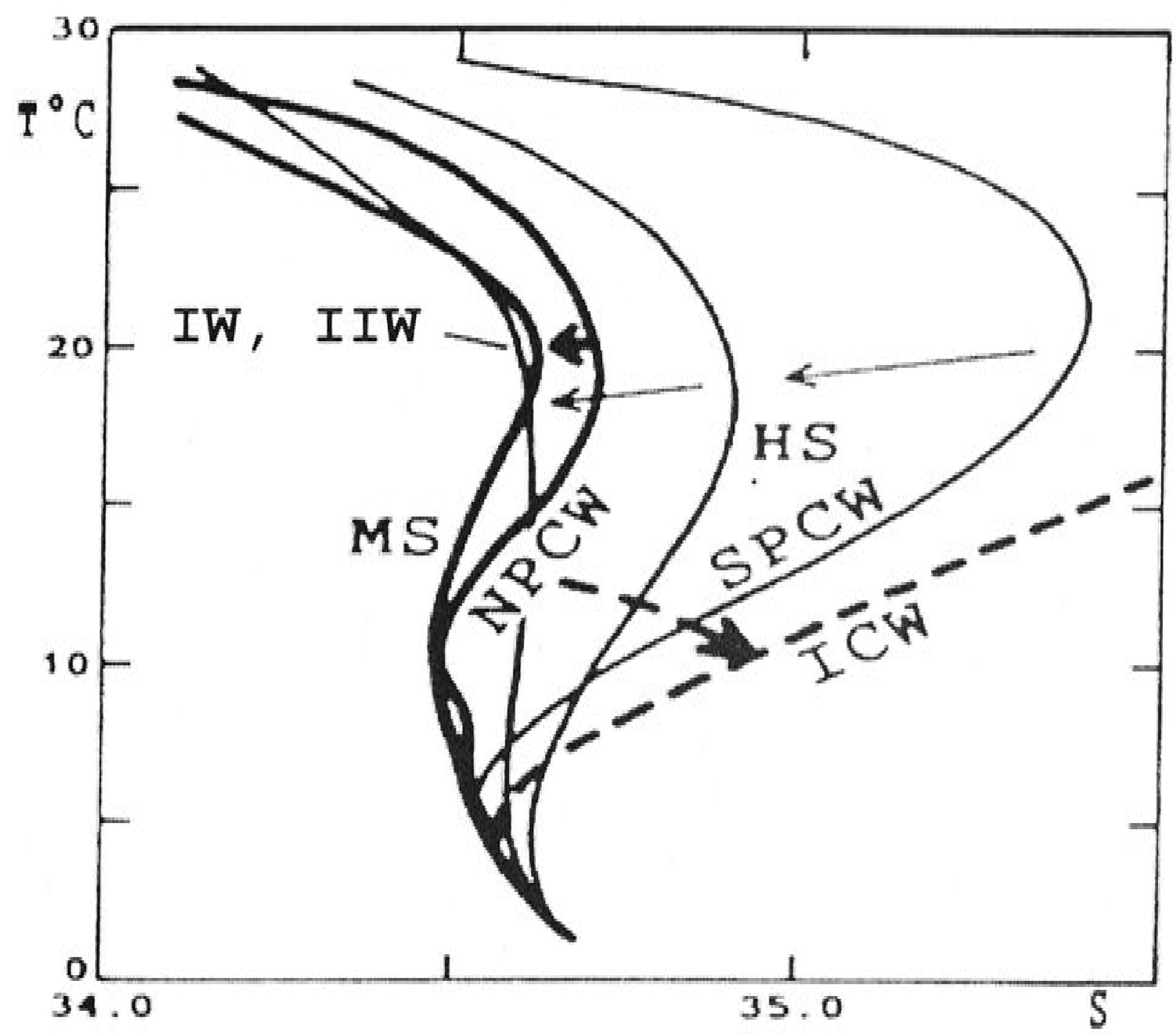

Fig. 3.3 – **Temperature-salinity diagram along the path of Indonesian Throughflow, showing the transformation of Pacific Central Water into Indonesian Intermediate Water and subsequently into Indian Central Water** (copied from Tomczak and Godfrey, 1994).
The South Pacific Central Water (SPCW) passes through Halamahera Sea (HS) into the South Banda Sea (BS) and Timor Sea (TS). The North Pacific Central Water (NPCW) passes through the Makassar Strait (MS) into the Timor Sea (TS). Both are then converted into the Indian Central Water. IW = Indonesian Water; IIW = Indonesian Intermediate Water.

The main ITF inlets and outlets are only 1500 m deep at the most whereas the Indonesian basins have a maximum depth of 4500 m, except for the deeper (6000 m) Weber Deep. In these deep basins waters renovating rate is low, determining a long permanence time. In the deepest part of this system ages of 120 years have been found and after such a long time, water mass that flows out in the Indian Ocean becomes strongly depleted in oxygen (less than 2ml/l) (Postma and Mook, 1988).

The major outlets of the Throughflow are the Lombok Strait, through which only the shallower component of the ITF can pass, and the Timor and Sawu Seas, where the sill depth is 1500 m (Gordon and Fine, 1995; Molcard et al., 2001). Here, waters from Indonesia interact with Indian Ocean surficial and intermediate water masses (Fieux et al., 1996a).

The strength of ITF is influenced by the monsoonal regime. During the Northwestern Monsoon, the Ekman transport associated to the winds direction is opposite to the flow from the Indonesian Archipelago to the Indian Ocean. During this time, the ITF is at its minimum. On the contrary, during the Southeastern Monsoon Ekman transport and ITF have the same direction. In this period of the year, the ITF is at its maximum (Wijffels et al., 1996). Of interest also is that an important flux of heat from the Pacific to the Indian Ocean is associated to the Indonesian Throughflow. The movement of warm waters through the Indonesian Archipelago reduces temperature in the equatorial Pacific, shifts the Warm Pool and atmospheric deep convection centres to the west (Schneider, 1998).

Many studies have presented different estimates or measurements of the volume of water transported by the Indonesian Throughflow. This variability is linked to the nature of the models used to describe ocean circulation, in case of theoretical models, or to the different time of the year when the measurements were made. Describing the oceanic circulation with a three layers model, Zhang et al. (1998) proposed for the Indonesian Throughflow a volume of 26 Sv. In their three layers global circulation model Ganachaud and Wunsch (2000) calculated a Throughflow intensity of 16 ± 5 Sv. Fieux et al. (1994), during August 1989, measured an ITF intensity of 18.6 ± 7 Sv. Schmitz (1995) and Schmitz (1996), using a four layers model, estimated a 10 Sv ITF, while Meyers (1996) proposed an annual mean transport for the first 400 m of 5 Sv. The analysis conduced by Toole and Warren (1993) suggested a transport of 7 Sv. Fieux et al. (1996b) during February-March 1992 measured an intensity of the flux of 2.6 ± 7 Sv.

3.2 Surface currents

In the eastern Indian Ocean, the monsoonal climate influences mainly the northern hemisphere oceanic circulation, but its effects are felt also south of the equator. During the Northwestern Monsoon the general picture of the oceanic circulation over this sector is the one illustrated in figure 3.4.

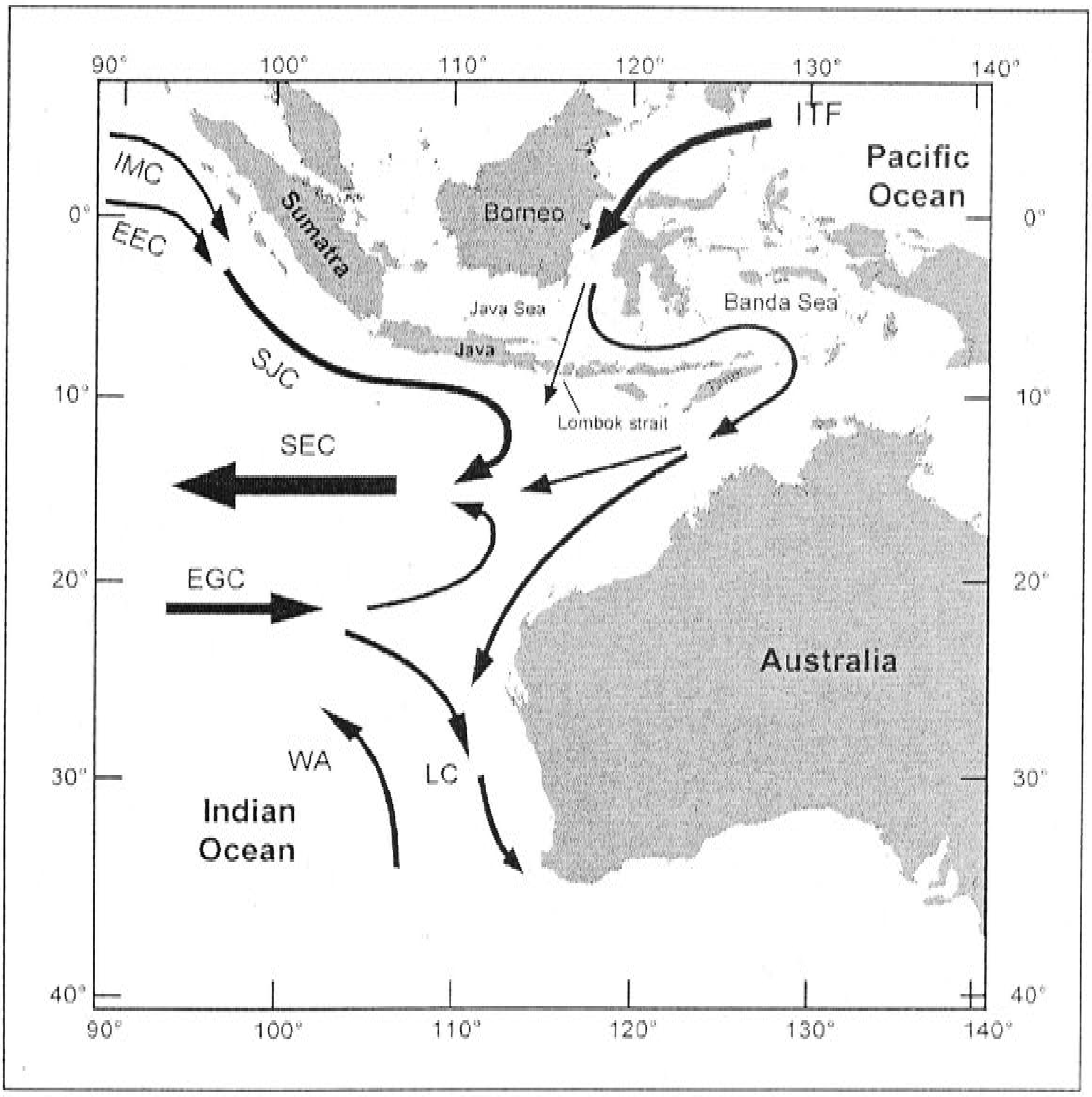

Fig. 3.4 – **Schematic near-surface current systems of the Indonesian Throughflow region** (after Wijffels et al., 1996).
IMC = Indian Monsoon Current; ECC = Equatorial Counter Current; SJC = South Java Current; SEC = South Equatorial Current; EGC = Equatorial Gyral Current; LC = Leeuwin Current; WA = Western Autralian Current.

West of Sumatra, the Indian Monsoon Current joins the Equatorial Counter Current and together they flow eastward as the South Java Current (SJC) (Wijffels et al., 1996). Once the SJC reaches 15° S, it flows westwards in the Southern Equatorial Current. From the Timor Sea, waters that originated in the Banda Seas move southwest as the Leeuwin Current (LC). This current of low salinity and warm water flows along the Western Australia coasts, driven by the difference in steric height that exists between northwest Western Australia and southern Western Australia (Cresswell, 1991). Parallel to the LC, there is the northward flow of the south Indian Ocean Gyre: the Western Australian Current (WA) (Pearce, 1991). Close to the Australian coasts, along the upper slope, the Western Australian Current flows below the less dense LC (Pearce and Creswell, 1985).

When the winds change direction, during the Southeastern Monsoon, the SJC reverses its flow moving this time westward (Tomczak and Godfrey, 1994), while the LC continues to flow along the coast of Western Australian, but this time with a minor strength (Pearce and Creswell, 1985).

3.3 Intermediate waters

Within a depth range of 300 m to 1500 m, four major intermediate water masses are present in the region (figure 2.2).

In the southern sector of the south Indian Ocean, at the Subtropical Convergence (STC), an excess of evaporation over precipitation determines the formation of salty and warm water that sinks and moves northward as the South Indian Central Water (the SICW) (Tchernia, 1980). The SICW is defined by high salinity levels (≥35) and by temperature between 8°C and 16°C.

Offshore Western Australia, at a depth of 1000 m, a combination of a salinity minimum (34.4), a potential temperature of 4-5°C and dissolved oxygen levels about 4.214 ml/l are indicating the presence of the Antarctic Intermediate Water (AAIW) (Rochford, 1961; Tomczak and Godfrey, 1994). This water mass originates in the Southern Ocean, at the Antarctic Polar Frontal Zone (AFZ) and derives from the sinking of the Antarctic Circumpolar Current ACC mixed to upwelled deep waters (Brown et al., 1989). From there, the AAIW spreads both east and west in the Indian Ocean (Toole and Warren, 1993). It is possible to detect the AAIW up to 15°S (Wijffels et al., 1996); here, it interacts with the westward flowing Indonesian Intermediate Water (IIW).

The IIW represents the intermediate component of the ITF and originates in the Banda Sea (Rochford, 1961; Van Aken et al., 1988). It is characterised by a salinity of 34.6-34.7 and a temperature of 5°C (Fieux et al., 1996a).

In the northern sector of the region another intermediate water is present. It is the North Indian Intermediate Water, which is characterised by high salinity (> 34.65) and low oxygen levels (1.8 ml/l) (Rochford, 1961; Fieux et al., 1996a). The NIIW originates in the northern Indian Ocean, in the Arabian Sea, and reaches the southeastern Indian Ocean flowing across the equator near Sumatra (Rochford, 1961; Fieux et al., 1994; Bray et al., 1997).

The differences in oxygen levels and salinity of these three water masses divide the region in three major domains: the northern, the central and the southern sectors (Brown et al., 1989). A temperature/salinity diagram and the oxygen values from seven different locations in the eastern Indian Ocean easily indicate the modifications that occurred during the lateral mixing of these water masses (figure 3.5).

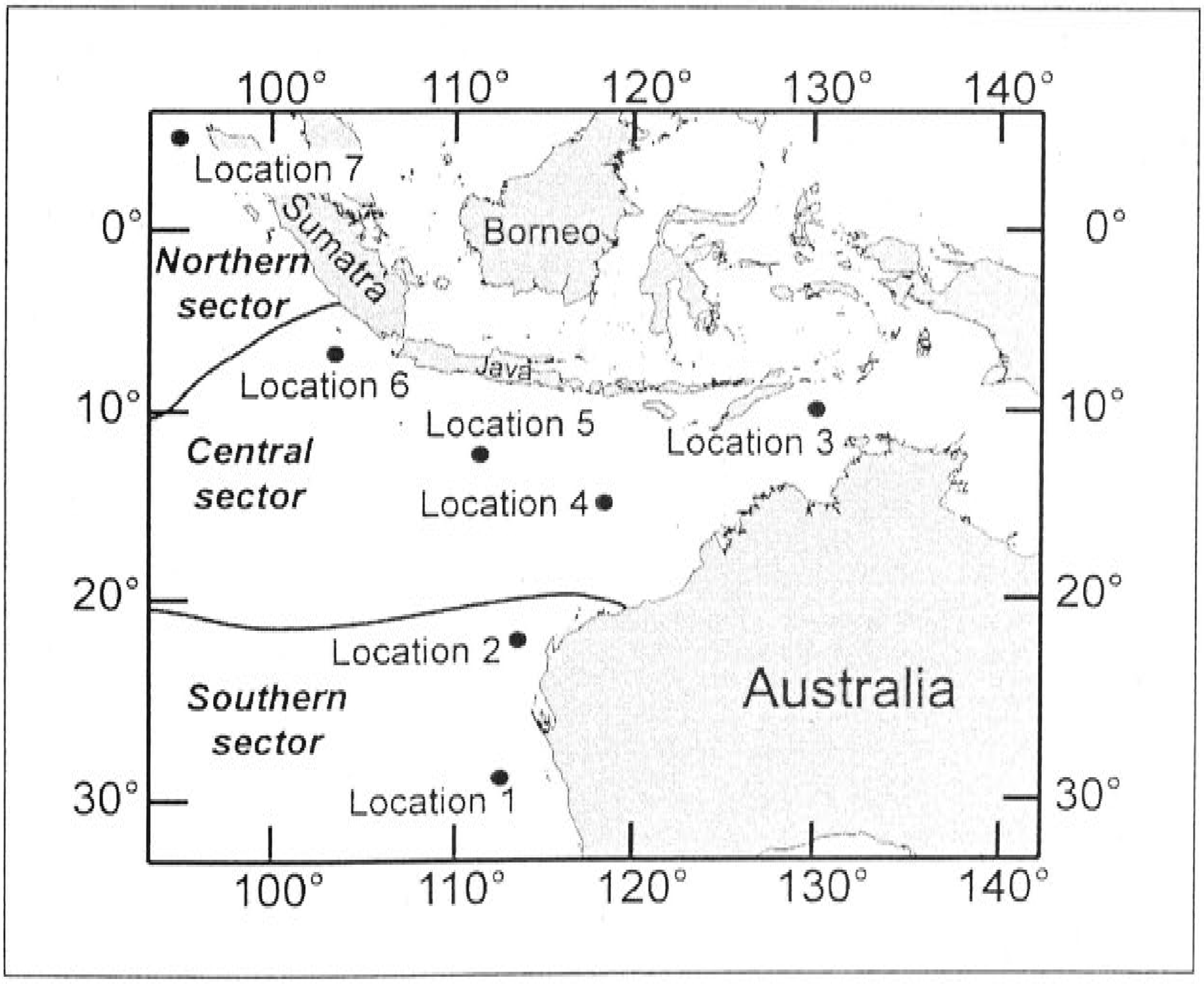

Fig. 3.5 – **Map showing the geographical position of the seven locations used here to document chemical and physical properties of intermediate waters in the eastern Indian Ocean and the limits of the three sectors identified by water masses characteristics** (after Brown et al., 1989).

3.3.1 The Southern Sector

In the southernmost part of this sector the AAIW and the SICW occupy the intermediate levels in the water column. At Location 1, the temperature/salinity scatter plot of the entire water column shows the typical profile found in the southern Indian Ocean (figure 3.6). The salinity minimum indicates the presence of the AAIW (700 - 900 m). Above, there is the SICW. Both these water masses are characterised by high oxygen values (figure 3.7a). The situation is different at Location 2 (figure 3.8). Here the AAIW and the SICW interact with the IIW, as it is pointed out by the reduction of the oxygen levels of the former two water masses (figure 3.7b).

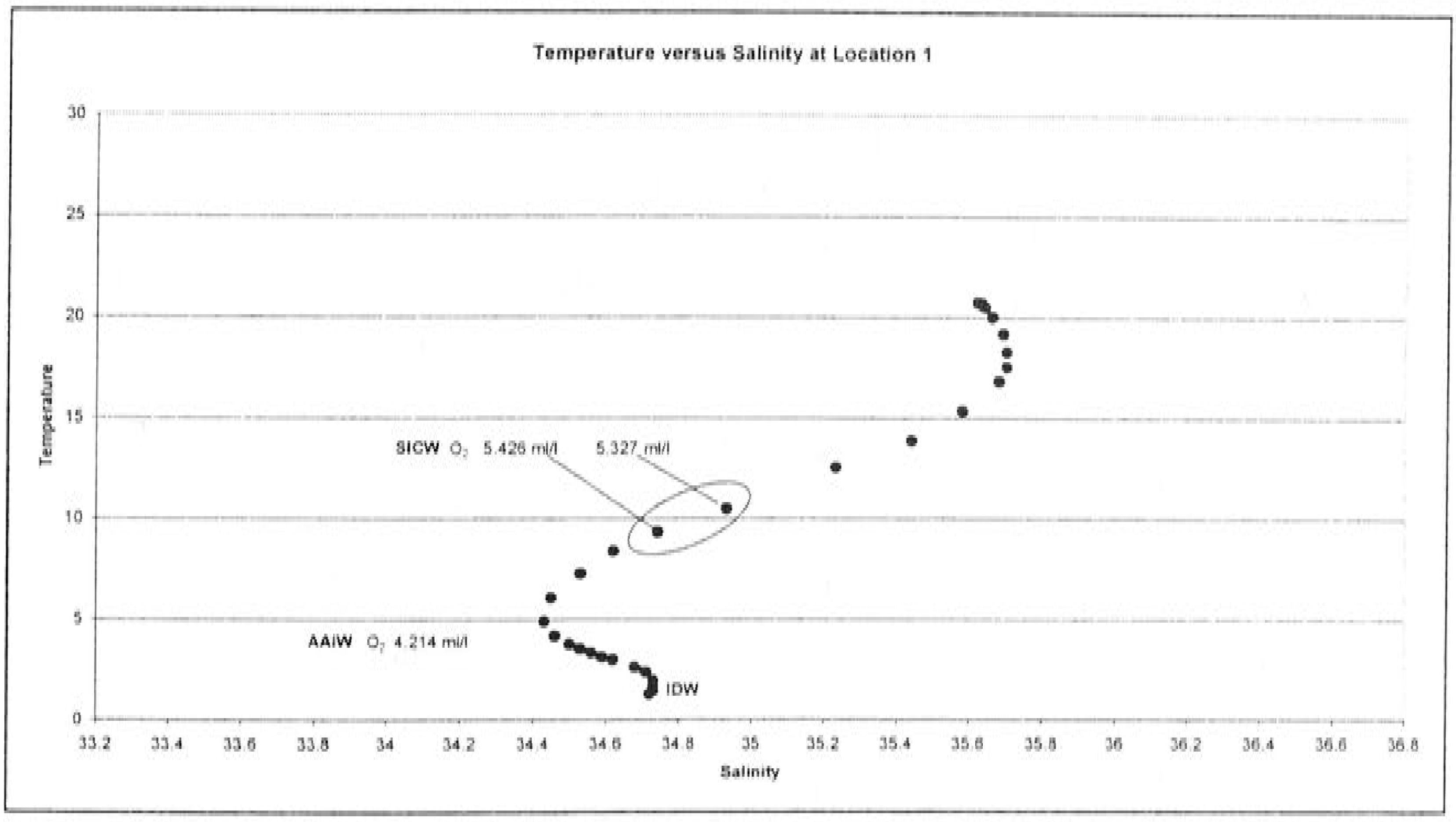

Fig. 3.6 – **Temperature versus Salinity diagram for Location 1.**
At intermediate depths, oxygen levels are high because of the presence of the SICW and the AAIW. The salinity minimum reflects the AAIW. At great depth, salinity increasing is due to the presence of the IDW (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column).

3.3.2 The Central Sector

In the Central Sector, the IIW flows from the Indonesian Archipelago into the Indian Ocean. At Location 3, the temperature/salinity profile shows the typical IIW features (low salinity for the entire water column) (figure 3.9).

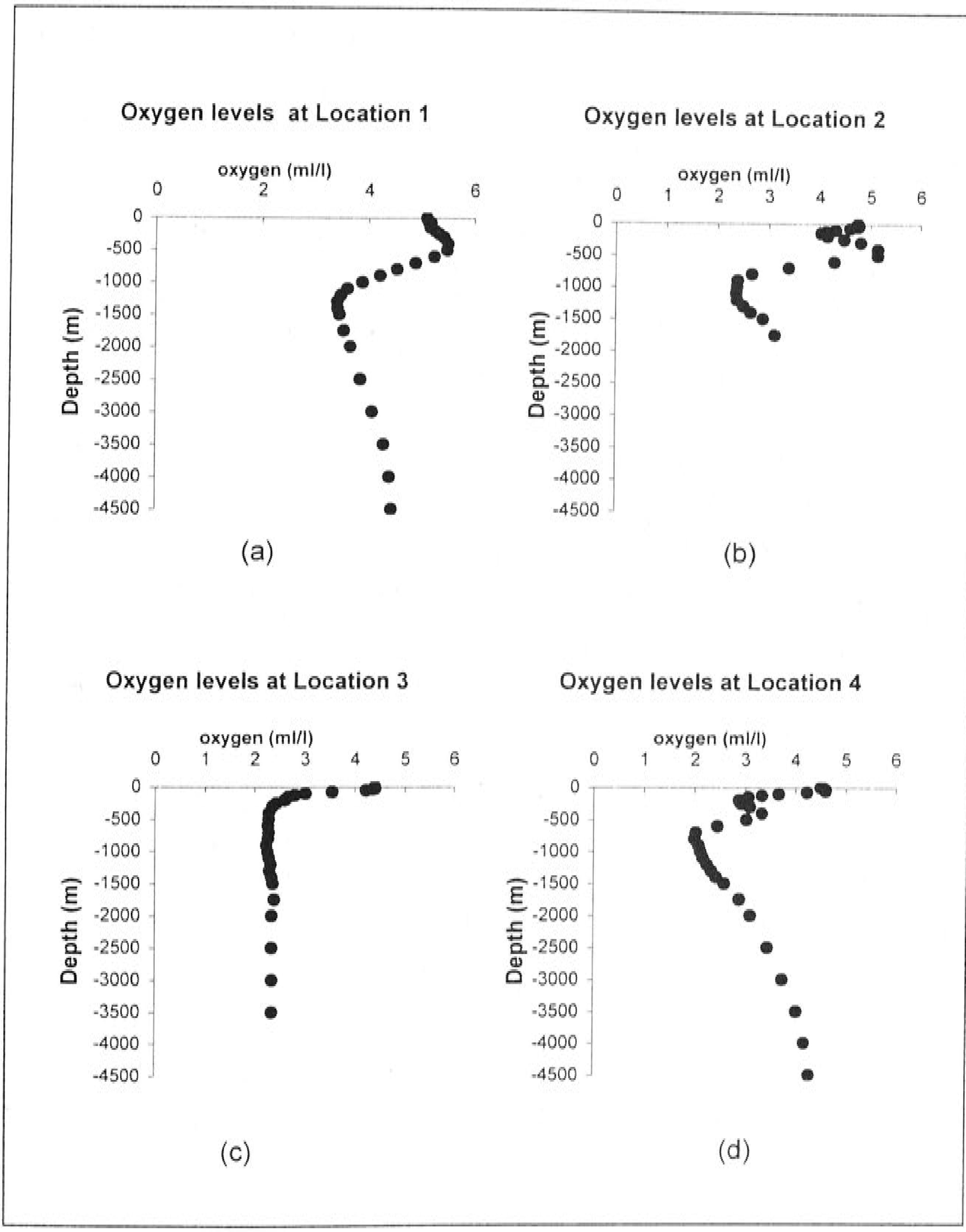

Fig. 3.7 – **Plots of oxygen levels versus depth for each of the seven locations mentioned in the text.** (data obtained from the World Ocean Atlas 1994 – Annual means)

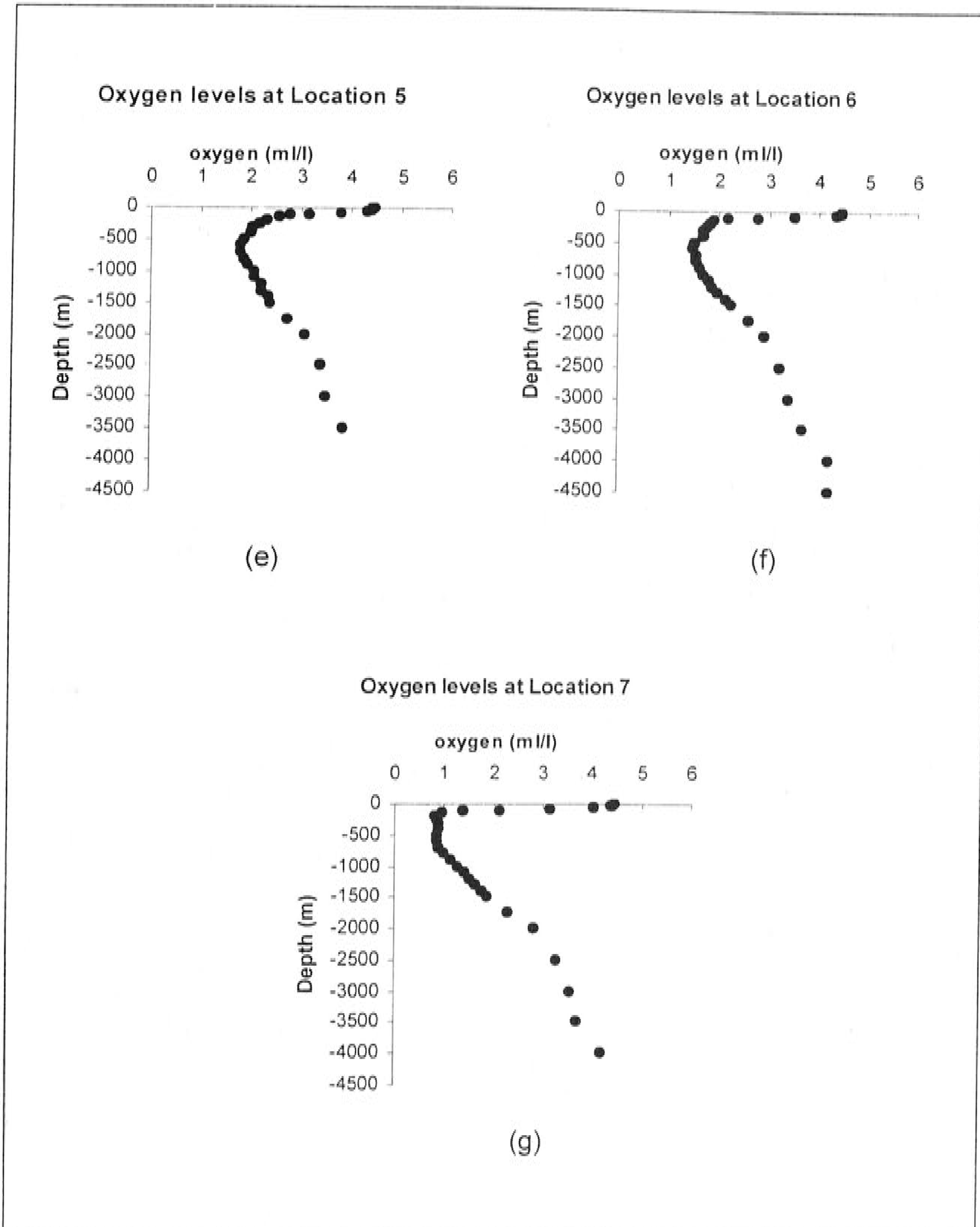

Fig. 3.7 – *(continued).*

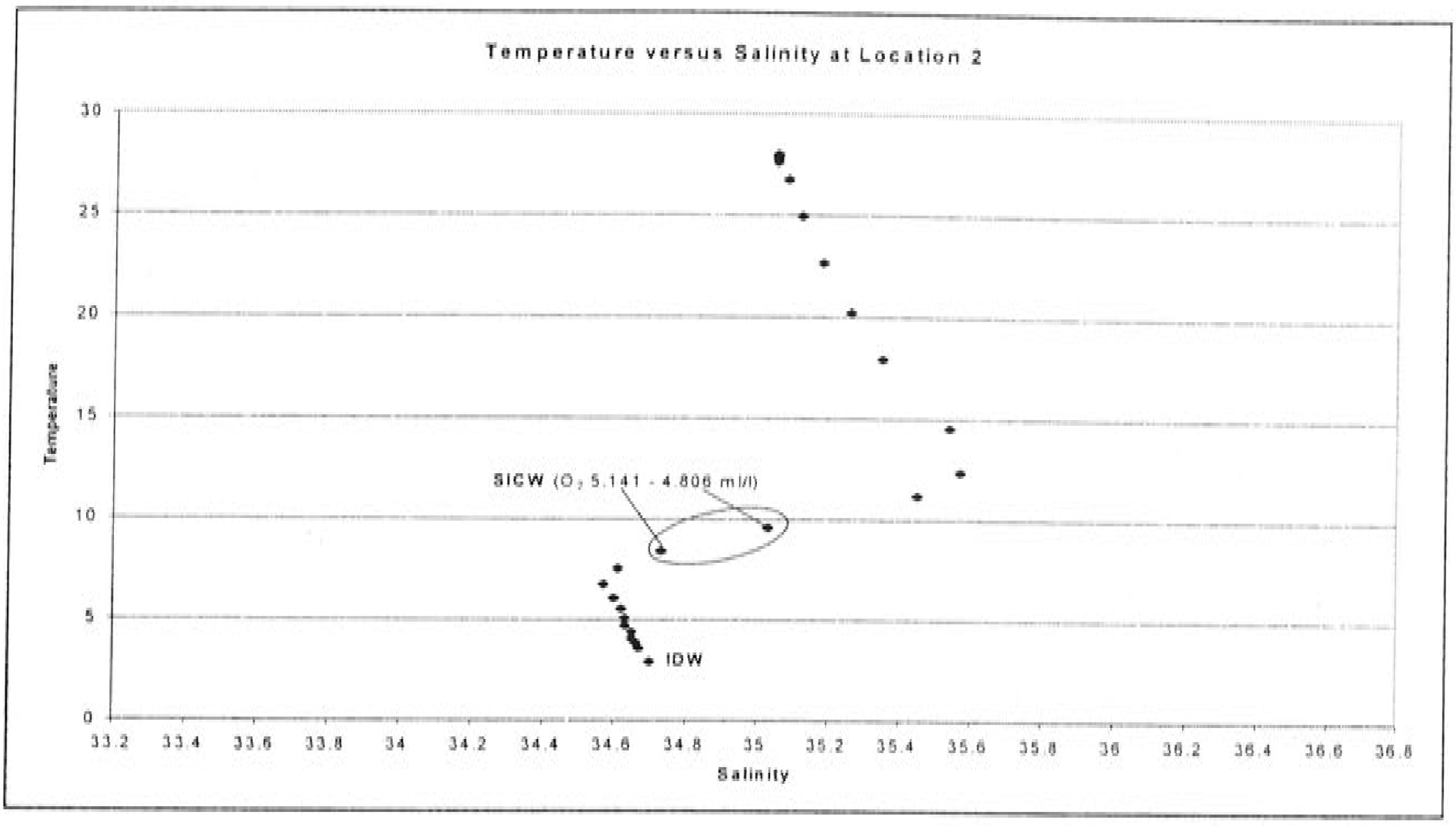

Fig. 3.8 – **Temperature versus Salinity diagram for Location 2.**
Salinity and temperature values recorded for this location are slightly different from those at Location 1. The IIW influence is seen by a change in oxygen concentration (see figure 3.7b) (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column).

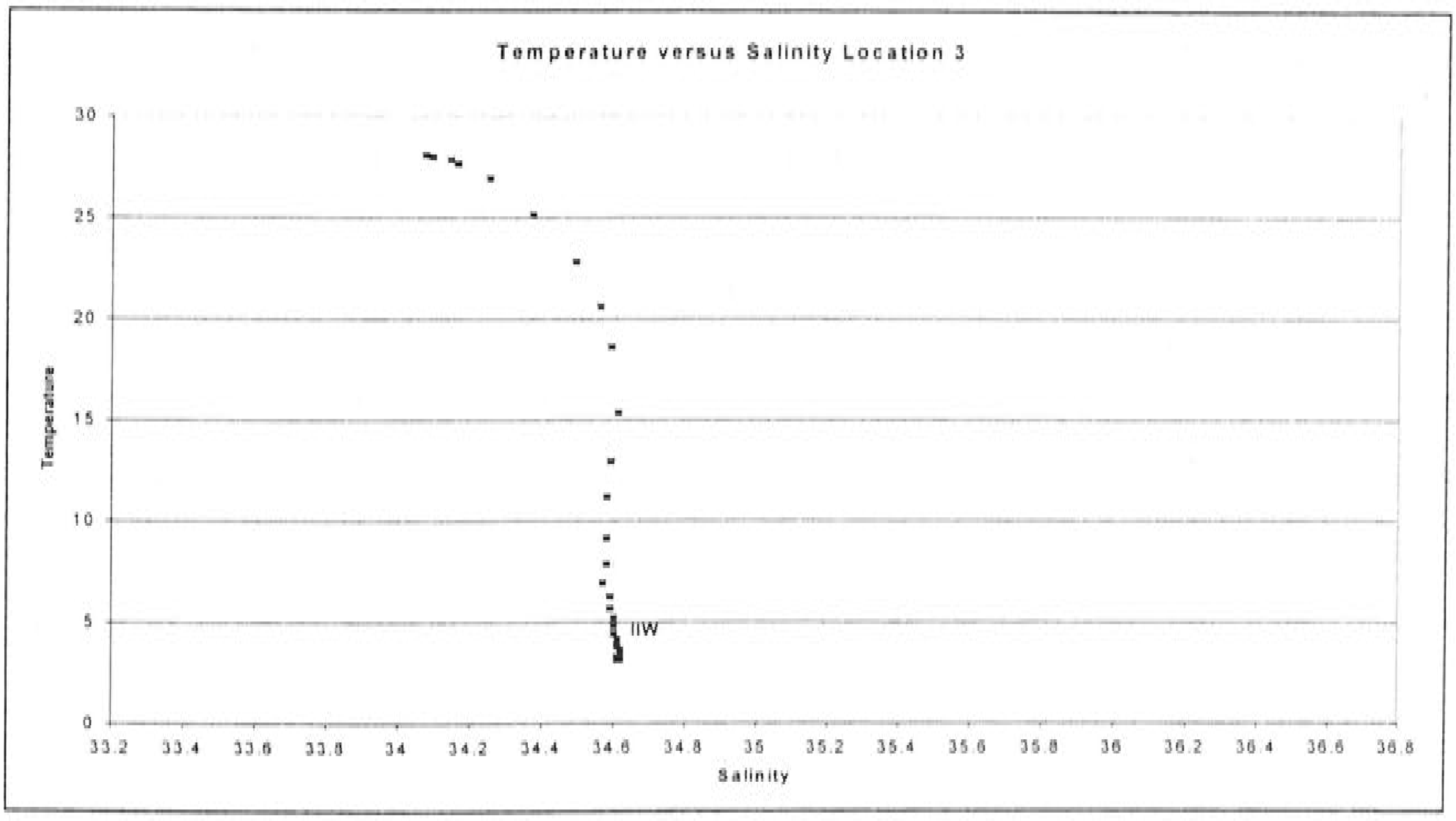

Fig. 3.9 – **Temperature versus Salinity diagram for Location 3.**
Below the thermocline, the presence of the IIW is marked by a fairly uniform salinity (constant at 34.6) for the entire water column (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column)

Below the thermocline, the water column is homogenous, with salinity levels constant around 34.6. At Location 4, the salinity minimum at 1000 m and the low oxygen levels marks the presence of the IIW (figure 3.10, 3.7d).

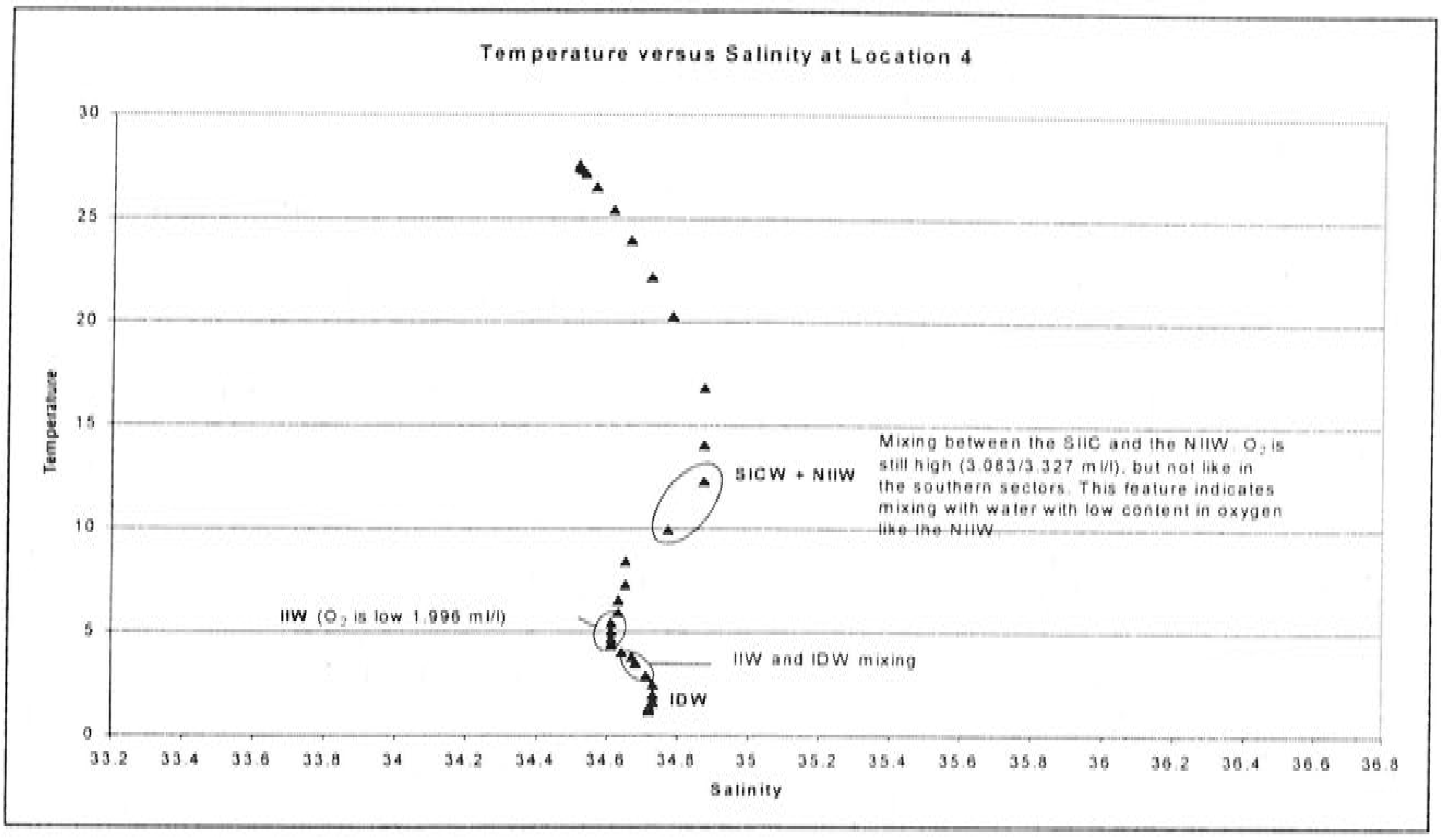

Fig. 3.10 – **Temperature versus Salinity diagram for Location 4.**
The interaction between the SICW and the NIIW is represented by the salinity maximum between 200 m and 600 m. The salinity minimum, at depths between 700 m and 1000 m, is due this time to the presence of the IIW (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column)

At depths between 200 m and 700 m, the IIW interacts with the SICW and the NIIW, that come from the south and the north respectively. The salinity peak seen in the profile marks the mixing processes at this depth range. The oxygen section between Australia and Indonesia (see figure 3.11) allows to distinguish between the SICW from the NIIW. The NIIW is mainly located in the northern part of the section and is marked by very low oxygen levels. The SICW flows along Australian coast and is characterised by higher oxygen levels. These two water masses are separated by a hydrological front seen below the thermocline down to 700 m (Fieux et al., 1994). From the North Australian Basin, the IIW flows westward along Java and Sumatra coasts (Rochford, 1961; Tomczak and Godfrey, 1994).

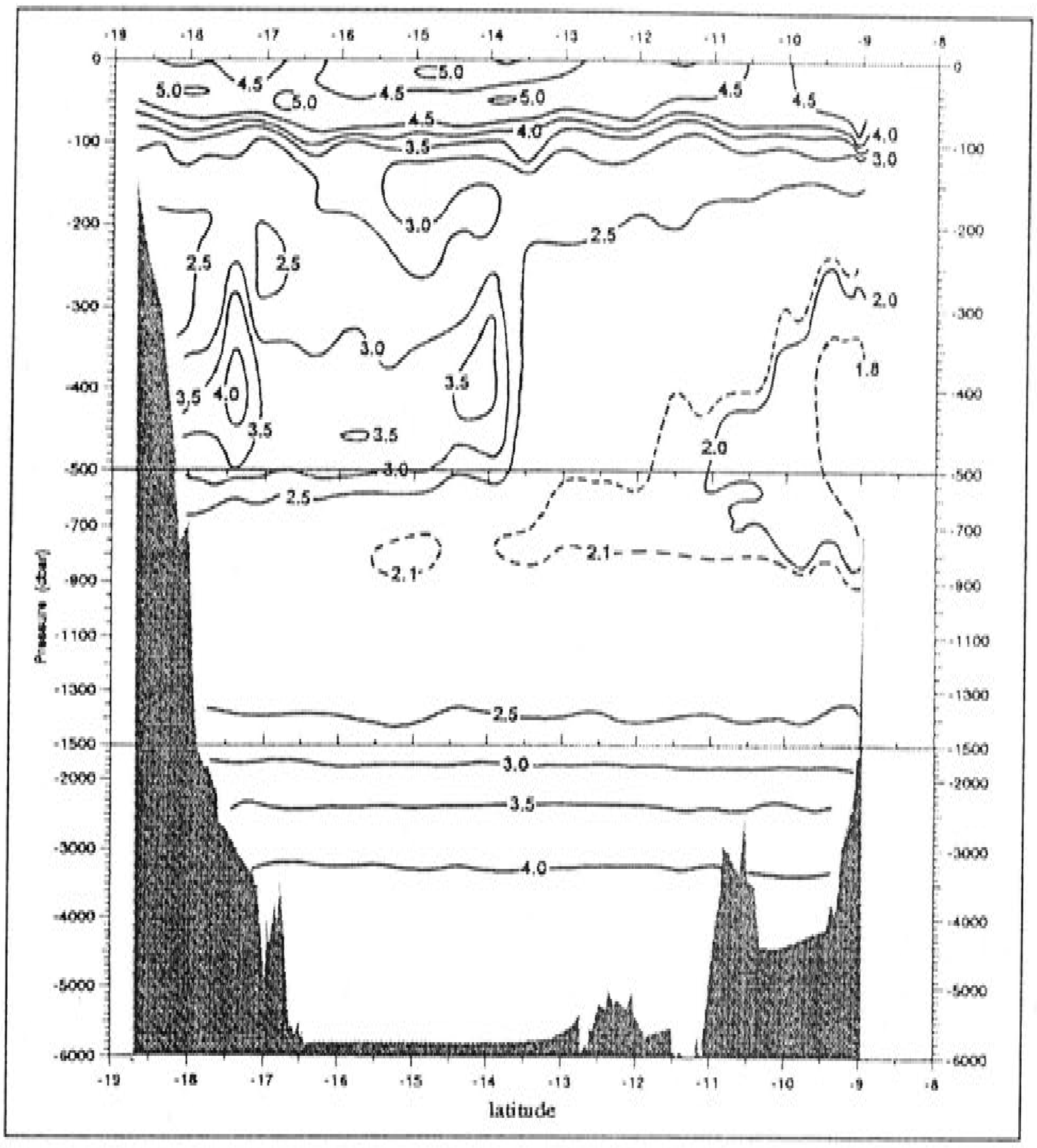

Fig. 3.11 – **Transect showing the dissolved oxygen levels between Australia and Bali (in millilitres per litre)** (copied from Fieux et al., 1994).
North of 14°S, between 200 dbar and 800 dbar, low oxygen levels indicate the NIIW. South of this latitude, for a similar depth range, oxygen concentration is higher, due to the presence of the SICW. Depth is expressed as dbar.

Close to the northernmost part of Java, at Location 5, the temperature/salinity profile is in agreement with the IIW (figure 3.12). Between 300 m and 600 m, a salinity maximum marks the presence of the NIIW. Oxygen remains low between the depth range occupied by the NIIW and the IIW (< 2 ml/l) (figure 3.7e). Further north, at Location 6 (figure 3.13), the salinity maximum seen at Location 5 is more intense and oxygen levels are still low (figure 3.7f). The influence of the northern origin NIIW on the IIW is stronger at this latitude.

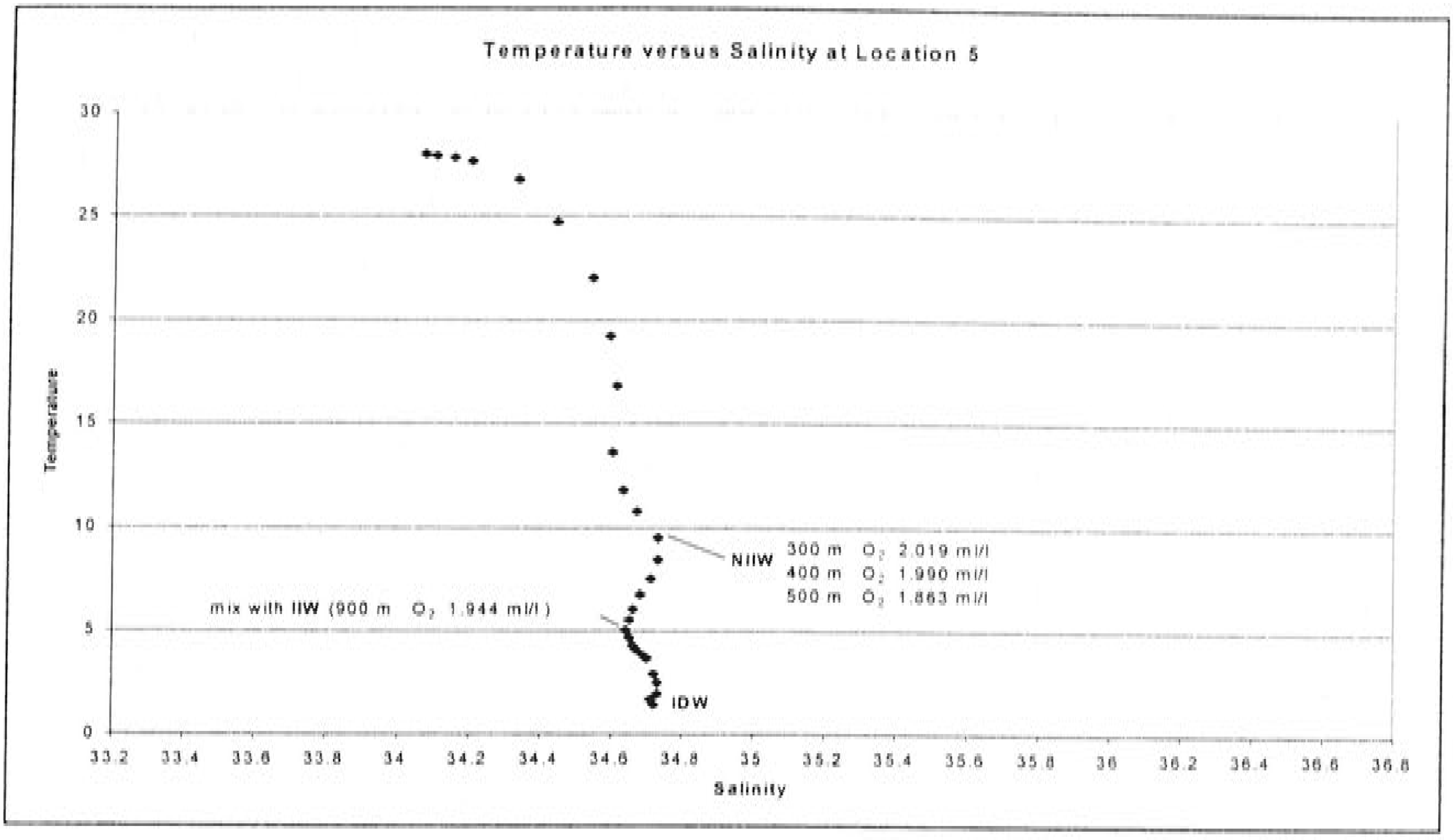

Fig. 3.12 – **Temperature versus Salinity diagram for Location 5.**
At intermediate depths, the NIIW and the IIW interact. Both water masses are characterised by low oxygen levels, but NIIW presents a higher salinity (causing the salinity maximum in the diagram) (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column).

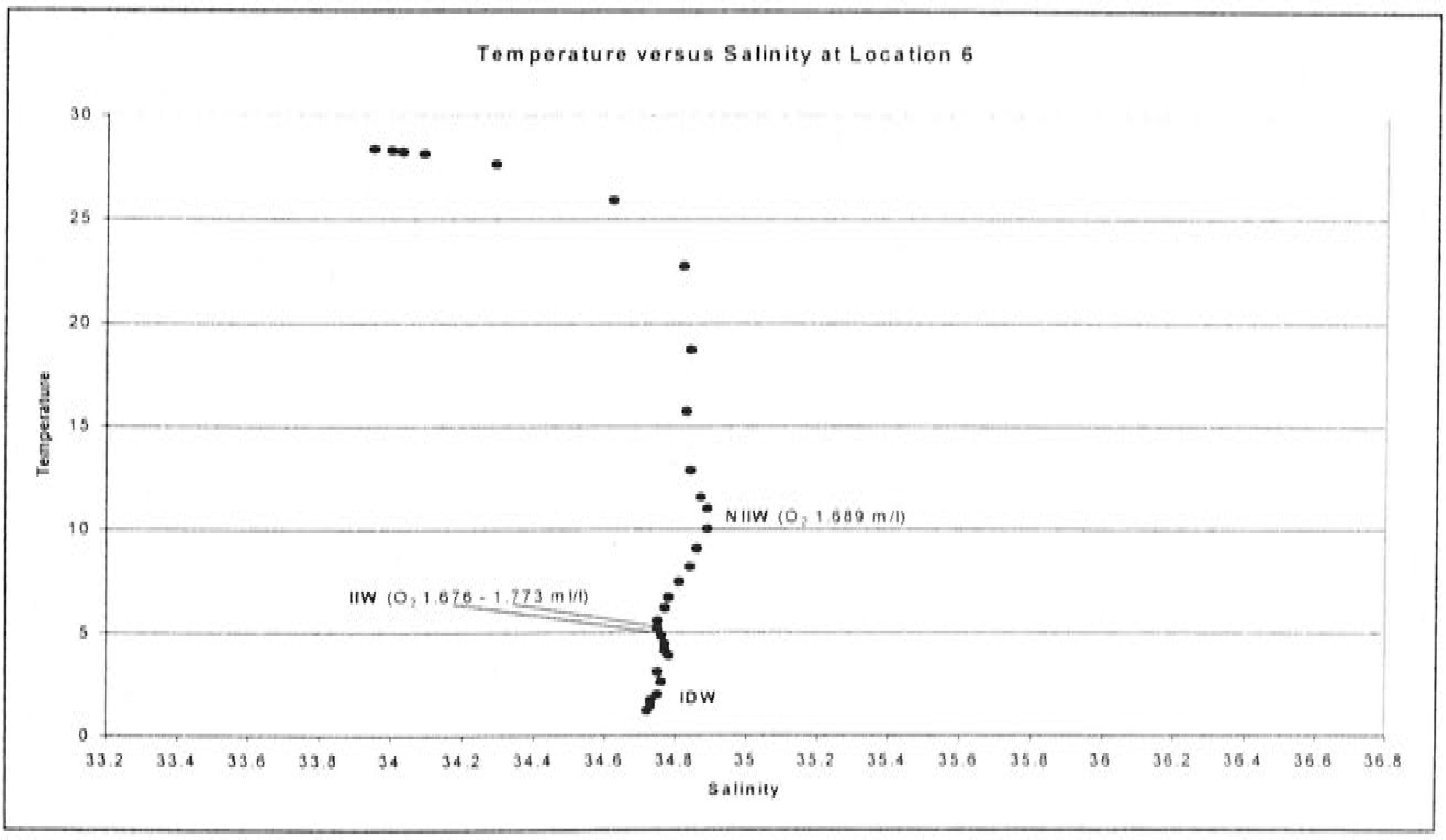

Fig. 3.13 – **Temperature versus Salinity diagram for Location 6.**
The influence of the IIW is reduced and below the thermocline salinity levels are higher (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column)
.

3.3.3 The Northern Sector

In the Northern Sector, the temperature/salinity profile shows only the presence of the NIIW at intermediate depth (figure 3.14). High salinity levels characterise the depth range between 125 m and 1500 m, reaching values of 35 around 600 m water depth. There, oxygen levels are extremely low: they do not exceed 2 ml/l (figure 3.7g).

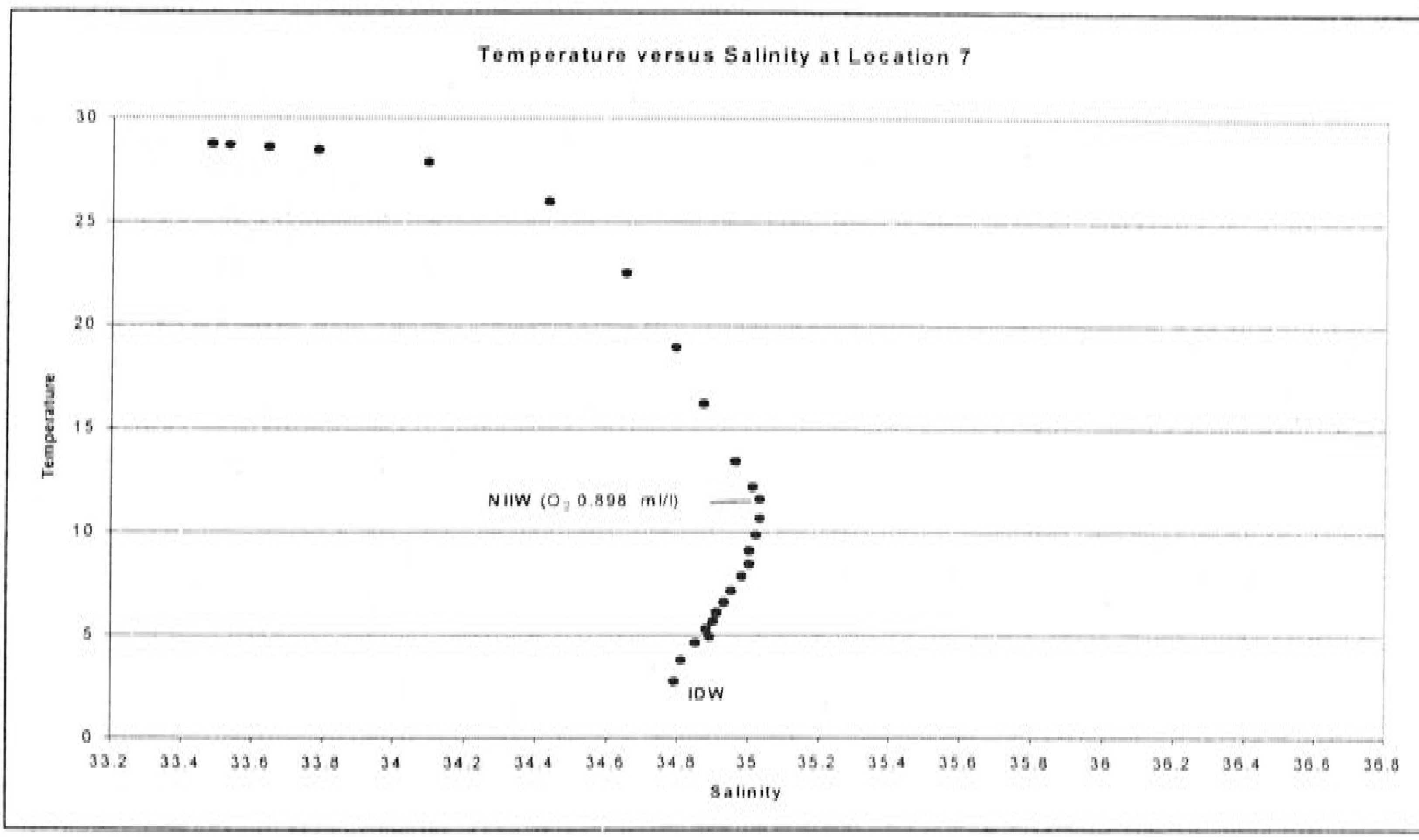

Fig. 3.14 – **Temperature versus Salinity diagram for location 7.**
At intermediate depths, only the NIIW is present. The salinity maximum seen at Location 6 is here more accentuated, reaching value >35 (data obtained from the World Ocean Atlas 1994 – Annual means; the values are referred to the entire water column).

3.4 Bottom and Deep waters

The Indian Ocean is considered to be an important element of the ocean global circulation. The net gain of heat characterising this basin is the expression of the conversion of deep waters coming from the Atlantic and the Southern Oceans in intermediate waters (Schmitz, 1995; Schmitz, 1996; Godfrey and Rintoul, 1998; Zhang et al., 1998; Ganachaud and Wunsch, 2000). The Ninetyeast Ridge and the

Central Indian Ridge separate the Warton Basin from the Central Indian Basin and the latter from a series of interconnected basins in the western part of Indian Ocean respectively (figure 3.15). The Warton Basin is a stretched basin and it is located in the eastern side of this ocean. In the central part of this basin water depth can reach 6000 m. It is delimited by the Ninety East Ridge west, by the Australian continental shelf and the Indonesian Archipelago east and by the Southeast Indian Ridge south.

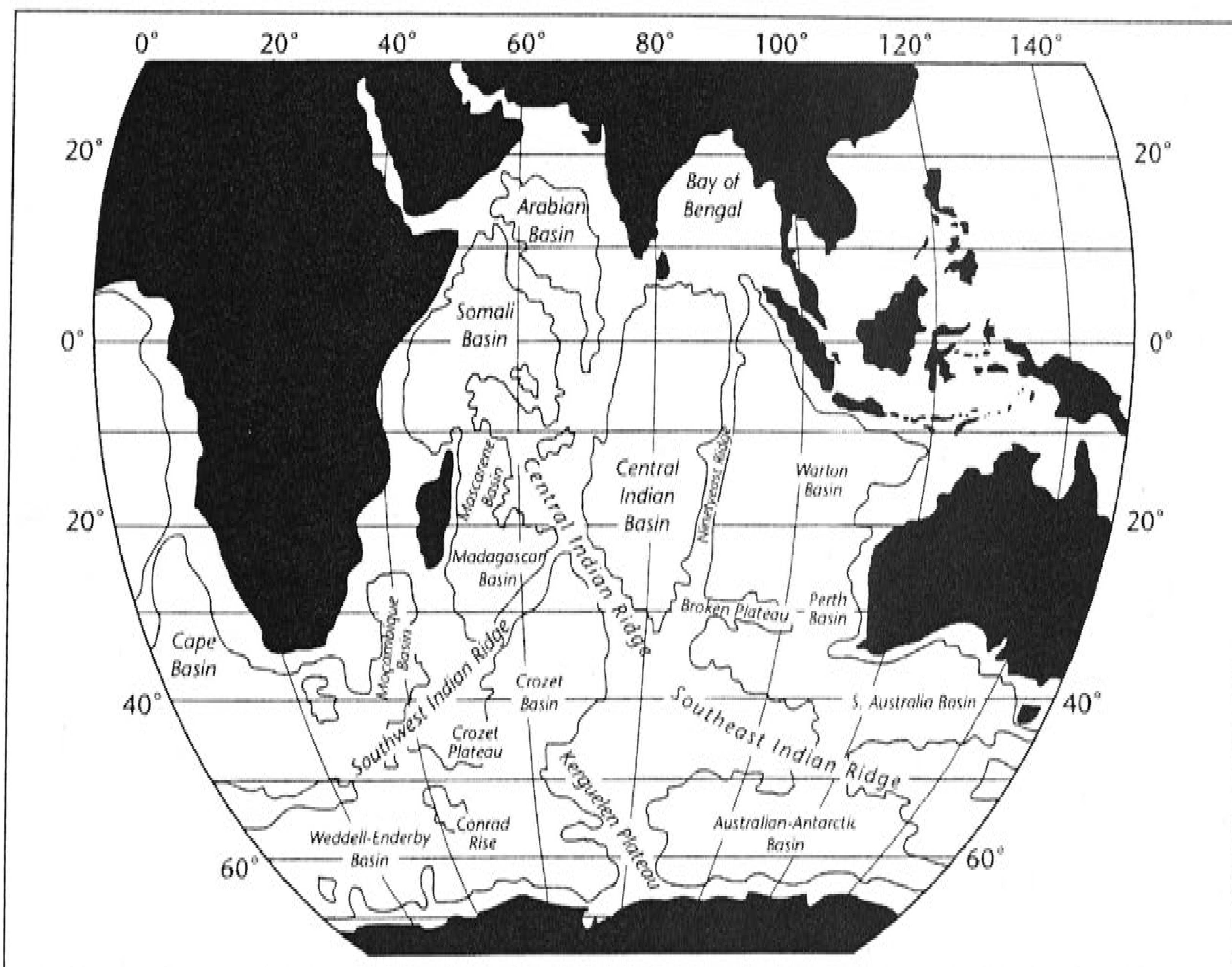

Fig. 3.15 – **Bottom topography of the Indian Ocean** (copied from Semhitz, 1996).

The deepest water mass in the region is the Antarctic Bottom Water (AABW) (Warren, 1981; Tomczak and Godfrey, 1994). It presents an average salinity of 34.7 and a potential temperature between 0.8°C and 1°C. Bottom water circulation is strongly conditioned by the topography of this area. There are few locations where the AABW can enter the Warton Basin. South of Australia, where the South Indian Ridge sector is characterised by fracture systems, Southern Ocean origin bottom water enters the South Australia Basin and the Warton Basin (Toole and Warren, 1993) (figure

3.16). The AABW then flows northward along the eastern flank of the Ninety East Ridge until the basin becomes too shallow (less than 4000 m). Part of the AABW, on its northward flow, spreads trough a discontinuity along the Ninety East Ridge in the Indian Central Basin (Warren, 1981). The remaining part upwells in the northern sector of the basin and then flows southward as deep water (Schmitz, 1995; Srinivasan et al., 2000) (figure 3.17). The AABW fills the Indian Ocean below 3800 m (Tomczak and Godfrey, 1994).

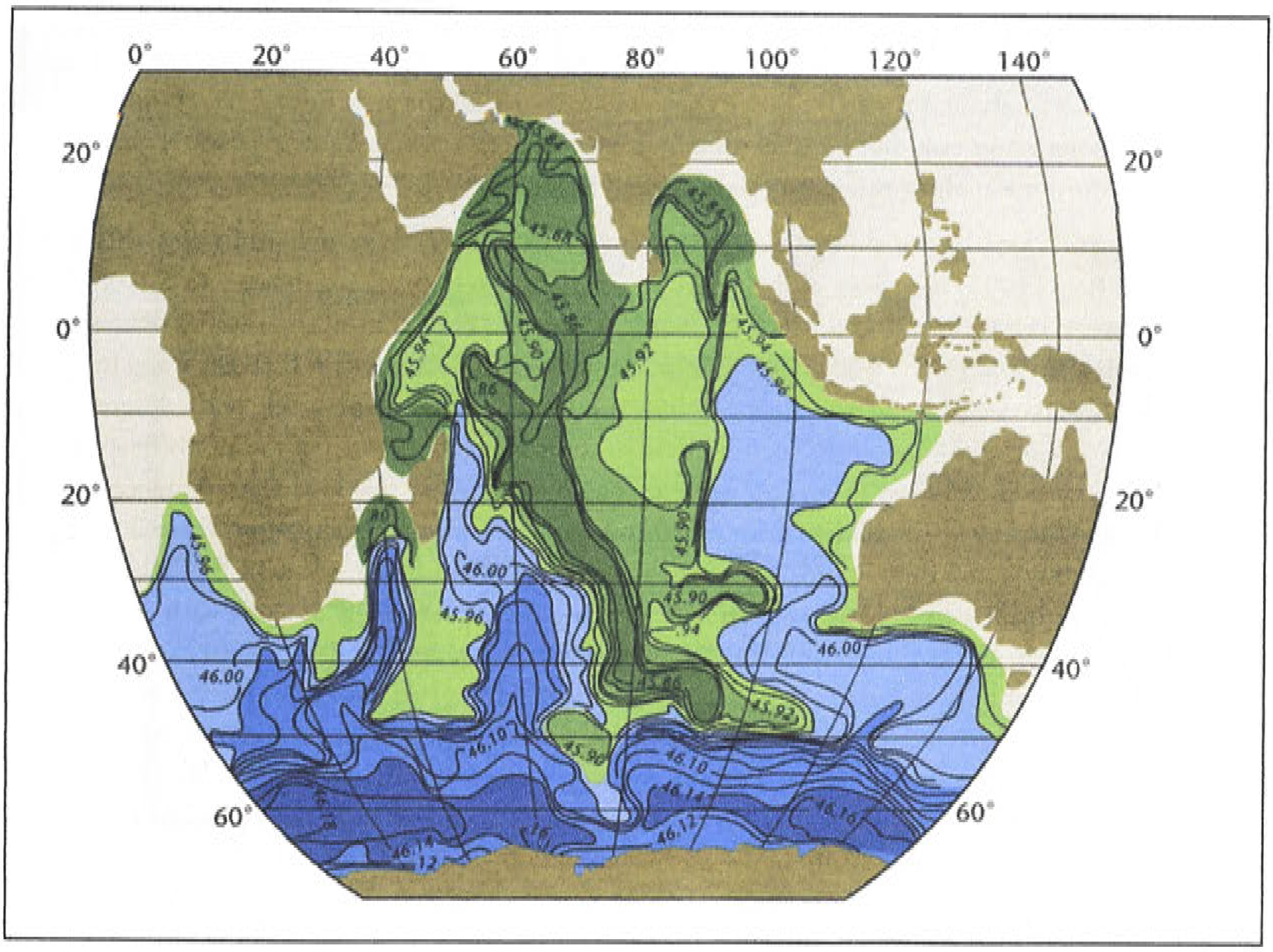

Fig. 3.16 - **Density levels [σ_4] (Kg m^{-3}) at the bottom of the Indian Ocean** (copied from Schmitz, 1996)
Density lines describe the AABW pattern in the Indian Ocean. This water mass enters the Warton Basin flowing through discontinuities in the Southeast Indian Ridge and on its northward flow enters the Central Indian Basin through a discontinuity of the Ninetyeast Ridge.

Above the AABW, there is the Indian Deep Water (IDW), which originates from the mix between deep waters flowing from the Atlantic and Southern Oceans (Toole and Warren, 1993; Tomczak and Godfrey, 1994; Macdonald and Wunsch, 1996; Ganachaud and Wunsch, 1998) and from bottom water, upwelled in the northern part of Indian Ocean (Schmitz, 1995; Zhang et al., 1998; Srinivasan et al., 2000). Bottom water from the Southern Ocean flows northward where it is progressively depleted in oxygen and raised in salinity, phosphate, nitrate and silica. Then it upwells and flows this time southward as the IDW (Toole and Warren, 1993). On its way towards the Southern Ocean the upper part of this water enters the Timor Sea below 1400 m (Van Bennekom et al., 1988; Fieux et al., 1994). In the Warton Basin, the IDW is present between 2000 m and 3800 m. Here, this water mass is characterised by a salinity maximum of 34.75 and a potential temperature of 2°C.

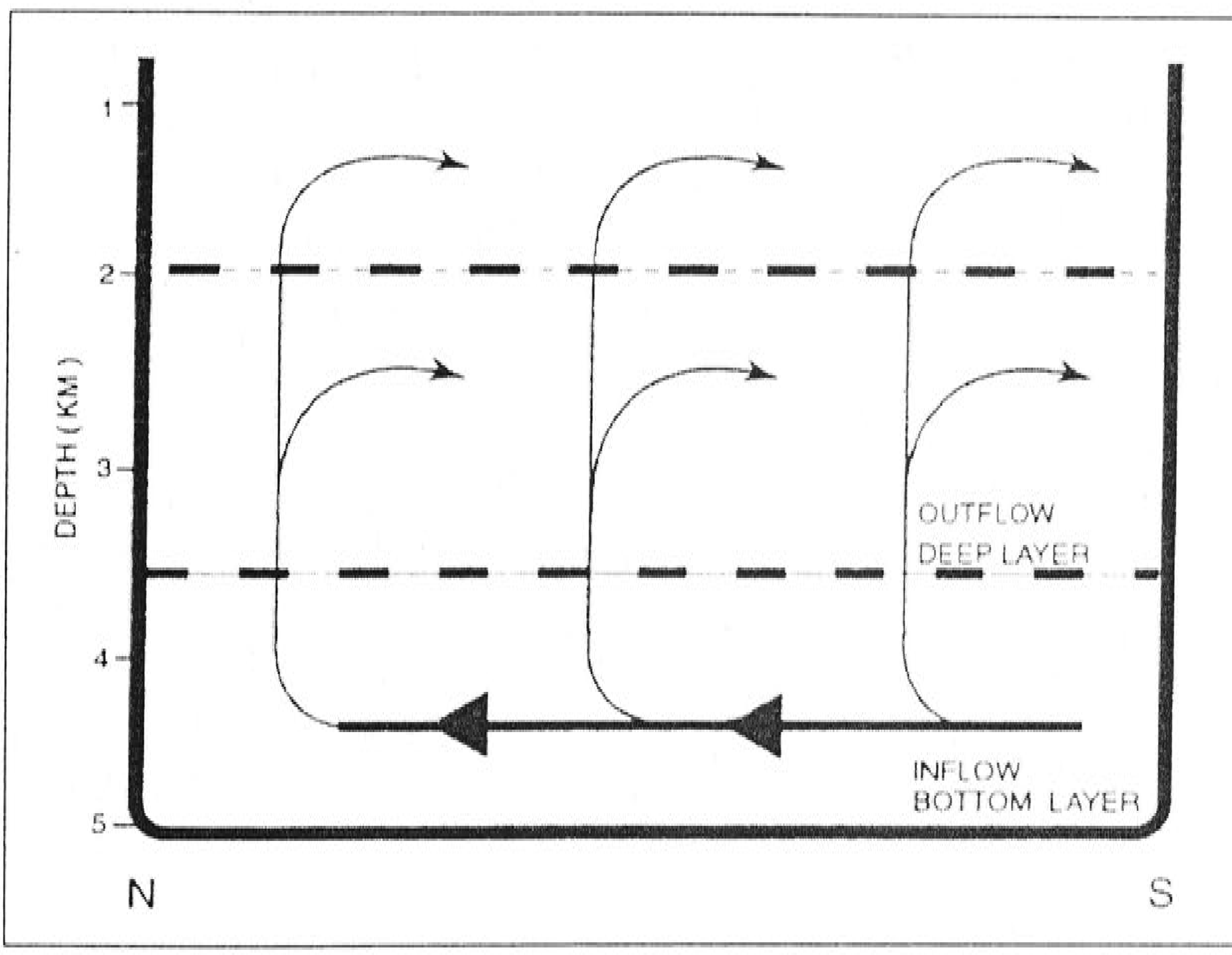

Fig. 3.17 – **Deep circulation pattern in the Indian Ocean basins** (copied from Srinivasan et, al, 2000)
Bottom water upwells and feeds the southward return flow at a lower depth.

3.5 Productivity at sea surface

Upwelling systems are present along the eastern boundaries of the Atlantic and Pacific Oceans, due to the Trade Winds action and Ekman transport. This particular scenario is different along the Indian Ocean's eastern boundary: there, the poleward flow of the LC is strong enough to override the wind-driven equatorward flow. The result of this phenomenon is the absence of upwelling along northwestern Australian coasts (Smith, 1992; Tomczak and Godfrey, 1994). In the Indonesian region, during the Southeastern Monsoon (September-October), along Java and Sumatra western coasts, the SJC's westward flow determines an upward motion of the thermocline (Colborn, 1975) (figure 3.18) accompanied by a high concentration of inorganic phosphate at the bottom of the euphotic layer and by high plankton biomass (Wyrtki, 1962; Fieux et al., 1994; Sprintall et al., 1999).

The upwelling intensity is related to the monsoonal regime and for this reason is variable. The upwelling system develops off the east coast of Java and then moves northward along the east coast of Sumatra due to the alongshore winds and to latitudinal changes in the Coriolis Effect (Susanto et al., 2001).

In the Indonesian Seas, productivity levels are those shown by the satellite imagery for August and February 2000 (figure 3.19a and 3.19b). During the Southeastern Monsoon, high chlorophyll levels (>1 mg/m^3) are recorded, while during the Northwestern Monsoon, they are generally low (0.1-0.2 mg/m^3).

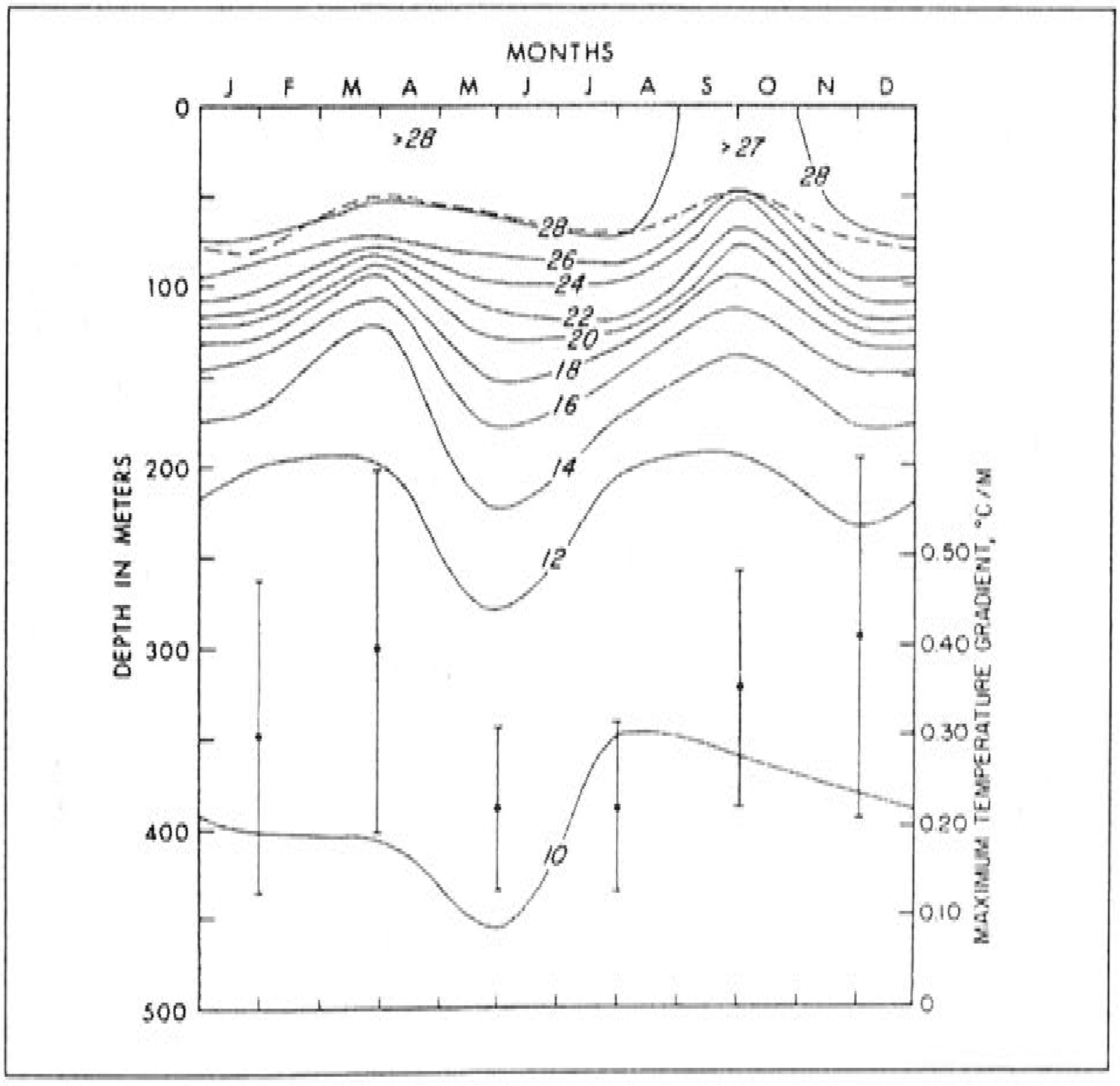

Fig. 3.18 – **Temperature profile for the eastern Indian Ocean Region near Sunda Strait. Seasonal variation of the thermal structure** (copied from Colborn, 1975).
During September and October it is recorded an upward motion of the isotherms related to upwelling.

The concentration of the chlorophyll at the sea surface is not the same for the entire region as a west-east phytoplankton biomass gradient is present (Wyrtki, 1958). In August-September, the eastern Banda Sea and the Arafura Sea are characterised by higher chlorophyll levels while more oligotrophic conditions are present in the Sulawesi Sea (Kinkade et al., 1997). This difference in productivity levels between the two regions is related to the "unbalance" between the water outflow to the Indian Ocean and the inflow of surficial waters from the Pacific Ocean and the consequent vertical advection of intermediate Banda and Arafura Seas waters which compensates this deficit (Wyrtki, 1958). During January-February, a slight increase in chlorophyll in the Makasar Strait is related to rivers runoff (Kinkade et al., 1997).

Rainfall contributes to increase the amount of organic matter produced at the sea surface. Over Indonesia, rain occurs nearly all time of the year (Kripalani and Ashwini, 1997; McBride, 1998) and rainfall levels are between 2500 and 3000 mm per annum (Arya et al., 1999). Under these conditions rivers deliver a large amount of sediment to the ocean (Milliman and Meade, 1983; Milliman et al., 1999) (figure 3.20).

Material delivered by the rivers represents an important source of nutrients, which favours phytoplankton growth at the sea surface (Parsons and Takahashi, 1973; Pettine et al., 1999). An opposite situation characterises northwestern and western Western Australia, where rainfalls are less abundant and more concentrated in defined periods of the year. Southwestern Western Australia is affected by rainfalls mainly during winter, while further north rainfalls are more frequent in summer and are linked to the monsoonal regime (Srikanthan and Stewart, 1991). In this context, the amount of sediment discharged by the rivers in the ocean is sensitively less than that recorded for Indonesia (Milliman and Meade, 1983). These differences between northwest Western Australia and Indonesia explain the productivity gradient at the sea surface existing between these two regions (figure 3.21).

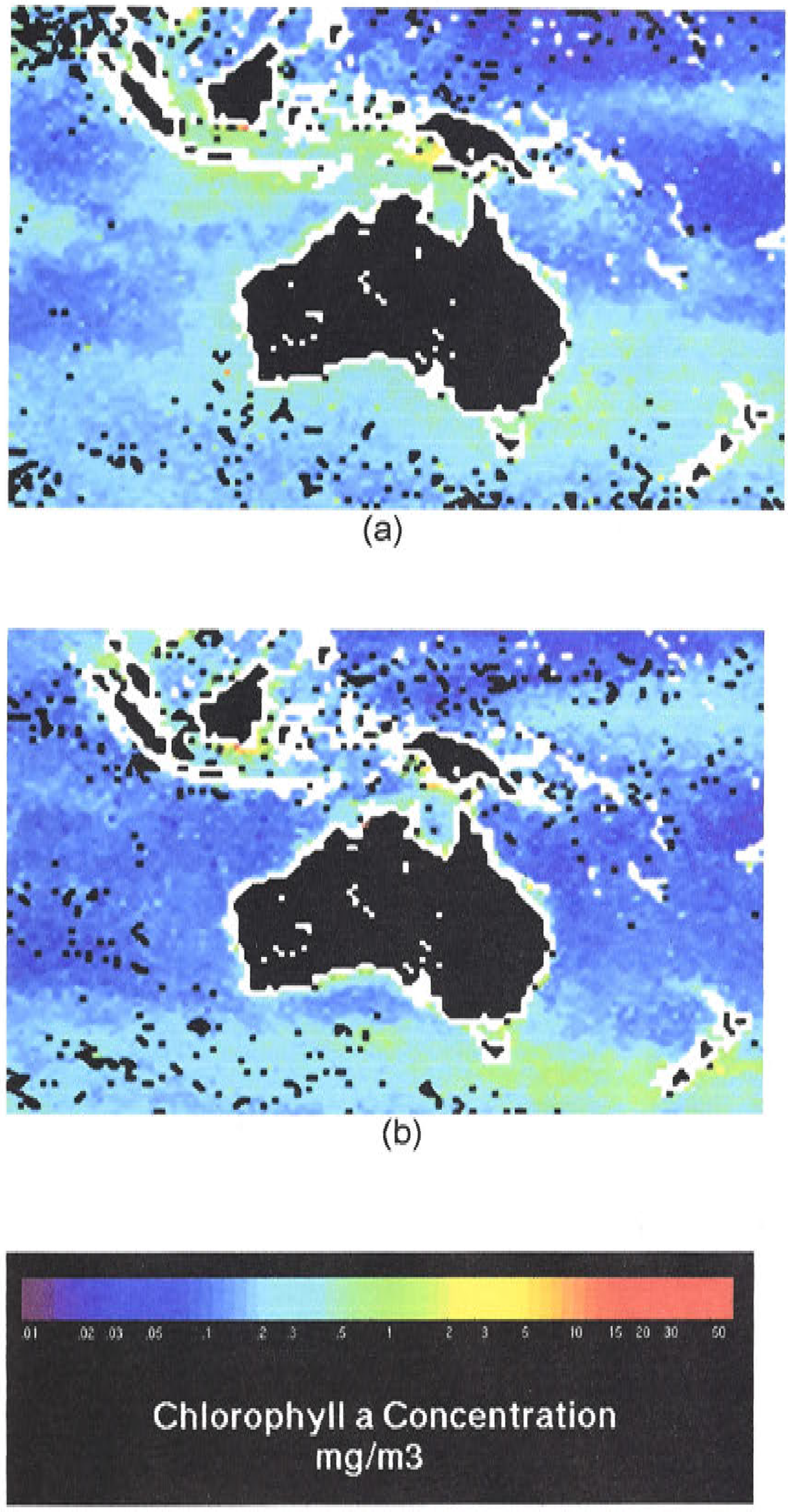

Fig. 3.19 – **Sea-surface chlorophyll levels for (a) the month of August [Southeastern Monsoon] and (b) February [Northwestern Monsoon]** (obtained from the SEAWIFS satellite imagery archive).

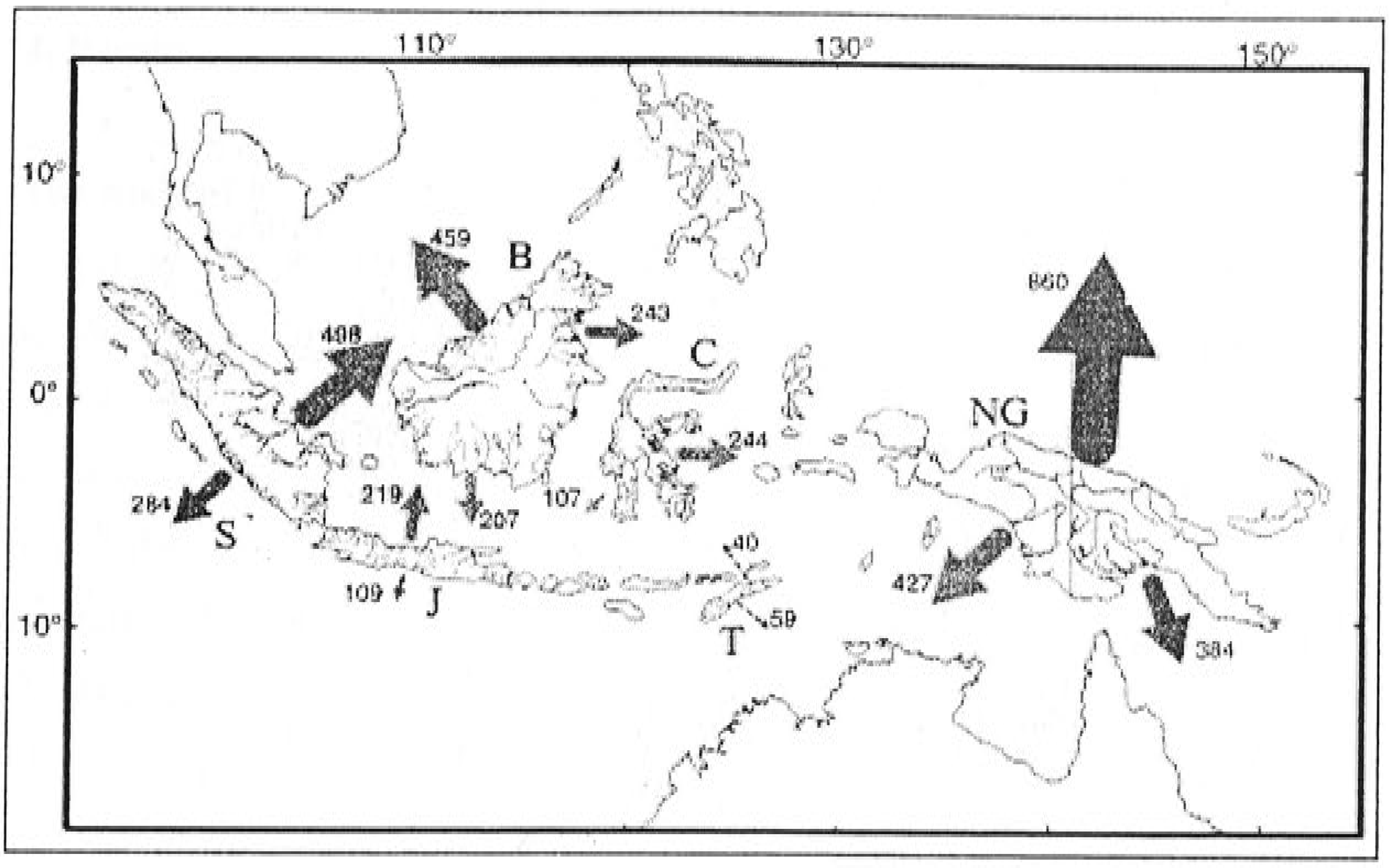

Fig. 3.20 – **Sediment discharge (10^6 t y^{-1}) from the Indonesian Archipelago and Papua New Guinea** (copied from Milliman et al., 1999)
Arrows width is proportional to annual load. Letters *S, J, B, C, T* and *NG* refer to Sumatra, Java, Borneo, Sulawesi (Celebes), Timor and New Guinea, respectively.

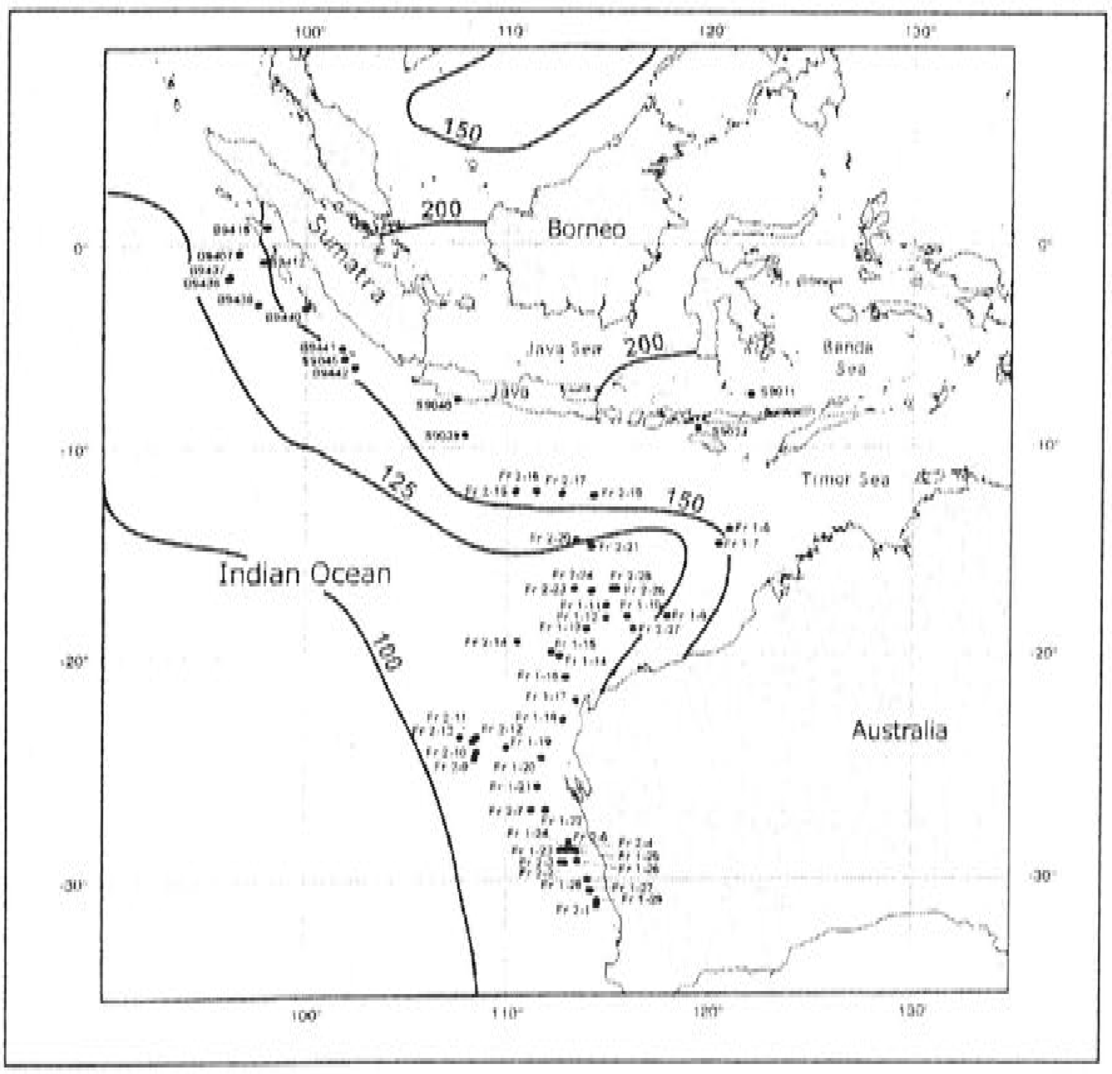

Fig. 3.21 – **Annual mean primary productivity (g C m^{-2} y^{-1}) at the sea surface in the eastern Indian Ocean estimated from satellite data** (after Antoine et al., 1996).

4. Results

The study of benthic foraminifera from the 57 core tops helped identify a total of 301 species whose mean abundance ranges between 8.96 % (*Globocassidulina subglobosa*) and 0.002% (*Pseudoguadryna atlantica*). The distribution versus depth for the most common taxa, with a percentage >2% in at least 10 samples, is shown in figure 4.1

From the species database, those taxa with best preservation potential and a percentage >2% in at least one sample were selected for statistical analyses, for a total of 75 species.

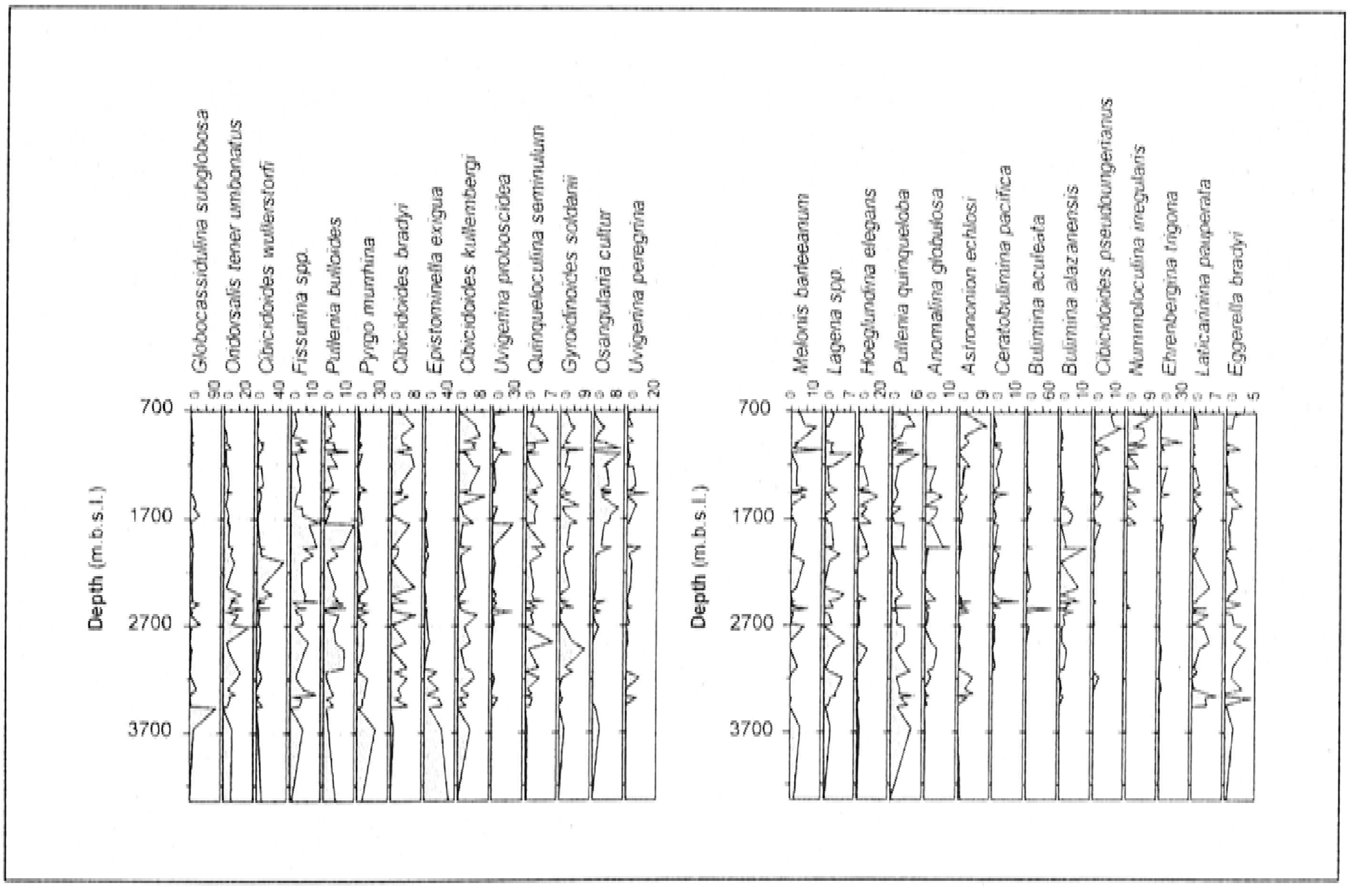

Fig. 4.1 – **Distribution of the most common species (percentage >2% in at least 10 samples) versus depth (m b.s.l.).**

4.1. Detrended Correspondence Analysis (DCA)

The DCA was performed to analyse the reduced species database (see section 2). The algorithm calculated four ordination axes, which account for 33.2% of the species variance. The variance justified by each axis is listed in Table 4.1. The first two axes represent more than 50% of the variance explained with the DCA and for this reason only these two have been considered for further analysis. Species scores and weights are listed in Table 4.2. The scores indicate the degree of correlation of each species with each axis; the species' weight indicates the influence of species on the analysis (ter Braak and Smilauer, 1998; Dale and Dale, 2002).

Table 4.1 – **Variance explained by each one of the four axes.**

Axis	Ax1	Ax2	Ax3	Ax4
Variance of species data	14.2 %	8.4 %	5.7%	4.6 %

Table 4.2 – **Detrended Correspondence Analysis results for the reduced species database. Scores of the species for axes 1, 2, 3 and 4 (for species codes see Appendix A1).**
In bold are indicated those species which present both high score on axes 1 or 2 and high weight

CODE	AX1	AX2	AX3	AX4	WEIGHT
Aaglob	-0.36	-0.03	-0.22	0.12	38.07
Astrech	0.16	-0.45	0.22	-0.07	32.75
Blql	1.66	1.54	-0.73	0.12	3.78
Bolro	1.12	0.65	0.59	0.36	5.17
Bolsem	0.37	-0.21	-0.43	-0.39	10.42
Brdi	1.10	0.86	0.54	-0.40	8.68
Brsem	-0.41	0.31	-0.63	-0.12	5.74
Buac	0.07	**1.13**	-0.23	0.38	**31.96**
Bualz	-0.48	0.02	-0.40	-0.16	35.45
Buco	0.27	0.85	0.03	-0.28	17.95
Buma	1.57	3.80	0.12	-0.75	0.69
Cascr	0.68	-0.10	0.01	-0.07	11.01
Caslae	0.35	-0.03	-0.44	-0.32	30.77
Cassre	-0.82	0.10	-0.62	-0.87	13.62
Cerpa	0.18	0.06	-0.02	-0.07	32.27
Chol	1.03	0.49	-0.29	0.44	11.57
Cibr	0.16	-0.16	0.07	0.13	61.03
Ciku	0.08	-0.13	0.11	0.10	58.36
Cipse	**0.97**	0.11	0.29	-0.33	**29.65**
Cirob	-0.11	-0.40	0.06	0.59	19.84
Ciwul	0.71	-0.04	-0.10	-0.02	88.24
Cisp	-0.19	0.08	0.14	-0.06	14.42
Egbr	-0.20	0.09	-0.10	-0.07	34.44
Ehtr	0.49	-0.29	0.88	0.60	23.39
Epex	**-0.91**	0.03	0.29	0.05	**60.39**
Exum	-0.29	-0.46	1.19	-1.22	14.8
Fispp	-0.19	0.05	-0.06	0.03	80.71
Furfs	-0.28	0.49	-0.25	0.17	8.01
Galo	1.00	-0.47	0.08	-0.16	20.04

Table 4.2 – *(continued)*.

CODE	AX1	AX2	AX3	AX4	WEIGHT
Glcsb	-0.21	0.00	-0.02	-0.17	112.68
Glpa	1.42	1.68	-0.39	0.14	3.04
Gyral	0.11	0.00	-0.05	-0.06	11.97
Gyrlmk	0.31	-0.85	-1.06	0.04	12.64
Gyror	-0.23	-0.13	0.06	0.25	29.42
Gyrpo	-0.84	-0.28	0.01	-0.12	22.4
Gyrso	0.12	-0.05	-0.01	-0.09	53.68
Hoel	0.14	0.07	-0.06	-0.06	52.09
Hurin	1.44	-0.78	-0.17	0.26	4.51
Hyba	1.61	3.31	-0.21	-0.39	1.29
Karbr	0.29	-0.24	0.38	-0.04	21.33
Laspp	-0.14	-0.02	-0.15	-0.01	49.79
Lespp	0.37	0.31	0.24	-0.05	21.29
Ltpa	-0.53	0.03	-0.10	0.42	32.26
Meba	0.43	0.19	0.19	0.02	44.4
Mepo	-1.09	-0.39	0.58	-1.15	3.51
Miob	1.15	-0.80	-0.34	0.00	5.62
Mtcom	0.85	2.14	-0.03	0.18	3.49
Nntu	1.60	-0.64	-1.78	0.67	0.8
Numir	**1.32**	-0.76	-0.28	-0.05	**21.21**
Oospp	-0.52	-0.09	-0.21	0.16	29.28
Ortu	**-0.35**	0.06	0.01	0.08	**88.34**
Oscu	0.34	-0.16	-0.07	-0.20	46.97
Paspp	-0.21	-0.15	-0.19	-0.20	20.71
Pu5	-0.17	-0.02	0.00	0.04	49.91
Pubu	-0.20	0.09	0.08	-0.05	72.37
Pyde	0.12	-0.06	0.16	0.19	33.73
Pyel	1.32	-0.72	0.63	0.14	6.37
Pylu	-0.23	-0.21	0.23	-0.28	10.74
Pyu	**-0.49**	-0.07	-0.07	0.01	**73.14**
Qusem	-0.02	-0.21	-0.13	0.01	50.96
Quve	-0.18	-0.59	0.01	0.60	11.16
Rbta	0.99	-0.60	-0.31	-0.05	12.91
Redi	1.42	-0.33	-0.35	-0.22	0.85
Sbull	-0.41	-0.29	-0.26	0.54	22.54
Sgmsch	0.25	0.24	0.29	0.10	27.21
Stxca	-0.42	0.08	0.18	0.40	16.99
Stxcu	0.76	-0.25	0.26	0.11	5.15
Trgo	0.94	0.11	-1.21	0.27	4.1
Trtr	0.61	-0.54	-0.72	-0.26	15.72
Txag	-1.20	-0.43	0.92	-0.31	0.82
Txlyt	0.88	-0.32	0.81	0.81	9.27
Txpgr	1.40	-0.11	-1.39	0.57	1.79
Uvpe	0.05	0.19	0.03	0.00	48.8
Uvprob	0.19	**0.50**	0.06	-0.13	**56.22**
Vlsp	1.17	-0.81	-0.24	0.20	2.44

The analysis of axis 1 allowed the identification of two groups of species. Species with negative score and high weight (in order of occurrences given in brackets): *Oridorsalis tener umbonatus* (55), *Pyrgo murrhina* (50) and *Epistominella exigua* (40). Species with positive score and high weight: *Cibicidoides pseudoungerianus* (27) and *Nummoloculina irregularis* (15).

Based on the scores of axis 2, two species are characterised by high weight and positive score: *Uvigerina proboscidea* (43) and *Bulimina aculeata* (23).

The first two axes of DCA were correlated to the environmental variables and faunal characteristics at each site (Table 4.3). The correlation matrix shows a significant correlation of axis 1 with most of the environmental variables taken into account except for the phosphate- and nitrate-concentrations and for the primary productivity levels at the sea surface. This axis is negatively ($r < -0.60$) correlated with the following variables: depth, pressure and salinity; it shows a positive correlation ($r > 0.60$) with temperature and carbon flux (calculated applying the two formulae used in this study). A minor positive correlation exists between axis 1 and Fisher's Alpha Diversity Index, Shannon Index and equitability, while an opposite correlation links this axis with dominance. Axis 1 is also weakly correlated with longitude, latitude and dissolved-oxygen concentration. Axis 2 shows a significant correlation with the following environmental variables: longitude, dissolved-oxygen concentration, salinity, phosphate, primary productivity at the sea surface, carbon flux (calculated applying the two formulae used in this study) and faunal characteristics (α, H(S), E, D). The variable characterised by the best correlation ($r = -0.52$) with this axis is dissolved-oxygen concentration.

4.2 Environmental variables-faunal characteristics correlation matrix

The environmental variables and faunal characteristics considered in this study appear to be related to water depth (Table 4.3). Those variables that are positively correlated to depth are: pressure, salinity, dissolved-oxygen concentration, dominance, primary productivity and longitude. Those characterised by a negative correlation are: temperature, carbon flux (Jz, C. flux (z)), H(S), E and α (figure 4.2).

However, two relevant parameters are not related to any depth variation: (a) dissolved-oxygen concentration is negatively correlated with phosphate and nitrate;

(b) primary productivity at the sea surface is strongly correlated with longitude.

Table 4.3 – **Correlation matrix between DCA ordination axes and the environmental variables-faunal characteristics.**
In bold are indicated those correlations significant at $p < 0.05$.

	Ax1	Ax2	Lat.	Long.	Depth	Diss. oxygen	Salinity	Temp.	Press.	Phosp.	Nit.	PP	Jz	C. flux (z)	H(S)	E	D	α
Ax1	1.00																	
Ax2	0.06	1.00																
Lat.	**0.36**	-0.09	1.00															
Long.	**-0.31**	**0.48**	**0.56**	1.00														
Depth	**-0.90**	-0.09	**0.29**	**-0.36**	1.00													
Diss. oxygen	**-0.37**	**-0.52**	**-0.44**	-0.01	**0.50**	1.00												
Salinity	**-0.69**	**0.28**	**0.49**	**-0.40**	**0.61**	-0.15	1.00											
Temp.	**0.88**	0.15	-0.19	0.22	**-0.91**	**-0.45**	**-0.60**	1.00										
Press.	**-0.90**	-0.09	**0.29**	**-0.36**	**1.00**	**0.50**	**0.61**	**-0.91**	1.00									
Phosp.	-0.08	**0.34**	**0.41**	-0.15	-0.08	**-0.63**	**0.40**	-0.07	-0.08	1.00								
Nit.	-0.19	0.21	**0.37**	-0.24	0.13	**-0.45**	**0.46**	-0.24	0.13	**0.40**	1.00							
PP	-0.22	**0.42**	**0.86**	**-0.45**	**0.31**	-0.25	**0.37**	-0.20	**0.31**	0.14	0.25	1.00						
Jz	**0.72**	**0.48**	0.21	0.03	**-0.70**	**-0.57**	**-0.34**	**0.84**	**-0.70**	0.02	-0.08	**0.29**	1.00					
C. flux(z)	**0.82**	**0.37**	0.05	0.11	**-0.80**	**-0.51**	**-0.48**	**0.92**	**-0.80**	-0.03	-0.17	0.12	**0.98**	1.00				
H(S)	**0.52**	**-0.27**	**-0.53**	**0.56**	**-0.53**	-0.09	**-0.37**	**0.41**	**-0.53**	-0.05	-0.17	**-0.44**	0.18	**0.27**	1.00			
E	**0.58**	**-0.35**	**-0.55**	**0.52**	**-0.55**	-0.02	**-0.47**	**0.45**	**-0.55**	-0.08	**-0.28**	**-0.47**	0.19	**0.30**	**0.91**	1.00		
D	**-0.41**	0.19	**0.42**	**-0.45**	**0.42**	0.09	0.24	**-0.33**	**0.42**	0.04	0.06	**0.34**	-0.18	-0.24	**-0.91**	**-0.74**	1.00	
α	**0.44**	**-0.37**	**-0.46**	**0.39**	**-0.42**	0.02	**-0.37**	**0.33**	**-0.42**	-0.06	-0.15	**-0.34**	0.12	0.20	**0.82**	**0.85**	**-0.68**	1.00

4.3 Correlation between the percentages of the species and the environmental variables-faunal characteristics

The correlation coefficients between the percentages of the taxa considered for DCA as well as the environmental variables and the faunal characteristics were also calculated (Table 4.4). The analysis of coefficients was carried out assuming the mean percentage of each species as indication of the taxon's relevance. The five species individuated by means of DCA appear to be related to the environmental variables and the faunal characteristics considered in this study, in particular with those whose correlation with the DCA ordination axes is high.

O. t. umbonatus, *E. exigua* and *P. murrhina* show a significant positive correlation primarily with depth (figure 4.3) and pressure, while to a lesser degree with salinity and, with the exception of *O. t. umbonatus*, the dissolved-oxygen concentration.

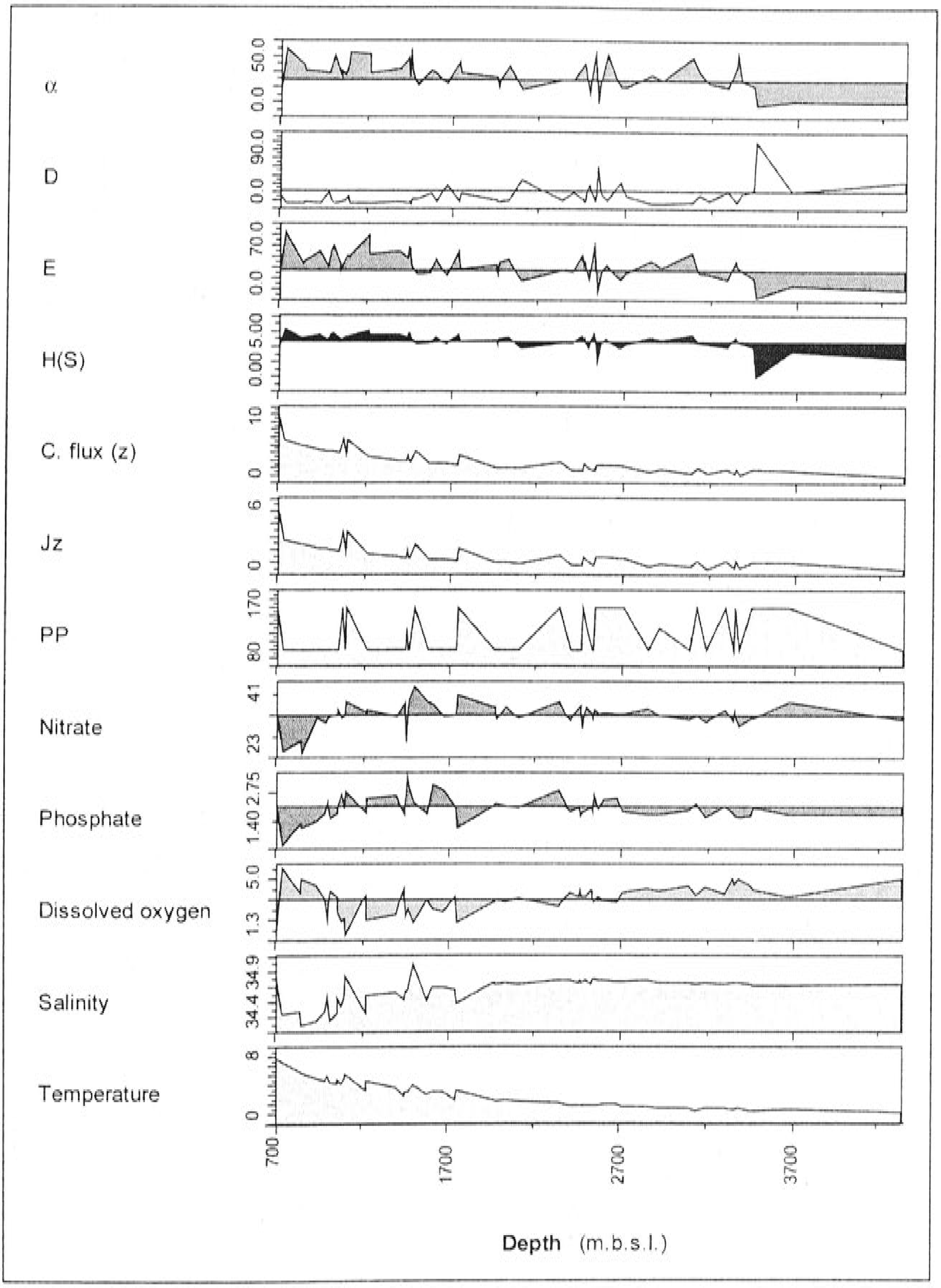

Fig. 4.2 – **Values of the environmental variables and faunal characteristics considered in this study versus depth.**
PP = Primary Productivity at the sea surface; Jz = carbon flux calculated using Berger and Wefer (1990) formula; C. flux (z) = carbon flux calculated using Suess (1980) formula; H(S) = Shannon-Weaver Index; E = Equitability; D = Dominance; α = Fisher's Alpha Index.

Table 4.4 – **Correlation coefficients between the relative percentages of benthic foraminifera species used for statistical analyses and the environmental variables-faunal characteristics considered in this study.**
In bold are indicated those correlations significant at p > 0.05. For species codes see Appendix A1.

Species Code	Lat.	Long.	Depth	Temp.	Salinity	Diss. Oxygen	Press.	Phosp.	Nit.	PP	Jz	C. flux(z)	H(S)	E	D	α
Aaglob	0.07	0.18	0.03	-0.16	**0.32**	-0.16	0.03	**0.28**	**0.32**	-0.18	-0.25	-0.25	0.12	0.05	-0.21	0.02
Astrech	**-0.34**	0.14	-0.15	0.25	**-0.38**	**0.33**	-0.15	**-0.41**	**-0.57**	-0.21	0.08	0.16	0.22	0.23	-0.22	0.20
Bolro	-0.04	0.16	**-0.31**	**0.34**	-0.17	**-0.42**	**-0.31**	0.12	0.03	-0.14	0.17	0.22	0.19	0.21	-0.09	0.16
Bolsem	-0.21	0.15	-0.23	0.14	-0.22	0.13	-0.23	-0.11	-0.10	-0.21	0.04	0.09	0.25	**0.29**	-0.23	**0.27**
Blql	0.00	0.21	**-0.28**	0.27	**-0.35**	-0.13	**-0.28**	0.02	-0.06	0.10	**0.42**	**0.40**	0.12	0.12	-0.12	0.02
Brdi	0.00	0.05	**-0.36**	**0.46**	-0.08	**-0.45**	**-0.36**	0.05	0.06	-0.07	**0.39**	**0.42**	0.11	0.10	-0.07	0.07
Brsem	0.00	0.15	0.03	-0.12	0.14	-0.01	0.03	0.05	0.09	-0.10	-0.15	-0.14	0.08	0.10	-0.02	0.08
Buac	0.23	-0.14	0.00	-0.05	0.15	-0.13	0.00	**0.27**	0.13	0.22	0.07	0.03	**-0.32**	**-0.27**	**0.31**	**-0.31**
Bualz	-0.01	0.03	0.13	**-0.29**	**0.32**	0.04	0.13	0.16	0.17	-0.09	**-0.29**	**-0.31**	0.09	0.01	-0.11	-0.03
Buco	0.05	0.04	-0.24	0.26	0.14	**-0.35**	-0.24	0.15	0.08	0.01	**0.37**	**0.35**	-0.02	-0.05	-0.04	-0.17
Buma	0.17	-0.08	-0.22	**0.40**	0.13	**-0.37**	-0.22	0.05	0.07	0.21	**0.65**	**0.59**	-0.07	-0.10	-0.01	-0.15
Caser	-0.20	0.11	**-0.32**	**0.30**	-0.25	-0.12	**-0.32**	-0.06	-0.05	-0.16	0.18	0.23	0.20	0.21	-0.20	**0.30**
Caslae	-0.25	0.08	**-0.30**	0.14	-0.24	-0.04	**-0.30**	-0.09	0.17	-0.12	0.12	0.15	0.17	0.17	-0.14	0.18
Cassre	-0.08	-0.12	0.14	**-0.26**	**0.26**	0.09	0.14	0.02	0.05	-0.16	**-0.29**	**-0.29**	0.00	-0.05	0.08	-0.07
Cerpa	-0.08	**0.33**	-0.18	0.07	0.05	-0.23	-0.18	0.12	0.12	-0.08	0.03	0.04	0.24	0.21	-0.24	**0.27**
Chol	0.06	0.04	**-0.28**	**0.35**	-0.22	-0.03	**-0.28**	-0.13	**-0.27**	0.10	**0.35**	**0.37**	0.08	0.21	0.02	0.05
Cibr	-0.15	-0.02	**-0.29**	**0.31**	**-0.33**	-0.04	**-0.29**	-0.18	-0.06	-0.04	0.20	0.25	**0.44**	**0.43**	**-0.47**	**0.52**
Ciku	-0.09	-0.15	-0.26	0.26	**-0.28**	-0.03	-0.26	-0.07	-0.02	-0.05	0.11	0.17	**0.30**	**0.27**	**-0.38**	0.24
Cipse	-0.21	0.12	**-0.59**	**-0.58**	**-0.58**	-0.05	**-0.59**	**-0.36**	**-0.40**	-0.10	**0.67**	**0.73**	0.21	0.22	-0.26	0.19
Cirob	-0.20	0.20	0.11	-0.11	-0.09	0.21	0.11	-0.15	-0.13	-0.02	-0.15	-0.14	0.22	0.21	-0.18	**0.30**
Ciwul	-0.06	-0.02	0.06	-0.15	0.19	-0.03	0.06	0.08	-0.02	-0.13	-0.19	-0.19	-0.07	-0.18	0.08	-0.20
Cisp	**-0.29**	0.19	**-0.30**	**0.36**	**-0.41**	0.15	**-0.30**	**-0.34**	**-0.27**	-0.13	**0.33**	**0.38**	**0.28**	**0.36**	-0.21	0.17
Egbr	0.08	-0.13	0.20	-0.19	0.19	0.14	0.20	-0.12	0.10	0.14	-0.06	-0.10	-0.10	-0.22	-0.01	-0.24
Ehtr	-0.09	0.14	**-0.29**	0.25	**-0.28**	-0.19	**-0.29**	0.11	-0.02	-0.17	0.11	0.17	0.12	0.09	-0.05	0.07
Epex	**0.27**	**-0.29**	**0.73**	**-0.52**	**0.29**	**0.37**	**0.73**	-0.14	0.01	**0.27**	**-0.38**	**-0.44**	**-0.45**	**-0.49**	**0.32**	**-0.43**
Exum	-0.04	-0.05	**0.26**	-0.08	-0.06	0.24	**0.26**	-0.16	-0.15	-0.11	-0.11	-0.10	**-0.30**	-0.26	0.19	**-0.28**
Fispp	-0.13	0.10	0.15	**-0.31**	0.21	0.08	0.15	0.01	0.17	-0.20	**-0.32**	**-0.33**	0.18	0.07	-0.21	0.06
Furfs	0.10	0.02	0.14	-0.11	0.13	-0.05	0.14	0.08	0.02	0.19	0.00	-0.05	0.03	-0.04	-0.03	-0.06
Galo	-0.02	-0.05	**-0.48**	**0.50**	-0.19	**-0.33**	**-0.48**	0.07	0.02	-0.03	**0.40**	**0.43**	**0.27**	**0.32**	-0.24	**0.29**
Glpa	0.07	0.12	**-0.30**	**0.40**	**-0.28**	-0.18	**-0.30**	-0.05	-0.12	0.17	**0.57**	**0.55**	0.12	0.13	-0.10	0.03
Glcsb	**0.37**	**-0.39**	0.24	-0.21	0.16	0.03	0.24	0.07	0.10	0.24	-0.13	-0.17	**-0.62**	**-0.44**	**0.71**	**-0.40**
Gyral	0.10	**0.26**	-0.13	0.08	0.01	**-0.27**	-0.13	0.10	0.11	0.14	0.10	0.07	0.09	0.04	-0.04	0.11
Gyrlmk	**-0.41**	0.16	-0.04	-0.07	-0.14	0.18	-0.04	-0.08	0.06	-0.25	-0.13	-0.10	**0.30**	**0.44**	-0.16	**0.36**
Gyror	0.06	-0.09	0.18	-0.14	0.15	0.05	0.18	0.10	0.09	0.05	-0.17	-0.17	0.13	0.13	-0.13	0.14
Gyrpo	0.05	**-0.34**	**0.53**	**0.33**	**-0.46**	**0.30**	**0.53**	-0.12	0.05	0.05	**-0.39**	**-0.44**	-0.17	-0.23	0.12	-0.25
Gyrso	-0.30	**0.27**	**-0.26**	-0.23	0.19	-0.07	**-0.26**	-0.06	-0.06	**-0.27**	0.03	0.09	**0.27**	0.22	-0.32	0.20
Hurin	-0.21	**0.27**	**-0.35**	**-0.41**	**0.31**	0.01	**-0.35**	-0.14	**-0.42**	-0.14	0.21	**0.27**	**0.34**	**0.49**	-0.19	0.21
Hoel	0.05	0.20	**-0.28**	0.15	0.14	**-0.34**	**-0.28**	**0.34**	0.18	-0.15	0.05	0.07	0.24	0.22	**-0.27**	0.03
Hyba	0.17	0.05	**-0.28**	-0.03	**0.41**	**-0.38**	**-0.28**	0.08	-0.01	0.25	**0.71**	**0.64**	-0.02	-0.06	-0.04	-0.14
Karbr	-0.24	0.14	**-0.41**	**-0.43**	**0.35**	-0.07	**-0.41**	-0.13	-0.05	**-0.32**	0.10	0.20	0.12	0.07	-0.09	0.15
Laspp	-0.03	-0.08	0.09	0.20	-0.08	-0.03	0.09	-0.08	0.14	-0.05	-0.04	-0.06	0.23	0.18	-0.23	0.26
Ltpa	0.03	-0.09	**0.39**	**0.29**	**-0.39**	0.26	**0.39**	0.05	0.04	0.13	**-0.32**	**-0.37**	0.06	-0.04	-0.11	0.15

Table 4.4 – *(continued)*.

Species Code	Lat.	Long.	Depth	Salinity	Temp.	Diss. Oxygen	Press.	Phosp.	Nit.	PP	Jz	C. flux(z)	H(S)	E	D	α
Lespp	0.21	0.04	**-0.35**	-0.12	**0.51**	**-0.52**	**-0.35**	-0.06	0.11	0.21	**0.58**	**0.55**	0.10	0.07	-0.09	0.16
Mtcom	**0.32**	0.14	-0.20	-0.14	0.24	**-0.41**	-0.20	0.08	0.11	**0.38**	**0.51**	**0.43**	0.04	0.00	-0.06	0.00
Meba	-0.15	0.04	**-0.39**	**-0.42**	**0.41**	-0.01	**-0.39**	-0.13	-0.19	-0.06	**0.33**	**0.38**	0.05	0.08	-0.08	0.06
Mepo	-0.10	-0.05	0.26	0.12	-0.20	0.20	0.26	-0.11	-0.09	-0.14	-0.21	-0.22	-0.17	-0.17	0.16	-0.18
Miob	**-0.35**	0.21	**-0.33**	**-0.56**	**0.42**	**0.35**	**-0.33**	**-0.48**	**-0.57**	-0.24	0.24	**0.33**	**0.36**	**0.54**	-0.22	**0.34**
Nntu	-0.26	0.11	-0.21	-0.26	0.20	0.26	-0.21	**-0.32**	-0.12	-0.15	0.10	0.15	0.20	**0.29**	-0.14	**0.29**
Numir	**-0.52**	0.25	**-0.54**	**-0.78**	**0.54**	**0.39**	**-0.54**	**-0.50**	**-0.48**	**-0.35**	**0.30**	**0.42**	**0.41**	**0.55**	-0.24	**0.42**
Oospp	0.05	-0.02	**0.42**	**0.26**	**-0.45**	**0.27**	**0.42**	-0.07	0.14	0.12	**-0.38**	**-0.41**	-0.06	-0.19	-0.03	-0.03
Ortu	0.10	-0.20	**0.52**	**0.46**	**-0.59**	0.25	**0.52**	0.03	0.11	0.12	**-0.48**	**-0.53**	-0.21	**-0.31**	0.14	-0.21
Oscu	-0.16	**0.31**	**-0.55**	-0.25	**0.39**	**-0.44**	**-0.55**	**0.31**	0.09	-0.25	0.20	0.26	**0.34**	**0.33**	**-0.28**	0.24
Paspp	**-0.32**	0.18	0.07	0.02	-0.12	**0.28**	0.07	-0.21	-0.17	**-0.27**	-0.22	-0.19	0.06	0.06	-0.03	0.09
Pubu	0.19	0.25	0.12	0.06	-0.16	-0.11	0.12	-0.02	0.07	0.14	-0.02	-0.07	0.14	0.07	-0.16	0.02
Pu5	0.09	-0.12	0.09	-0.01	0.04	0.09	0.09	-0.20	-0.11	0.16	0.05	0.04	0.10	0.06	-0.18	0.21
Pyde	-0.02	0.15	-0.23	-0.18	0.14	-0.15	-0.23	0.12	-0.10	-0.01	0.09	0.12	0.25	0.20	**-0.26**	0.25
Pyel	**-0.38**	0.15	**-0.46**	**-0.65**	**0.44**	0.09	**-0.46**	-0.21	-0.21	**-0.31**	0.24	**0.35**	0.25	0.31	-0.16	0.25
Pylu	-0.12	0.01	0.10	-0.13	-0.03	**0.30**	0.10	-0.19	**-0.33**	-0.04	-0.07	-0.05	-0.01	-0.03	-0.05	-0.02
Pyu	0.25	**-0.37**	**0.60**	**0.35**	**-0.52**	**0.32**	**0.60**	-0.08	0.16	**0.29**	**-0.37**	**-0.44**	**-0.26**	**-0.36**	0.11	**-0.34**
Qusem	**-0.53**	0.22	-0.16	-0.21	0.02	0.23	-0.16	-0.06	-0.06	**-0.61**	**-0.27**	-0.16	**0.38**	**0.35**	**-0.33**	**0.28**
Quve	-0.19	0.23	0.11	0.00	-0.14	0.18	0.11	-0.15	0.04	0.00	-0.10	-0.11	0.09	0.06	-0.08	0.24
Redi	-0.09	-0.01	-0.23	**-0.28**	0.25	0.00	-0.23	-0.09	0.02	-0.04	0.21	0.24	0.15	0.18	-0.13	0.10
Rbta	**-0.36**	0.24	**-0.47**	**-0.49**	**0.43**	0.07	**-0.47**	-0.21	-0.20	**-0.28**	0.23	**0.32**	**0.34**	**0.45**	-0.25	**0.29**
Sgmsch	0.04	-0.10	-0.16	-0.03	0.11	-0.16	-0.16	**0.29**	-0.03	-0.03	0.07	0.09	0.14	0.15	-0.18	**0.27**
Stxca	-0.01	-0.06	0.23	0.17	-0.22	0.14	0.23	0.02	-0.05	0.02	-0.20	-0.22	-0.10	-0.12	0.12	-0.05
Stxcu	-0.03	0.09	-0.26	-0.06	**0.28**	-0.22	-0.26	0.00	0.04	-0.07	0.15	0.19	0.09	0.10	-0.13	0.03
Sbull	-0.25	0.14	0.26	0.06	-0.16	**0.46**	0.26	**-0.39**	-0.21	-0.13	-0.22	-0.21	0.19	0.21	-0.19	0.15
Txag	-0.13	-0.05	**0.36**	0.13	-0.23	0.25	**0.36**	-0.14	-0.11	-0.17	**-0.26**	-0.26	-0.13	-0.13	0.02	-0.13
Txlyt	-0.10	0.15	**-0.34**	**-0.30**	**0.31**	-0.25	**-0.34**	0.07	-0.10	-0.12	0.21	0.25	0.20	0.22	-0.08	0.13
Txpgr	-0.25	0.15	-0.23	**-0.29**	0.19	0.18	-0.23	-0.23	-0.07	-0.14	0.12	0.17	0.20	**0.26**	-0.15	0.26
Trtr	**-0.30**	0.15	-0.24	-0.15	0.22	0.04	-0.24	-0.16	-0.11	-0.17	0.11	0.16	**0.38**	**0.52**	-0.19	**0.39**
Trgo	-0.19	0.25	-0.19	-0.21	0.06	-0.02	-0.19	-0.09	0.12	-0.06	0.07	0.08	0.11	0.09	-0.09	0.17
Uvpe	-0.16	0.06	-0.20	0.06	0.10	-0.21	-0.20	**0.38**	0.10	**-0.36**	-0.07	-0.02	0.06	-0.02	-0.10	-0.02
Uvprob	0.17	0.24	**-0.27**	-0.04	**0.34**	**-0.49**	**-0.27**	-0.02	0.10	0.22	**0.46**	**0.42**	0.04	-0.04	-0.01	-0.04
Vlsp	-0.24	0.18	**-0.31**	**-0.44**	**0.28**	0.06	**-0.31**	-0.11	-0.15	-0.20	0.14	0.21	**0.33**	**0.49**	-0.20	**0.32**

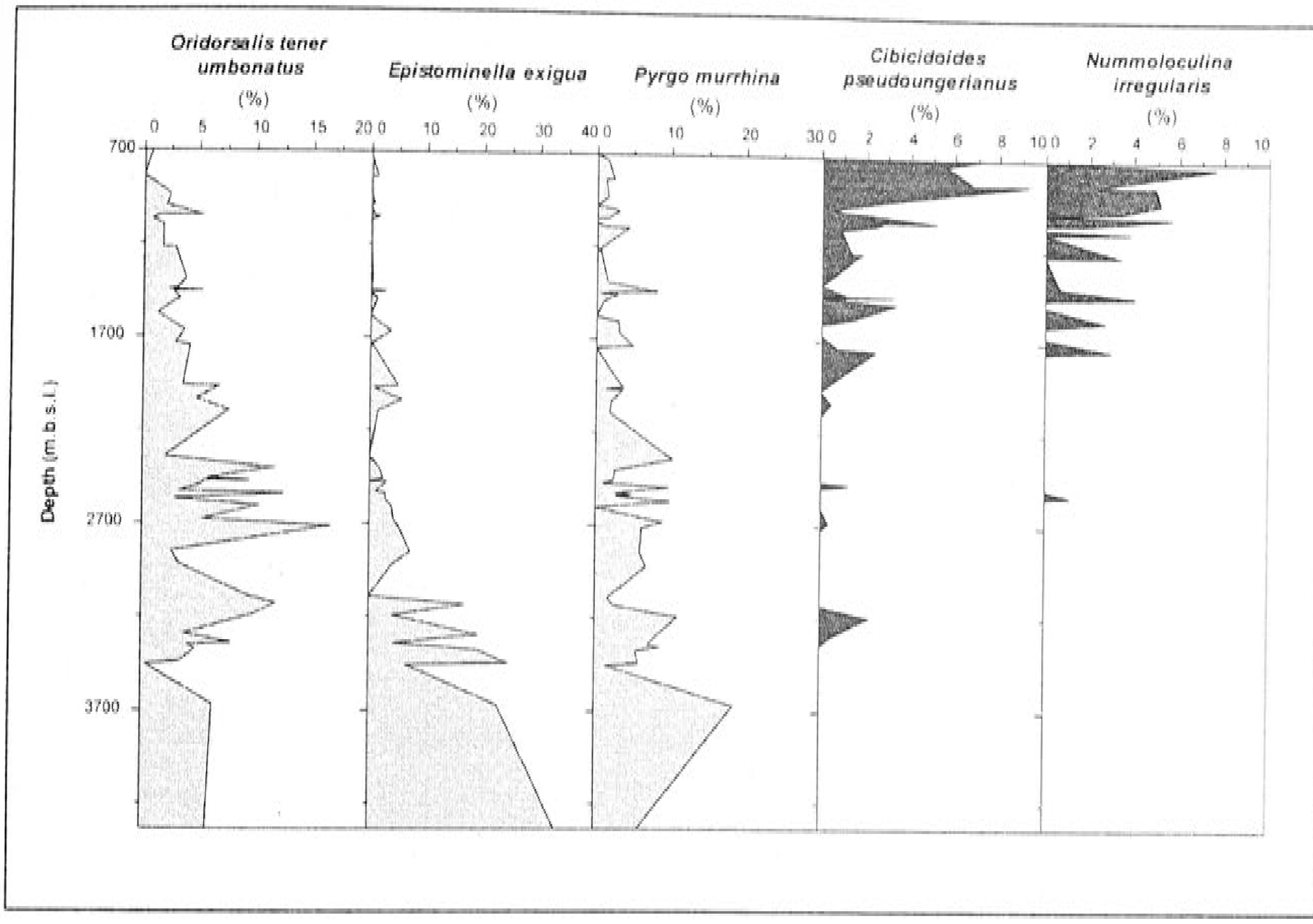

Fig. 4.3 – **Species showing highest correlation with depth.**
Percentages of *O. t. umbonatus*, *E. exigua* and *P. murrhina* (listed in order of mean percentage) increase when depth increases, while an opposite trend characterises the percentages of *C. pseudoungerianus* and *N. irregularis* (listed in order of mean percentage).

O t. umbonatus, *P. murrhina* and *E. exigua* have a negative correlation with temperature and carbon flux (Jz and C. flux(z)). *E. exigua* and *P. murrhina* also show a negative correlation with the faunal diversity, while being directly related to dominance.

On the other hand, *C. pseudoungerianus* and *N. irregularis* are characterised by opposite trends, being negatively correlated with depth (figure 4.3) and pressure and positively with temperature. *C. pseudoungerianus* shows high correlation with carbon flux (Jz and C. flux(z)) (figure 4.4a and 4.4b). *N. irregularis* is correlated with salinity, dissolved oxygen (figure 4.5) and the faunal diversity.

U. proboscidea is positively correlated with the carbon flux (Jz and C. flux(z)) and negatively with dissolved-oxygen concentration (figure 4.6) . The distribution of *B. aculeata* is related to phosphate concentration (figure 4.7) and dominance, while it is negatively correlated with faunal diversity.

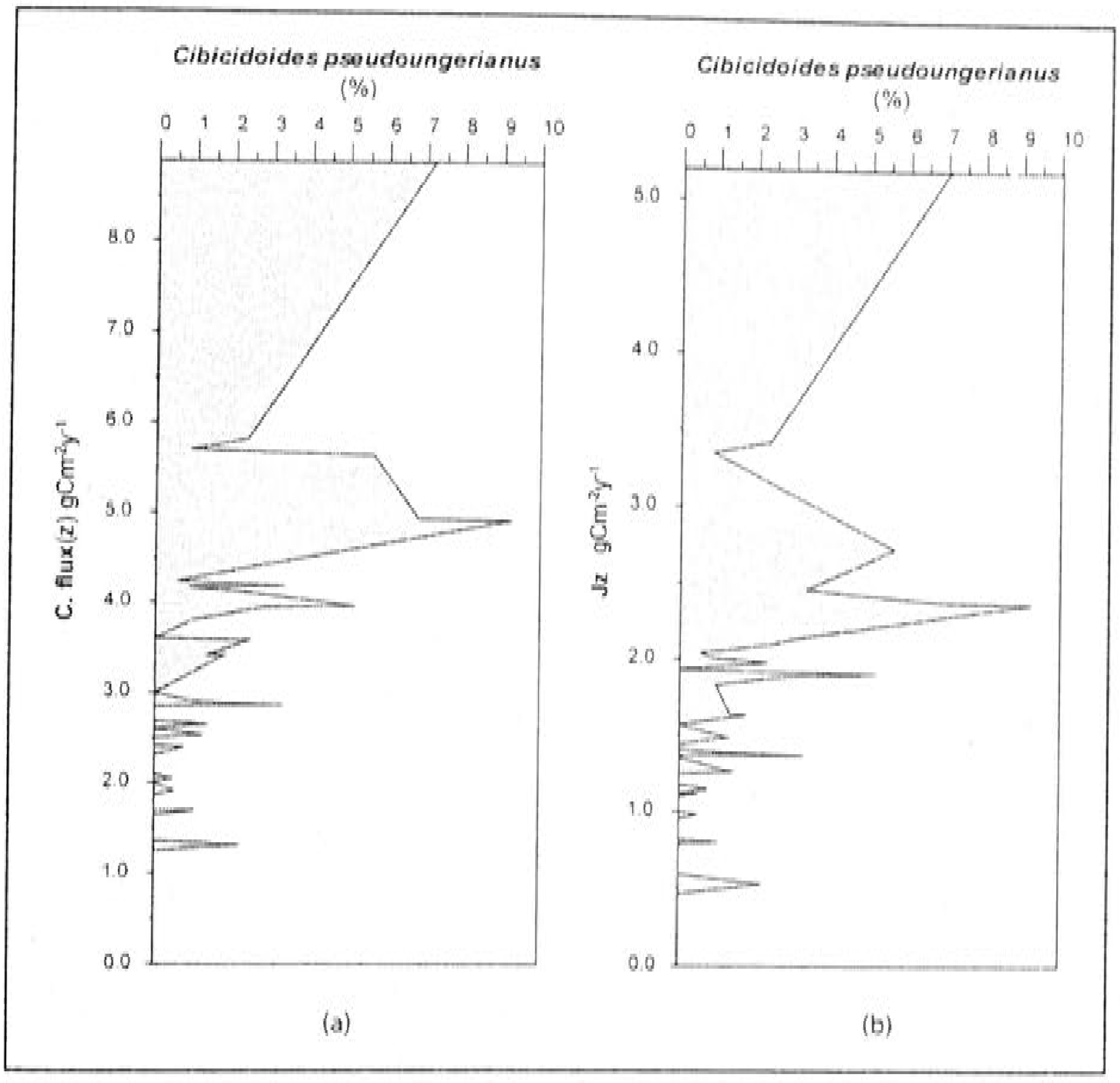

Fig. 4.4 – **Diagram showing the correlation between the distribution of *C. pseudoungerianus* and carbon flux, calculated using (a) Suess (1980) [C. flux(z)] and (b) Berger and Wefer (1990) [Jz] formulae.**

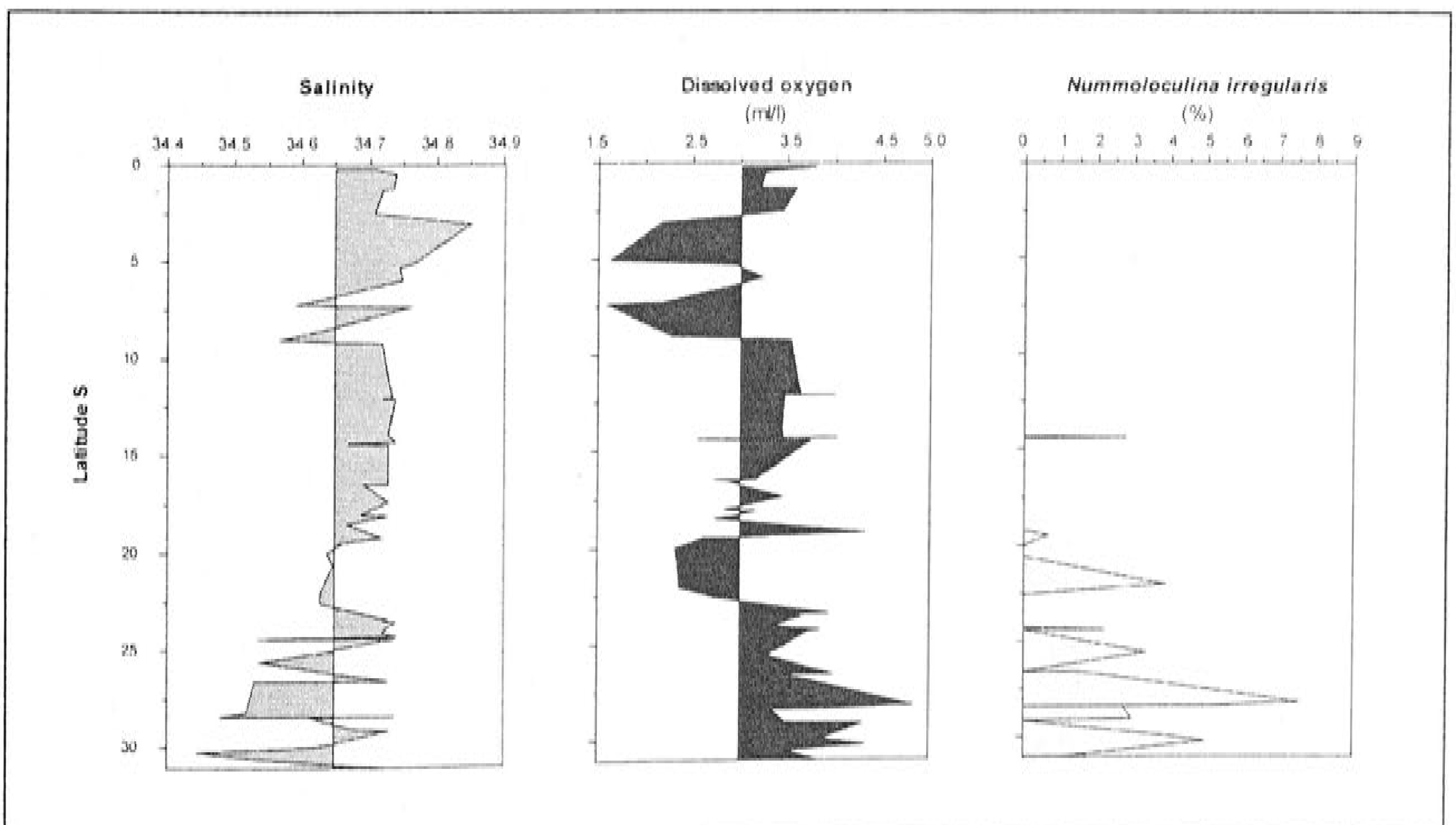

Fig. 4.5 – ***N. irregularis*** **has higher percentages south of 20°S, for environments characterised generally, by high dissolved-oxygen concentration.**

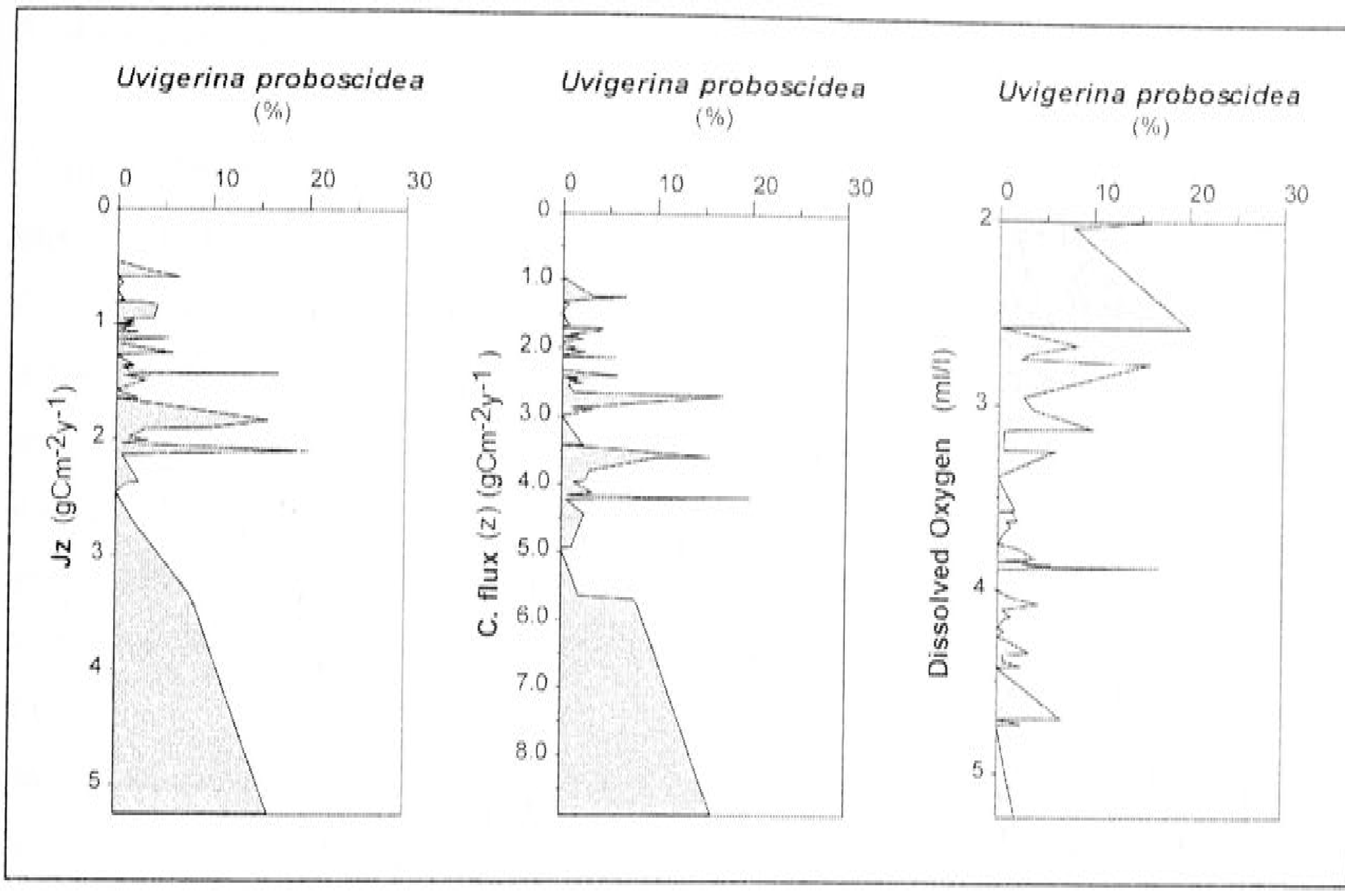

Fig. 4.6 – **Percentages of *U. proboscidea* plotted versus carbon flux calculated using Berger and Wefer (1990) [Jz], Suess (1980) [C. flux(z)] formulae and dissolved-oxygen concentration.**
The percentage of this species shows higher values when carbon flux reaches values around 2-3 $gCm^{-2}y^{-1}$ and when dissolved-oxygen concentration is lower than 3ml/l.

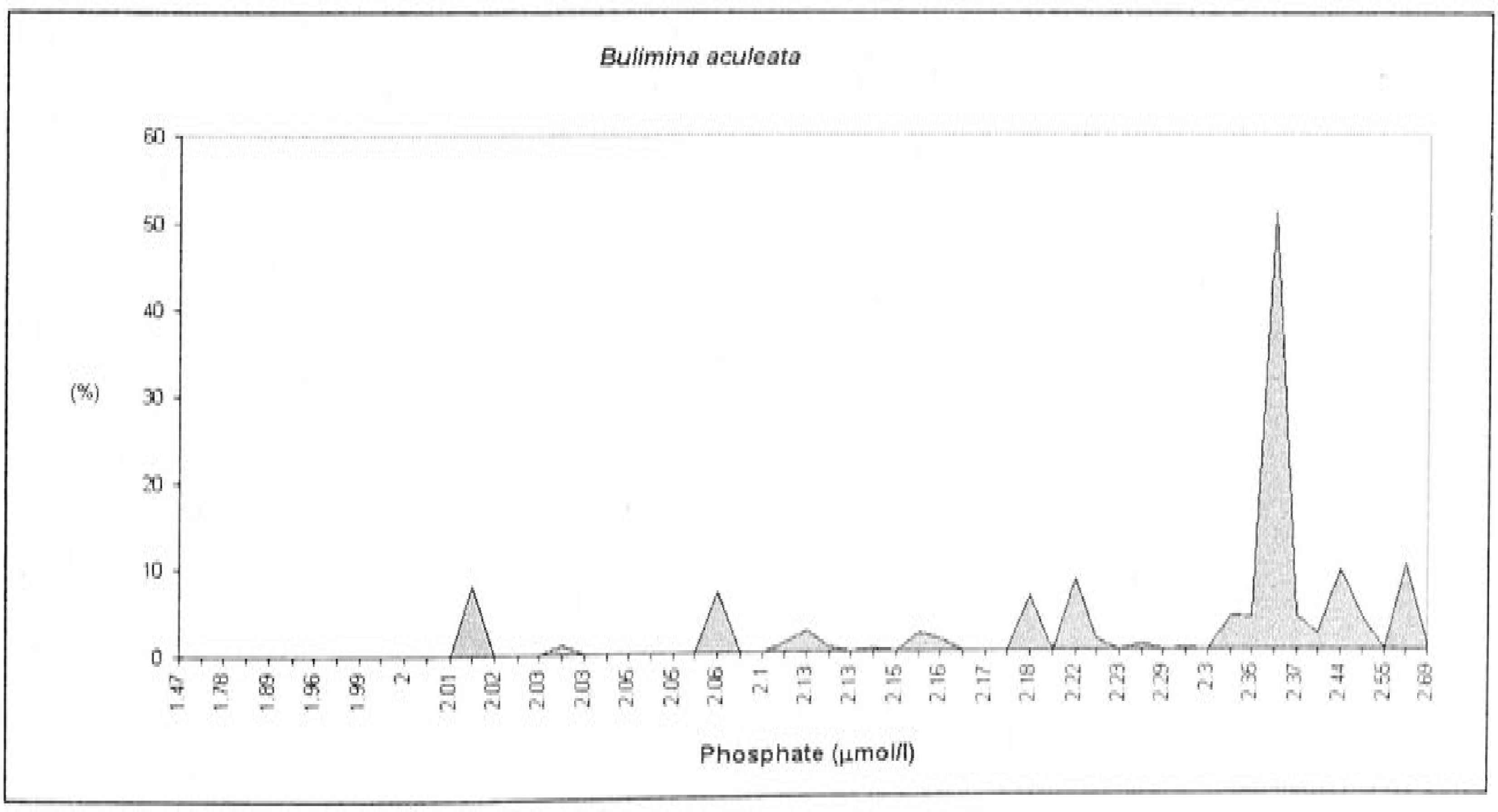

Fig. 4.7 – **Percentage of *B. aculeata* plotted versus phosphate concentration (µmol/l). This species has higher percentages for high phosphate concentration levels.**

4.4 Canonical Correspondence analysis (CCA)

In order to evaluate how well the environmental variables and faunal characteristics explain the distribution of the identified species a Canonical Correspondence Analysis (CCA) was performed. The total variance explained by the algorithm is 30.7%. This value is close to the percentage of variance explained by mean of DCA. CCA produced axes that are mirror-like to those produced by DCA. In any case, the relationships species-axes are the same as those given by the indirect gradient analysis. In Table 4.5, the interset correlations between the environmental variables, faunal characteristics and the canonical axes are given. The relationship between species distribution and depth is indicated also by this ordination technique, as underlined by the strong correlation between the first axis and this variable. A similar observation can be made for temperature, salinity and carbon flux. There is also a significant correlation between the second axis of the CCA and two environmental variables: dissolved-oxygen concentration and phosphate. The relationships between the environmental variables, the Canonical Correspondence axes, the five species individuated by DCA are shown in figure 4.8. *O. t. umbonatus*, *E. exigua* and *P. murrhina* are on the right-hand side of the diagram and show a close relationship with depth. *C. pseudoungerianus* and *N. irregularis* are on the left-hand side, showing a negative correlation with this parameter. The second taxon shows a correlation with the three indexes calculated to measure the faunal diversity. *U. proboscidea* is negatively correlated with dissolved-oxygen concentration; *B. aculeata* is directly related to phosphate concentration.

Table 4.5 – **Intereset correlations between the first two ordination axes calculated by means of Canonical Correspondence Analysis and the environmental variables-faunal characteristics considered in this study.**
High positive and negative correlations are indicated in bold.

	CCA1	CCA2
Latitude	0.31	-0.52
Longitude	-0.34	-0.01
Depth	**0.91**	0.16
Dissolved Oxygen	0.35	**0.78**
Salinity	**0.71**	-0.41
Temperature	**-0.88**	-0.09
Pressure	**0.91**	0.16

Table 4.5 – *(continued).*

	CCA1	CCA2
Phosphate	0.10	**-0.61**
Nitrate	0.22	-0.43
PP	0.22	-0.29
Jz	**-0.73**	-0.29
C. flux(z)	**-0.83**	-0.20
H(S)	-0.54	0.22
E	-0.59	0.33
D	0.41	-0.13
α	-0.34	0.32

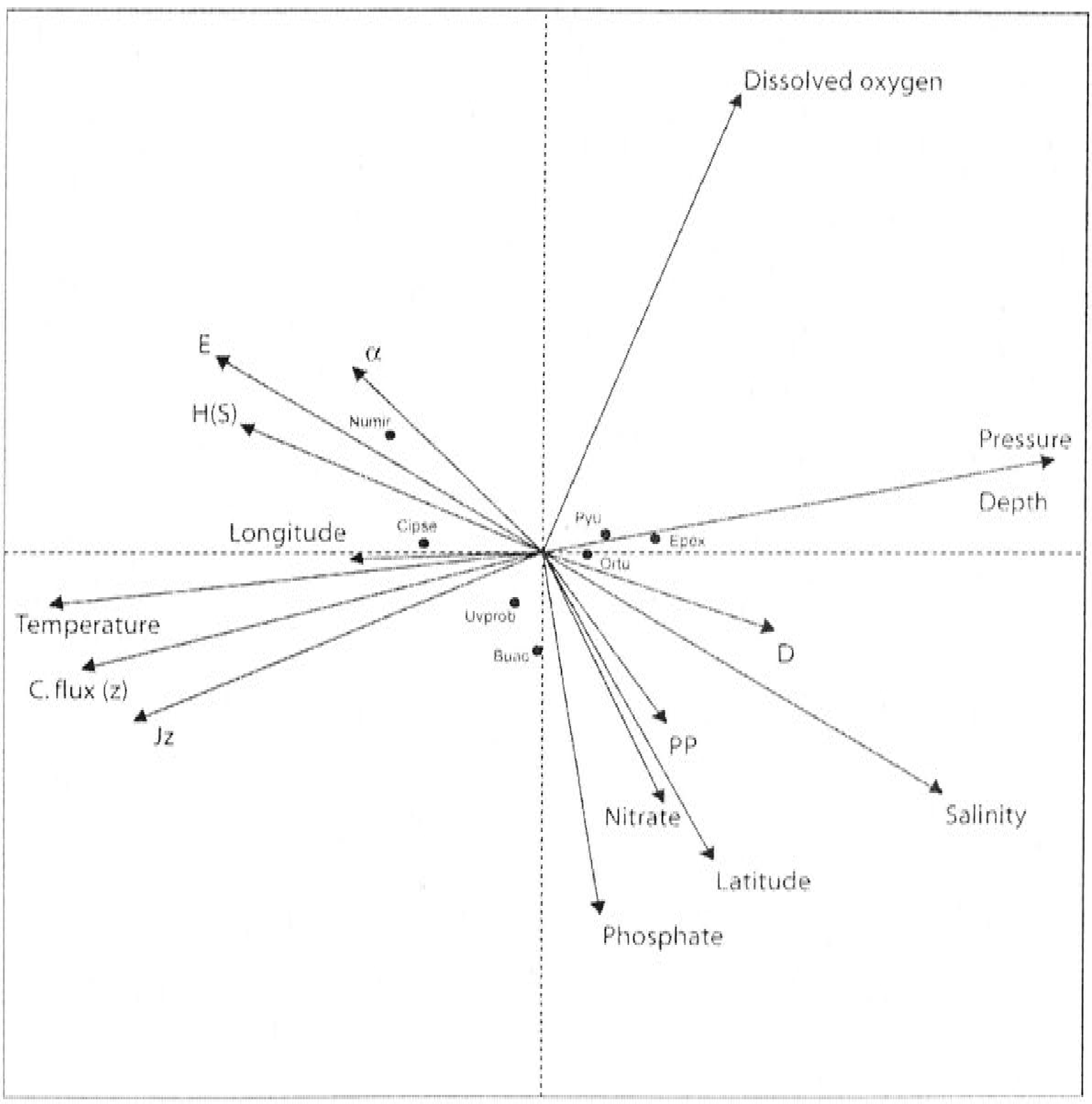

Fig. 4.8 – **Diagram showing the relationships between the environmental variables, faunal characteristics (arrows) and the first two CCA axes (see text for further explanation).** The length of the arrows indicates the influence of the variables on the axes and the angles between the arrows and the axes are inversely proportional to the correlation variable-axis. The five species individuated with DCA are also plotted on the diagram and their position outlines their relationships with the CCA axes and with the environmental variables. Species codes: Cipse = *C. pseudoungerianus*; Numir = *N. irregularis*; Ortu = *O. t. umbonatus*; Epex = *E. exigua*; Pyu = *P. murrhina*; Uvprob = *U. proboscidea*; Buac = *B. aculeata*.

4.5 Correlation between the agglutinated, calcareous infaunal and porcellaneous taxa and the environmental variables-faunal characteristics

In order to investigate the relationship between the three groups of benthic foraminifera (agglutinated, calcareous infaunal [hereafter referred as infaunal] and porcellaneous), the measured environmental variables and the faunal characteristics the correlation matrix shown in Table 4.6 was calculated.

Table 4.6 – **Correlation coefficients between the percentages of the agglutinated, calcareous infaunal and porcellaneous taxa and the environmental variables-faunal characteristics considered in this study.**
Those correlations significant at $p > 0.05$ are indicated in bold.

	Agglutinated	Infaunal	Porcellaneous
Latitude	-0.11	0.01	**-0.38**
Longitude	0.05	**0.32**	0.09
Depth	0.17	**-0.51**	-0.14
Dissolved oxygen	0.15	**-0.54**	**0.39**
Salinity	0.05	-0.08	**-0.44**
Temperature	-0.17	**0.46**	0.08
Pressure	0.17	**-0.51**	-0.14
Phosphate	0.05	0.19	**-0.31**
Nitrate	0.01	0.11	**-0.31**
PP	0.05	0.00	-0.21
Jz	-0.16	**0.54**	-0.06
C. flux(z)	-0.17	**0.53**	0.02
H(S)	**0.28**	0.21	0.37
E	0.23	0.12	**0.40**
D	**-0.29**	-0.20	**-0.32**
α	**0.49**	0.06	**0.33**

The distribution of the agglutinated group is positively correlated with α and H(S), while it shows a negative correlation with dominance. The infaunal species distribution is negatively correlated with dissolved oxygen, depth, and pressure, while it is positively correlated with Jz, C. flux(z), temperature and longitude. The porcellaneous taxa distribution is negatively correlated with salinity, latitude, phosphate and nitrate concentrations and dominance. This group of species shows a positive correlation with dissolved oxygen, equitability and α.

5. Discussion

The distribution of the 75 species analysed here appears to be controlled by depth. On the basis of the score sign on axis 1 and the weight of each species, two major groups of taxa were identified: one is negatively correlated with depth (species with positive score on axis 1) and the other is characterised by an opposite trend (species with negative score on axis1).

The first group is dominated by *C. pseudoungerianus* and *N. irregularis*, whose distribution is limited to the upper water column between 700 m and 2000 m water depth (figure 4.3), where water temperature is warm.

The distribution *C. pseudoungerianus* is strongly correlated to carbon flux and this species becomes abundant when this parameter is ≥ 1.5-2 $gCm^{-2}y^{-1}$ (figure 4.4). A limited distribution of this species to the upper part of the water column was observed by other studies where it is indicated to be typical of neritic-bathyal (Barbieri, 1998) and bathyal settings (Spencer, 1996). In the Atlantic Ocean, *C. pseudoungerianus* is indicated as a species present in samples from the first 1500 m of the water column, where carbon-flux rate is higher than 2 $gCm^{-2}y^{-1}$ (Altenbach et al., 1999).

N. irregularis is a miliolid taxon, whose distribution is related to low salinity and to prevalently high dissolved-oxygen concentration: in the eastern Indian Ocean, these two conditions are verified mainly south of 20°S (figure 4.5). The low salinity level (34.4), which characterises the latitudinal and depth range where this species is found, is due to the presence of the Antarctic Intermediate Water (AAIW). High dissolved-oxygen concentrations are related to two major factors: the presence of the AAIW, whose oxygen concentration is > 4 ml/l, and low primary productivity level at the sea surface (figures 3.21), which in turn determines low organic-carbon flux to the sea floor. In an environment where the amount of organic matter reaching the sea floor is scarce, the consequent oxygen depletion related to its oxidation is minimal. Furthermore, miliolid taxa have already been associated with increased ventilation in the Arabian and the South China Seas (den Dulk et al., 2000; Huang, 2002).

The second group includes three species: *O. t. umbonatus*, *E. exigua* and *P. murrhina*. The distribution of these three taxa is strongly controlled by depth (figure 4.3). In this region the measured variables - with the exception of phosphate and nitrate - are all correlated with depth: any variation of this latter determines a modification of the other parameters. According to the correlations between species percentages and the environmental variables, *O. t. umbonatus*, *E. exigua* and *P. murrhina* find better conditions in a deep environment characterised by low water temperature, which is relatively well oxygenated and oligotrophic, where the amount of organic matter reaching the sea floor is reduced and/or concentrated in specific periods. In the eastern Indian Ocean, *O. t. umbonatus* was found to be abundant in deep water (>2500 m) by Corliss (1979a) and Peterson (1984), who both associated this species to Antarctic Bottom Water and Indian Deep Water respectively. In the Atlantic Ocean, the Sulu Sea and the South China Sea, *O. t. umbonatus* percentages have been observed to rise with increasing depth and decreasing organic carbon values (Mackensen et al., 1985; Miao and Thunell, 1993; Rathburn and Corliss, 1994). Rathburn and Corliss (1994) mentioned the capability of this species to make use of limited amounts of food.

E. exigua has been observed to inhabit phytodetritus layers deposited on the sea-floor (Gooday, 1988; Gooday, 1993; Smart et al., 1994). This species is known to behave as an *r-strategist* (Jannik et al., 1998), being able to grow and reproduce rapidly in the presence of phytodetritus (Kurbjeweit et al., 2000), thus becoming the most abundant taxon and determining high-dominance levels. This last condition is verified for the samples in which *E. exigua* is found. This adaptative mechanism could favour its appearance in presence of pulsed fluxes of organic matter in an environment prevalently characterised by oligotrophic conditions. These pulses could be related to the monsoonal climate: the change of wind direction determines the presence/absence of the South Java Upwelling System, offshore Java and Sumatra, and, by affecting rainfall levels, the amount of riverine discharge offshore northwest Western Australia.

In the Indian Deep Water assemblage, as defined by Peterson (1984), one of the relevant taxa among *Pyrgo* spp., was *P. murrhina*. In the Sulu Sea, Miao and Thunell (1993) found that the abundance of their *P. murrhina* assemblage was negatively correlated with sediment organic carbon content and positively correlated with the thickness of the oxygenated layer in the sediment.

On the basis of DCA weight species and their scores on axis 2, it is possible to isolate two taxa: *U. proboscidea* and *B. aculeata*. *U. proboscidea* is correlated with carbon flux and with dissolved-oxygen concentration. The percentage of this species is higher for values of carbon flux ≥ 1.5-2 gCm^2y^{-1} and low dissolved-oxygen concentration (<3ml/l) (figure 4.6). In this region, these conditions are verified mainly for intermediate depth. In one case (sample B9442), when the percentage of this taxon is higher below 2000 m, the carbon flux is still above the indicated threshold. This aspect could indicate that the distribution of *U. proboscidea* is related to the co-variance of these two parameters: oxygen and carbon flux. At the sea floor, these two parameters are correlated: the dissolved-oxygen concentration is given by the value typical of each water mass combined with the oxygen depletion due to the oxidation of the organic matter. The distribution of *U. proboscidea* is mainly limited north of 25°S and between a 700-2000 m depth. These spatial ranges are characterised by two factors: (a) the presence of oxygen-depleted water masses such as Indonesian Intermediate Water (IIW) and North Indian Intermediate Water (NIIW) and (b) high primary productivity at the sea surface, with consequent high carbon flux (figure 5.1).

In the Sulu Sea, Rathburn and Corliss (1994) observed that, for the area studied, the abundance of *U. proboscidea* was associated to high-organic carbon values irrespective of bottom-water oxygen levels. Miao and Thunell (1993) identified in the Sulu Sea the *Uvigerina* spp. assemblage abundant above 1500 m. This assemblage is associated to the shallowest oxygen penetration in the sediment and the higher carbon content in the surface sediments. In the Indian Ocean, *U. proboscidea* has been utilised in palaeoenvironmental studies by Gupta and Srinivasan (1992) and by Wells et al. (1994), as its abundance is correlated to past enhanced productivity periods,.

B. aculeata is associated with high phosphate concentration (figure 4.7) and high dominance level. The distribution of this taxon is mainly limited to low latitude (off shore Java and Sumatra), where phosphate concentration (figure 5.2a) and primary productivity (figure 3.21) are high, in an area with a steep slope, which could favour downward advection of part of the organic matter sunk to the shelf. The higher phosphate concentration recorded within that depth range is associated with the phosphate enrichment of the Indian Deep Water during its northward pattern: the organic matter received from the sea surface and the continental margins causes enrichment in nutrients (Toole and Warren, 1993). The preference of *B. aculeata* for refractory organic matter (Jannik et al., 1998; Kurbjeweit et al., 2000) could explain a situation where a more degraded organic matter is then sporadically transported from the shelf to the depth where this species shows higher percentages in this region

(1300-2500 m) (figure 5.2b). The relationship with dominance could then be related to an opportunistic behaviour (Jannik et al., 1998), marked by periods of high reproduction (*r-strategist*) related to this unpredictable/pulsed food-availability (caused by seasonal events, sporadic lateral advection from the shelf and terrigenous inputs).

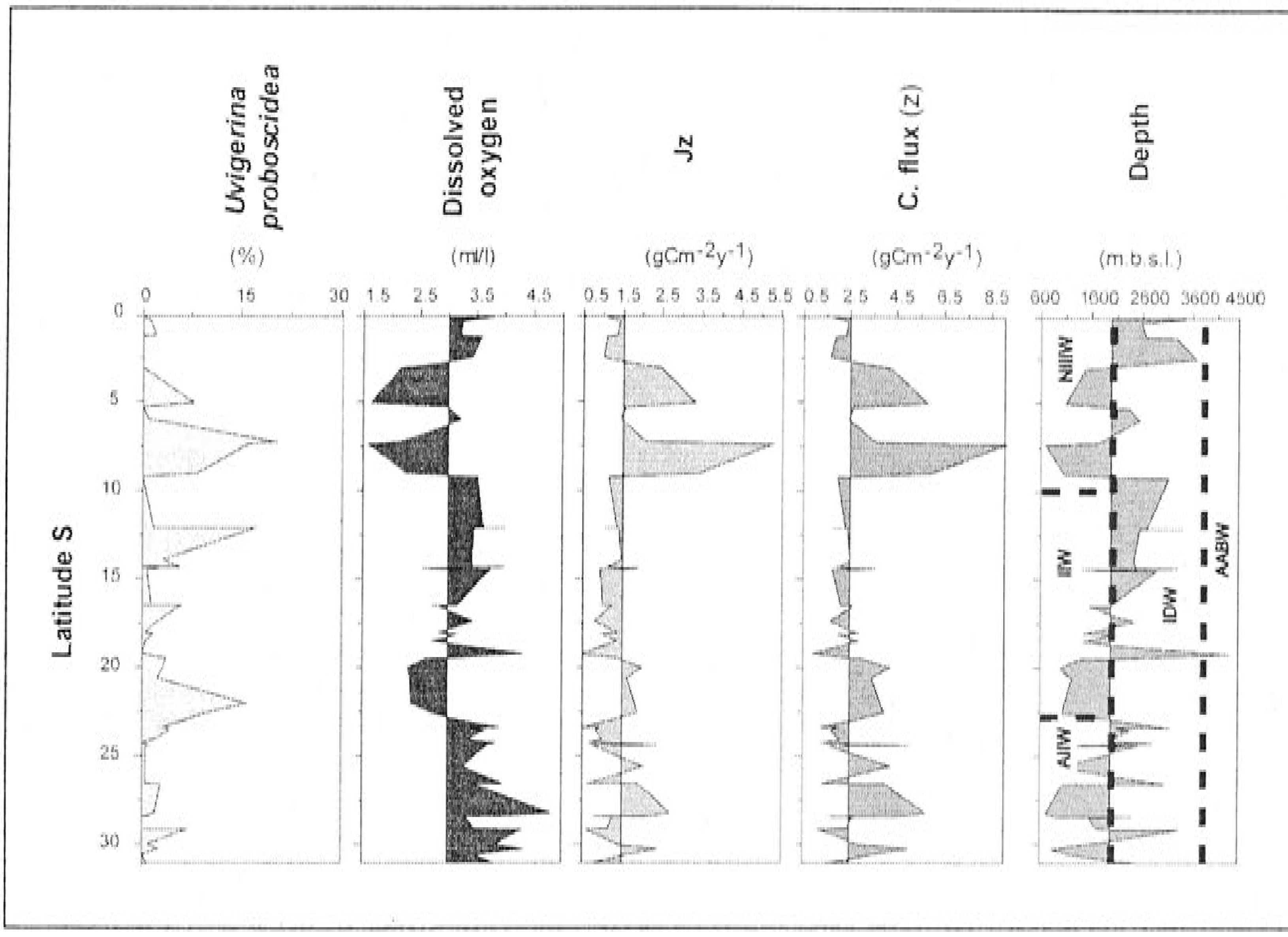

Fig. 5.1 – **Diagram to show the relationship between *U. proboscidea* percentages, dissolved-oxygen concentration, carbon flux calculated using Berger and Wefer (1990) [Jz] and Suess (1980) [C. flux (z)] formulae and depth versus latitude.**
The distribution of *U. proboscidea* appears to be controlled by two factors: carbon flux and oxygen levels. This species shows higher percentages when carbon flux is ≥ 1.5-2 gCm^2y^{-1} and dissolved-oxygen concentration <3ml/l. The latitudinal and depth range where this species is mainly found corresponds to areas characterised by high carbon-flux rate and by the presence of two oxygen-depleted intermediate water-masses: IIW and NIIW. Water masses: AAIW = Antarctic Intermediate Water; IIW = Indonesian Intermediate Water: NIIW = North Indian Intermediate Water; IDW = Indian Deep Water; AABW = Antarctic Bottom Water. The boundaries of the water masses are represented by dashed lines to indicate the lateral and/or vertical mixing between them.

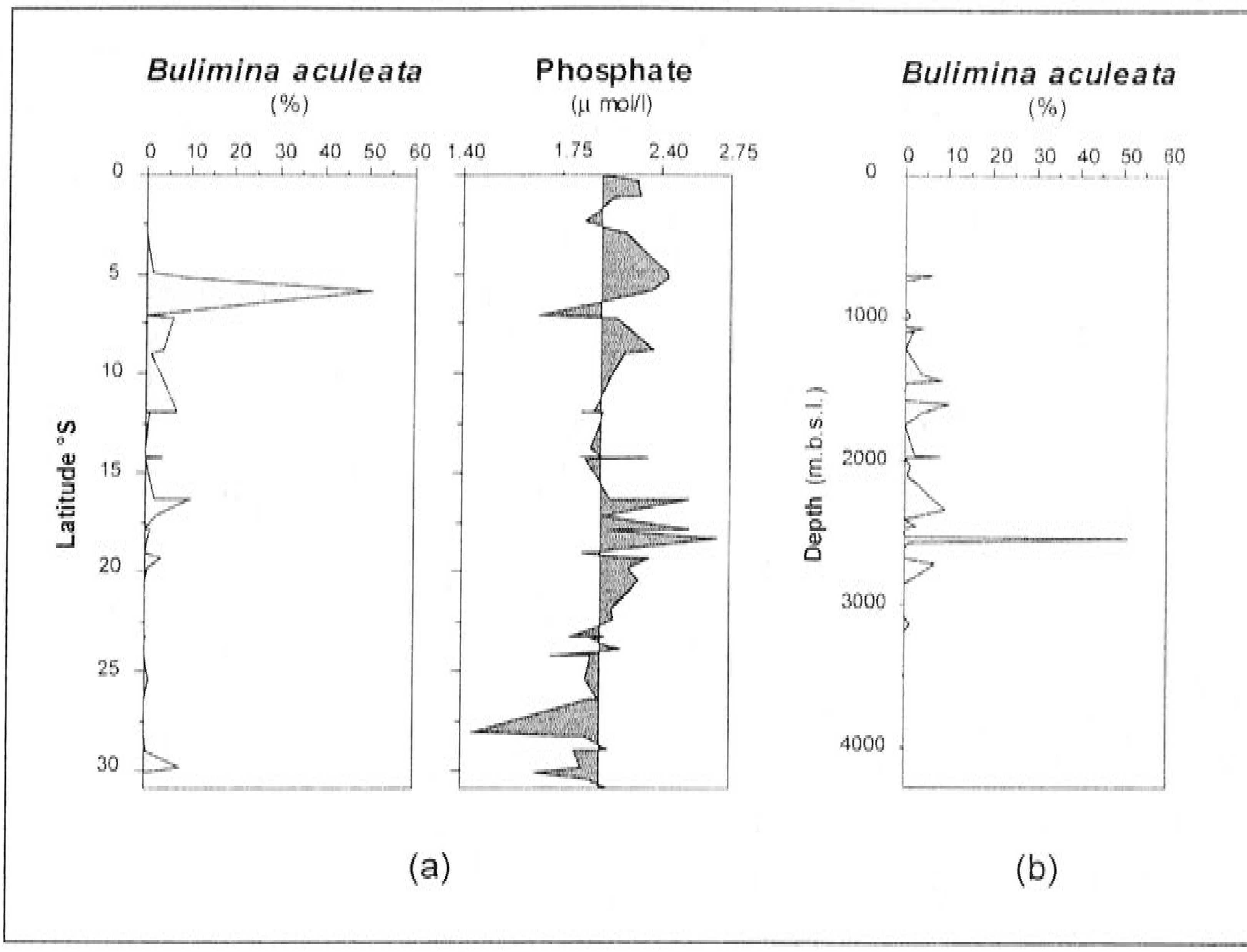

Fig. 5.2 – **Diagram to show (a) *B. aculeata* percentages and phosphate concentration plotted versus latitude and (b) *B. aculeata* percentages plotted versus depth.**
The distribution of this species is limited mainly to low latitude where phosphate concentration is higher and for a depth range between 1300 m and 2800 m.

5.1 Faunal groups

The percentages of three benthic foraminiferal faunal groups were correlated with the environmental variables considered in this study.

The agglutinated taxa display a preference for assemblages characterised by high diversity. This faunal pattern could derive from competitiveness deficiency.

The infaunal species group seems to be typical of a shallow and warm environment characterised by high carbon-flux rate and low dissolved-oxygen concentration. The positive correlation with longitude could reflect the fact that these conditions are found close to the continental-shelves margins, in areas characterised by high primary productivity at the sea surface. In the eastern Indian Ocean, primary productivity at the sea surface is characterised by a NW-SE gradient: values increase while moving from off the west coast of Western Australia towards the Indonesian region and the

Banda Sea (figure 3.21). At shallow depths along this gradient, not only does the carbon flux increase, but also the dissolved-oxygen concentration decreases, due to the presence of oxygen-depleted water masses (IIW and NIIW) and the oxidation of the organic matter. The tendency of infaunal taxa to thrive under enhanced carbon flux was already reported by Rathburn and Corliss (1994), Schmiedl et al. (1997) and Gooday and Rathburn (1999). The studied area is characterised by prevalently oligotrophic conditions. In such an environment, the living conditions for infaunal species become progressively favourable (Jorissen et. al, 1995): the higher is the amount of organic matter reaching the sea floor, the higher percentage of this can be buried within the sediment, representing an increased food source for the infaunal taxa (Fontanier et al., 2002).

The porcellaneous species, on the other hand, seem to prefer environmental conditions characterised by low salinity, high dissolved-oxygen concentration, low concentration of nutrients and high species-diversity. These conditions are present mainly in the southern region, where, as indicated when discussing the distribution of *N. irregularis*, the presence of AAIW determines low salinity levels and, together with a reduced amount of organic matter to sea floor determined by the low primary productivity levels at the sea surface, high dissolved-oxygen concentrations. This supports the observations from other regions, which indicate this group of taxa to be indicative of enhanced ventilation during the past (den Dulk et al., 2000; Huang et al., 2002).

6. Conclusions

This study links benthic foraminifera from 57 core-tops from the eastern Indian Ocean with the environmental variables that influence their distribution. The possible relationships between foraminiferal distribution and oceanographic characteristics in this area have been investigated considering different variables identifying water masses described for the region: temperature, salinity and oxygen. Nutrients, such as nitrate and phosphate, were also considered. In order to define possible links with processes occurring at the surface of the ocean, levels of primary productivity were used to estimate organic carbon flux at the sea floor, utilising two different formulae: one by Suess (1980) and the other by Berger and Wefer (1990).

The distribution of benthic foraminifera appears to be controlled by depth and the first ordination axis produced by both the ordination techniques used is strongly correlated with this factor. Correlation coefficients and Canonical Correspondence Analysis (CCA) outline how several of the measured environmental variables are significantly correlated to this parameter. Therefore, the observed faunal depth-related patterns appear to be the consequence of a co-variation of different factors: temperature, carbon flux, salinity, dissolved oxygen, phosphate.

Detrended Correspondence Analysis (DCA) was performed on a group of selected species (section 2) in order to define the relationship between benthic foraminiferal faunas, environmental variables and faunal characteristics.

Two groups of species were individuated by the first ordination axis:

(1) *O. t. umbonatus*, *E. exigua* and *P. murrhina* whose percentage increases with depth. These three taxa prefer a cold and well-oxygenated environment, where the carbon flux to the sea floor is low. In this group of species, two taxa are interpreted as indicators of reduced food availability: *O. t. umbonatus* and *P. murrhina*. *E. exigua* is characterised by high percentages and dominates the faunas of the samples in which it is found. This feature is interpreted as the expression of an opportunistic behaviour (*r-strategist*) triggered by pulsed fluxes of organic matter to the sea floor. *E. exigua* could be a seasonality indicator and its blooms could be associated with the presence of the South Java Upwelling System, offshore Java and Sumatra, or an increased riverine discharge offshore northwest Western Australia.

(2) *C. pseudoungerianus* and *N. irregularis*: these two species are typical of

shallow depths. *C. pseudoungerianus* is typical of a warm environment and where the carbon-flux rate is high. The distribution of *N. irregularis* is associated to low salinity and well-oxygenated waters. The presence of this species is mainly limited south of 20°S, between 700 m and 2000 m, a depth range that coincides with the AAIW ones. In this area, the contemporary presence of AAIW, characterised by low salinity and high dissolved-oxygen concentration, and low primary productivity (which causes low oxygen consumption at the sea floor) create the ideal conditions for this species.

Two other species were individuated by means of axis 2 of DCA: *U. proboscidea* and *B. aculeata*. *U. proboscidea* thrives in areas characterised by carbon flux ≥ 1.5-2 gCm^2y^{-1} and low dissolved-oxygen concentration. These conditions are verified for latitudes, where higher primary productivity at the sea surface determines higher carbon-flux rate and low oxygen levels are due to organic matter oxidation and the contemporary presence of oxygen-depleted intermediate water masses (IIW and NIIW). *B. aculeata* is present at low latitude in areas characterised by high phosphate concentration and high primary productivity. The depth range (1300-2800 m) of this species, the morphology of the area where it reaches its peak, combined with observations from other basins, could indicate a preference of this taxon for refractory phytodetritus transported down-slope from the shelf, where the amount of organic matter from the sea surface is higher. The high dominance levels associated with this species may indicate an opportunistic behaviour determined by the rarity of these inputs of food: for this reason *B. aculeata* could be associated to seasonal events.

The three major groups of taxa (agglutinated, infaunal and porcellaneous) were correlated with the environmental variables and faunal characteristics considered in this study. In essence, the infaunal and the porcellaneous taxa in this region display significant distributional patterns. The first group of species is indicative of high carbon-flux rates and low dissolved-oxygen concentrations, while the second group of species indicates high dissolved-oxygen and low salinity levels.

PART II: The Late Quaternary palaeoceanography of the eastern Indian Ocean

7. Late Quaternary palaeoceanography of the eastern Indian Ocean based on benthic foraminiferal evidences.

7.1 Previous work

The eastern Indian Ocean is an important region in order to understand the mechanisms ruling the global oceanic circulation (Wjiffels et al., 1996). In addition, a large number of oceanographic studies were conducted in order to describe the oceanic process which take place in this area (Wyrtky, 1958; Wyrtky, 1962; Fieux et al., 1994; Fieux et al., 1996; Godfrey, 1996; Gordon and Fine, 1996; Wjiffels et al., 2002). Therefore, the study of the palaeoceanographic evolution for the eastern Indian Ocean during the Late Quaternary represents an important step towards reconstructing the environmental modifications recorded for this region.

At the present the excess of precipitation over evaporation is responsible for the presence of a low-salinity water cap over the Indo-Pacific Warm Pool region (Tomczak and Godfrey, 1994). This low-saline water flows into the eastern Indian Ocean, preventing upwelling phenomena off the western Australian coast (Pearce, 1991) and reducing the effectiveness of the South Java Upwelling System (Wyrtki, 1962). Studies on pollens transported to the sea from the continents during the past indicate, for the period between 40 and 14 Kyr BP, more arid conditions and reduced precipitations over the Australasian region (van der Kaars, 1991; van der Kaars and Dam, 1995; van der Kaars and Dam, 1997; van der Kaars and De Deckker, 2002). In this scenario, sea-surface and intermediate waters salinity levels for the Indo_Pacific Warm Pool region were higher (Martinez et al., 1998b) and, together with modified intermediate and deep-water circulations (Duplessy et al., 1988; Duplessy et al., 1989; Rutberg et al., 2000), a different situation could have characterised the eastern Indian Ocean before MIS1.

Most research from this region has focused on past sea-surface conditions (Okada and Wells, 1997; Martinez et al., 1997; Martinez et al., 1998a; Martinez et al., 1998b; Takahashi and Okada, 2000; Gingele et al., 2001; Spooner, 2001; Gingele et al., 2002), as well as on the situation at the sea floor (Van Marle, 1988; Van Marle, 1989; McCorkle et al., 1994; Wells et al., 1994; Veeh et al., 2000).

Results obtained, so far, regarding the palaeoceanographic setting for the eastern Indian Ocean during the LGM would suggest a different pattern for the LC accompanied by an increased intensity of the South Java Upwelling System (Martinez et al., 1999; Takahashi and Okada, 2000; Gingele et al. 2001) and increased productivity for the Banda Sea (Spooner, 2001). Conflicting results were obtained from off the west coast of Western Australian. While Prell et al. (1980) and Wells and Wells (1994) indicated a decreased sea-surface temperature during the LGM, Martinez et al. (1999) suggested no significant temperature variation. The use of different proxies has also provided contradictory answers regarding the productivity levels: some (benthic foraminifera accumulation rate, sediment uranium content, $CaCO_3$ mass accumulation rate, benthic foraminifera distribution) would indicate increased productivity (McCorkle et al., 1994; Wells et al., 1994), while others ($\delta^{13}C$ of *C. wuellerstorfi*, nannoplankton, planktonic foraminifera) would suggest a situation similar to the present (Wells et al., 1994; Okada and Wells, 1997; Martinez et al., 1999). Furthermore the absence of data related to the sea floor from the Indonesian region does not allow a complete reconstruction for the palaeoenvironmental condition of the entire eastern Indian Ocean. This fragmented picture may hide the explanation for the ambiguous records reported from offshore Western Australia.

7.2 What could benthic foraminifera reveal?

In this second part of this thesis, four cores collected from offshore Western Australia, Java and Sumatra and from the Banda Sea will be studied. The information obtained about the distribution of the Recent benthic foraminifera from the eastern Indian Ocean will be utilised to interpret changes of the benthic foraminifera faunal content for each core. The $\delta^{13}C$ of *C. wuellerstorfi* will also be analysed in order to detect variations of the intermediate- and deep-water circulation and/or increased amounts of organic matter at the sea floor. The aim of this study is to investigate possible links between eventual variations of sea-floor faunal patterns and the palaeoceanographic changes, which previous research indicated for the sea surface. In this respect, the analysis of benthic foraminifera and of the $\delta^{13}C$ of *C. wuellerstorfi* will be used to answer the following questions:

- How climatic changes during the last 40 Kyrs affected the distribution of benthic foraminifera?

- How did the intensity of the intermediate- and deep-water circulation change?
- Did productivity levels off the west coast of Western Australia increase during the LGM, following a reduction or absence at that site of the LC and/or the establishment of intermediate-water upwelling?
- Was the AAIW – IIW front located at a different latitude during the past?
- Did the productivity of the Banda Sea increase during the past, as analysis on planktonic foraminifera would suggest?
- Did the strength of the South Java Upwelling System increase during the LGM?

8. Materials and methods

Four cores (Table 8.1) selected from the collections of cores recovered during *Fr 10/95*, *Fr 2/96*, *Barat* and *Shiva* cruises were studied for detailed micropalaeontological analysis covering the last 30 to 60 Kyr. The selection of the cores is based on the information available regarding the oceanography of the region and the results obtained from analysis of the benthic foraminifera extracted from the 57 core-tops. The location of the cores is illustrated in figure 8.1.

Table 8.1 – **List of the cores used in this study.**
BAR = *Barat*; SHI = *Shiva*.

Core	Type	Latitude S	Longitude E	Water depth (m)	Sampling interval (cm)	Previous work
Fr10/95 GC17	gravity core	22°07.74'	113°30.11'	1093	4	Martinez et al., 1999 Takahashi et al., 2000 Gingele et al., 2001 van der Kaars and De Deckker, 2002
Fr10/95 GC5	gravity core	14°00.55'	121°01.58'	2452	4	Martinez et al., 1999 Gingele et al., 2001
SHI9016	piston core	8°27.35'	127°53.83'	1802	4	Ahmad et al. 1995 Spooner, 2001 Gingele et al., 2001
BAR9403	piston core	5°49.20'	103°61.90'	2034	5	–

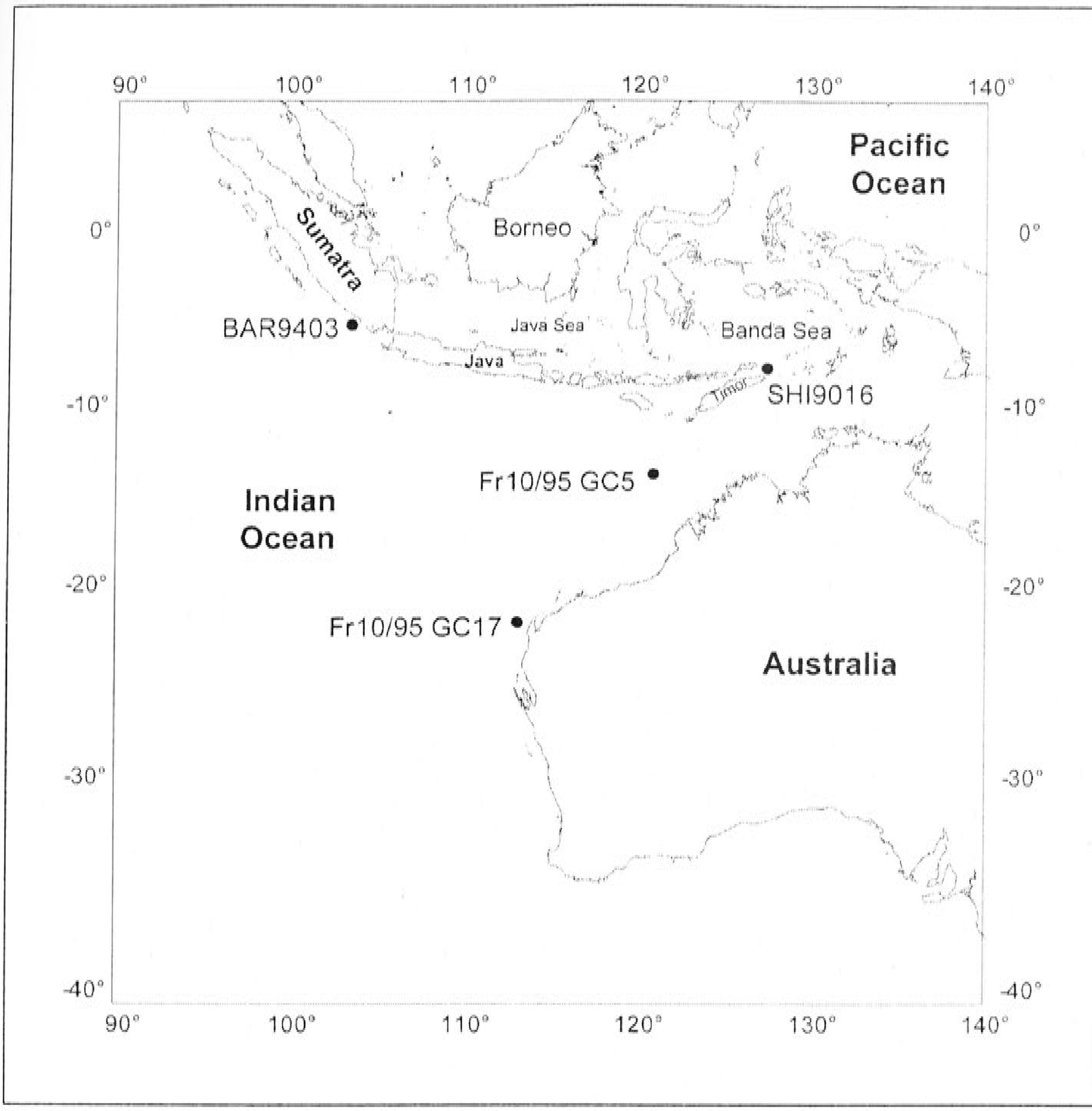

Fig. 8.1 – **Location of the selected cores from the eastern Indian Ocean.**

8.1 Gravity core Fr10/95 GC17

This core was collected during cruise *Fr10/95,* off the west coast of Western Australia. The top 178 cm of the core were used for micropalaeontological analysis. Along the core, two clay units are recognized on the basis of their colour (figure 8.2). The top 88 cm of the core are represented by yellowish brown clay. A transition interval between 88 cm and 108 cm separates the first section from the second; these latter 70 cm are represented by greyish-olive clay. Below 80 cm, minor bioturbation is observed and, between 160 cm and 170 cm, non-parallel lamination is also present.

The samples used for benthic foraminifera analysis were taken every 4 cm from the set of samples taken by Martinez et al. (1999), who sampled the core at 2 cm intervals.

Fr10/95 GC17 was recovered at near 22°S at 1093 m water depth. These latitude and depth ranges correspond to the area where the IIW and the AAIW undergo lateral mixing today (Fieux et al., 1996a). This phenomenon is marked by the dissolved-oxygen concentration, which, in this area, is characterised by values intermediate between those typical of AAIW (>4ml/l) and IIW (<2 ml/l), respectively. Core *Fr10/95 GC17* corresponds to the southernmost site where the species *U. proboscidea* is found on the sea floor today. This taxon is interpreted as indicative of low-oxygen levels and, relative to this area, a high carbon-flux rate. Any variation of the benthic foraminifera fauna could therefore be indicative of modifications of the past patterns of the intermediate water masses and/or palaeoproductivity levels at the sea surface.

8.2 Gravity core Fr10/95 GC5

This core was collected during *Fr10/95* cruise off the Australian Northwest Shelf. The top 122 cm of the core were utilised for micropalaeontological analysis. This section of the core consists of greyish olive clay, with alternating laminations and minor bioturbation (figure 8.2). Planktic foraminifera from this core were previously studied by Martinez et al. (1999), who sampled the core every 2 cm. From that same material, samples taken every 4 cm were used for benthic foraminifera analysis.

The core was recovered from a water depth of 2452 m, where at Present the species that are related to shallow environments (*C. pseudoungerianus* and *N. irregularis*) are replaced by taxa, which prefer deeper environments (*O. t. umbonatus*, *E. exigua* and *P. murrhina*). The water depth of gravity core *Fr10/95 GC5* is also within the depth range where at Present *B. aculeata* is found in this region. Faunal changes detected by analysing benthic foraminifera from this core could be indicative of past changes of the sea-surface productivity.

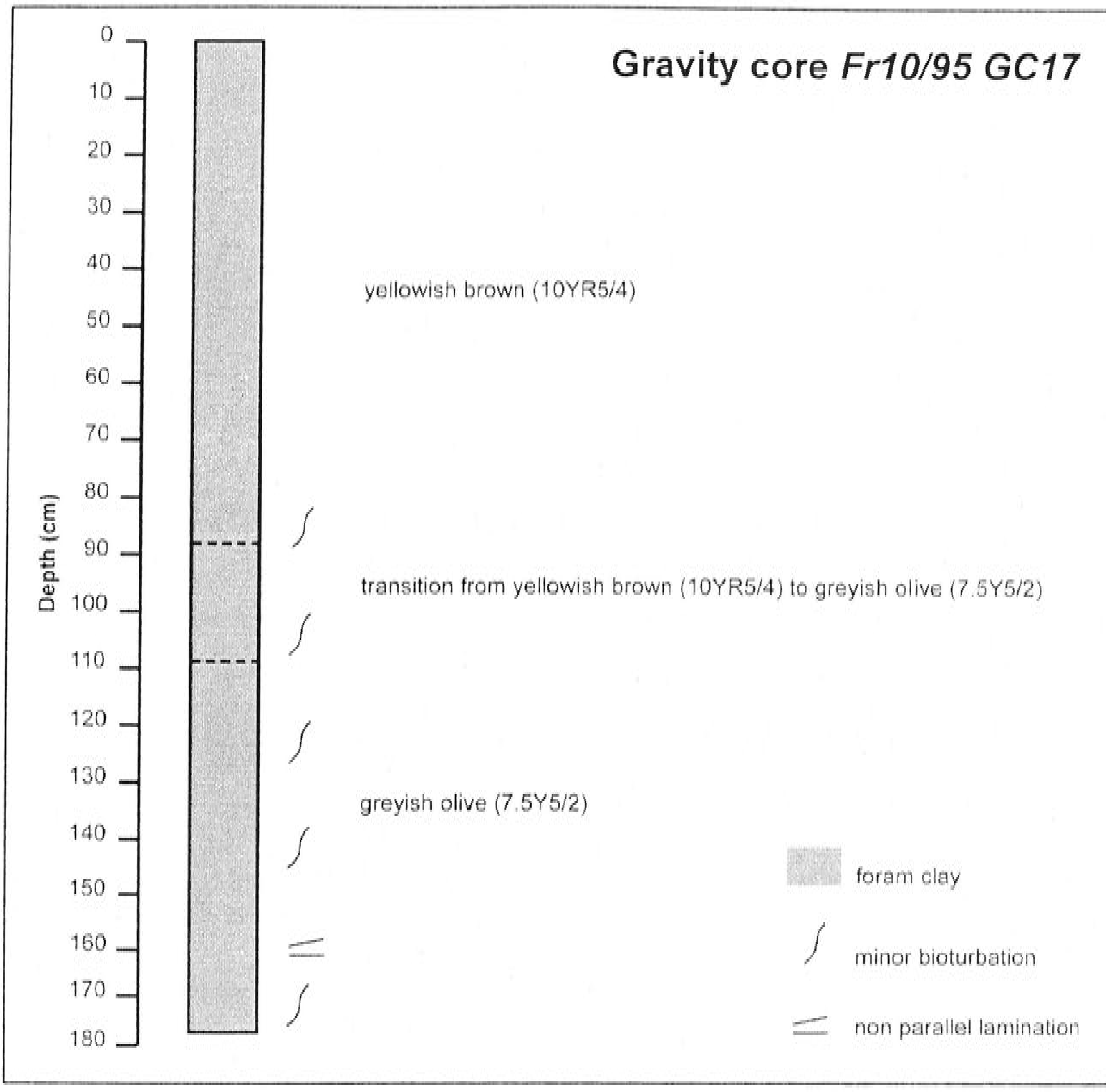

Fig. 8.2 – **Lithological log of gravity core *Fr10/95 GC17*** (adapted from Martinez et. al, 1999). The log covers only the interval sampled for this study.

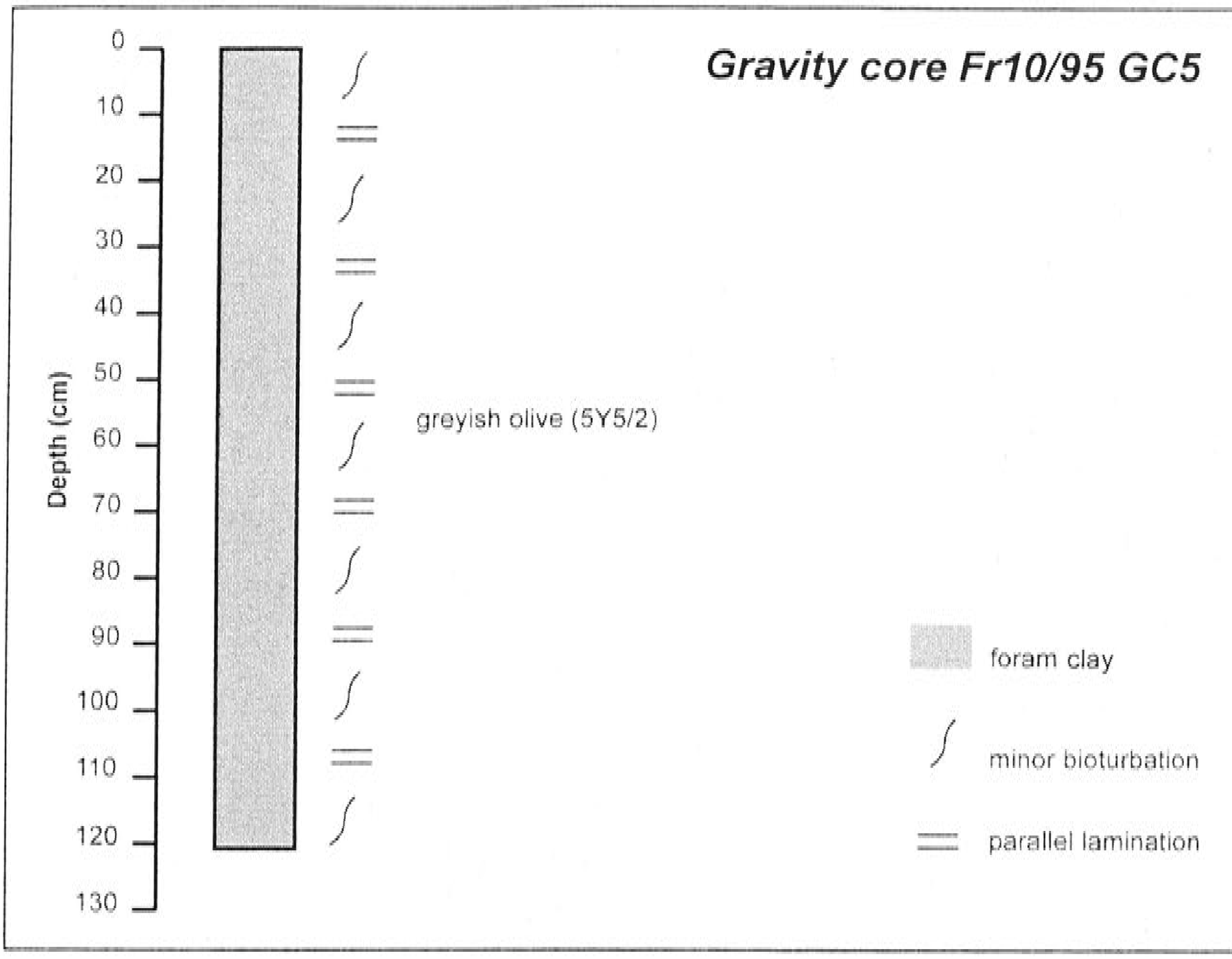

Fig. 8.3 – **Lithological log of gravity core *Fr10/95 GC5*** (adapted from Martinez et. al, 1999). The log covers only the interval sampled for this study.

8.3 Piston core SHI9016

Piston core *SHI9016* was collected east of Timor in the Timor Passage, at a depth of 1802 m. The top 163 cm of this core were examined for benthic foraminifera analysis. The sediment of the section studied is consists predominantly of grey or olive-grey clay, with sandy levels at 160 cm and lamination between 50 cm and 60 cm (figure 8.4).

The depth, at which this core was taken is close to the depth range where at Present the faunal change between shallow and deep taxa is recorded and also within the depth range where *B. aculeata* and *U. proboscidea* are found. This core is believed to provide information about changes of the primary productivity levels for the Banda Sea as well as past ventilation of the Indonesian basins.

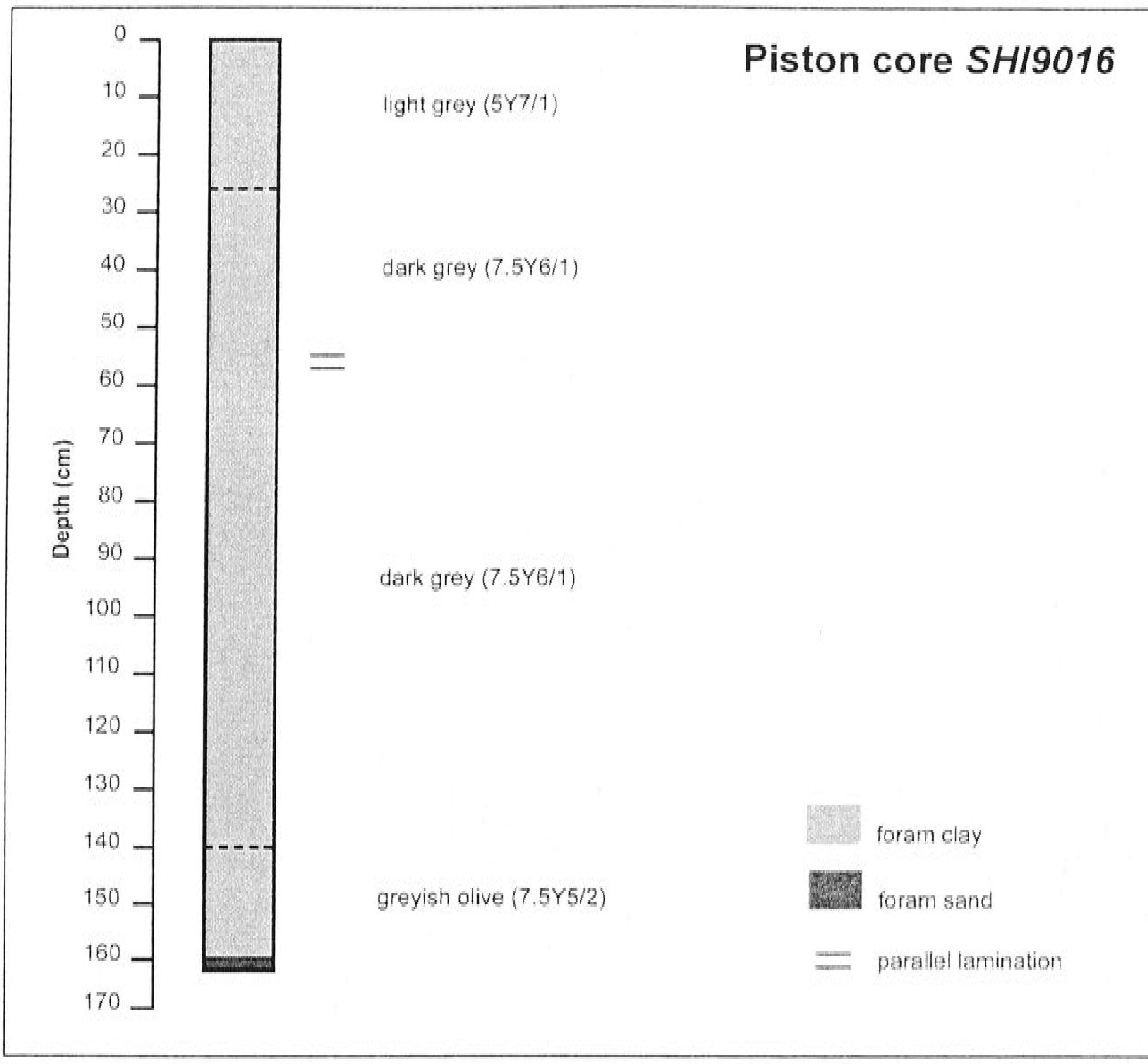

Fig. 8.4 – **Lithological log of piston core *SHI9016*** (adapted from Spooner, 2001). The log covers only the interval sampled for this study

8.4 Piston core BAR9403

This core was recovered offshore of Sumatra, west of its southern extremity at a depth of 2034 m. The first 276 cm of this core were sampled every 5 cm. The top 105 cm of the core consist of light yellow clay. Below 105 cm, the sediment consists of by greyish olive clay, with some levels (155 cm and 245-255 cm) where the sediment is sandier (figure 8.5).

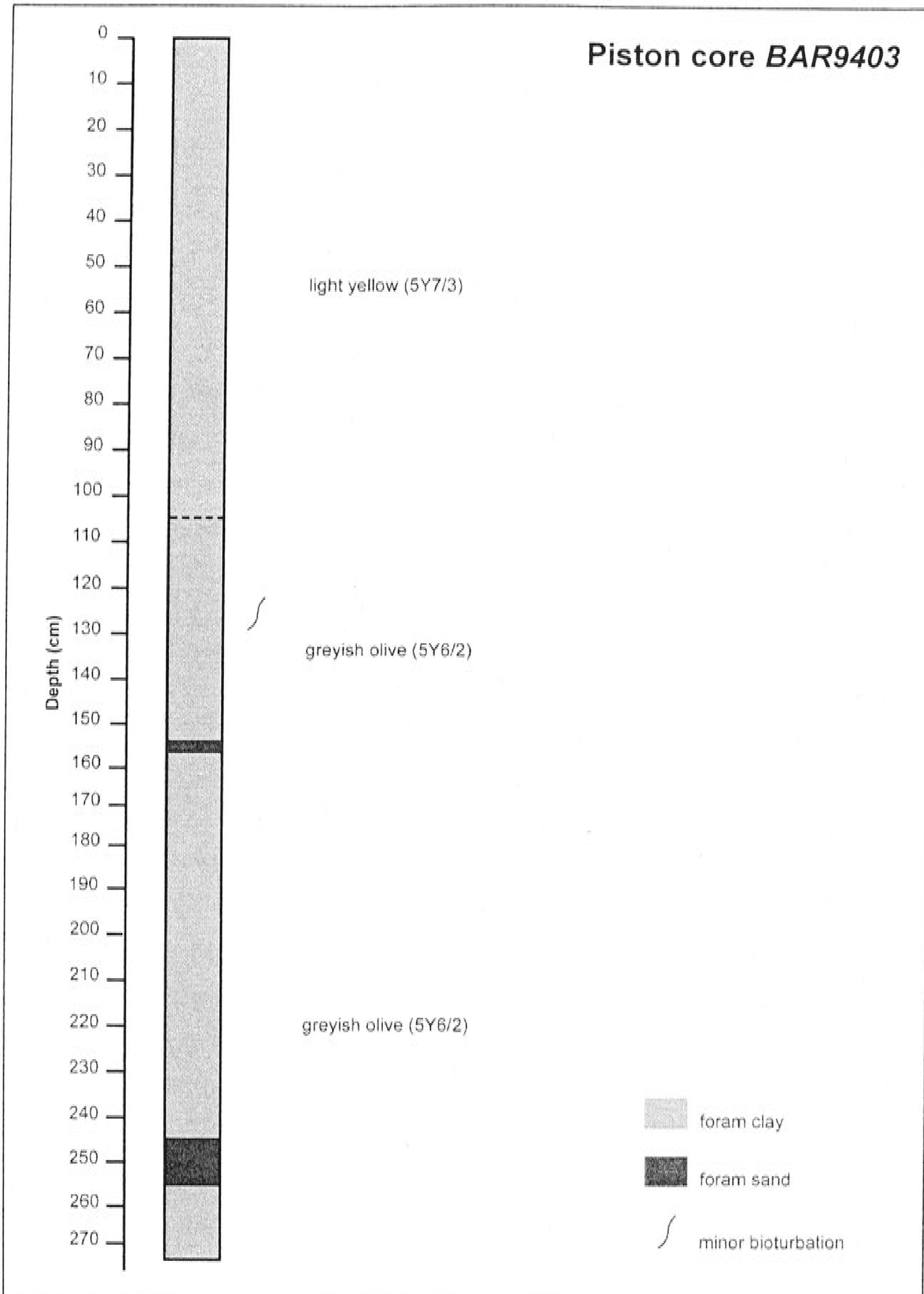

Fig. 8.5 – **Lithological log of piston core *BAR9403*.**
The log covers only the interval sampled for this study.

The depth of this core, as for *SHI9016* and *Fr10/95 GC5*, is within the depth range where at Present the faunal turnover between shallow and deep species is recorded, and it is also within the depth range of *B. aculeata* and *U. proboscidea*. *BAR9403* is located in an area under the influence of the South Java Upwelling System and therefore faunal changes of benthic foraminifera, if related to any variation of the productivity at the sea surface, could provide information about modifications of past upwelling intensity.

8.5 Micropalaeontological analysis

The analysis of the benthic foraminiferal faunas from gravity cores *Fr10/95 GC17* and *Fr10/95 GC5* was completed on the same samples processed by Martinez et al. (1999), who studied the cores at 2 cm intervals (3cc. in volume). Samples were dried in an oven to obtain dry weight and then soaked in a dilute (3%) hydrogen peroxide solution until the clays had fully disaggregated. Samples were then washed with a gentle water jet through a 63 µm sieve and the coarse fraction dried at 40°C. For piston cores *SHI9016* and *BAR9403*, approximately 5-6 cc. of sediment were processed following the same procedure mentioned above. Sampling intervals were 4 cm for *SHI9016* and 5 cm for *BAR9403*.

Specimens from the >150 µm fraction of each sample were isolated, counted and mounted on micropalaeontological slides. In order to compare the results of the study of benthic foraminifera from the core with the result of the analysis of the core-tops, the absolute number of individuals for each species was converted as the percentage of total foraminifera present in each sample.

Species present with a percentage >2% in at least 1 sample were used for statistical analyses. Similar to the situation observed for the core tops, the specimens belonging to the genera *Fissurina*, *Lagena*, *Lenticulina*, *Oolina* and *Parafissurina* were present in many samples with high species diversity. For this reason, all the species belonging to these genera and used for statistical analysis were grouped together as *Fissurina* spp., *Lagena* spp., *Lenticulina* spp., *Oolina* spp. and *Parafissurina* spp.

The program STATISTICA 5.0 was used to perform *Q* – mode Factor Analysis (Principal Components) on the species dataset of each core. The number of species >2% in at least one sample varied and the number of taxa included for statistical analyses for each core is listed in table 8.2.

Table 8.2 – **Number of benthic foraminifera species included for statistical analyses in each core and average number of specimens counted for each core.**

	Fr10/95 GC17	*Fr10/95 GC5*	*SHI9016*	*BAR9403*
No. of species	53	36	56	62
Average number of specimens counted	171	336	184	358

The use of species percentages can affect the statistical analysis due to matrix closure problems (Loubere and Qian, 1997). In order to assess the eventual presence of such an effect, the Factor Analysis was also run on a dataset, where species were represented as the number of individuals per gram of dry sediment (n/g).

Based on the percentages of species identified in the samples, the faunal diversity (expressed as the Fisher's Alpha index (α), the Shannon-Weaver index H(S), the equitability (E) and the dominance (D)), the percentage of agglutinated taxa, the percentage of porcellaneous taxa and the percentage of presumed infaunal calcareous benthic foraminifera were calculated.

8.5.1 Benthic Foraminifera Accumulation Rate (BFAR): applications and problems

A linear relationship between the accumulation rate of benthic foraminifera (BFAR) and the amount of organic matter reaching the sea floor was outlined by Herguera and Berger (1991) and by Herguera and Berger (1994). BFAR has been used worldwide as a proxy to estimate variations of the past carbon-flux rate to the sea floor (Struck, 1995; Thomas et al., 1995; Loubere, 1996; Herguera, 2000; Diester-Haass and Zahn, 2001; Diester-Haass et al., 2002; Rasmussen et al., 2002;). However, recent studies from the Arabian Sea found that the relationship between BFAR and organic carbon (C_{org}) is not valid for suboxic/dysoxic environments, where extremely low-oxygen levels can play a major role in controlling the population of benthic foraminifera by reducing the predation by macro-fauna (Naidu and Malmgren, 1995; den Dulk et al., 2000). The analysis of the cores allowed the identification of levels characterised by the presence of parallel lamination for gravity core *Fr 10/95 GC5* and piston core *SHI9016*. In the first case, laminations are alternating with bioturbated levels, while in the second case the laminations are limited to a short interval related to the LGM (figures 8.3 and 8.4). These observations do not support the idea of past reduced dissolved-oxygen concentrations comparable with those recorded for the Arabian Sea. Another factor that could undermine the reliability of BFAR is represented by the taphonomic processes affecting the benthic foraminiferal assemblage before its definitive burial, with the consequent loss of specimens in the fossil assemblage (see section 2.1). For the eastern Indian Ocean, the selective dissolution of calcareous foraminiferal tests is excluded, as the lysocline is presently indicated at a depth of 2400 m, north of 15°S, and at a depth of 3600 m south of 15°S (Martinez et al., 1998a), deeper than the sites studied here. The selective destruction of soft-cemented agglutinated foraminifera is instead a phenomenon recorded for the analysed samples, but it affects a minimal percentage of the total assemblage and should not preclude the use of BFAR. Finally, since the BFAR is a function of the linear sedimentation rate (LSR), this parameter needs to be carefully determined. For the examined cores, LSR was calculated using the *Analyseries* software (Paillard et al., 1996). The values obtained were integrated, where possible (see section 8.7), by AMS measurements (figure 8.7).

The total number of foraminifera isolated in each sample was used to calculate the benthic foraminifera accumulation rate (BFAR), following the formula proposed by Herguera and Berger (1991):

$$BFAR = (F) \cdot (LSR) \cdot (DBS)\ [n/cm^2Kyr];$$

where F is the abundance of foraminifera (n/g), LSR is the linear sedimentation rate (cm/Kyr) and DBS is the dry bulk sediment (g/cm^3) [g = grams of dry sediment].

The accumulation rate (AR) of the species (*B. aculeata*, *U. proboscidea*, *E.exigua*), quantitatively relevant in all cores (see Appendices 2-5) and at the Present correlated with carbon-flux or associated with the presence of organic matter at the sea floor, was calculated applying Heguera and Berger's (1991) formula as follows:

$$AR = (n/g) \cdot (LSR) \cdot (DBS)\ [n/cm^2Kyr];$$

where n/g indicates the abundance of species in the sample. As these species are related to the presence of organic matter at the sea floor (*B. aculeata* and *E. exigua*) or high carbon-flux rate and low dissolved-oxygen levels (*U. proboscidea*) (see section 5), their AR was used to assess conditions of enhanced supply of organic matter to the sea floor and/or reduced oxygen levels.

8.6 Isotope analyses

8.6.1 Methodology

The $\delta^{18}O$ record of planktonic foraminifera was measured in order to produce an age model for the studied cores, while the $\delta^{13}C$ isotopic signal from the benthic foraminifera was measured in order to acquire information about the deep-water circulation and/or the presence of organic matter at the sea floor.

The species used for isotope analyses were: *C. wuellerstorfi* for benthic foraminifera, *Globigerinoides sacculifer* (without a sac-like final chamber) and *Globigerinoides ruber* (white variety) for planktic foraminifera.

C. wuellerstorfi occupies an epifaunal microhabitat (Lutze and Thiel, 1988) and the isotopic composition of its test appears in equilibrium with the TCO_2 of the ambient deep water mass (Duplessy et al., 1984; Altenbach and Sarnthein, 1989). For this reason, the isotopic trend of this species reflects the one characterising the water at the sea floor (Duplessy et al., 1984).

The methodology followed for the preparation of the samples for isotopic analyses is the same for the two types of foraminifera. A number of specimens sufficient to reach the minimum weight of material (180 μg) detectable by the mass spectrometer, were handpicked from each sample from the >250 μm fraction. Specimens were then washed in alcohol and placed in an ultrasonic cleaner for 5 seconds (up to 10 seconds when processing benthic foraminifera), in order to eliminate any contaminating residual adhering to the foraminifer test. Oxygen- and carbon-isotopic data obtained are reported in the usual δ notation, which is referred to the PeeDee belemnite (V-PDB) standard. Samples were calibrated against the National Bureau of Standards calcite (NBS-19), assuming values of $\delta^{18}O_{V\text{-}PDB}$ = -2.20 ‰ and $\delta^{13}C_{V\text{-}PDB}$ = -1.95 ‰.

Analyses were conducted utilising a Finnigan-MAT 251 mass spectrometer at the Research School of Earth Sciences (RSES) at the Australian National University (ANU). Isotopes analyses of benthic foraminifera from gravity core *Fr10/95 GC17* were processed in the same way using the Finnigan-MAT 251 mass spectrometer at the Geomar Insitute, Germany. The external errors related to the two spectrometers are reported in Table 8.3.

Table 8.3 – **External errors of the two mass spectrometers used for isotope analyses.**

Finnigan-MAT 251	$\delta^{18}O$	$\delta^{13}C$
RSES-ANU	0.05 ‰	0.08 ‰
Geomar, Kiel	0.08 ‰	0.06 ‰

8.7 Chronology

8.7.1 Gravity core Fr10/95 GC17

The age model for *Fr10/95 GC17* was proposed by Martinez et al. (1999), who based it on the $\delta^{18}O$ record of *G. sacculifer* (without a sac-like final chamber). The isotope record was calibrated against the SPECMAP chronology (Martinson et al., 1987) using the *Analyseries* software (Paillard et al., 1996).

That model was supplemented by 13 AMS ^{14}C dates (van der Kaars and De Deckker, 2002). The section studied here covers the last 30 Kyr BP (figure 8.6). The estimated linear sedimentation rate is given in figure 8.7.

8.7.2 Gravity core Fr10/95 GC5

The age model for *Fr10/95 GC5* was proposed by Gingele et al. (2001), who used a combination of the $\delta^{18}O$ record of *G. sacculifer* (0-93cm), as measured by Martinez et al., (1999), and the $\delta^{18}O$ record of *G. ruber* (93-122cm) (figure 8.6). Due to the different habitats characterising the two species, a value of 1‰ was subtracted from all the $\delta^{18}O$ values of *G. ruber* (Gingele et al., 2001). The isotope record for this core was calibrated against the SPECMAP chronology (Martinson et al., 1987) using the *Analyseries* software (Paillard et al., 1996). This procedure allowed the identification of the following marine isotope events: 1.1, 2.0 and 3.0. The base of the studied section was given an age of 35 Kyr BP.

One AMS date is available for the sample 57-58cm, which has a calibrated age of 20.4 Kyr BP (Gingele et al., 2001). The calculated linear sedimentation rate is presented in figure 8.7.

8.7.3 Piston core SHI9016

The age model for piston core *SHI9016* is the one proposed by Gingele et al. (2001) and Spooner (2001) (figure 8.6). Chronology of the core is based on the $\delta^{18}O$ record of *G. ruber*. The base of the studied section was given an age of 62 Kyr BP and, by calibrating the $\delta^{18}O$ curve against the SPECMAP chronology (Martinson et al., 1987), using the *Analyseries* software (Paillard et al., 1996), the following isotope events were identified: 1.1, 2.0, 3.0 and 4.0. The calculated linear sedimentation rate is given in figure 8.7.

8.7.4 Piston core BAR9403

The age model for piston core *BAR9403* is based on the $\delta^{18}O$ of *G. ruber* (figure 8.6). The isotope curve was calibrated against the SPECMAP chronology (Martinson et al., 1987) using the *Analyseries* software (Paillard et al., 1996). After calibration and comparison of the *BAR9403* $\delta^{18}O$ isotopic curve with the age model proposed by Gingele et al. (2002) for piston core *BAR9442* (which was recovered in the vicinity of *BAR9403* and with similar sedimentation rate), the following $\delta^{18}O$ isotope events were identified: 1.1, 2.0 and 3.0. The base of the section studied was given an age of 33.2 Kyr BP. The calculated linear sedimentation rates are given in figure 8.7.

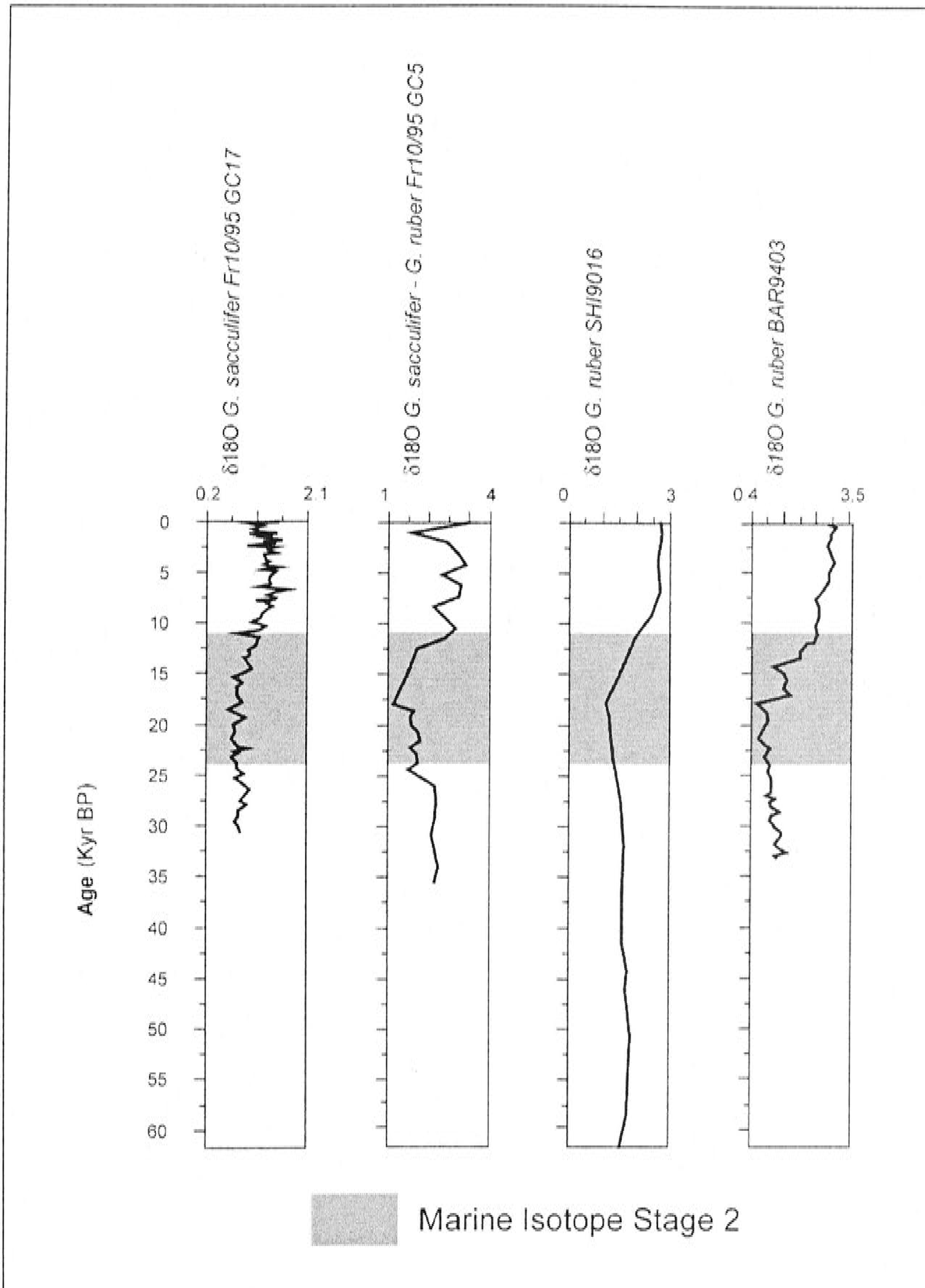

Fig. 8.6 – $\delta^{18}O$ **curves for the four studied cores from the eastern Indian Ocean.**
Age models for *Fr10/95 GC17* and *Fr10/95 GC5* are those proposed by Martinez et al. (1999); age model for *SHI9016* is the one proposed by Gingele et al. (2001) and Spooner (2001). Grey shading indicates Marine Isotope Stage 2.

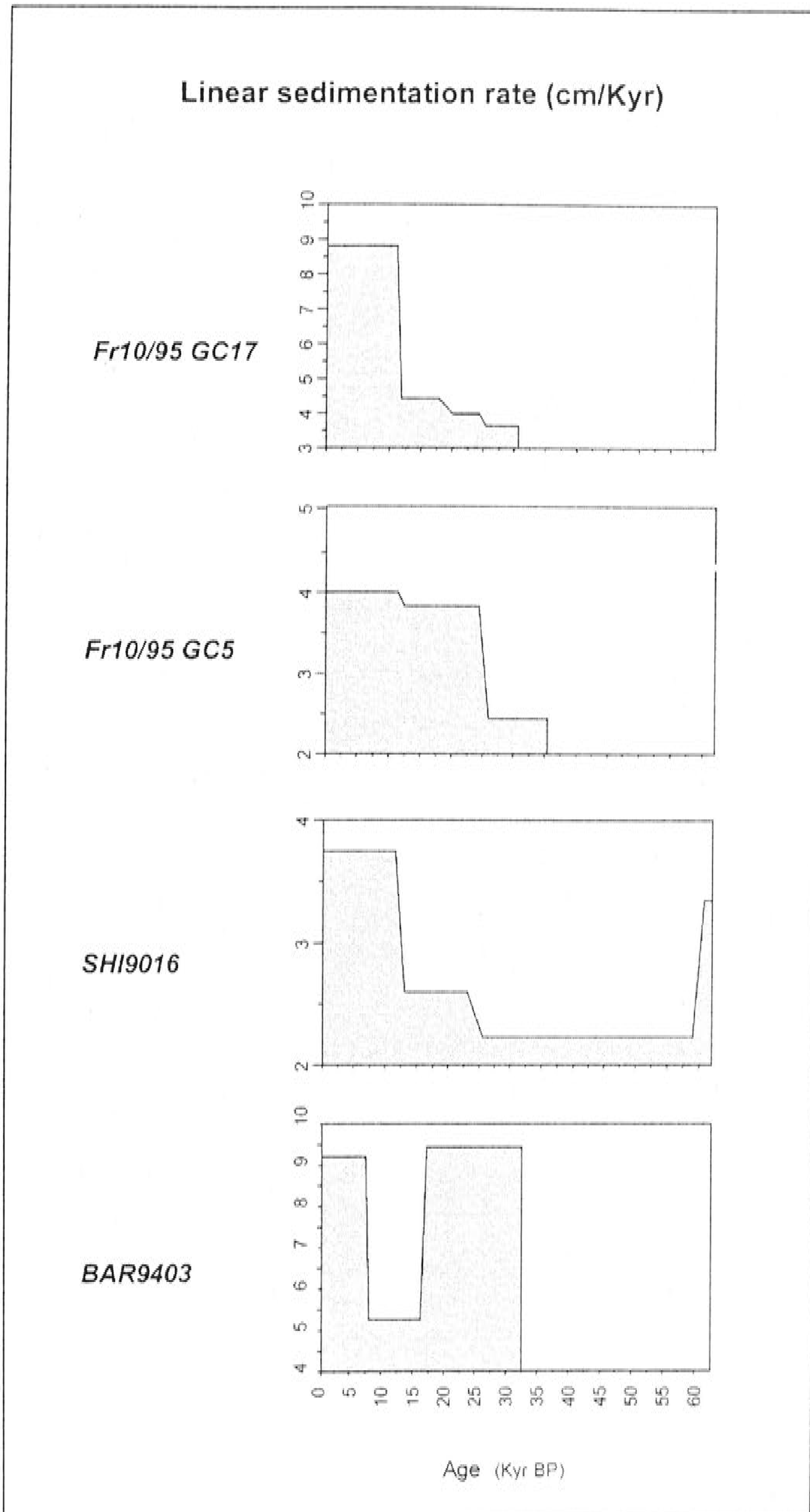

Fig. 8.7 – Linear sedimentation rates calculated for the selected cores from the eastern Indian Ocean using the *Analyseries* software (Paillard et al., 1996).

9. Results

9.1 Gravity core Fr10/95 GC17

A total of 182 benthic foraminifera species were recognised in the samples collected from core *Fr10/95 GC17* (Appendix A2), with average percentages ranging between 6.5% (*N. irregularis*) and 0.004% (*Trifarina bradyi*). From this dataset, 53 species characterised by a percentage >2% in at least one sample were selected for statistical analyses.

9.1.1 Fr10/95 GC17: Factor analysis

Q – mode Factor analysis (Principal Components) calculated three varimax factors, which accounted for 77% of the total variance of the 53 species analysed. The species scores related to these two axes are listed in Table 9.1

Table 9.1 – ***Q*-mode Factor Analysis (Principal Components) results for the reduced species dataset of gravity core *Fr 10/95 GC17*: scores for varimax Factors 1, 2 and 3.**
Those species, which present high score on F1, or F2, or F3, and high mean percentage, are indicated in bold.

Species	F1	F2	F3	Mean %
Astrononion echolsi	-0.43	-0.48	0.59	1.54
Bolivina robusta	**3.23**	-0.72	0.11	4.44
Bolivinita quadrilatera	-0.55	-0.49	0.01	0.98
Brizalina dilatata	0.88	-1.08	0.22	1.92
Bulimina aculeata	-0.53	0.63	-0.98	0.71
Bulimina alazanensis	-0.45	-0.72	-0.58	0.71
Bulimina costata	-0.17	-0.33	-0.55	0.70
Ceratobulimina pacifica	0.24	-0.35	1.07	2.65
Chilostomella oolina	-0.22	-0.43	-0.56	0.66
Cibicidoides bradyi	0.48	-0.04	2.10	3.91
Cibicidoides kullenbergi	-0.37	0.12	0.14	1.60
Cibicidoides pseudoungerianus	0.40	0.80	0.93	3.44
Cibicidoides robertsonianus	-0.42	-0.46	-0.36	0.61
Cibicidoides wuellerstorfi	-0.16	**4.21**	0.18	5.01
Dentalina inornata	-0.35	-0.66	-0.82	0.06

Table 9.1 – *continued.*

Species	F1	F2	F3	Mean %
Dorothia bradyana	-0.50	-0.04	-0.81	0.35
Ehrenbergina trigona	0.01	3.08	-1.00	3.84
Epistominella umbonifera	-0.27	-0.67	-0.40	0.52
Fissurina spp.	-0.27	0.27	-0.43	1.29
Fursenkoina fusiformis	-0.35	-0.39	-0.45	0.62
Gavelinopsis lobatulus	-0.06	-0.15	0.20	1.86
Globocassidulina subglobosa	-0.49	-1.05	**4.86**	5.03
Gyroidinoides orbicularis	-0.09	-0.71	0.44	1.50
Gyroidinoides polius	-0.37	-0.49	-0.82	0.18
Gyroidinoides soldanii	-0.07	-0.38	-0.04	1.21
Hauerinella incostans	-0.53	0.22	-0.63	0.87
Hoeglundina elegans	-0.15	1.51	-0.35	2.79
Karreriella bradyi	-0.27	-0.04	-0.78	0.66
Lagena spp.	-0.24	-0.30	-0.48	0.84
Lenticulina spp.	-0.12	-0.64	-0.40	0.68
Martinottiella communis	-0.38	-0.59	-0.59	0.26
Melonis barleeanum	-0.08	-0.52	-0.21	1.16
Melonis pompilioides	-0.61	-0.65	-0.25	0.42
Miliolinella oblonga	-0.36	-0.30	-0.27	0.97
Nummoloculina contraria	-0.57	-0.41	-0.14	0.77
Nummoloculina irregularis	0.58	1.40	**3.04**	6.79
Oridorsalis tener umbonatus	0.07	-0.34	0.15	1.62
Osangularia cultur	0.20	-0.41	0.73	2.36
Pullenia bulloides	-0.19	-0.09	-0.21	1.29
Pullenia quinqueloba	-0.19	-0.49	-0.29	0.86
Pyrgo elongata	-0.32	-0.31	-0.21	0.97
Pyrgo murrhina	-0.13	-0.13	0.07	1.47
Quinqueloculina seminulum	0.18	0.57	0.12	2.62
Robertina tasmanica	-0.36	-0.39	-0.19	0.94
Sigmoilopsis schlumbergeri	-0.40	-0.41	-0.06	1.03
Sphaeroidina bulloides	1.03	0.24	0.29	2.97
Textularia lythostrota	-0.52	-0.03	-0.80	0.37
Textularia pseudogramen	-0.40	-0.10	-0.49	0.79
Triloculina subvalvularis	-0.30	-0.21	-0.39	0.89
Triloculina tricarinata	-0.19	-0.21	-0.11	1.37
Uvigerina peregrina	-0.60	2.95	0.50	3.18
Uvigerina proboscidea	**5.72**	0.15	-1.08	6.04

F1 is dominated by two taxa (their number of occurrences is given in brackets): *U. proboscidea* (46) and *B. robusta* (46). F2 is dominated by *C. wuellerstorfi* (46) and F3 is dominated by *G. subglobosa* (45) and *N. irregularis* (46). As shown by column five in Table 9.1, all these taxa are characterised by high mean %.

Table 9.2 – **Factor loadings for the 46 samples from gravity core *Fr10/95 GC17*.**
Factor loadings >0.70 are indicated in bold.

Sample depth	Age (Kyr BP)	F1	F2	F3
0-1 cm	0	**0.89**	0.01	0.20
3-4 cm	0.44	**0.91**	0.08	0.28
5-6 cm	0.74	**0.96**	0.05	0.11
9-10 cm	1.13	**0.94**	0.06	0.24
13-14 cm	1.33	**0.94**	0.05	0.11
17-18 cm	1.53	**0.93**	0.05	0.10
21-22 cm	1.82	**0.94**	0.05	0.21
25-26 cm	2.18	**0.90**	0.05	0.24
29-30 cm	2.55	**0.92**	0.11	0.13
33-34 cm	2.92	**0.82**	0.18	0.30
37-38 cm	3.29	**0.78**	0.30	0.29
41-42 cm	3.66	0.65	0.27	0.38
45-46 cm	4.03	0.39	0.05	0.63
49-50 cm	4.33	0.36	0.22	0.64
53-54 cm	4.62	0.33	0.20	**0.71**
57-58 cm	4.91	0.19	0.08	**0.85**
61-62 cm	5.72	0.22	-0.01	**0.85**
65-66 cm	6.54	0.19	0.04	**0.91**
69-70 cm	7.03	0.29	0.07	**0.86**
73-74 cm	7.52	0.27	0.14	**0.85**
77-78 cm	7.92	0.24	0.18	**0.79**
81-82 cm	8.21	0.20	0.37	**0.75**
85-86 cm	8.76	0.22	0.22	**0.85**
89-90 cm	9.55	0.22	0.21	**0.85**
93-94 cm	10.34	0.11	0.12	**0.85**
97-98 cm	11.13	0.46	0.38	0.57
101-102 cm	11.92	0.00	0.23	**0.84**
105-106 cm	12.71	0.26	0.17	**0.86**
109-110 cm	13.44	0.21	0.32	0.63
113-114 cm	13.46	0.12	0.06	**0.82**
117-118 cm	14.91	0.28	0.19	**0.80**
121-122 cm	15.92	0.11	0.34	0.60
125-126 cm	17.16	0.04	0.53	0.47
127-128 cm	17.89	-0.02	0.21	0.16
133-134 cm	20.10	0.09	**0.88**	0.10
137-138 cm	21.57	0.06	**0.82**	0.07
141-142 cm	22.51	0.09	**0.75**	0.02
145-146 cm	22.93	0.08	**0.88**	0.18
149-150 cm	23.36	0.10	**0.91**	0.16
153-154 cm	24.41	0.09	**0.81**	0.36
157-158 cm	25.46	0.07	**0.95**	0.18
161-162 cm	26.51	0.07	**0.92**	0.08
165-166 cm	27.57	-0.05	**0.95**	0.10
169-170 cm	28.62	0.17	**0.90**	0.17
173-174 cm	29.67	0.12	**0.86**	0.08
177-178 cm	30.72	0.18	**0.88**	0.13

Factor analysis also calculated the factor loadings for each sample (Table 9.2) and trends related to F1, F2 and F3 are plotted in figure 9.1. Three groups of samples were identified on the basis of the factor loadings:

- Group1: samples with high factor loadings on F1 (4 Kyr BP – Present).
- Group2: samples with high factor loadings on F3 (17 – 4 Kyr BP).
- Group3: samples with high factor loadings on F2 (31 – 17 Kyr BP).

The percentages of the three groups of taxa, which dominated the three factors, are plotted in figure 9.2. *C. wuellerstorfi* dominated the benthic foraminiferal fauna from 31 to 18 Kyr BP (termination of MIS3 – mid MIS2), *G. subglobosa* and *N. irregularis* showed highest percentages between 17 and 4 Kyr BP (mid MIS2 – mid MIS1). *B. robusta* and *U. proboscidea* dominated during the last 4 Kyrs (late MIS1).

9.1.2 Fr10/95 GC17: faunal characteristics

For each sample, the following parameters, which provide faunal characteristics were calculated: the percentage of agglutinated taxa, the percentage of porcellaneous taxa, the percentage of infaunal taxa, Fisher's Alpha index (α), Shannon-Weaver index (H(S)), equitability (E) and dominance D (figure 9.3). Species included in the infaunal taxa are listed in Appendix B.

Agglutinated species percentage constantly decreased from nearly 12%, 31 Kyr BP, to 7.56%, 24 Kyr BP (termination of MIS3). For the entire MIS2 and MIS1, these species were present in low percentages, ranging between 3% and 6%. Porcellaneous taxa followed three different trends. From 31 to 24 Kyr BP (termination of MIS3), this group of species was characterised by lower percentages (about 16%). Between 24 and 8 Kyr BP (MIS2 – early MIS1), the percentage of these taxa was higher (>20%), while for the last 8 Kyrs, percentages were generally below 10%. The percentage of the infaunal taxa increased from 31 to 17 Kyr BP, passing from 28 to 41%. Between 17 and 4 Kyr BP, this group displayed values always <30%. Values ranging between 30 and 40% were recorded for the last 4 Kyrs (late MIS1).

Diversity index curves followed similar patterns. The α, H(S) and E were characterised by high values (>22, > 3.4 and >32 respectively) until 4 Kyr BP. Lower values were recorded from that age until the Present (late MIS1) (<22, <3.4 and <32 respectively). Dominance followed an opposite trend, showing higher values for the last 4 Kyrs (>14%) and lower values before (<14%).

9.1.3 Gravity core Fr10/95 GC17: Benthic Foraminifera Accumulation Rate (BFAR) and accumulation rates calculated for B. aculeata, E. exigua and U. proboscidea

Benthic Foraminifera Accumulation Rate (BFAR), calculated for the gravity core *Fr10/95 GC17* samples, ranged between 600 and 800 n/cm^{2}Kyr (n=number of benthic foraminifera), from 32 to 15 Kyr BP (termination of MIS3 – termination of MIS2), following a rather regular pattern (figure 9.4a). At 13 Kyr BP, BFAR decreased reaching a value of 301 n/cm^{2}Kyr. This minimum was followed by a sudden increase, with a peak of 922 n/cm^{2}Kyr, at 10 Kyr BP. BFAR decreased again during the following 5 Kyr, reaching another minimum value at 5 Kyr BP (317 n/cm^{2}Kyr). During the last 5 Kyrs, BFAR increased until 1 Kyr BP, reaching 799 n/cm^{2}Kyr and then decreased to 547 n/cm^{2}Kyr, for the Present.

The accumulation rate (AR) calculated for the species *B. aculeata*, *E. exigua* and *U. proboscidea* is plotted in figure 9.4b. *E. exigua* was never found in the benthic foraminiferal assemblage at this core site. *B. aculeata* displayed generally very low values during the last 30 Kyrs, with an accumulation rate of ~20 n/cm^{2}Kyr recorded before the LGM. *U. proboscidea* AR remained below 50 n/cm^{2}Kyr between 30 Kyr BP and 4 Kyr BP. During the last 4 Kyrs, *U. proboscidea* AR increased reaching a maximum value of 210 n/cm^{2}Kyr, at 1 Kyr BP.

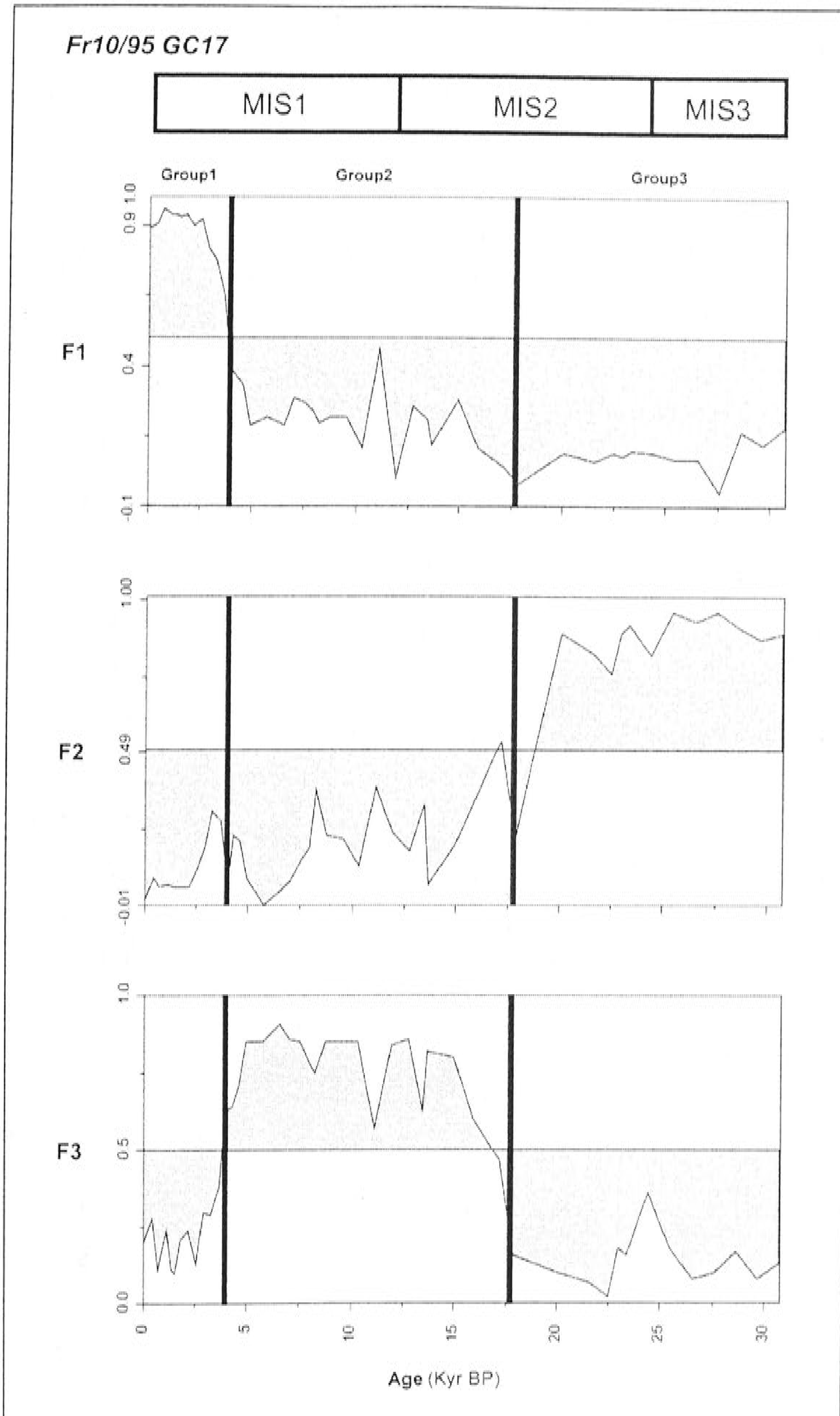

Fig. 9.1 – **Factor loadings for the samples of *Fr10/95 GC17* calculated for each one of the three factors and plotted versus age (Kyr BP).**

Three groups of samples are identified on the basis of the factor loadings on the three axes: Group1, which includes samples characterised by high factor loadings on Factor 1, Group2, which include samples with high factor loadings on Factor 3, and finally Group3, which include those samples with high factor loadings on Factor 2. At the top of the diagram, Marine Isotope Stages are shown.

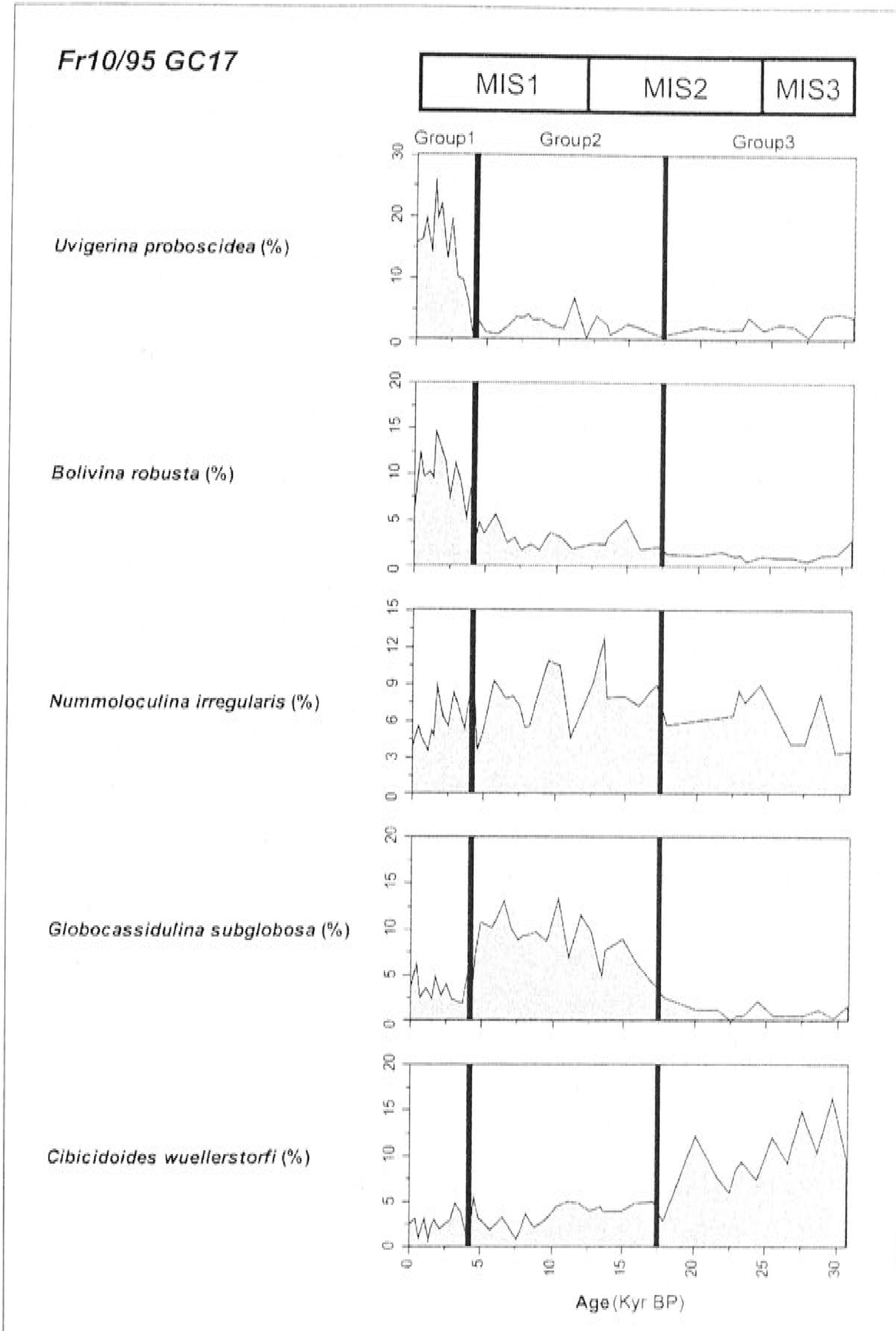

Fig. 9.2 – **Diagram showing the percentages of those species, which dominate the benthic foraminiferal faunas in the three groups of samples, from gravity core *Fr10/95 GC17*, identified by means of the Factor Analysis.**
At the top of the diagram, Marine Isotope Stages are shown. Vertical lines indicate the three groups individuated by means of factor loadings.

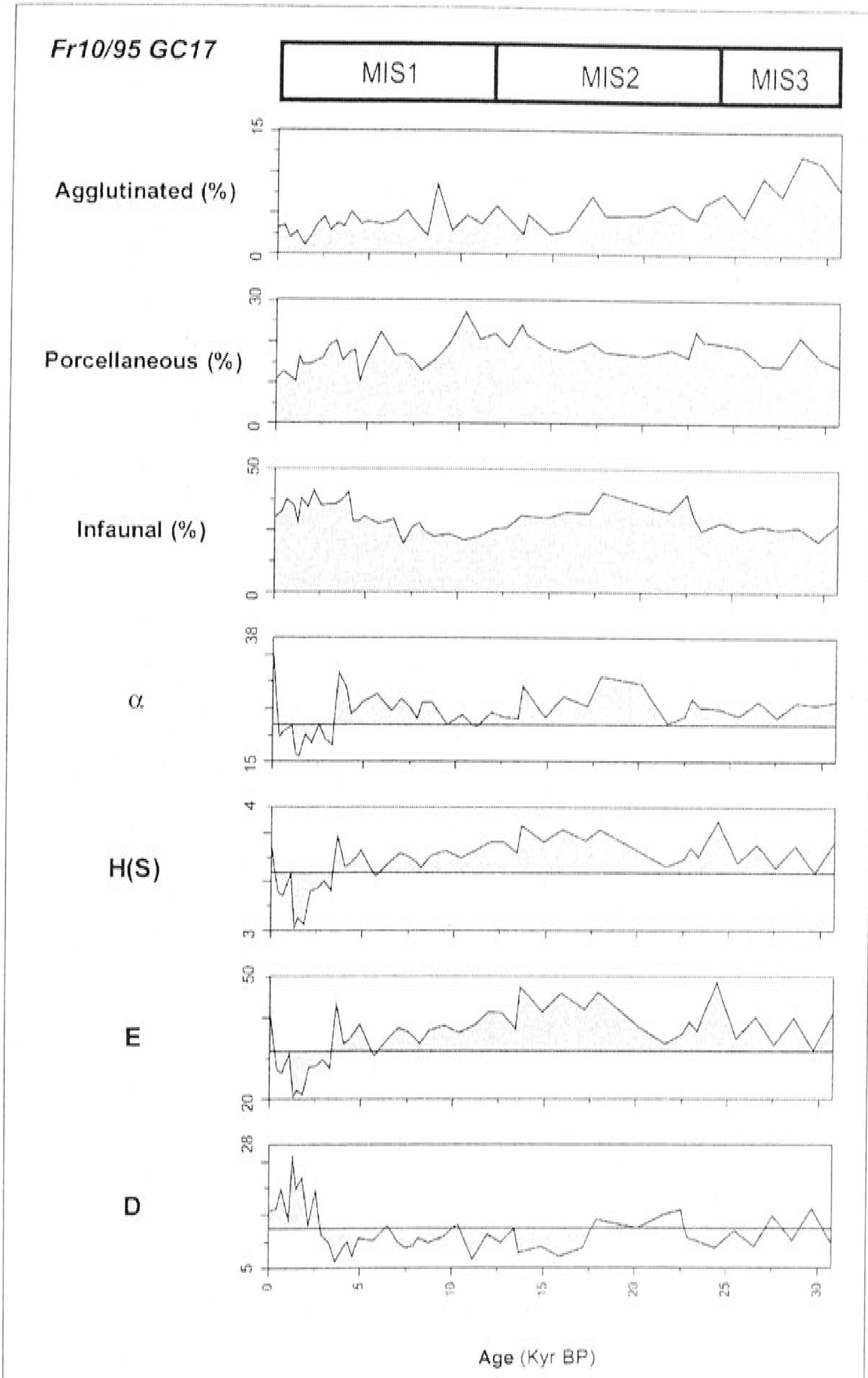

Fig. 9.3 – **Faunal characteristics calculated for each sample from gravity core *Fr10/95 GC17*.** Percentages of Agglutinated, Porcellaneous and Infaunal taxa; α: Fisher's Alpha index, H(S): Shannon-Weaver index; E: equitability; D: dominance. At the top of the diagram, Marine Isotope Stages are shown.

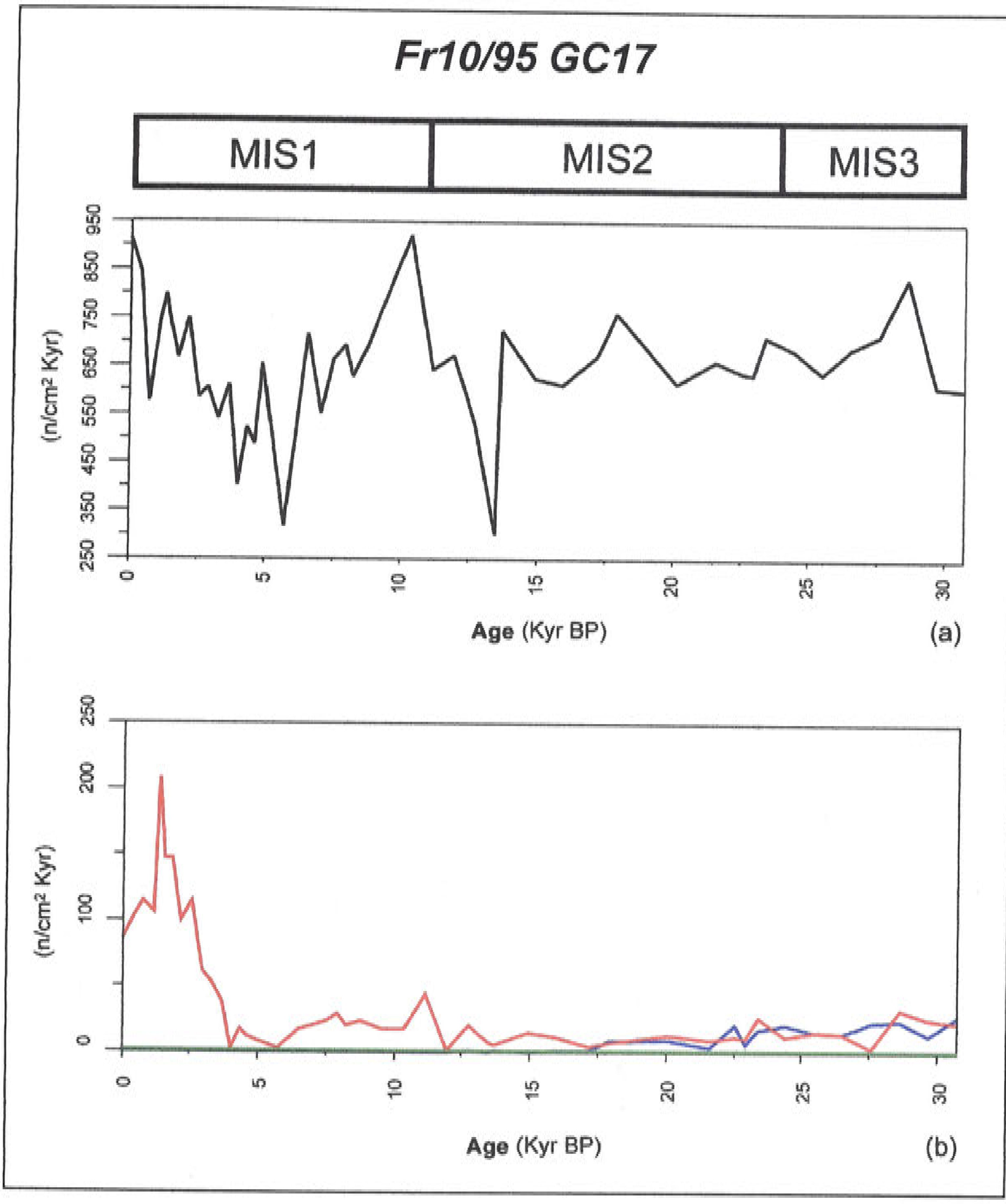

Fig. 9.4 – **Gravity core *Fr10/95 GC17*: (a) Benthic Foraminifera Accumulation Rate (BFAR) and (b) accumulation rates of *B. aculeata* (blue line), *E. exigua* (green line) and *U. proboscidea* (red line).**

(a) The curve indicates the BFAR (expressed as number of benthic foraminifera accumulated over 1 cm^2 each thousand years) variations during the last 30 Kyrs.

(b) *E. exigua* was not found in the samples from this core. *B. aculeata* AR was extremely low before the LGM. *U. proboscidea* AR increased during the last 5 Kyrs.

At the top of the diagram, Marine Isotope Stages are shown

9.2 Gravity core Fr10/95 GC5

A total of 87 benthic foraminifera species were recognised in the samples collected from core *Fr10/95 GC5* (Appendix A3). Their average percentages ranged between 16.36% (*B. aculeata*) and 0.01% *(Robertina tasmanica*). The species present in at least one sample with a percentage >2% were processed by means of Factor Analysis, for a total of 36 taxa.

9.2.1 Fr10/95 GC5: Factor analysis

The two varimax factors, calculated by *Q* – mode Factor analysis (Principal Components), explained 80% of the total species variance. Species scores calculated by means of Factor analysis are listed in Table 9.3.

Table 9.3 – ***Q*-mode Factor Analysis results for the reduced species dataset of gravity core *Fr10/95 GC5*: species scores for varimax Factors 1 and 2.**
Those species, which present both high score on F1 or F2 and high mean percentage, are indicated in bold.

Species	F1	F2	Mean %
Astrononion echolsi	0.91	-0.04	6.47
Bulimina aculeata	-1.06	**5.67**	16.36
Bulimina costata	-0.05	-0.18	1.32
Cassidulina laevigata	0.07	-0.17	1.59
Ceratobulimina pacifica	-0.77	-0.32	1.19
Chilostomella oolina	2.12	0.71	5.67
Cibicidoides bradyi	-0.81	-0.27	1.45
Cibicidoides robertsonianus	-0.62	-0.33	0.24
Cibicidoides wuellerstorfi	**3.49**	0.09	11.46
Epistominella exigua	1.59	0.58	10.51
Fissurina spp.	0.41	-0.20	3.18
Globobulimina affinis	-0.32	-0.24	0.43
Globobulimina pacifica	-0.56	-0.27	0.18
Globocassidulina subglobosa	-0.53	-0.22	2.11
Gyroidinoides orbicularis	-0.33	-0.23	0.96
Hoeglundina elegans	-0.11	-0.29	1.86
Lagena spp.	-0.49	-0.27	0.73
Laticarinina pauperata	-0.56	-0.29	0.47
Melonis pompilioides	-0.10	-0.21	1.09
Oolina spp.	-0.50	-0.23	0.51
Oridorsalis tener umbonatus	1.90	0.29	9.25
Osangularia cultur	-0.59	-0.33	0.10
Parafissurina spp.	-0.21	-0.21	1.04
Pullenia bulloides	-0.42	-0.28	1.06
Pullenia quinqueloba	-0.55	-0.17	0.57
Pyrgo depressa	-0.62	-0.29	0.37
Pyrgo murrhina	1.58	-0.11	5.69
Pyrgo sp.	-0.28	-0.30	0.4
Quinqueloculina seminulum	-0.34	-0.26	0.92
Quinqueloculina venusta	-0.64	-0.25	0.62
Robertinoides bradyi	-0.68	-0.30	0.32
Sigmoilopsis schlumbergeri	-0.42	-0.28	0.38
Sphaeroidina bulloides	-0.60	-0.20	1.67
Uvigerina peregrina	1.02	-0.13	3.14
Uvigerina porrecta	-0.59	-0.33	0.10
Uvigerina proboscidea	-0.34	-0.12	1.65

F1 and F2, are dominated by *C. wuellerstorfi* (31) and *B. aculeata* (28), whose number of occurrences is given in brackets.

The Factor loadings (Table 9.4) distinguish two major groups of samples (figure 9.5):

- Group1: samples with high factor loadings on F2 (18– 4 Kyr BP)
- Group2: samples with high factor loadings on F1 (35 – 18 Kyr BP).

Table 9.4 – **Factor loadings for the 46 samples from gravity core *Fr10/95 GC5*.**
Factor loadings >0.70 are indicated in bold.

Sample depth	Age (Kyr BP)	F1	F2
0-1 cm	0	0.30	-0.08
5-6 cm	1.04	0.35	0.34
9-10 cm	2.09	0.36	0.37
13-14 cm	3.13	0.41	0.28
17-18 cm	4.17	0.04	**0.92**
21-22 cm	5.22	0.04	**0.98**
25-26 cm	6.26	0.06	**0.98**
29-30 cm	7.30	0.06	**0.99**
33-34 cm	8.35	0.18	**0.96**
37-38 cm	9.39	0.24	**0.96**
41-45 cm	10.44	0.02	**0.99**
49-50 cm	11.48	0.02	**0.99**
53-54 cm	12.52	0.33	**0.89**
57-58 cm	15.19	0.27	**0.87**
61-62 cm	17.85	**0.76**	0.20
65-66 cm	18.58	**0.86**	0.11
69-70 cm	19.31	**0.64**	0.55
73-74 cm	20.04	**0.87**	0.17
77-78 cm	20.77	**0.93**	0.18
81-82 cm	21.49	**0.93**	0.15
85-86 cm	22.22	**0.95**	0.06
89-90 cm	22.95	**0.90**	0.05
93-94 cm	23.68	**0.90**	0.14
97-98 cm	24.41	**0.92**	0.10
101-102 cm	25.99	**0.81**	0.17
105-106 cm	27.57	0.67	0.18
109-110 cm	29.15	**0.78**	0.04
113-114 cm	30.74	**0.70**	0.12
117-118 cm	32.32	**0.79**	0.02
121-122 cm	33.90	**0.93**	0.09

In figure 9.6, the percentages of the species that dominate the two factors are plotted versus age (Kyr BP). *C. wuellerstorfi* showed the highest percentages between 35 and 18 Kyr BP (termination of MIS3 – mid MIS2). Between 18 and 4 Kyr BP (termination of MIS2 – mid MIS1), *B. aculeata* dominated the benthic foraminiferal fauna.

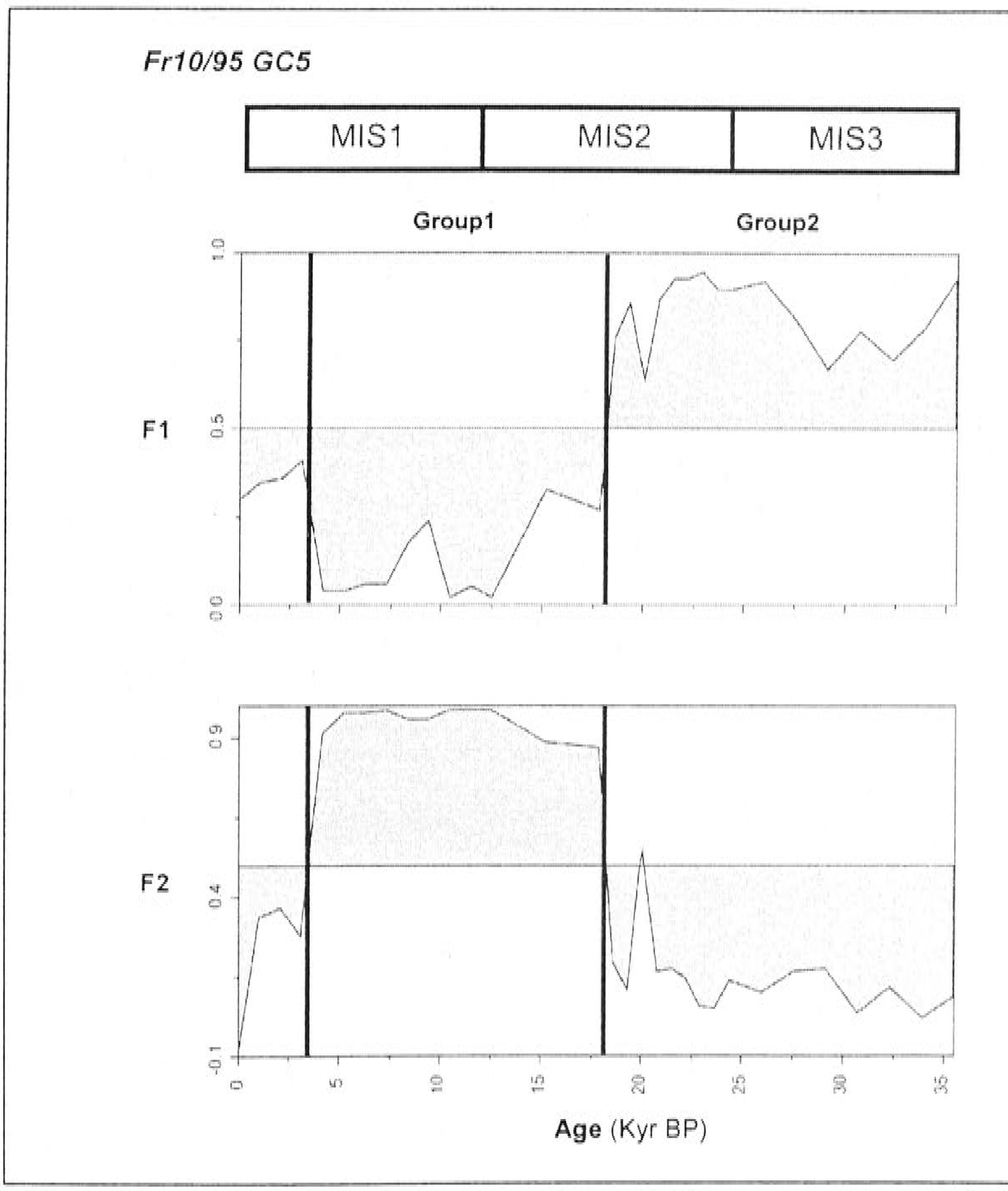

Fig. 9.5 – **Factor loadings for the samples of *Fr10/95 GC5* calculated for each one of the two factors and plotted versus age (Kyr BP).**
Two groups of samples are identified on the basis of the analysis of their scores on the two axes: Group1, which includes samples characterised by factor loadings on F1, and Group2, which includes samples with high factor loadings on F2. At the top of the diagram, Marine Isotope Stages are shown

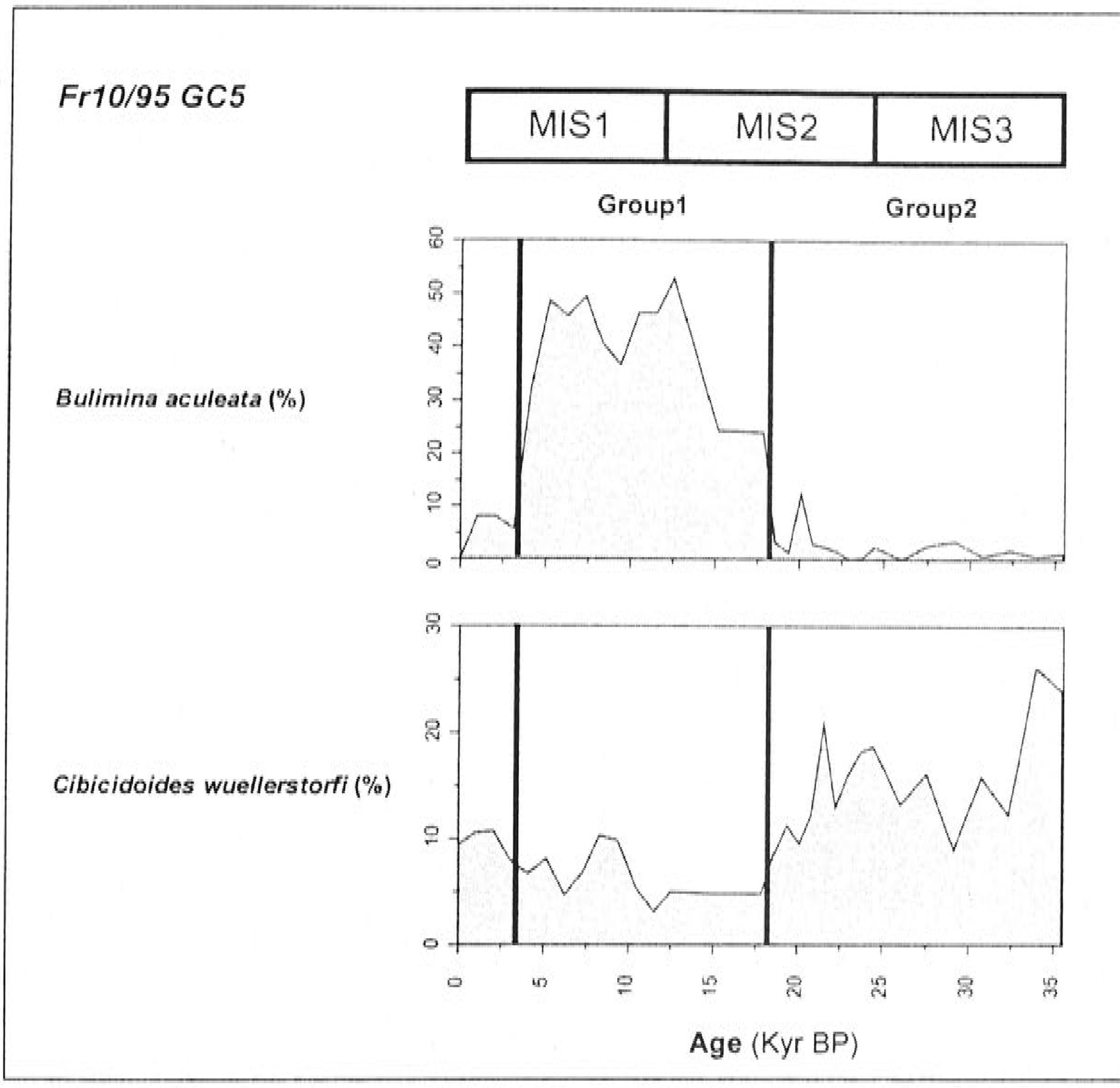

Fig. 9.6 – **Diagram showing the percentages of those species from gravity core *Fr10/95 GC5*, identified by means of Factor Analysis.**
At the top of the diagram, Marine Isotope Stages are shown. Vertical lines indicate the limits of the two groups of samples individuated by means of the factor loadings.

9.2.2 Fr10/95 GC5: faunal characteristics

As for *Fr10/95 GC17*, the total percentages of agglutinated, porcellaneous and infaunal taxa (for the species included in this last group see Appendix B), α, H(S), E, D were calculated for each core sample (figure 9.7).

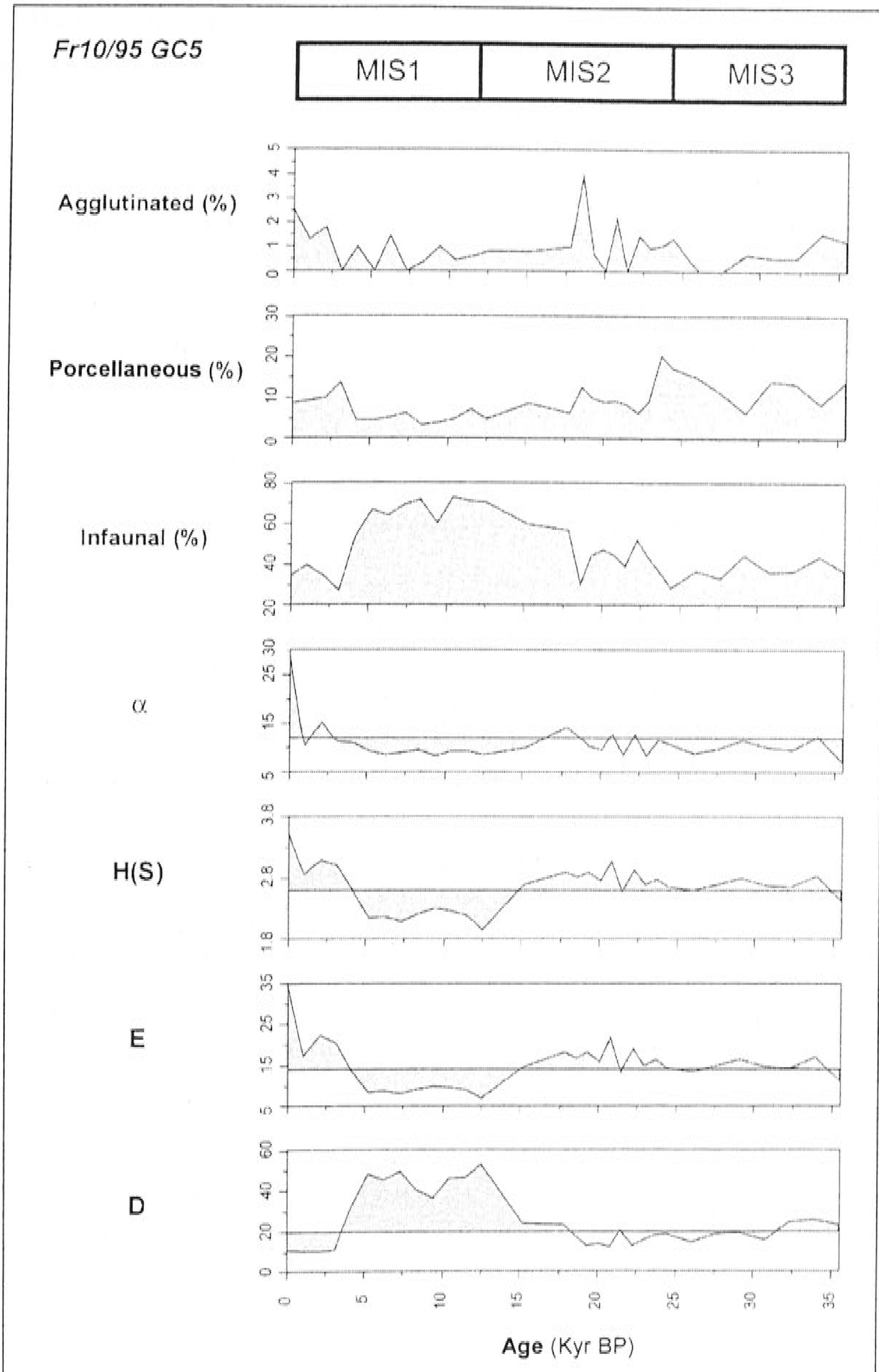

Fig. 9.7 – **Faunal characteristics calculated for each sample from gravity core *Fr10/95 GC5*.** Percentages of Agglutinated, Porcellaneous and Infaunal taxa; α: Fisher's Alpha index, H(S): Shannon-Weaver index; E: equitability; D: dominance. At the top of the diagram, Marine Isotope Stages are shown.

The percentage of agglutinated species was characterised by a monotonous trend, showing low values (<2%) throughout the time interval considered in this study. This group of species reached a peak at 18 Kyr BP (termination of MIS2), when they showed a percentage of 4%. Porcellaneous taxa percentages, from 35 to 22 Kyr BP (termination of MIS3 – early MIS2), ranged between 15% and 20%, with a peak at the beginning of MIS2. From this point until the Present, the percentage of this group of species always remained below 15%. Infaunal species, from 35 to 18 Kyr BP (termination of MIS3 – mid MIS2), showed percentages <50%. Between 18 and 5 Kyr BP (termination of MIS2 – mid MIS1), the percentages were high (>60%). They decreased towards the Present, taking on values similar to those seen for the older part of the studied section of the core, being again <50%.

Diversity indices followed similar patterns: α, H(S) and E were characterised by low values, especially between 18 and 5 Kyr BP (termination of MIS2 – mid MIS1), while, for the last 5 Kyrs (late MIS1), they indicated increased species diversity. An opposite trend was shown by dominance, which reached the highest values between the end of MIS2 and the mid MIS1, while from 35 to 18 Kyr BP and for the last 5 Kyrs, this parameter showed lower values (<20).

9.2.3 Gravity core Fr10/95 GC5: Benthic Foraminifera Accumulation Rate (BFAR) and accumulation rates calculated for B. aculeata, E. exigua and U. proboscidea

The rate of accumulation of benthic foraminifera, for the last 35 Kyrs, at the *Fr10/95 GC5* site is displayed in figure 9.8a. Between 35 and 20 Kyr BP, the BFAR increased, passing from 70 to 92 n/cm^{2}Kyr. At 24 Kyr BP, the BFAR reached values close to 140 n/cm^{2}Kyr. Between 20 and 5 Kyr BP, the BFAR was characterised by high values, which ranged between 150 and 200 n/cm^{2}Kyr. During the last 5 Kyrs, BFAR decreased, passing from 200 to 70 n/cm^{2}Kyr.

The accumulation rates (AR) calculated for *B. aculeata*, *E. exigua* and *U. proboscidea* are shown in figure 9.8b. When *B. aculeata* AR reached values of 45 n/cm^{2}Kyr, at 20 Kyr BP, *E. exigua* passed from 15 to more than 20 n/cm^{2}Kyr. Between 20 and 5 Kyr, these two species were characterised by AR ranging between 40 and 100 n/cm^{2}Kyr, and between 5 and 25 n/cm^{2}Kyr, respectively. *U. proboscidea*, despite it never reached high AR during the last 30 Kyrs, displayed values close to 5 n/cm^{2}Kyr soon after 20 Kyr BP, until the present.

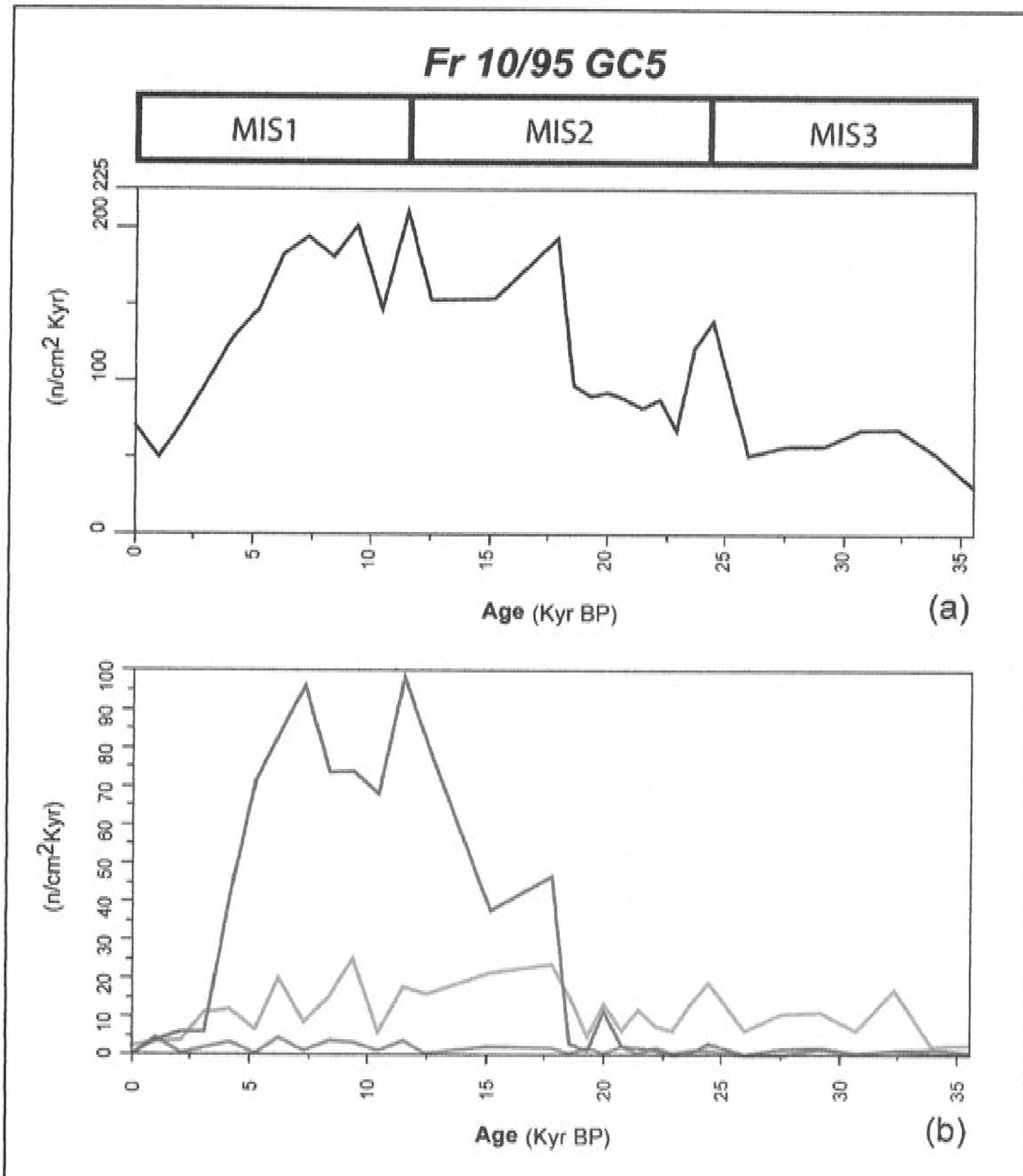

Fig. 9.8 – **Gravity core *Fr10/95 GC5*: (a) Benthic foraminifera Accumulation Rate (BFAR) and (b) accumulation rates of *B. aculeata* (blue line), *E. exigua* (green line) and *U. proboscidea* (red line).**

(a) The curve indicates the BFAR (expressed as number of benthic foraminifera accumulated over 1 cm^2 each thousand years) variations during the last 30 Kyrs.

(b) The highest AR values calculated for the three selected species are recorded for the period between 20 and 5 Kyr BP.

At the top of the diagram, Marine Isotope Stages are shown

9.3 Piston core SHI9016

The analysis of benthic foraminifera species, extracted from samples from piston core *SHI9016*, led to the identification of 138 taxa (Appendix A4), with mean percentages ranging between 14.03% (*B. aculeata*) and 0.01% (*Guttulina pacifica*). Those species present with a percentage >2% in at least one sample were selected for *Q* – mode Factor Analysis (Principal Components). A total of 56 species were selected for the statistical analysis.

9.3.1 SHI9016: Factor Analysis

Factor analysis calculated two varimax factors, explaining 82.7% of the total variance of the species distribution. Species scores related to the two factors are listed in Table 9.5.

Table 9.5 – ***Q*-mode Factors Analysis (Principal Components) results for the reduced species dataset of piston core *SHI9016*: species scores for varimax Factors 1 and 2.**
Those species, which present high score on F1, or F2, and high mean percentage, are indicated in bold.

Species	F1	F2	Mean%
Anomalina globulosa	-0.30	-0.50	0.50
Astrononion echolsi	0.36	0.54	2.92
Bolivina robusta	-0.39	-0.43	0.40
Bulimina aculeata	**6.61**	-2.02	14.03
Bulimina costata	-0.34	0.11	1.17
Buliminella elegantissima	-0.37	-0.66	0.21
Cassidulina crassa	-0.34	-0.68	0.23
Cassidulina laevigata	0.25	0.25	2.49
Ceratobulimina pacifica	-0.52	0.27	0.96
Chilostomella oolina	-0.53	1.17	1.98
Cibicidoides bradyi	0.80	0.80	4.15
Cibicidoides kullenbergi	-0.48	-0.17	0.51
Cibicidoides pseudoungerianus	-0.46	0.44	1.18
Cibicidoides robertsonianus	-0.34	-0.62	0.31
Cibicidoides wuellerstorfi	0.48	**2.90**	5.72
Cibicidoides sp.	-0.30	-0.65	0.35
Dentalina communis	-0.40	-0.52	0.27
Eggerella bradyi	-0.33	-0.50	0.46
Ehrenbergina trigona	-0.11	-0.52	0.87

Table 9.5 – *continued.*

Species	F1	F2	Mean %
Epistominella exigua	0.62	-0.79	2.17
Fissurina spp.	0.91	2.03	5.56
Gavelinopsis lobatulus	-0.16	-0.41	0.90
Globocassidulina elegans	-0.49	-0.27	0.38
Globocassidulina subglobosa	0.08	2.70	4.66
Gyroidinoides altiformis	-0.34	-0.50	0.42
Gyroidinoides orbicularis	-0.15	0.35	1.74
Gyroidinoides soldanii	-0.29	-0.50	0.51
Hoeglundina elegans	-0.32	0.71	1.82
Karreriella bradyi	-0.34	-0.71	0.24
Lagena spp.	0.05	-0.15	1.63
Laticarinina pauperata	-0.35	-0.38	0.52
Lenticulina spp.	-0.39	-0.33	0.54
Martinottiella communis	-0.33	-0.51	0.47
Melonis barleeanum	0.64	-0.27	2.71
Melonis pompilioides	-0.17	-0.76	0.54
Nummoloculina irregularis	-0.38	-0.39	0.51
Oolina spp.	-0.37	-0.55	0.36
Oridorsalis tener umbonatus	0.66	1.22	4.17
Parafissurina spp.	-0.24	0.02	1.17
Pullenia bulloides	0.30	2.71	4.86
Pullenia quinqueloba	0.09	0.25	2.05
Pyrgo depressa	-0.15	0.08	1.37
Pyrgo murrhina	-0.04	-0.07	1.51
Pyrulina gutta	-0.41	-0.68	0.11
Quinqueloculina lamarckiana	-0.41	-0.54	0.31
Quinqueloculina seminulum	-0.27	0.13	1.25
Quinqueloculina venusta	-0.28	-0.71	0.36
Robertina tasmanica	-0.40	-0.70	0.14
Robertinoides brady	-0.41	-0.73	0.10
Sigmoilopsis schlumbergeri	-0.23	-0.24	0.96
Siphotextularia sp.	-0.41	-0.67	0.11
Sphaeroidina bulloides	-0.42	-0.15	0.71
Triloculina tricarinata	-0.21	-0.30	0.92
Uvigerina proboscidea	1.47	2.79	7.71
Valvulineria araucana	-0.16	-0.88	0.45

F1 is dominated by *B. aculeata* (25), while F2 is dominated by *C. wuellerstorfi* (35) (the number of occurrences of the species is given in brackets). The species identified by Factor Analysis are characterised by high mean percentages.

Factor loadings for each sample are listed in table 9.6. By means of these values, it is possible to identify two groups of samples (figure 9.9):

- Group1: samples with high loadings factor on F2 (15 Kyr BP – Present).

- Group2: samples with high loadings factor on F1 (62 – 15 Kyr BP).

Table 9.6 – **Factor loadings for the 46 samples from piston core *SH19016*.**
Factor loadings >0.70 are indicated in bold.

Sample depth	Age (Kyr BP)	F1	F2
0-1 cm	0	0.12	0.69
4-5 cm	1.15	0.14	**0.81**
8-9 cm	3.44	0.11	**0.77**
12-13 cm	4.59	0.16	**0.86**
16-17 cm	5.50	0.13	**0.89**
22-23 cm	6.89	0.13	**0.88**
26-27 cm	8.03	0.08	**0.80**
32-33 cm	9.18	0.16	**0.87**
36-37 cm	10.33	0.18	**0.82**
42-43 cm	11.48	0.05	**0.81**
46-47 cm	12.94	0.16	**0.72**
52-53 cm	15.17	0.34	**0.77**
56-57 cm	16.00	**0.80**	0.50
58-59 cm	17.85	**0.92**	0.20
62-63 cm	19.32	**0.91**	0.18
66-67 cm	21.53	**0.95**	0.13
72-73 cm	23.01	**0.97**	0.02
76-77 cm	25.53	**0.88**	0.35
82-83 cm	27.43	**0.87**	0.41
86-87 cm	30.28	**0.78**	0.48
92-93 cm	32.18	0.69	0.62
96-97 cm	35.03	**0.85**	0.42
102-103 cm	36.92	**0.95**	0.11
106-107 cm	39.77	**0.98**	-0.08
112-113 cm	41.67	**0.75**	0.45
116-117 cm	44.52	**0.98**	-0.04
122-123 cm	46.41	**0.98**	0.06
126-127 cm	49.26	**0.95**	0.18
132-133 cm	51.01	**0.90**	0.26
136-137 cm	52.99	**0.96**	-0.02
142-143 cm	54.19	**0.99**	-0.01
146-147 cm	57.37	**0.92**	0.16
152-153 cm	58.96	**0.91**	0.25
156-157 cm	60.75	**0.92**	0.26
162-163 cm	61.95	**0.94**	0.10

Percentages of the species characterised by the highest factor scores on the two axes are plotted in figure 9.10. From 62 to 15 Kyr BP, *B. aculeata* dominated the benthic foraminiferal fauna, while *C. wuellerstorfi* dominated during the last 15 Kyrs.

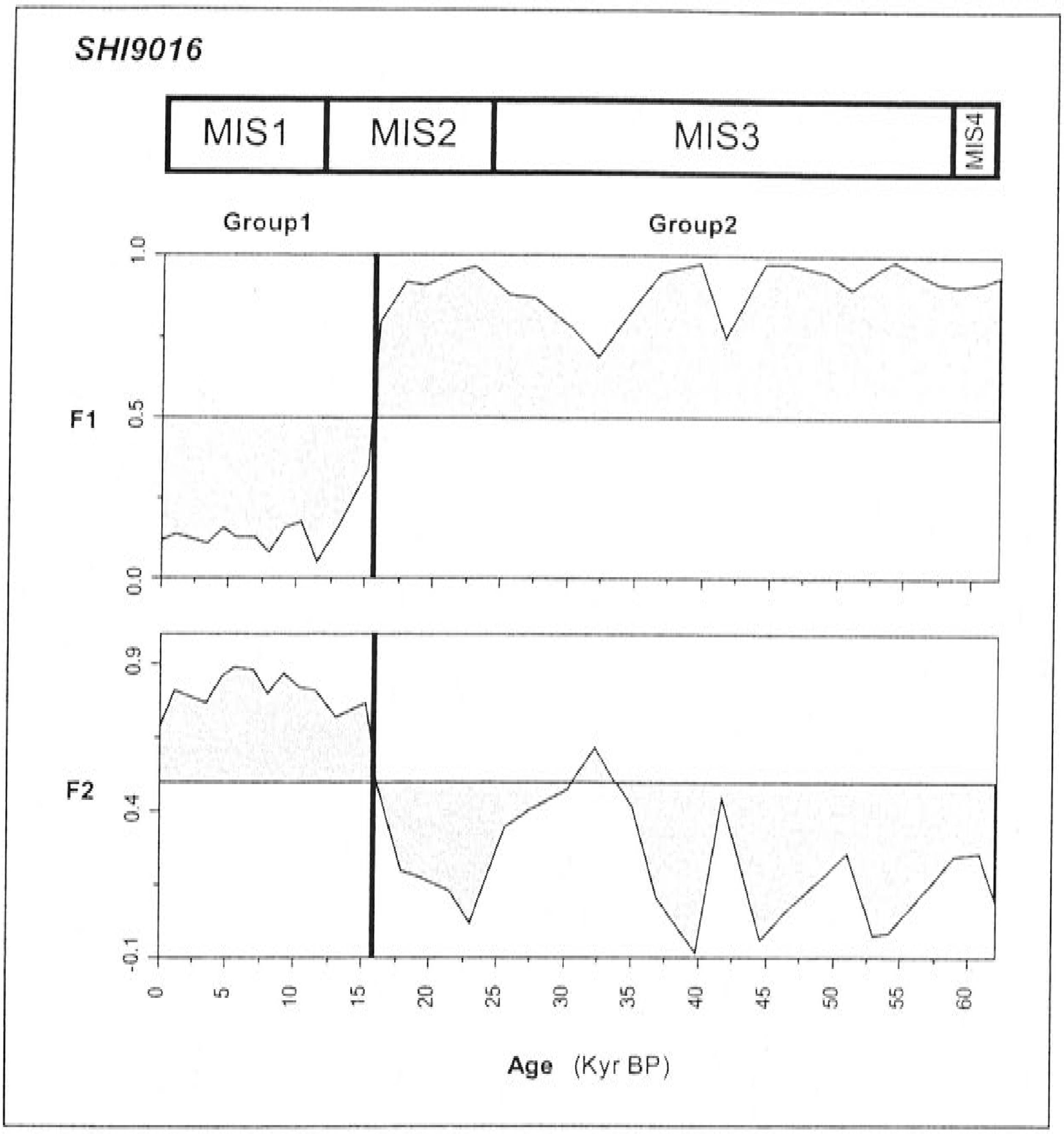

Fig. 9.9 – **Factor loadings for the samples of *SHI9016* calculated for the two factors and plotted versus age (Kyr BP).**

Two groups of samples are identified on the basis of the factor loadings on the axes: Group1, which includes samples characterised by high factor loadings on Factor 2 and Group2, which include samples with high factor loadings on Factor 1. At the top of the diagram, Marine Isotope Stages are shown.

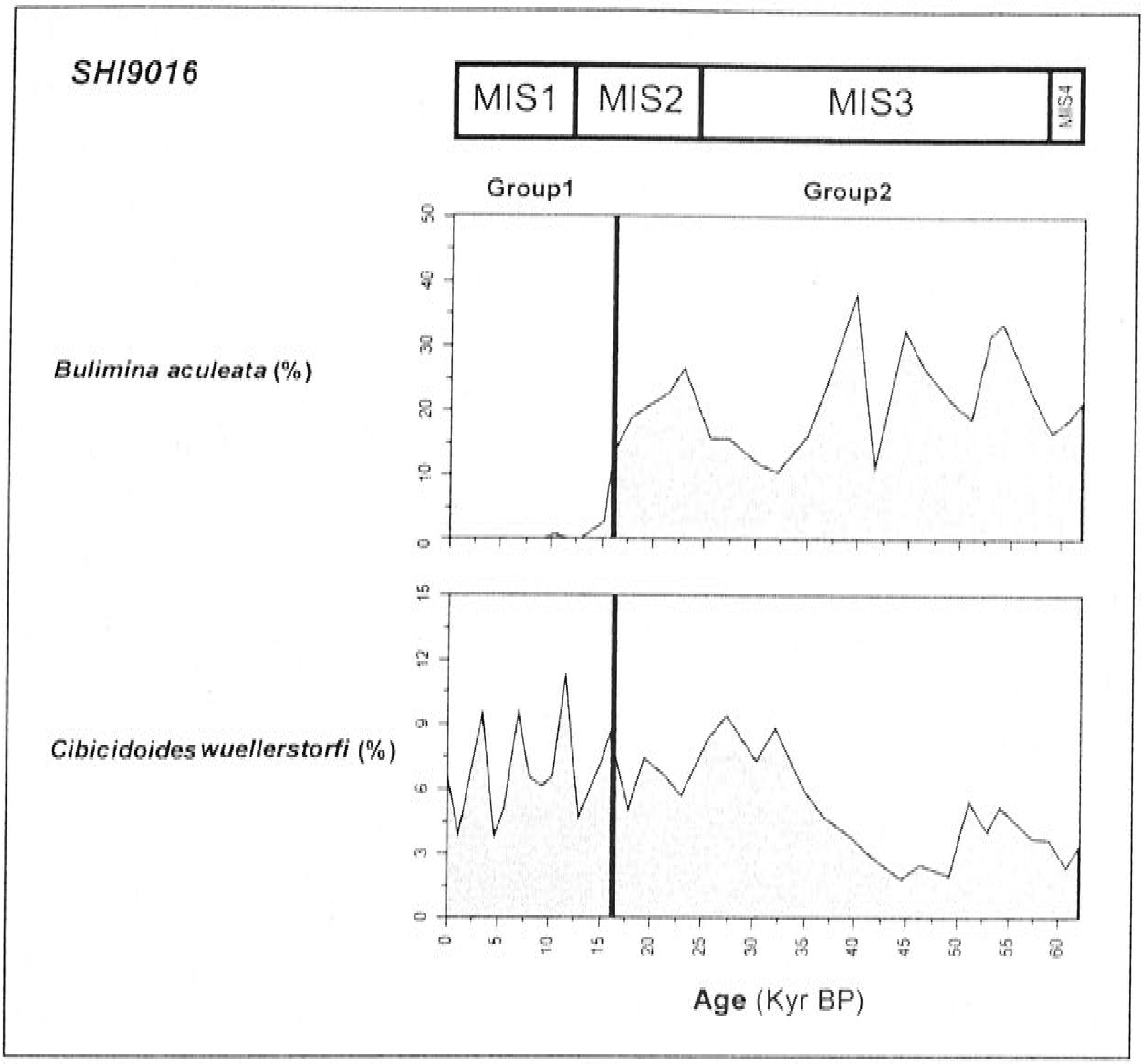

Fig. 9.10 – **Diagram showing the percentages of those species from piston core *SHI9016*, identified by means of Factor Analysis.**
At the top of the diagram, Marine Isotope Stages are shown. Vertical lines indicate the limits of the two groups of samples individuated by means of the factor loadings.

9.3.2 SHI9016: faunal characteristics

Percentages of the agglutinated, porcellaneous and infaunal species (for the species included in this last group see Appendix B), together with the values calculated for α, H(S), E and D are plotted in figure 9.11.

The agglutinated species showed low percentages (<4%) for the time interval studied from piston core *SHI9016*. Before 18 Kyr BP (termination of MIS4 –early MIS2), agglutinated species were characterised by percentages always <2%. Percentages >2% were recorded between 18 and 5 Kyr BP (mid MIS2 – late MIS1). During the last 5 Kyrs, these taxa, again, had percentages <2%. Between 62 and 27

Kyr BP (termination of MIS4 – early MIS3), the porcellaneous taxa showed percentages between 2% and 8%. After, and until 18 Kyr BP (mid MIS3 – early MIS2), the percentages were always <2%. Higher values were reached by these species for the last 18 Kyrs (termination of MIS2 – MIS1). The infaunal taxa followed two major patterns. Before 15 Kyr BP (termination of MIS4 – mid MIS2), they were characterised by percentages >75% (reaching 88%, during early MIS3). Their percentages were lower (generally <75%) for the last 15 Kyrs (termination of MIS2 – MIS1). During this period, the percentages showed an irregular pattern, ranging between 64% and 77%.

Diversity indices (α, H(S), E) calculated for the samples of *SHI9016* displayed similar trends. Before 16 Kyr BP (termination of MIS4 – mid MIS2), they were characterised by low values (<20, <3.8 and <28 respectively), while, during the last 16 Kyrs (termination of MIS2 – MIS1), they increased, maintaining higher values compared to the former time interval. Dominance was characterised by an inverse pattern, showing high values (>15%) during the period comprised between termination of MIS4 and early- mid-MIS2 (62 Kyr BP – 16 Kyr BP), and low values (<15%) during the last 16 Kyrs.

9.3.3 Piston core SHI9016: Benthic Foraminifera Accumulation Rate (BFAR) and accumulation rates calculated for B. aculeata, E. exigua and U. proboscidea

The curve related to the Benthic Foraminiferal Accumulation Rate (figure 9.12a), for piston core *SHI9016* samples, displays two major patterns. Between 62 and 20 Kyr BP, BFAR was characterised by high values (≥200 n/cm^{2}Kyr) with a peak of 326 n/cm^{2}Kyr, at 23 Kyr BP. After 15 Kyr BP, the accumulation rate of benthic foraminifera decreased, maintaining values close to 100 n/cm^{2}Kyr, which decreased to 50 n/cm^{2}Kyr, for the Present.

The accumulation rate of *B. aculeata* mirrored the BFAR trend (figure 9.12b). Between 62 and 15 Kyr BP, *B. aculeata* AR ranged between 20 and 90 n/cm^{2}Kyr. After 15 Kyr BP, this species was absent at this site. *E. exigua* showed a similar pattern, with AR ranging between 5 and 20 n/cm^{2}Kyr, before 15 Kyr BP, and disappearing after that period. *U. proboscidea* was still present after 15 Kyr BP, but as for the other two species, it displayed higher AR values (>10 n/cm^{2}Kyr) between 62 and 15 Kyr BP. During the last 15 Kyrs, *U. proboscidea* AR decreased constantly from 10 to 5 n/cm^{2}Kyr, for the Present.

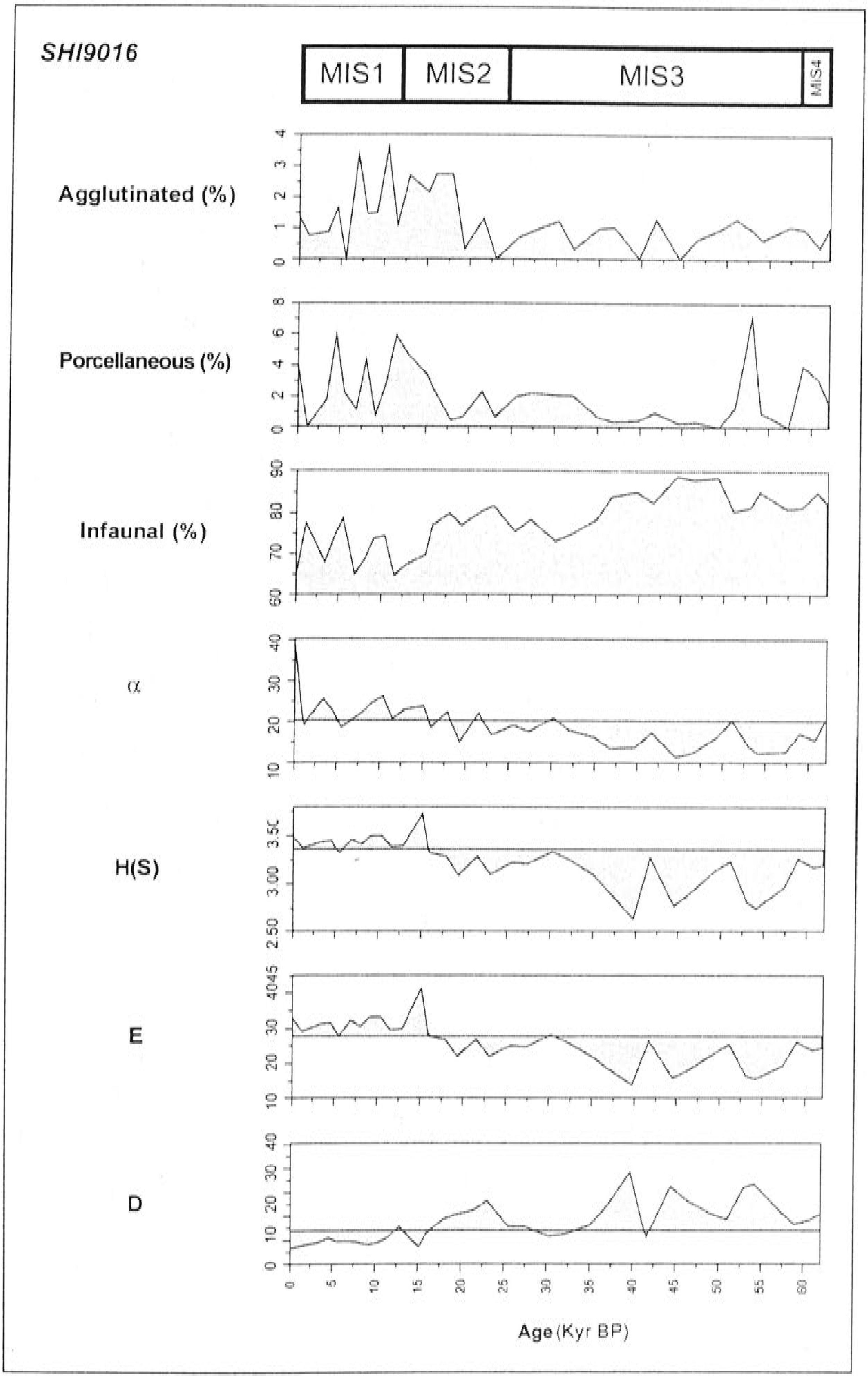

Fig. 9.11 – **Faunal characteristics calculated for each sample from piston core *SHI9016*.** Percentages of Agglutinated, Porcellaneous and Infaunal taxa; α: Fisher's Alpha index, H(S): Shannon-Weaver index; E: equitability; D: dominance. At the top of the diagram, Marine Isotope Stages are shown.

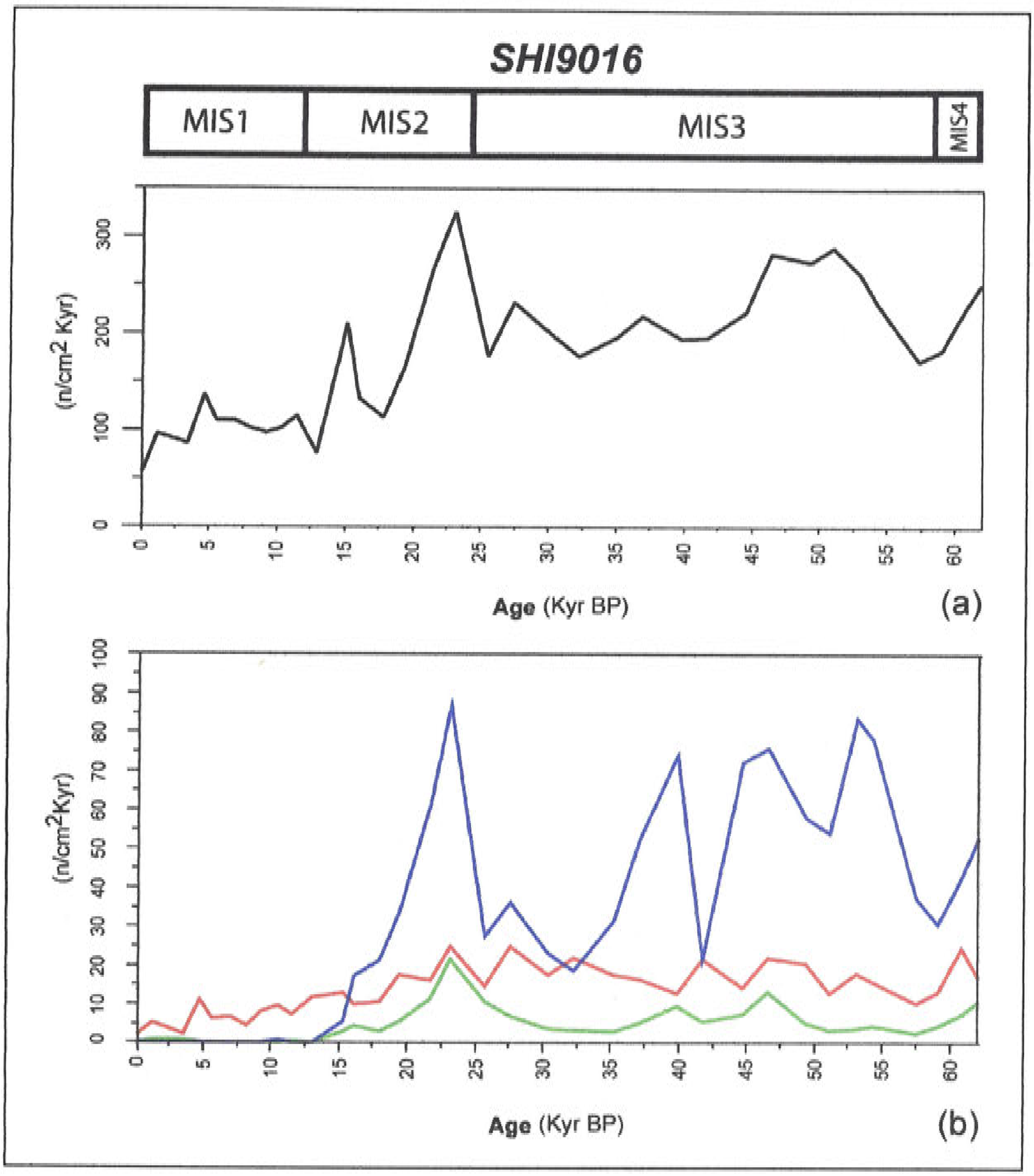

Fig. 9.12 – **Piston core *SHI9016*: (a) Benthic foraminifera Accumulation Rate (BFAR) and (b) accumulation rates of *B. aculeata* (blue line), *E. exigua* (green line) and *U. proboscidea* (red line).**
(a) The curve indicates the BFAR (expressed as number of benthic foraminifera accumulated over 1 cm^2 each thousand years) variations during the last 30 Kyrs.
(b) The highest AR values calculated for the three selected species are recorded between 62 and 15 Kyr BP.
At the top of the diagram, Marine Isotope Stages are shown.

9.4 Piston core BAR9403

Ninety-three benthic foraminifera species were identified (Appendix A5) in *BAR9403* samples. Their mean percentages ranged between 17.8% (*B. aculeata*) and 0.01% (*Bolivina albatrossi*). Similar to the procedure followed for the species identified in samples from the other cores, the taxa showing a percentage >2% in at least one sample were selected for *Q* – mode Factor analysis (Principal Components).

9.4.1 BAR9403: Factor Analysis

Factor analysis calculated four varimax factors, which explained 85.33% of the variance of the species distribution. The species scores are listed in Table 9.7.

Table 9.7 – ***Q*-mode Factors analysis (Principal Components) results for the reduced species dataset of piston core *BAR9403*: factor scores for varimax Factors 1, 2, 3 and 4.**
Those species, which present high score on F1, or F2, or F3 or F4 and high mean percentage, are indicated in bold.

Species	F1	F2	F3	F4	Mean %
Allomorphina pacifica	-0.30	-0.18	-0.13	-0.44	0.26
Anomalina globulosa	-0.09	-0.34	-0.50	-0.10	0.30
Astrononion echolsi	-0.06	-0.23	-0.56	0.30	0.80
Bolivina robusta	-0.12	-0.25	-0.40	-0.38	0.25
Bolivinita quadrilatera	-0.03	-0.25	-0.20	-0.44	0.57
Brizalina semilineata	-0.22	-0.27	-0.31	-0.33	0.15
Bulimina aculeata	**7.48**	0.55	-1.08	-0.63	17.79
Bulimina costata	0.01	0.92	0.88	-0.53	3.34
Bulimina exilis	-0.16	0.39	-0.34	-0.75	0.83
Cassidulina laevigata	0.16	0.79	-0.16	0.16	3.08
Ceratobulimina pacifica	-0.14	-0.28	-0.38	-0.42	0.12
Chilostomella oolina	-0.18	-0.01	0.57	1.23	2.62
Cibicidoides bradyi	-0.11	-0.29	-0.10	0.88	1.57
Cibicidoides pseudoungerianus	-0.17	-0.43	-0.31	0.30	0.56
Cibicidoides robertsonianus	-0.24	-0.31	-0.08	-0.46	0.14
Cibicidoides wuellerstorfi	0.46	0.10	-0.03	**5.83**	7.56
Eggerella bradyi	-0.19	-0.30	-0.05	-0.36	0.36
Epistominella exigua	0.98	-1.04	**6.93**	-0.96	7.82
Fissurina spp.	-0.07	-0.24	-0.05	-0.13	0.89
Fursenkoina bradyi	-0.18	-0.27	-0.20	-0.53	0.19
Fursenkoina fusiformis	-0.06	0.40	-0.26	0.26	2.06

Table 9.7 – *continued.*

Species	F1	F2	F3	F4	Mean %
Fursenkoina sp.	-0.22	-0.31	-0.19	-0.45	0.12
Gavelinopsis lobatulus	-0.05	-0.30	-0.47	-0.13	0.46
Globobulimina affinis	-0.22	-0.09	0.47	-0.30	1.16
Globobulimina pacifica	-0.21	-0.33	0.41	0.04	1.03
Globocassidulina subglobosa	0.16	-0.43	-0.01	0.76	1.94
Gyroidinoides orbicularis	-0.22	-0.33	-0.41	0.67	0.69
Gyroidinoides polius	-0.27	-0.33	0.17	0.19	0.74
Gyroidinoides soldanii	-0.21	-0.14	-0.46	-0.33	0.30
Hoeglundina elegans	0.26	0.22	-0.38	0.76	2.70
Hyalinea balthica	-0.26	-0.20	-0.02	-0.47	0.28
Karreriella bradyi	-0.28	-0.27	-0.08	-0.34	0.22
Lagena spp.	-0.25	-0.35	0.05	-0.22	0.35
Lenticulina spp.	-0.26	-0.14	-0.19	-0.48	0.27
Loxostomum karrerianum	-0.26	-0.27	-0.06	-0.45	0.18
Melonis barleeanum	-0.40	0.08	-0.01	1.68	2.18
Melonis pompilioides	-0.26	-0.29	-0.15	-0.47	0.08
Miliolinella subrotunda	-0.24	-0.16	-0.27	-0.57	0.11
Nonionella bradyi	-0.24	-0.16	-0.35	-0.48	0.19
Nummoloculina irregularis	-0.22	-0.12	-0.30	-0.58	0.18
Oridorsalis tener umbonatus	-0.64	**7.22**	0.69	-0.11	11.28
Osangularia cultur	-0.16	-0.11	-0.47	-0.29	0.36
Parafissurina spp.	-0.15	-0.21	-0.36	-0.43	0.24
Pullenia bulloides	-0.24	-0.31	0.23	0.01	0.80
Pullenia quinqueloba	-0.19	-0.32	0.02	-0.18	0.51
Pyrgo depressa	-0.16	-0.03	-0.39	-0.40	0.51
Pyrgo lucernula	-0.24	0.04	-0.45	-0.60	0.21
Pyrgo murrhina	-0.05	0.94	1.74	0.50	4.63
Pyrgo serrata	-0.09	-0.12	-0.29	-0.58	0.46
Quinqueloculina seminulum	-0.25	-0.13	-0.21	-0.34	0.34
Quinqueloculina venusta	-0.17	0.73	-0.35	-0.82	1.43
Robertinoides brady	-0.11	-0.26	-0.35	-0.53	0.19
Sigmoilopsis schlumbergeri	-0.17	-0.03	-0.74	0.89	1.35
Siphogenerina raphanus	-0.26	-0.18	-0.28	-0.58	0.04
Siphotextularia catenata	-0.19	-0.03	-0.36	-0.58	0.29
Sphaeroidina bulloides	-0.22	-0.38	-0.07	0.01	0.48
Spiroloculina tenuis	-0.26	-0.14	-0.40	-0.45	0.13
Triloculina tricarinata	-0.26	-0.11	-0.41	-0.47	0.17
Uvigerina peregrina	0.10	-0.54	0.85	1.60	3.11
Uvigerina proboscidea	0.32	-0.35	0.56	2.43	4.13
Valvulineria araucana	0.30	-0.17	0.09	-0.42	1.77

The four factors are dominated by four taxa all characterised by high mean percentages. F1 is dominated by *B. aculeata* (43), F2 is dominated by *O. t. umbonatus* (51), F3 is dominated by *E. exigua* (44) and F4 is dominated by *C. wuellerstorfi* (53) (number of occurrence is given in brackets).

The loading factors (Table 9.8) identify four groups of samples (figure 9.13):

- Group1: samples with high factor loadings on F3 (3 Kyr BP – Present).
- Group2: samples with high factor loadings on F4 (15 – 3 Kyr BP).
- Group3: samples with high factor loadings on F1 (27 – 15 Kyr BP).
- Group4: samples with high factor loadings on F2 (33 – 27 Kyr BP).

The percentages of the species, which dominate the four factors, are plotted in figure 9.14. *O. t. umbonatus* showed the highest percentages from 33 to 26 Kyr BP (termination of MIS3 – MIS2), while values between 10% and 20% were recorded between 15 and 2 Kyr BP (termination of MIS2 – late MIS1). *B. aculeata* showed high percentages (>30%) from 26 until 15 Kyr BP (MIS2). Between 4 and 2 Kyr (late MIS1), this species was characterised by percentages ranging between 10% and 20%. *E. exigua* reached percentages >10%, at 33 Kyr BP, between 24 and 20 Kyr BP (early MIS2) and during the last 3 Kyrs. *C. wuellerstorfi* was characterised by high relative percentage between 12 and 5 Kyr BP (termination of MIS2 – late MIS1). This taxon reached percentages >10% between 30 and 28 Kyr BP (mid MIS3).

Table 9.8 – **Factor loadings for the 53 samples from piston core *BAR9403*.**
Factor loadings >0.70 are indicated in bold.

Sample depth	Age (Kyr BP)	F1	F2	F3	F4
0-1 cm	0	0.02	0.33	0.53	0.39
5-6 cm	0.58	0.12	0.25	**0.89**	0.22
10-11 cm	1.16	0.12	0.25	**0.79**	0.26
15-16 cm	1.74	0.12	0.26	**0.88**	0.01
20-21 cm	2.32	0.39	0.32	**0.77**	0.16
25-26 cm	2.76	**0.70**	0.53	0.40	0.02
30-31cm	3.21	0.55	0.29	0.62	0.16
35-36 cm	4.09	0.54	0.42	0.35	0.42
39.5-40.5 cm	4.98	**0.74**	0.56	0.05	0.13

Table 9.8 – *continued.*

Sample depth	Age (Kyr BP)	F1	F2	F3	F4
45-46 cm	5.86	0.26	0.67	0.07	0.22
50-51 cm	6.75	0.28	0.49	0.11	**0.71**
55-56 cm	7.63	0.07	0.12	0.37	**0.71**
60-61 cm	8.52	0.16	0.52	0.52	0.41
65-66 cm	9.40	-0.03	**0.85**	0.29	0.23
70-71 cm	10.29	0.01	**0.77**	0.24	0.51
75-76 cm	11.17	0.08	0.40	0.19	**0.77**
80-81 cm	12.06	0.08	0.31	0.10	**0.82**
85-86 cm	12.37	0.07	0.31	0.42	0.69
90-91 cm	12.78	0.03	0.13	-0.02	**0.82**
95-96 cm	13.50	0.20	0.52	0.10	0.63
100-101 cm	14.23	-0.09	0.47	-0.05	0.32
105-106 cm	14.95	0.58	0.38	-0.02	0.49
110-111 cm	15.68	**0.70**	0.54	-0.04	0.36
115-116 cm	16.40	**0.88**	0.27	-0.03	0.19
120-121 cm	17.13	**0.90**	0.22	-0.06	0.19
125-126 cm	17.85	**0.98**	0.08	-0.03	0.03
130-131 cm	18.74	**0.92**	0.10	0.05	0.11
135-136 cm	19.64	**0.94**	0.11	0.02	0.00
140-141 cm	20.53	**0.97**	0.13	0.09	0.03
145-146 cm	21.43	**0.99**	0.10	0.04	0.00
150-151 cm	22.32	**0.93**	0.19	-0.01	0.19
155-156 cm	23.21	**0.94**	0.16	0.11	0.18
160-161 cm	24.11	**0.95**	0.14	0.27	-0.02
165-166 cm	24.77	**0.87**	0.03	0.46	-0.02
170-171 cm	25.42	**0.93**	0.23	0.21	0.05
175-176 cm	25.82	**0.94**	0.08	0.31	0.01
180-181 cm	26.22	**0.99**	0.12	0.08	0.00
185-186 cm	26.62	**0.84**	0.16	0.50	-0.01
190-191 cm	27.02	**0.97**	0.15	0.11	0.05
195-196 cm	27.42	**0.86**	0.44	0.02	0.02
200-201 cm	27.61	**0.72**	0.36	0.24	0.28
205-206 cm	27.81	0.21	**0.89**	0.14	0.19
210-211 cm	28.21	**0.89**	0.14	0.19	0.18
215-216 cm	28.61	0.60	0.66	0.32	0.19
230-231 cm	29.81	0.28	**0.74**	0.24	0.40
235-236 cm	30.21	0.69	0.64	0.23	0.12
240-241 cm	30.61	0.27	**0.84**	0.24	0.27
245-246 cm	31.01	0.36	0.62	0.24	0.47
255-256 cm	31.80	0.32	**0.90**	0.16	0.13
260-261 cm	32.20	0.04	**0.87**	0.13	0.11
265-266 cm	32.60	0.42	**0.78**	0.21	0.10
270-271 cm	33.00	0.57	**0.38**	0.64	0.06
275-276 cm	33.40	0.40	**0.75**	0.42	0.11

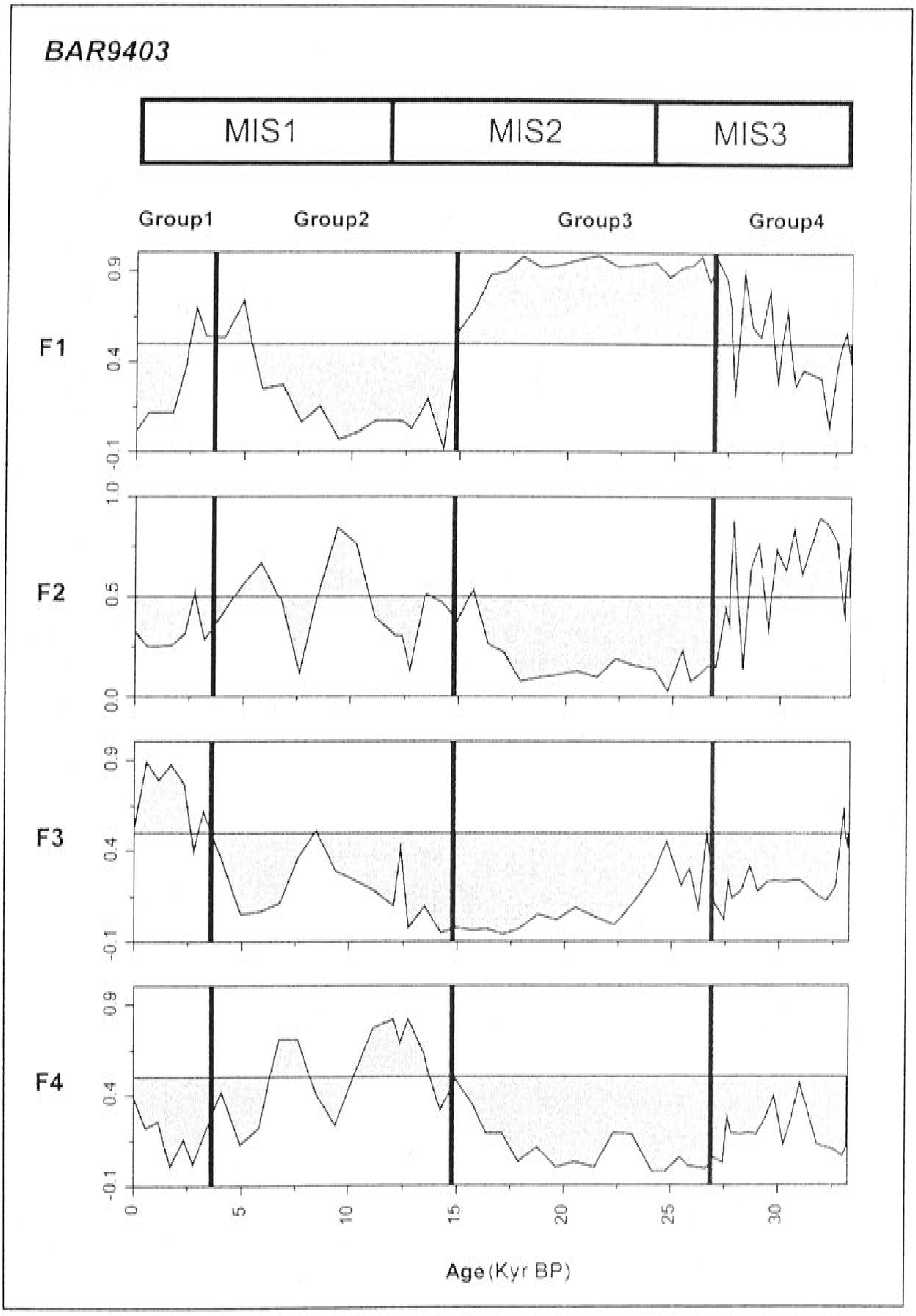

Fig. 9.13 – **Factor loadings for the samples of *BAR9403* calculated for the four factors and plotted versus age (Kyr BP).**

Four groups of samples were identified on the basis of the factor loadings on the axes: Group1, which includes samples characterised by high factor loadings on Factor 3, Group2, which include samples with high factor loadings on Factor 4, Group3, which includes samples with high factor loadings on Factor1 and Group4, which includes samples with high factor loadings on Factor 2. At the top of the diagram, Marine Isotope Stages are shown.

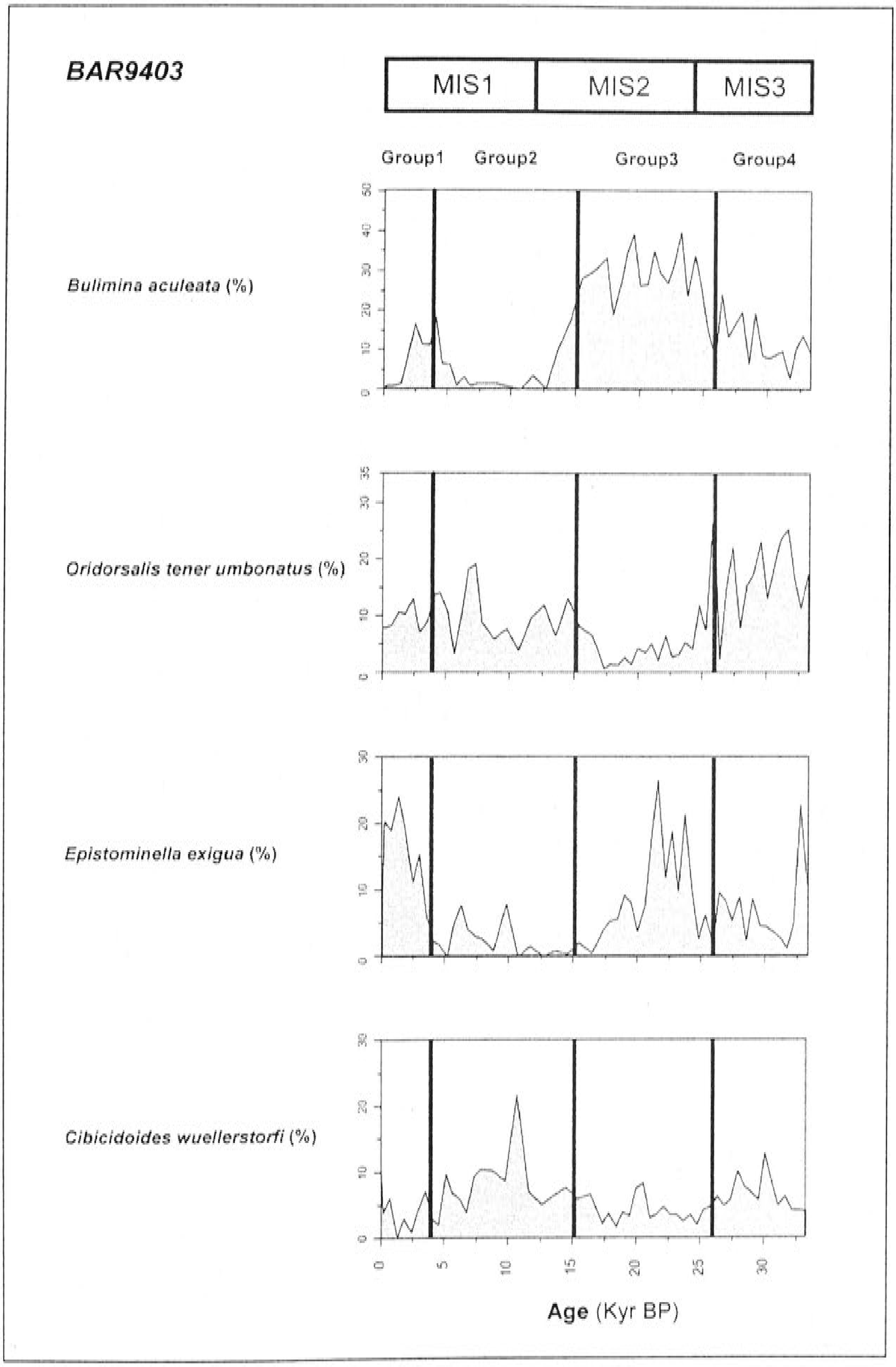

Fig. 9.14 – **Diagram showing the percentages of those species from piston core *BAR9403*, identified by means of Factor Analysis.**
At the top of the diagram, Marine Isotope Stages are shown. Vertical lines indicate the limits of the two groups of samples individuated by means of the factor loadings.

9.4.2 BAR9403: faunal characteristics

Faunal characteristics (agglutinated taxa %, porcellaneous taxa %, infaunal taxa % [Appendix B], α, H(S), E and D) are plotted in figure 9.15.

Between 33 Kyr BP and 15 Kyr BP (MIS3 – termination of MIS2), the agglutinated species percentages were always <5%. They were characterised by high percentages for the last 15 Kyrs (termination of MIS2 – MIS1), ranging between 3% and 14.5%. Porcellaneous taxa percentages before 27 Kyr BP were >15%. Between 27 and 15 Kyr BP (mid MIS3 – mid MIS2) values decreased, being <15%, and increased again during the last 16 Kyrs. Infaunal taxa were <40% before 27 Kyr BP. Between 27 and 13 Kyr BP, percentages were always >50%, with a peak of 68% (17 Kyr BP). During the last 10 Kyrs, this group of species displayed percentages <60%, ranging between 28% and 57%.

Diversity indexes α, H(S) and E followed similar patterns. Before 25 Kyr BP, α values remained below the limit of 10, while H(S) and E displayed a more irregular patterns, ranging between 2.5 and 3 and between 10 and 20 respectively. Between 25 and 16 Kyr BP, they were characterised by lower values (<10 α, <2.75 H(S) and <15 E). Only at 18 Kyr BP, did their values exceed the indicated thresholds. For the last 16 Kyrs (termination of MIS2 – MIS1), diversity indexes displayed high values, indicating high faunal diversity. Before 25 Kyr BP, dominance values ranged between 20% and 30%. Values increased, exceeding 30%, between 25 and 15 Kyr BP. During the last 15 Kyrs, dominance was characterised by values below 20%.

9.4.3 Piston core BAR9403: Benthic Foraminifera Accumulation Rate (BFAR) and accumulation rates calculated for B. aculeata, E. exigua and U. proboscidea

The BFAR curve (figure 9.16a) showed values ranging between 71 and 240 n/cm^{2}Kyr, for the period between 33 and 27 Kyr BP. Between 27 and 15 Kyr BP, BFAR was generally higher, reaching values >250 n/cm^{2}Kyr. After 15 Kyr BP, BFAR was characterised by lower values. Between 15 and 10 Kyr BP, BFAR decreased passing from 180 to 90 n/cm^{2}Kyr and between 10 and 5 Kyr BP, it ranged between 160 and 53 n/cm^{2}Kyr. During the last 5 Kyrs, BFAR decreased, reaching a value of 20 n/cm^{2}Kyr, for the Present.

The accumulation rate of *B. aculeata* reached values >30 n/cm^{2}Kyr, between 27 and 15 Kyr BP, with a peak of 170 n/cm^{2}Kyr at 23 Kyr BP (figure 9.16b). After 15 Kyr BP, this species was nearly absent. A small increase in *B. aculeata* AR was recorded for the last 5 Kyrs. *E. exigua* was characterised by high AR, between 27 and 15 Kyr BP, ranging between 10 and 60 n/cm^{2}Kyr. After 15 Kyr BP, the AR of this taxa was nearly 0. It increased again during the last 5 Kyrs, reaching values >10 n/cm^{2}Kyr. *U. proboscidea* followed a pattern similar to the former two species, although it was characterised by lower AR values compared to the other two taxa. Between 27 and 15 Kyr BP, *U. proboscidea* AR ranged between 5 and 20 n/cm^{2}Kyr. After 15 Kyr, this species displayed AR values <5 n/cm^{2}Kyr, with an isolated peak at 5 Kyr BP, when it reached an AR of 15 n/cm^{2}Kyr.

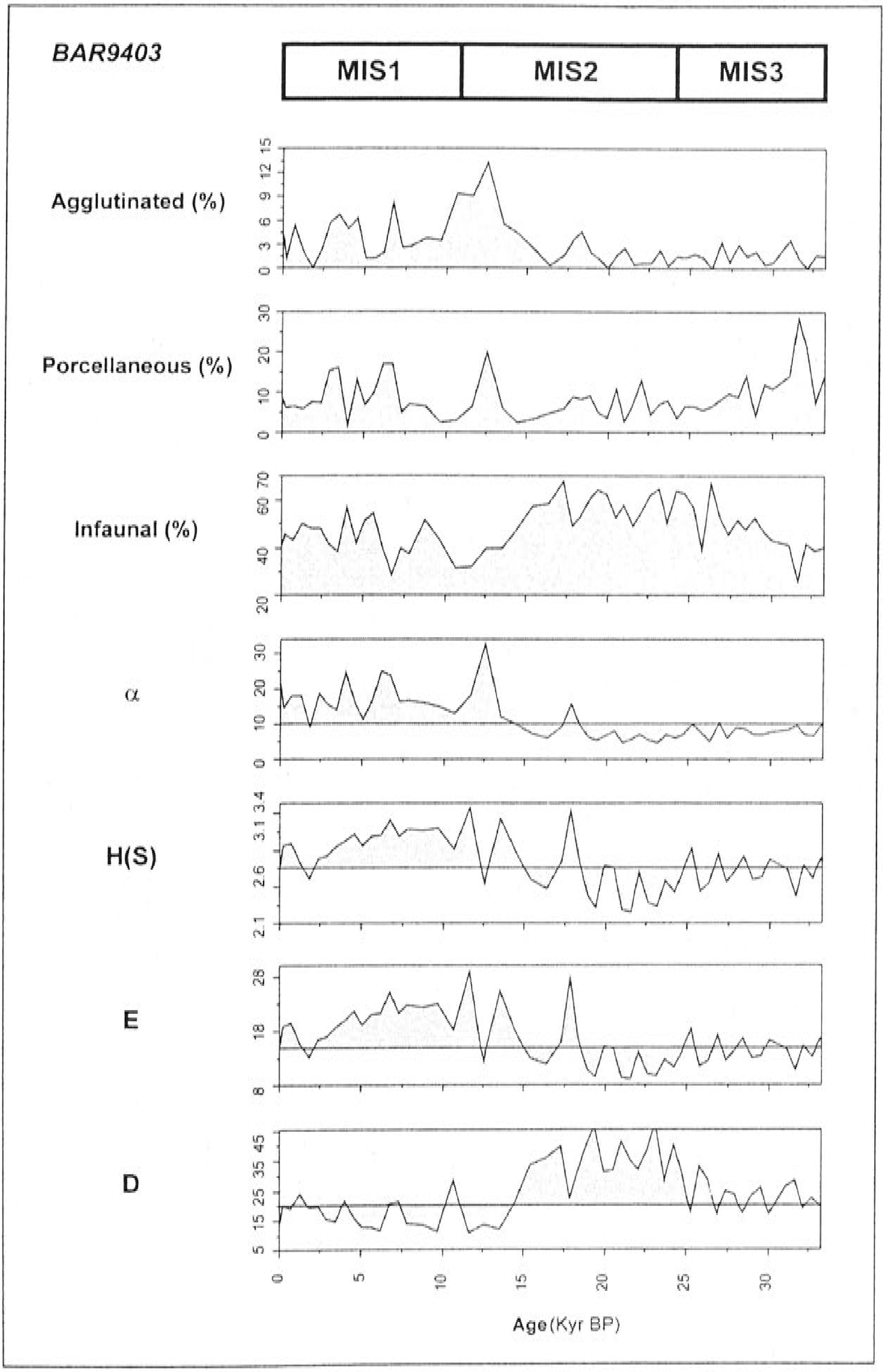

Fig. 9.15 – **Faunal characteristics calculated for each sample from piston core *BAR9403*.** Percentages of Agglutinated, Porcellaneous and Infaunal taxa; α: Fisher's Alpha index, H(S): Shannon-Weaver index; E: equitability; D: dominance. At the top of the diagram, Marine Isotope Stages are shown.

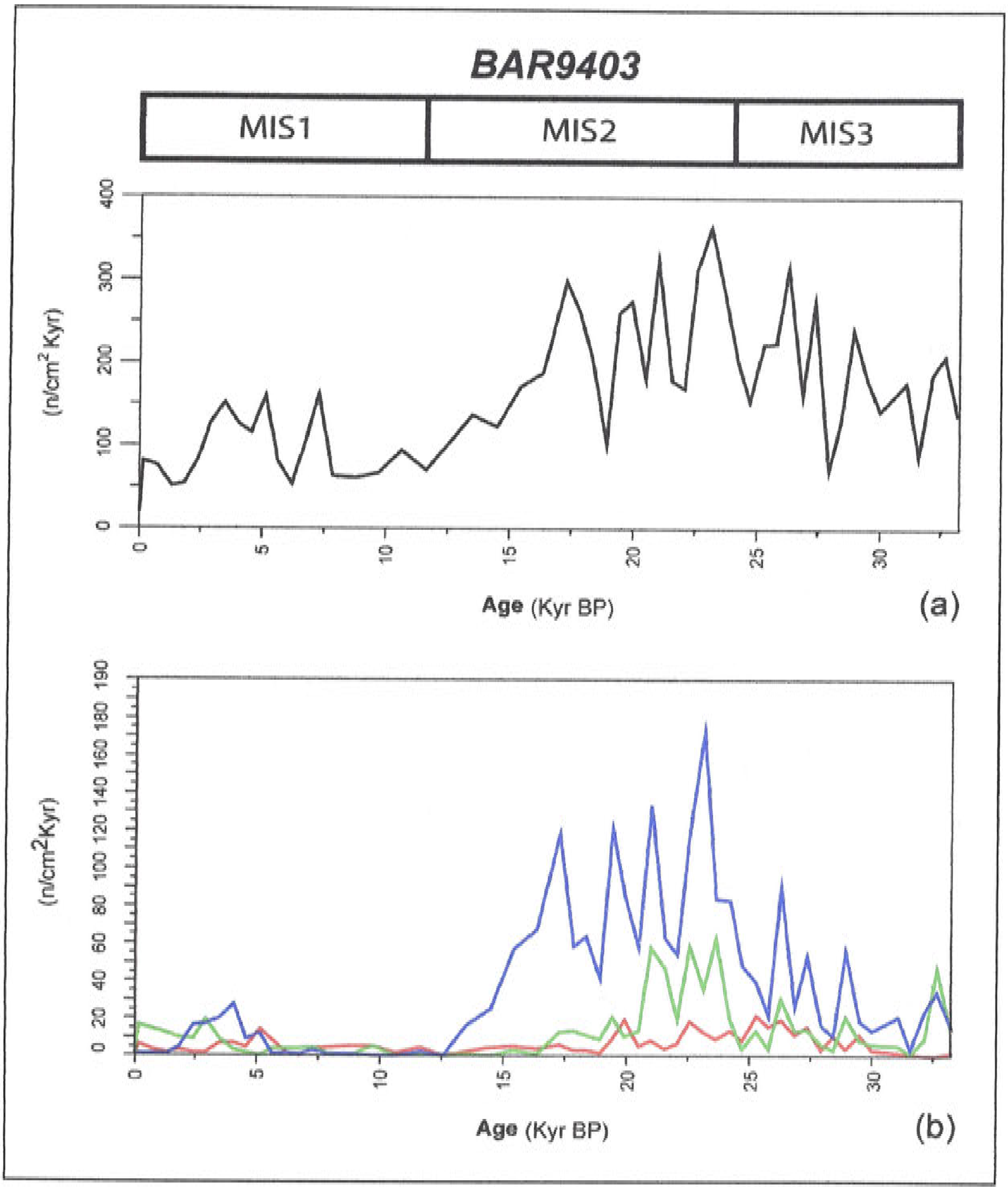

Fig. 9.16 – **Piston core *BAR9403*: (a) Benthic foraminifera Accumulation Rate (BFAR) and (b) accumulation rates of *B. aculeata* (blue line), *E. exigua* (green line) and *U. proboscidea* (red line).**
(a) The curve indicates the BFAR (expressed as number of benthic foraminifera accumulated over 1 cm^2 each thousand years) variations during the last 30 Kyrs.
(b) The highest AR values calculated for the three selected species are recorded between 27 and 15 Kyr BP. A slight increase of AR values is still present for the last 5 Kyrs, with values below 30 n/cm^2Kyr.
At the top of the diagram, Marine Isotope Stages are shown

9.5 $\delta^{13}C$ results

$\delta^{13}C$ values obtained from the test composition of *C. wuellerstorfi* specimens, collected from the four cores, are listed in table 9.9.

Table 9.9 – $\delta^{13}C$ (‰) **isotope data of** ***C. wuellerstorfi*** **vs. PDB in** ***Fr10/95 GC17*****,** ***Fr10/95 GC5*****,** ***SH19016*** **and** ***BAR9403*****.**

Samples *Fr10/95 GC17*	$\delta^{13}C$	Samples *Fr10/95 GC5*	$\delta^{13}C$	Samples *SH19016*	$\delta^{13}C$	Samples *BAR9403*	$\delta^{13}C$
0-1 cm	0.61	0-1 cm	0.33	0-1 cm	0.46	0-1 cm	0.33
3-4 cm	0.65	5-6 cm	0.25	4-5 cm	0.48	30-31cm	0.36
5-6 cm	0.66	9-10 cm	0.20	8-9 cm	0.59	35-36 cm	0.26
9-10 cm	0.67	13-14 cm	0.22	12-13 cm	0.53	50-51 cm	0.13
13-14 cm	0.57	17-18 cm	0.09	16-17 cm	0.46	55-56 cm	0.06
17-18 cm	0.58	21-22 cm	0.01	22-23 cm	0.34	65-66 cm	0.04
21-22 cm	0.69	25-26 cm	-0.06	32-33 cm	0.44	70-71 cm	0.21
25-26 cm	0.67	29-30 cm	-0.05	36-37 cm	0.42	80-81 cm	0.02
29-30 cm	0.67	33-34 cm	0.01	42-43 cm	0.33	85-86 cm	-0.04
33-34 cm	0.74	37-38 cm	0.01	46-47 cm	0.22	90-91 cm	0.07
37-38 cm	0.59	41-45 cm	0.03	52-53 cm	0.01	95-96 cm	0.13
41-42 cm	0.66	45-46 cm	-0.11	56-57 cm	0.20	105-106 cm	0.10
45-46 cm	0.68	49-50 cm	-0.07	58-59 cm	0.11	115-116 cm	-0.13
49-50 cm	0.69	53-54 cm	-0.10	62-63 cm	-0.01	120-121 cm	-0.07
53-54 cm	0.67	57-58 cm	-0.03	66-67 cm	0.16	130-131 cm	0.06
57-58 cm	0.66	61-62 cm	-0.10	72-73 cm	0.13	135-136 cm	0.10
61-62 cm	0.67	65-66 cm	-0.02	76-77 cm	0.09	145-146 cm	0.07
65-66 cm	0.68	69-70 cm	-0.01	82-83 cm	0.26	150-151 cm	-0.07
69-70 cm	0.48	73-74 cm	-0.02	86-87 cm	0.22	160-161 cm	-0.07
73-74 cm	0.51	77-78 cm	-0.04	92-93 cm	0.13	165-166 cm	-0.16
77-78 cm	0.57	81-82 cm	0.01	96-97 cm	0.27	170-171 cm	0.13
81-82 cm	0.56	85-86 cm	0.03	102-103 cm	0.25	180-181 cm	-0.15
85-86 cm	0.58	89-90 cm	-0.03	112-113 cm	0.24	185-186 cm	0.05
89-90 cm	0.54	93-94 cm	0.06	116-117 cm	0.11	190-191 cm	-0.07
93-94 cm	0.44	97-98 cm	-0.04	122-123 cm	0.15	200-201 cm	-0.09
97-98 cm	0.53	10-102 cm	0.11	132-133 cm	0.11	205-206 cm	-0.12
101-102 cm	0.33	105-106 cm	0.10	136-137 cm	-0.07	210-211 cm	-0.11
105-106 cm	0.62	109-110 cm	0.04	142-143 cm	0.04	215-216 cm	-0.10
109-110 cm	0.56	113-114 cm	0.09	146-147 cm	-0.01	220-221 cm	-0.10
113-114 cm	0.47	117-118 cm	0.20			225-226 cm	-0.03
117-118 cm	0.40	121-122 cm	0.21			230-231 cm	-0.17
121-122 cm	0.58					240-241 cm	-0.05
						255-256 cm	-0.05

Table 9.9 – *continued.*

Samples *Fr10/95 GC17*	$\delta^{13}C$	Samples *Fr10/95 GC5*	$\delta^{13}C$	Samples *SHI9016*	$\delta^{13}C$	Samples *BAR9403*	$\delta^{13}C$
125-126 cm	0.42			152-153 cm	-0.10	270-271 cm	0.00
127-128 cm	0.57			156-157 cm	-0.04	275-276 cm	0.08
133-134 cm	0.45			162-163 cm	-0.03		
137-138 cm	0.34						
141-142 cm	0.38						
145-146 cm	0.51						
149-150 cm	0.22						
153-154 cm	0.64						
157-158 cm	0.42						
161-162 cm	0.44						
165-166 cm	0.36						
169-170 cm	0.45						
173-174 cm	0.43						
177-178 cm	0.61						

The values obtained with the $\delta^{13}C$ analysis of *C. wuellerstorfi* from *Fr10/95 GC17* range between 0.74‰ and 0.22‰. The maximum value (0.74‰) is measured for the specimens collected from sample 33-34 cm (3 Kyr BP) and the minimum (0.22‰) from the sample 149-150 cm (23 Kyr BP). The analysis related to the time interval between 31 Kyr BP (177-178 cm) and 7 Kyr BP (69-70 cm) gave values, which ranged between 0.22‰ and 0.64‰. Isotopic values obtained for the last 7 Kyrs are all >0.5‰.

The $\delta^{13}C$ values from *Fr10/95 GC5* range between 0.33‰ and – 0.11‰. The minimum value (-0.11 ‰) was obtained with the analysis of *C. wuellerstorfi* specimens from sample 45-46 cm (11 Kyr BP), while the maximum value (0.33‰) is related to sample 0-1 cm (Present). The trend shown by $\delta^{13}C$ appears regular with values constantly decreasing from 0.21‰, at 35 Kyr BP (121-122 cm), to 0.03‰, at 11 Kyr BP, and then constantly increasing during the last 11 Kyrs, reaching a value of 0.33‰ for the Present (0-1 cm).

$\delta^{13}C$ values from *SHI9016* range between 0.59‰ and –0.1‰. The maximum value (0.59‰) is recorded for the sample 8-9 cm (3 Kyr BP) and the minimum (-0.10‰) for the sample 152-153 cm (59 Kyr BP). The isotopic data follow a pattern characterised by the presence of two points where the values reach two minima. After a slight decrease, between 62 (162-163 cm) and 59 Kyr BP (152-153 cm), when $\delta^{13}C$ passed from –0.03‰ to –0.10 ‰, $\delta^{13}C$ increased, reaching 0.27‰, 35 Kyr BP. It showed a new relative minimum (-0.01‰), at 19 Kyr BP (62-63 cm), and the constantly increased until the Present.

The $\delta^{13}C$ record for *BAR9403* obtained from *C. wuellerstorfi* displays values ranging between 0.36‰, for the sample 30-31 cm (3 Kyr BP), and -0.17‰, for the sample 230-231 cm (30 Kyr BP). Two major patterns characterised the $\delta^{13}C$ values. The first begins at 33 Kyr BP ($\delta^{13}C$ = 0.08‰, sample 275-276 cm) and ends at 16 Kyr BP ($\delta^{13}C$ = -0.13‰, sample 115-116 cm), when isotopic values ranged between 0.13‰ (25 Kyr BP, sample 170-171 cm) and –0.17‰ (30 Kyr BP, sample 230-231cm), and were characterised by prevalently negative sign. The second pattern includes mostly positive values, which showed an overall increase from 16 Kyr BP until the Present, ranging between –0.04‰, 12 Kyr BP (85-86 cm), and 0.36‰, 3 Kyr BP (30-31 cm).

9.6 Factor Analysis of the species abundance datasets: evaluating the matrix closure effect

The species abundance (number of foraminifera per gram of dry sediment n/g) datasets for the four studied cores were analysed by means of *Q* – mode Factor Analysis (Principal Components). The varimax factors identified for these datasets are dominated by the same taxa identified with the species percentages datasets analysis (Table 9.10). The number of varimax factors, calculated for each core, and the cumulative variance, explained by the factors, are also indicated in Table 9.10. The complete list of the species scores and samples loading-factors are presented in Appendix C.

The comparison between the factor loadings calculated for the species percentage and the species abundance datasets did not reveal any major difference between the two trends (figure 9.17, 9.18, 9.19, 9.20). This would suggest that the matrix closure effect is absent or minimal. For this reason, the species percentage results can be considered reliable and since their format allows a direct comparison with the core-tops species dataset, this data format will be utilised for the discussion of the results.

Table 9.10 – **Factor Analysis results for the species abundance datasets for the four cores: dominant species factor scores, cumulative variance explained by the axes.**

Core	Species	F1	F2	F3	F4
Fr10/95 GC17	*Uvigerina proboscidea*	**11.76**	0.32	-2.32	
Fr10/95 GC17	*Bolivina robusta*	**6.70**	-1.09	0.57	
Fr10/95 GC17	*Cibicidoides wuellerstorfi*	-0.24	**8.44**	0.04	
Fr10/95 GC17	*Globocassidulina subglobosa*	-0.67	-2.08	**9.57**	
Fr10/95 GC17	*Nummoloculina irregularis*	1.02	2.57	**5.65**	
	Cumulative variance %	**60**	74	**83**	
Fr10/95 GC5	*Bulimina aculeata*	-1.72	**9.94**		
Fr10/95 GC5	*Cibicidoides wullerstorfi*	**5.25**	-0.02		
	Cumulative variance %	**61**	**84**		
SH19016	*Bulimina aculeata*	**11.13**	-3.17		
SH19016	*Cibicidoides wuellerstorfi*	0.90	**4.75**		
	Cumulative variance %	67	**85**		
BAR9403	*Bulimina aculeata*	**10.71**	0.80	-1.55	-0.90
BAR9403	*Oridorsalis tener umbonatus*	-0.86	**10.31**	0.96	-0.25
BAR9403	*Epistominella exigua*	1.49	-1.41	**9.93**	-1.37
BAR9403	*Cibicidoides wuellerstorfi*	0.70	0.19	-0.07	**8.11**
	Cumulative variance %	60	76	**82**	**86**

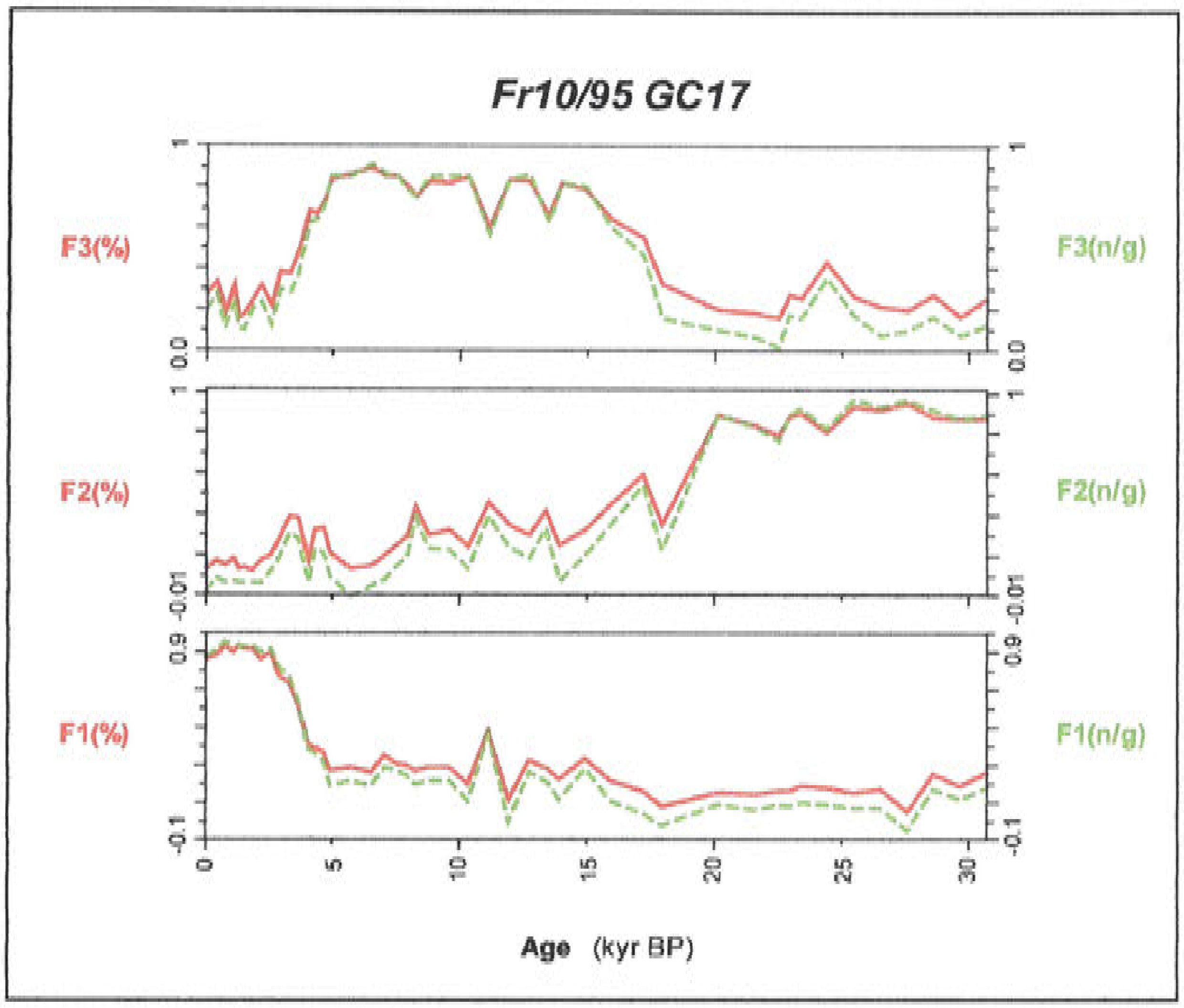

Fig. 9.17 – **Factor loadings calculated using the species percentage (red line) [F1(%), F2 (%) and F3(%)] and the species abundance (green dashed line) [F1(n/g), F2(n/g) and F3(n/g)] datasets.**
The patterns followed by the two series are very similar, especially when factor loadings are characterised by high values.

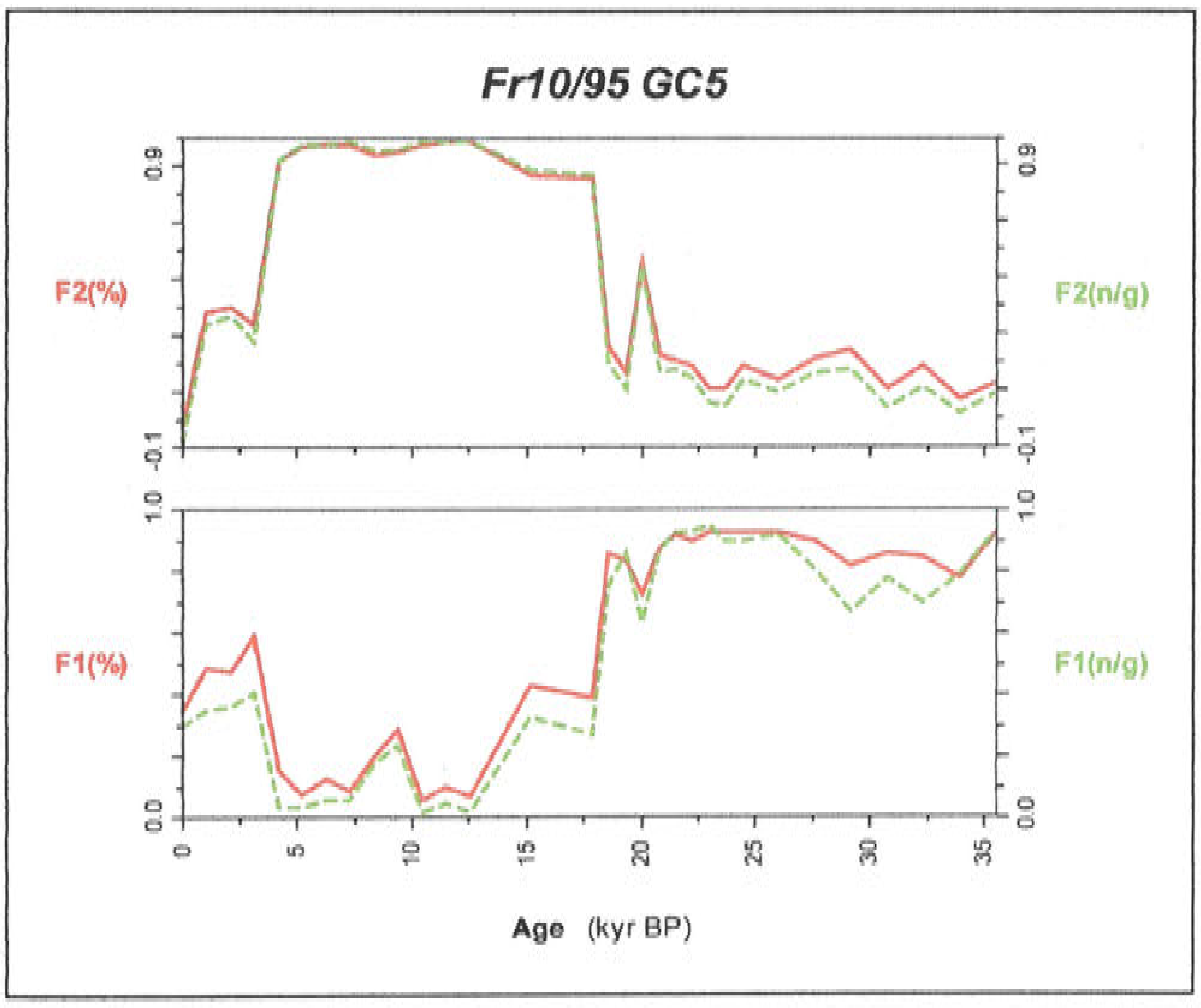

Fig. 9.18 – **Factor loadings calculated using the species percentage (red line) [F1(%) and F2 (%)] and the species abundance (green dashed line) [F1(n/g) and F2(n/g)] datasets.**
The patterns followed by the two series are very similar, especially when factor loadings are characterised by high values.

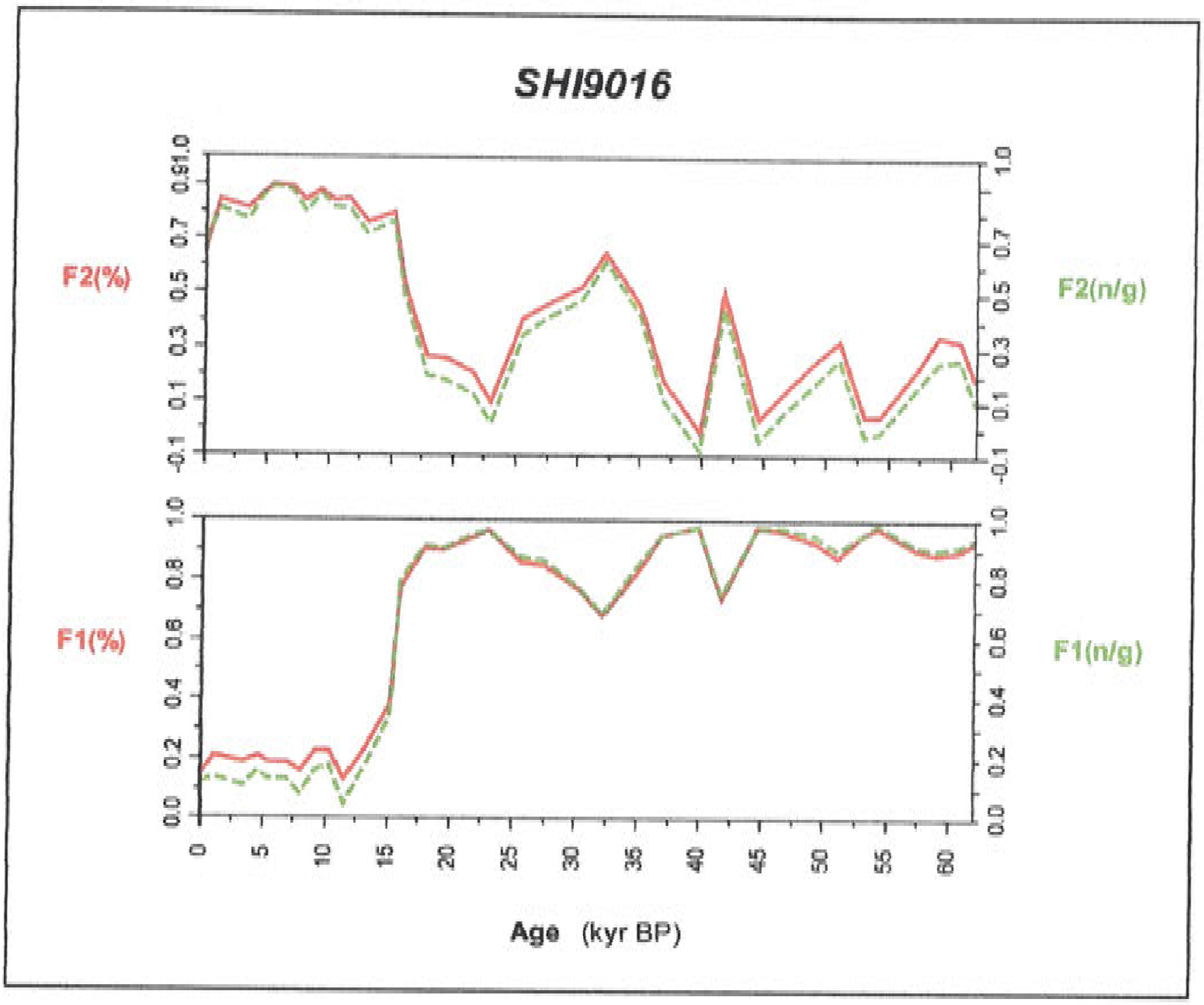

Fig. 9.19 – **Factor loadings calculated using the species percentage (red line) [F1(%) and F2 (%)] and the species abundance (green dashed line) [F1(n/g) and F2(n/g)] datasets.**
The patterns followed by the two series are very similar, especially when factor loadings are characterised by high values.

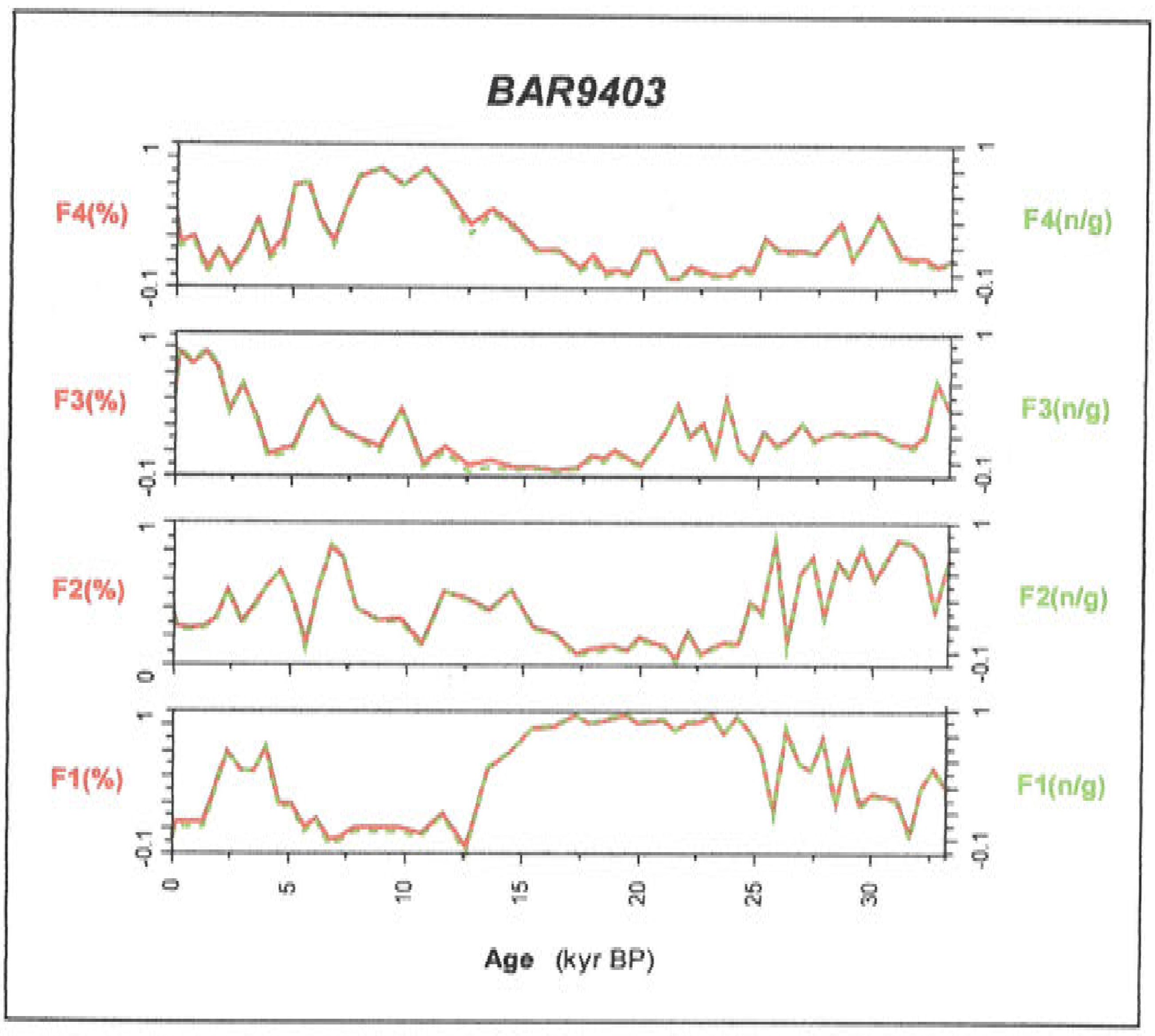

Fig. 9.20 – **Factor loadings calculated using the species percentage (red line) [F1(%), F2 (%), F3(%) and F4(%)] and the species abundance (green dashed line) [F1(n/g), F2(n/g), F3(n/g) and F4(n/g)] datasets.**
The patterns followed by the two series are very similar especially, when factor loadings are characterised by high values.

10. Discussion

The analysis of benthic foraminifera and of the $\delta^{13}C$ of *C. wuellerstorfi* from the four selected cores allowed the identification of different faunal patterns, which can be interpreted as a consequence of past environmental changes.

In this section the isotopic signal of *C. wuellerstorfi* and its significance will be discussed. The faunal changes for each of the four cores will be then considered separately. Finally, the results from each core will be correlated in an attempt to understand environmental changes, which took place in the eastern Indian Ocean during the Late Quaternary.

10.1 The distribution of $\delta^{13}C$ in the Indian Ocean

10.1.1 The $\delta^{13}C$ signal of water masses, carbon isotopes fractionation and the use of C. wuellerstorfi as a proxy to detect water carbon chemistry variations

The distribution of $\delta^{13}C$ in the oceans is mainly controlled by photosynthesis and the consequent production of organic matter, and by the mixing of water masses characterised by different $\delta^{13}C$ signal (Levinton, 1982). At the sea surface, the preferential uptake of ^{12}C during photosynthesis determines enrichment in ^{13}C and the complete consumption of nutrients determines a 10% reduction of the TCO_2 reservoir, with a $\delta^{13}C$ enrichment of 2‰, compared to the $\delta^{13}C$ mean ocean value (Curry et al., 1988). Part of the organic matter produced at the sea surface sinks to the sea floor where it is oxidised. This process determines the release of ^{12}C which reduces the $^{13}C/^{12}C$ ratio and lowers the $\delta^{13}C$ of TCO_2. Thus, the $\delta^{13}C$ of the water column is characterised by higher values at the sea surface and lower values at the sea floor (Berger, 1979). Deep-water formation is localised at high latitude, where heat exchange between shallow water and the atmosphere reduces water temperature and increases its density (Tomczak and Godfrey, 1994); water then sinks into the deep ocean carrying the $\delta^{13}C$ resulting from phytoplankton activity (Rohling and Cooke, 1999). Along its path, the $\delta^{13}C$ composition of deep water masses varies as a function of two factors: mixing with other water masses and the oxidation at the sea floor of the organic matter, which comes from the sea surface (Duplessy et al., 1988; Mackensen and Bickert, 1999). As such, the $\delta^{13}C$ values of water mass decreases as they moves from their area of origin, due to the progressive oxidation of the organic matter: this is called the *ageing* effect by Duplessy et al., 1988.

A useful proxy to detect past variations of the $\delta^{13}C$ of deep waters is the epifaunal benthic foraminiferal species *C. wuellerstorfi*. This taxon secretes its calcite test close to the bottom water $\delta^{13}C_{\Sigma CO_2}$ (Bickert, 2000; Curry and Lohmann, 1982; Zahn et al., 1986). Duplessy et al. (1984) demonstrated that:

$$\delta^{13}C_{\Sigma CO_2} = 1.04\ \delta^{13}C\ C.\ wuellerstorfi - 0.096$$

Past changes in bottom water $\delta^{13}C_{\Sigma CO_2}$, reflecting transfer of ^{13}C-depleted terrestrial or shallow-marine organic carbon to the oceanic reservoir and/or changes in the oceans CO_2 concentration can be detected by measuring the $\delta^{13}C$ of *C. wuellerstorfi*. In areas which were not characterised by an increased export of organic matter to the sea floor during the past, the $\delta^{13}C$ of *C. wuellerstorfi* gives only the water mass signal. In areas of past high-productivity levels at the sea-surface, the increased flux of organic matter at the sea floor causes further depletion in ^{13}C in the deep water that is reflected during the calcification of *C. wuellerstorfi* test (McCorkle et al., 1997).

10.1.2 The mean $\delta^{13}C$ Interglacial – Glacial variation for the Indian Ocean

Past variations at global scale of deep water $\delta^{13}C$ values emerged from the analysis of deep-sea cores collected from the three major oceans, with the $\delta^{13}C$ generally lower at the LGM, compared to the Holocene record (Duplessy et al., 1984; Curry et al., 1988; Sarnthein et al., 1988). This phenomenon is attributed to the reduction of the continental biosphere and the consequent transfer of organic carbon depleted in ^{13}C to the oceans (Shackelton, 1977; Adams et al, 1990). Calculations made on the data obtained from cores collected worldwide in the oceans suggest a $\delta^{13}C$ 0.46‰ more negative during the LGM (Curry et al., 1988). This value represents the mean of the differences between the interglacial $\delta^{13}C$ and glacial $\delta^{13}C$ (I-G $\delta^{13}C$), calculated for the four ocean basins. When these basins are considered separately the difference varies from ocean to ocean (Curry et al., 1988). In the eastern Indian Ocean, the I-G $\delta^{13}C$ difference reported by Duplessy et al. (1989) is 0.32‰. This value is much lower than the depletion recorded for the Southern Ocean (0.8‰) or for the Atlantic Ocean (0.5‰) (Curry et al., 1988). The I-G $\delta^{13}C$ difference proposed for the eastern Indian Ocean is similar to the difference for the entire Indian Ocean. The latter has been calculated here considering a dataset of 36 deep-sea cores collected from the eastern, northern and western parts of this ocean (figure 10.1). The cores used for this calculation are listed in Table 10.1. The average I-G $\delta^{13}C$ differences calculated for all the cores, as well as for the cores collected above and below 2000 m, are illustrated in figure 10.2.

The I-G $\delta^{13}C$ differences range between –0.29‰ (offshore South Australia) and 0.7‰ (Bay of Bengal). For the cores collected at intermediate depths, the I-G $\delta^{13}C$ difference is on average smaller (0.23‰) than 0.32‰, while, for deep waters, the I-G $\delta^{13}C$ difference is larger (0.37‰). Duplessy et al. (1989) explained this phenomenon by suggesting that a strengthened intermediate water circulation and a more sluggish deep-water circulation determined this gradient at 2000 m depth. A gradient between intermediate- and deep-water masses during the LGM for the Indian Ocean was already proposed by Kallel et al. (1988). A similar result is reported for the Pacific Ocean (Herguera et al., 1992), suggesting that this situation could have been common for both the Indian and Pacific basins (Wells et al., 1994).

10.1.3 $\delta^{13}C$ trends from the cores collected from the eastern Indian Ocean

The $\delta^{13}C$ curves related to the last 35 Kyrs for the four studied cores are shown in figure 10.3. The depletion measured for the LGM at the *Fr10/95 GC17* site is well above the average calculated for the Indian Ocean. This would suggest a more intense circulation at intermediate depths. The values recorded for *Fr10/95 GC5* reflect the condition present in the Indian Ocean during the LGM, with $\delta^{13}C$ values lower than 0.32‰, indicating a reduced deep-water circulation. An increased amount of organic matter to the sea floor could be suggested for *F10/95 GC5*, where the $\delta^{13}C$ shows a depletion ≥ 0.32‰ during the period between 10 and 5 Kyr BP. The isotopic record for *BAR9403* would indicate a reduced deep-water circulation for the LGM. The $\delta^{13}C$ also shows values <0.32‰ for the period between 30 and 22 Kyr BP. This data supports the idea of a more stratified water column off Java and Sumatra before the LGM (Gingele et al., 2002). Values measured for the LGM for *SHI9016* are lower than the $\delta^{13}C$ Indian Ocean average depletion. Considering that this core was collected at a depth of 1802 m, a smaller depletion than or similar to 0.32‰ depletion would be expected. This could indicate conditions of reduced circulation (Gingele et al. 2001) paralleled by an increased amount of organic matter at this site.

Table 10.1 – **Location, depth and I-G $\delta^{13}C$ difference measured for the cores collected from the Indian Ocean.**
In the last column the authors of the papers from which these data were taken are indicated. For the original references related to each one of the listed cores, refer to Naqvi et al. (1994), Ahmad et al. (1995), Sarnthien et al. (1988) and McCorckle et al. (1998).

Core	Latitude	Longitude E	Depth (m)	I-G $\delta^{13}C$ difference	Authors
RS102-GC09	33°3' S	128°16'	769	-0.29	McCorckle et al. (1998)
RS53-GC04	19°35' S	113°32'	956	0.22	McCorckle et al. (1998)
RS53-GC09	20°03' S	112°55'	962	0.01	McCorckle et al. (1998)
RS102-GC13	33°49' S	130°48'	1008	0.1	McCorckle et al. (1998)
Fr10/95 GC17	22°07' S	113°30'	1093	0.19	This study
14807-1	16.56' S	118°50'	1186	0.31	Sarnthein et. Al (1988)
RS53-GC11	20°53' S	112°2'	1432	0.23	McCorckle et al. (1998)
RS102-GC14	34°22' S	130°25'	1502	0.24	McCorckle et al. (1998)
MD76-127	12°05' N	75°54'	1610	0.58	Sarnthein et. Al (1988)
MD76-128	13°08' N	73°19'	1712	0.22	Sarnthein et. Al (1988)
SHI9016	8°27' S	127°53'	1802	0.35	This study
MD76-125	8°35' N	75°2'	1878	0.31	Sarnthein et. Al (1988)
MD76-135	14°26' N	50°01'	1895	-0.03	Sarnthein et. Al (1988)
MD79-254	17°53' N	38°4'	1934	0.62	Sarnthein et. Al (1988)
RS53-GC06	19°32' S	112°45'	1979	0.39	McCorckle et al. (1998)
RS102-GC15	34°35' S	130°15'	2003	0.24	McCorckle et al. (1998)
BAR9403	5°29' S	103°37'	2034	0.4	This study
RC12-334	13°21' N	96°12'	2140	0.7	Naqvi et al. (1994)
RS53-GC07	18°54' S	112°37'	2256	0.57	McCorckle et al. (1998)
MD77-202	19°13' N	60°40'	2427	0.31	Sarnthein et. Al (1988)
MD77-203	20°41' N	59°34'	2442	0.2	Sarnthein et. Al (1988)
RS102-GC16	34°45' S	130°85'	2495	0.25	McCorckle et al. (1998)
Fr10/95 GC5	14°00' S	121°01'	2542	0.36	This study
RS53-GC15	29°22' S	113°13'	2750	0.38	McCorckle et al. (1998)
V34-55	6°02' S	88°57'	2992	0.2	McCorckle et al. (1998)
RS102-GC17	34°53' S	130°33'	3001	0.36	McCorckle et al. (1998)
RC12-339	9°12' N	90° 31'	3010	0.5	Naqvi et al. (1994)
SHI9014	5°46' S	126°58'	3163	0.04	Ahmad et al. (1995)
V34-54	6°05' S	89°1'	3254	0.4	McCorckle et al. (1998)
SO28-5	6°39' N	61°08'	3335	0.43	Sarnthein et. Al (1988)
S042-57	20°54' N	63°07'	3422	0.57	Sarnthein et. Al (1988)
RS102-GC18	34°57' S	130°04'	3504	0.28	McCorckle et al. (1998)
V34-53	6°07' S	89°35'	3812	0.62	McCorckle et al. (1998)
SO28-11	5°23' N	60°15'	3859	0.31	Sarnthein et. Al (1988)
SO28-5	1°24' N	67°21'	4101	0.36	Sarnthein et. Al (1988)
V34-51	6°11' S	89°58'	4382	0.48	McCorckle et al. (1998)

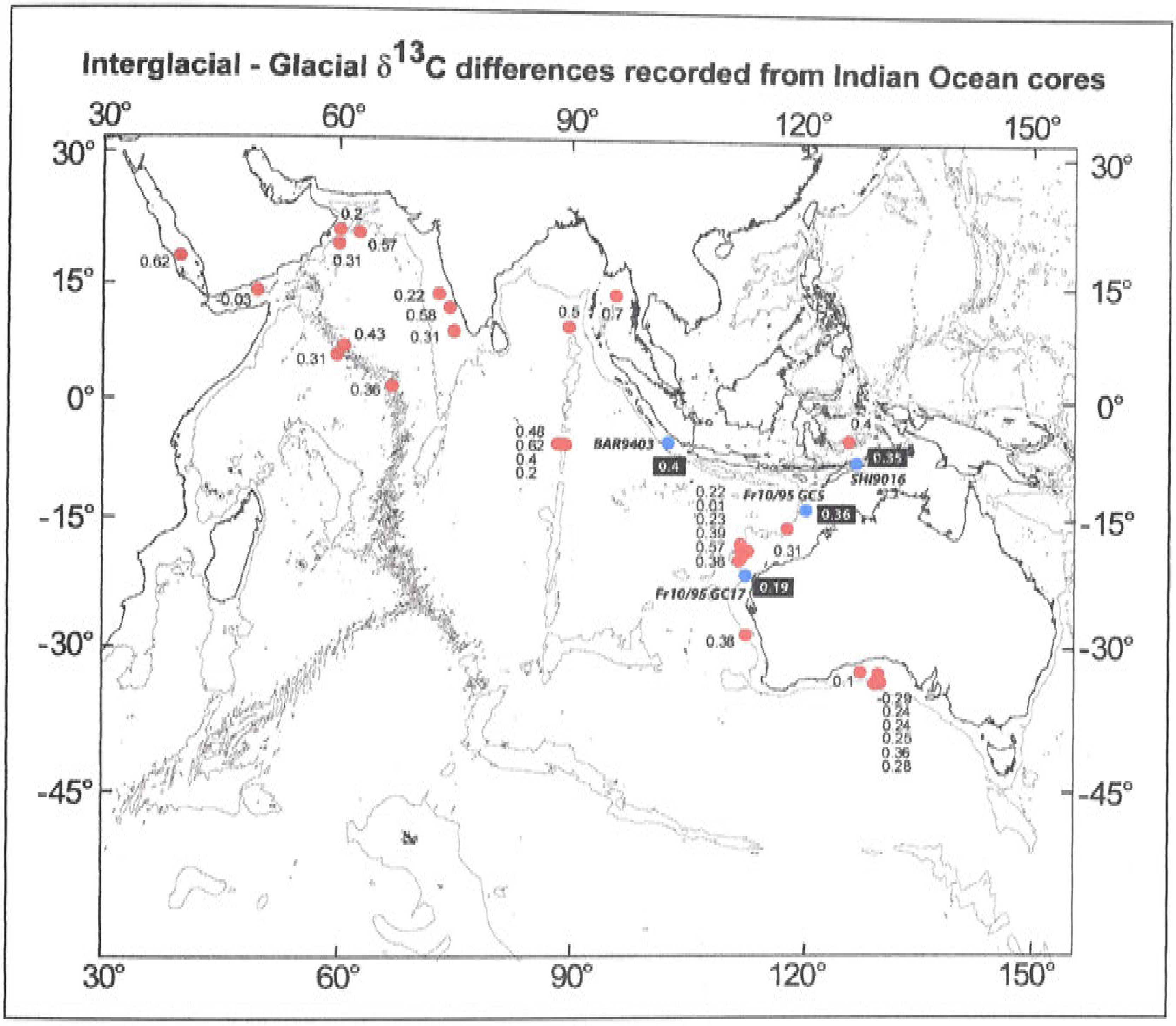

Fig. 10.1 – **Location of the deep-sea cores (solid circles) utilised to calculate the average I-G $\delta^{13}C$ difference for the Indian Ocean.**

The numbers near the location of each core indicate the I-G $\delta^{13}C$ difference (‰) at those sites. The cores from Naqvi et al. (1994), Ahmad et al. (1995), Sarnthein et al. (1988) and McCorckle et al. (1998) are indicated in red. When the circles are overlapped, the values are given from the shallowest core to the deepest. The four cores utilised for this study are indicated in blue. The thinner line indicates the 3000 m isobath.

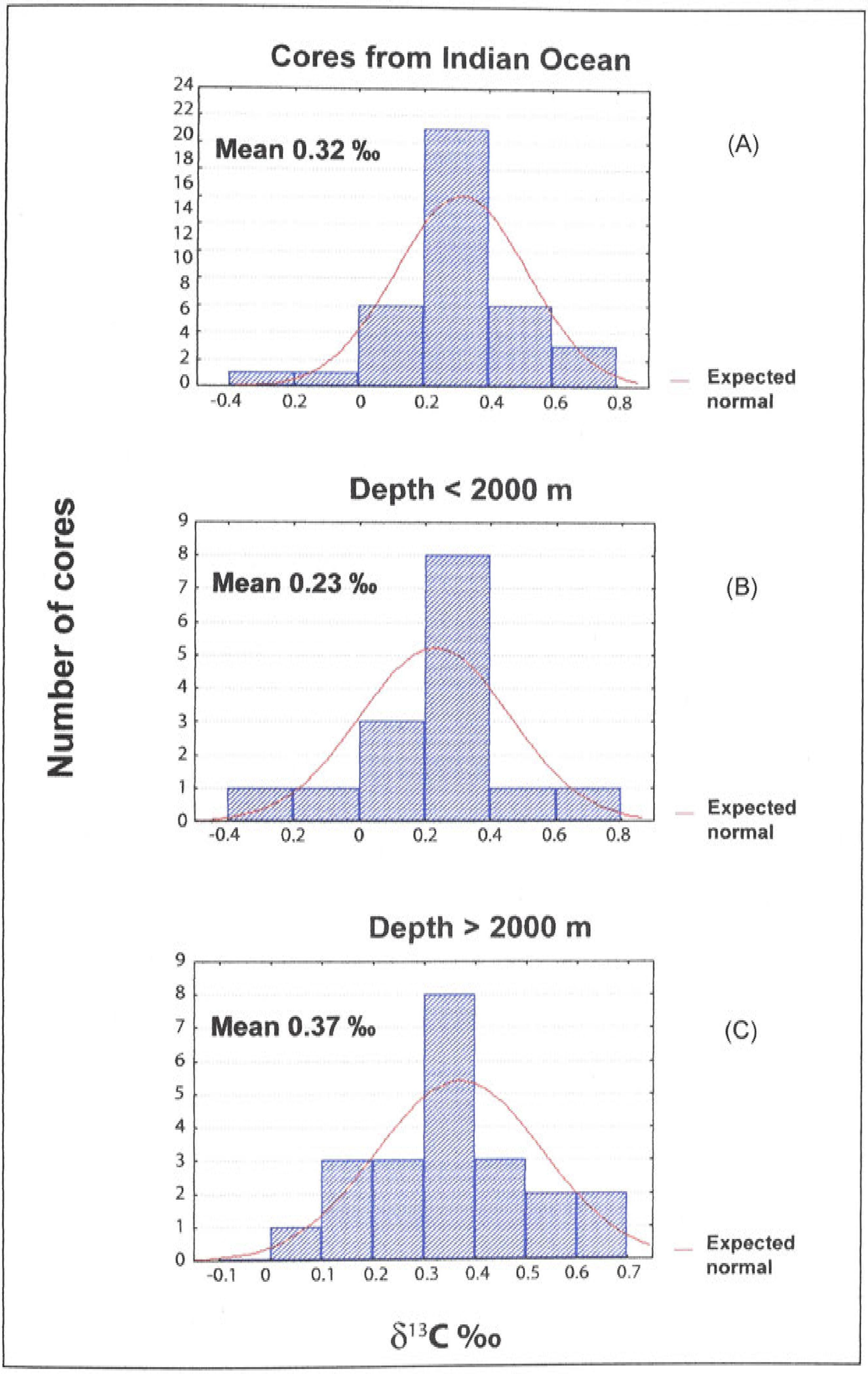

Fig. 10.2 – **Mean I-G $\delta^{13}C$ difference calculated for the cores from the Indian Ocean.**
(a) Mean I-G $\delta^{13}C$ difference calculated for the entire core dataset (Table 1.1); (b) mean I-G $\delta^{13}C$ difference calculated for the cores collected at intermediate depth; (c) mean I-G $\delta^{13}C$ difference calculated for the cores collected from a depth >2000 m. On the left hand-side of each diagram, the number of cores for each group is indicated. The red line indicates the expected normal distribution for each one of the three datasets.

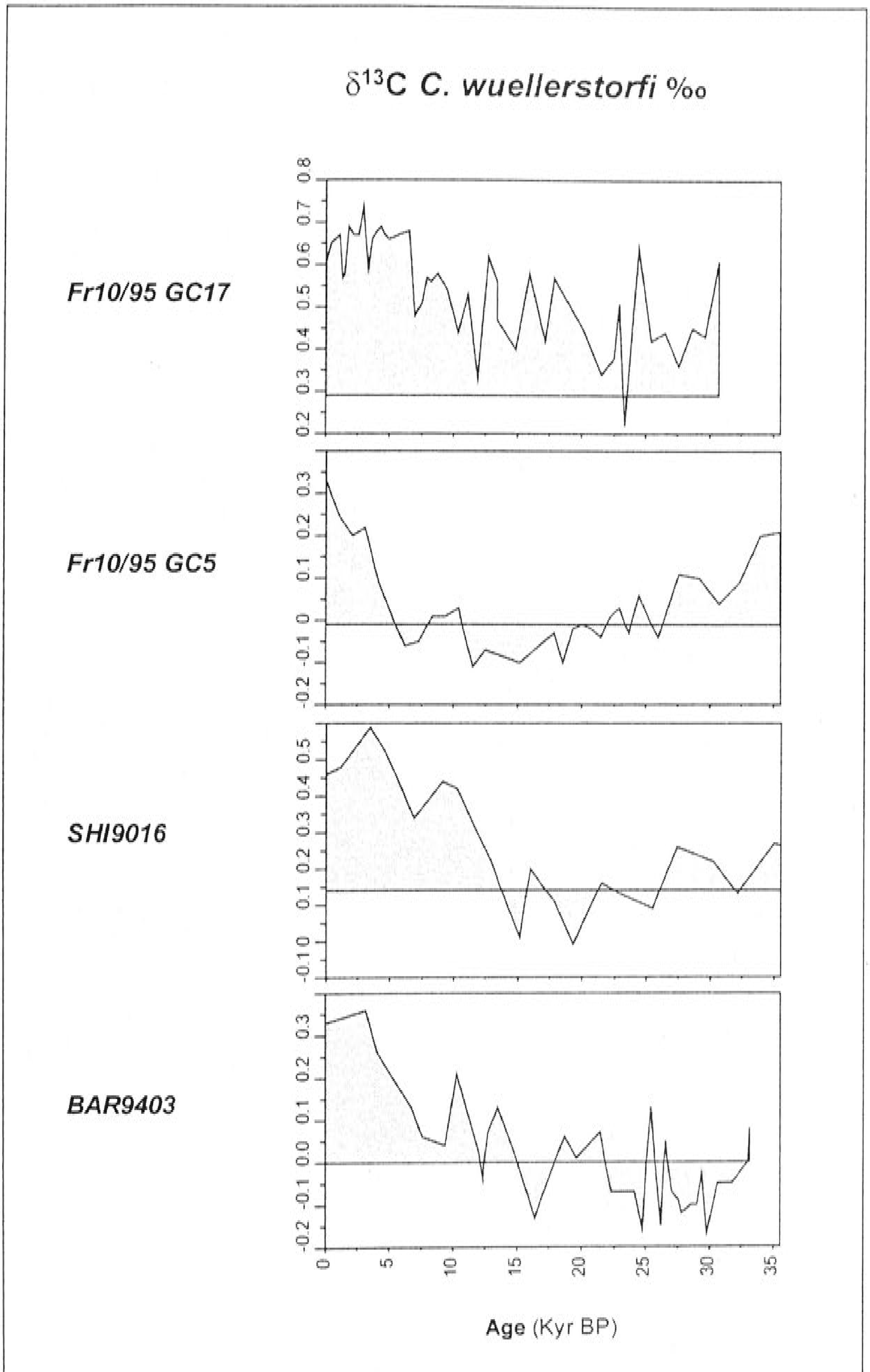

Fig. 10.3 – **$\delta^{13}C$ curves for the four cores studied in this research for the last 35 Kyrs.**
The horizontal reference line represents the I-G $\delta^{13}C$ difference calculated for the Indian Ocean. The curve related to *Fr10/95 GC17* follows the typical pattern recorded at intermediate depths for the Indian Ocean, displaying a $\delta^{13}C$ depletion at the LGM smaller than the Indian Ocean mean. For the other three cores, the $\delta^{13}C$ depletion at the LGM is larger than 0.32 ‰.

10.2 The distribution of C. wuellerstorfi and G. subglobosa of application for the study of palaeoceanography of the eastern Indian Ocean

Varimax factors 1 (*Fr10/95 GC5*), 2 (*Fr10/95 GC17* and *SHI9016*), and 4 (*BAR9403*) calculated by *Q* – mode Factor Analysis are dominated by the species *C. wuellerstorfi*. Varimax factor 3 (Fr10/95 GC127) is dominated by *G. subglobosa*. The analysis of the core tops revealed that *C. wuellerstorfi* and *G. subglobosa* are two cosmopolitan species commonly present in all the samples (see Appendix A1). In order to understand the environmental conditions which for the Present favour, these two taxa, the values of the environmental variables measured for each sample dominated (highest percentage) by these species were considered and were compared with those measured at *Fr10/95 GC17*, *Fr1095 GC5*, *SHI9016* and *BAR9403* locations (figure 10.4).

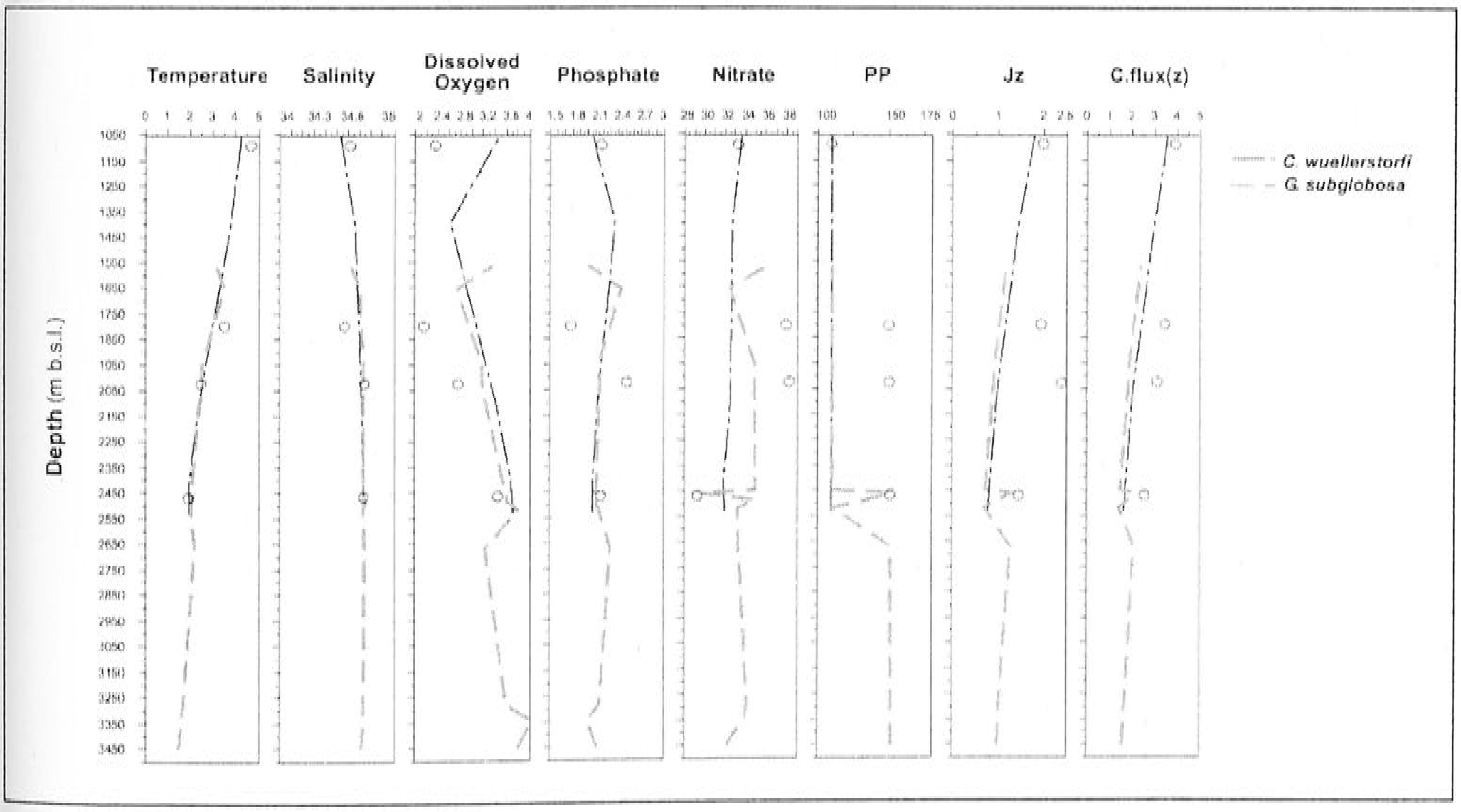

Fig. 10.4 – **Values of the environmental variables considered in this study measured for each sample dominated (high percentage) by *C. wuellerstorfi* and *G. subglobosa*, for the Present.** The circles indicates the values for the environmental variables measured for the four studied cores locations, for the Present [*Fr10/95 GC17* (1093 m b.s.l.), *SHI9016* (1802 m b.s.l.), *BAR9403* (2043 m b.s.l.), *Fr10/95 GC5* (2452 m b.s.l.)]

Today, *C. wuellerstorfi* and *G. subglobosa* dominate (highest percentage) the benthic foraminiferal assemblage for those samples characterised by temperature and salinity levels similar to those recorded for the four studied cores locations. Nitrate and phosphate levels measured for the four cores display values ranging above and below the levels measured for the samples dominated (highest percentage) by the two taxa.

These species seem to prefer an environment characterised by higher dissolved-oxygen concentration and lower carbon-flux rate than those recorded today for the four cores locations. Also, sea-surface primary productivity levels for the studied cores display the identical or lower values than those recorded for the samples where *C. wuellerstorfi* and *G. subglobosa* are the dominant (highest percentage) species. These data indicate a preference of these two taxa for an oligotrophic and well-oxygenated environment.

Studies of living (rose-Bengal stained) specimens support this interpretation. *C. wuellerstorfi* is a species typical of environments characterised by low carbon-flux rate (Altenbach, 1992; Burke et al., 1993; Mackensen et al., 1985; Altenbach et al., 1999) or by pulsed fluxes of organic matter (Mackensen et al., 1985).. In presence of reduced organic matter supply from the sea surface, the oxygen consumption for its oxidation is reduced, favouring high dissolved-oxygen concentrations. A well ventilated environment can also be associated to active bottom water circulation. Lutze and Thiel (1988) described *C. wuellerstorfi* as an epifaunal-suspension-feeder species, adapted to this kind of environment and able to exploit the organic matter laterally advected by bottom currents (Lutze and Thiel, 1988).

G. subglobosa has been associated with low carbon-flux rates in other studies (Loubere and Banonis, 1987; Loubere et al., 1988; Burke et al., 1993; Faridduddin and Loubere, 1997; Schmiedl et al., 1997). The analysis of the core tops revealed that *G. subglobosa* is a species commonly present in all the samples. This taxon is strongly correlated with low faunal diversity. In the core-top samples, large numbers of *G. subglobosa* are found only when this taxon displays the highest percentage of the assemblage; when other species are characterised by higher percentages, it is present with fewer specimens, outlining a competitiveness deficit (Appendix A1). Loubere et al. (1988) associated this species with a low carbon-flux and to low percentages of planktonic species typical of high productivity areas. These authors explained this behaviour by speculating that this species is adapted to a low food supply: when organic matter increases, *G. subglobosa* is unable to compete with species that are quicker at utilising the food source. Also in this case, the preference for this taxon for a well-oxygenated environment can be related to the low amount of organic matter at the sea floor and the consequent low-oxygen consumption for its oxidation.

10.3 Gravity core Fr10/95 GC17

Five species dominated the benthic foraminiferal assemblage at *Fr10/95 GC17* site, during different periods of the Late Quaternary (figure 10.5a). Between 31 and 18 Kyr BP, *C. wuellerstorfi* dominated the fauna. This species was replaced by *N. irregularis* and *G. subglobosa*, which dominated until 4 Kyr BP. For the last 4 Kyrs, the foraminiferal assemblage was dominated by *U. proboscidea* and *B. robusta*.

The high percentages of *C. wuellerstorfi* between 31 and 18 Kyr BP would suggest oligotrophic conditions and increased ventilation (see section 10.2), where sporadic amounts of organic matter were laterally advected by active bottom currents. At Present, the presence of a low salinity and less dense water, represented by the southward-flowing LC offshore Western Australia, causes a deepening of the nutricline, thus preventing the production of organic matter and determining conditions of low productivity at the sea surface. During MIS3, a different pattern for the LC was suggested by Gingele et al. (2001), who indicated the absence/reduction of this current at this site. Under such a scenario, the absence of a low salinity cap at the sea surface could have caused an upward shift of the nutricline towards the photic layer, thus enhancing a slight increase in the production of organic matter. The presence of a shallower nutricline, during MIS3-early MIS2, is suggested by studies on nannofossils (Takahashi and Okada, 2000). During MIS3, the increased percentage of *N. dutertrei* was indicated by Martinez et al. (1999) as a consequence of a shallower and more productive nutricline. The $\delta^{13}C$ of *C. wuellerstorfi*, between 31 and 18 Kyr BP, displayed the lowest values recorded for the entire section, being 0.22‰ lower than the modern-day values (figure10.3). This value does not indicate a significant increase of the amount of organic matter at the sea floor. Furthermore, the BFAR and low accumulation rates of *U. proboscidea* and *B. aculeata* would indicate oligotrophic conditions, as they did not display higher values, compared to those recorded for the period after 20 Kyr BP (figure 10.5b). The low relative percentage of infaunal species recorded for this period (figure 9.3) could be the consequence of an environment more suitable for epifaunal suspension feeder species (e.g. better adapted to exploit the organic matter transported by bottom current). This supports the idea of a more active circulation at intermediate depths towards the end of MIS3 and the early phase of MIS2. The reduced amount of clay, relative to silt, during MIS3 was the consequence of an intense bottom current, which prevented the deposition of the finest sediment particles (Gingele et al., 2001). The higher percentage of agglutinated taxa, during this period, would suggest the presence of more corrosive intermediate water, but the high percentage of porcellaneous taxa contradicts this interpretation. The increased percentage of agglutinated taxa could then be explained considering that calcareous infaunal species and agglutinated ones occupy a similar microhabitat. Due to adverse conditions, a reduction in competitiveness of the first group of taxa could have led to a relative increase of the second.

The benthic foraminiferal fauna dominated by *C. wuellerstorfi* was replaced by another one, dominated by *N. irregularis* and *G. subglobosa*, with the onset of the LGM, (figure 10.5a). At Present, the distribution of *N. irregularis* is correlated with low productivity levels at the sea surface and with the distribution of AAIW (see sections 5 and 6) and *G. subglobosa* with low carbon flux-rate and high dissolved-oxygen concentrations.

High percentages of *N. irregularis* between 17 and 4 Kyr BP could indicate an increased influence at this latitude by the AAIW over the scarcely oxygenated IIW and a situation of low productivity at the sea surface. The presence in this assemblage of *G. subglobosa* and the reduced percentage of infaunal taxa for this period (figure 9.3) would substantiate this observation.

C. wuellerstorfi $\delta^{13}C$ values for this period are higher compared to those recorded before 20 Kyr BP. During glacial times, the mass reduction of the continental biosphere induced a reduction of 0.32‰ of the mean isotopic composition of the total dissolved CO_2 in the eastern Indian Ocean (Duplessy et al., 1989); the $\delta^{13}C$ depletion recorded for the same period at this site is 0.19‰. The smaller variation compared to the global signal was explained by Duplessy et al., (1989) as the result of an enhanced ventilation of the intermediate water masses during the LGM. Prell et al. (1980) indicated a northward shift of the Polar Front and the Sub-Tropical Convergence by 5°-10° and by 5° respectively in the Indian Ocean, with an increased northward influence of the AAIW, up to 20°S. Since gravity core *Fr10/95 GC17* is located ~22°S it would have been within the influence of the AAIW, during the LGM. The percentage of agglutinated taxa during this period was low (<5%) (figure 9.3), while the relative abundance (%) of porcellaneous species remained close to 20%. This seems to contradict the concept of a more "corrosive" AAIW during MIS2, as indicated by the high percentage of porcellaneous species.

At the same time, more arid conditions over the Australasian region led to a reduction of rainfall (van der Kaars, 1991; van der Kaars and Dam, 1995; Gingele et al., 2001; De Deckker et al., 2002; van der Kaars and De Deckker, 2002). The arid conditions and the reduced precipitation caused a reduction of the riverine discharge to the ocean (Gingele et al., 2001) and may have caused a decrease in the amount of nutrients for the phytoplankton, causing low primary productivity conditions. Another factor, which may have prevented the productivity enhancement off the west coast of Western Australia, could have been the increased intensity of the South Java Upwelling System (see section 10.6). This phenomenon could have increased the steric height between the northern and the southern eastern Indian Ocean, determining a southward Ekman transport and a geostrophic-flow off the west coast of Western Australia, thus suppressing an eventual upwelling of intermediate water (Martinez et al., 1999). The presence of a less productive nutricline seems to be confirmed by the low percentages of *N. dutertrei* between 20 and 5 Kyr BP (Martinez et al., 1999). The period between 14 and 5 Kyr BP was characterised by wetter climate with heavier summer rain (van der Kaars and De Deckker, 2002). The resulting increased riverine discharge could have resulted in an increase of the amount of nutrient injected into the sea and higher primary productivity. The isotopic record does not substantiate this scenario, as the $\delta^{13}C$ of *C. wuellerstorfi* maintained values similar to those measured for the LGM. It may be that the large amount of freshwater injected into the sea by the rivers engendered a low-salinity cap at the sea surface, causing a temporary deepening of the nutricline and a reduction of primary productivity. The BFAR peaks can be attributed to minor and sporadic events characterised by increased production of organic matter (figure 10.5b). The fact that these events are not recorded by any faunal change can be explained considering that, under conditions of strong bottom currents and well-oxygenated water, the preservation of a relatively small amount of organic matter at the sea floor could have been greatly prevented, due to lateral transport and/or rapid oxidation. High dissolved-oxygen concentrations at intermediate depths and low productivity at the sea surface seem to have been maintained until 4 Kyr BP, when the assemblage dominated by *N. irregularis* and *G. subglobosa* was replaced by one dominated by *U. proboscidea* and *B. robusta* (figure 10.5a). At Present, *U. proboscidea* is mainly found at low latitudes, where higher primary productivity at the sea surface determines higher carbon-flux rate with low oxygen levels resulting from the oxidation of the organic matter and the contemporary presence of oxygen-depleted intermediate water masses (IIW and NIIW) (see sections 5 and 6). The distribution of *B. robusta* is limited to intermediate depths (700 – 2000 m) and to environments with low dissolved-oxygen concentrations (Table 4.4). A relationship between this taxon and low-oxygen levels was already described for the Australian-Irian Jaya continental margin by Van Marle (1988). Conditions of low dissolved-oxygen concentration could have been the consequence of the increased influence of the IIW in this area. During the last 5 Kyrs, the LC increased its strength (De Deckker, 2001; van der Kaars and De Deckker, 2002); the presence of a low salinity water cap, typical of the LC, could have also engendered a more stratified water column. Similar to what happened at the sea surface, the influence of the Indonesian waters at intermediate depths, with IIW becoming more important, could explain a reduction of dissolved-oxygen concentrations. The high percentage of *U. proboscidea* and *B. robusta* would suggest this situation. Another factor, which corroborates the hypothesis of scarce oxygenation, is represented by the faunal characteristics of the benthic foraminiferal assemblage during the last 5 Kyrs. Low diversity (α, H(S), E) and high dominance are recorded for this period (figure 9.3), suggesting a fauna which thrived under low-oxygen conditions (Lutze and Coulbourn, 1983; Denne and Sen Gupta, 1991; Sen Gupta and Machain-Castillo, 1993; Jannik et al., 1998; den Dulk, 2000). The decreased percentage of porcellaneous taxa and the increased percentage of infaunal species would also point to a less oxygenated environment. At Present, porcellaneous species are correlated with low salinity and high dissolved-oxygen levels, while infaunal species tend to increase when oxygen decreases. These two opposite trends recorded for the last 5 Kyrs would then suggest reduced ventilation at intermediate depths compared to the past.

Another factor, which could contribute to low-oxygen condition, is the oxidation of organic mater at the sea floor. The $\delta^{13}C$ of *C. wuellerstorfi* recorded for the last 5

Kyrs, which shows the highest values measured, do not confirm this hypothesis. Therefore, conditions of increased productivity during the last 5 Kyrs are not substantiated by the isotopic record. The BFAR for this period of time gives values similar to those recorded for the former 25 Kyr and does not indicate any productivity increase (figure 10.5b). The increased percentages of *U. proboscidea* and infaunal taxa would also suggest increased carbon-flux rate. In this case, in the presence of low dissolved-oxygen levels, the oxidation of organic matter would be slower. Under these conditions the "food" availability at the sea floor could have increased, even with no variation of primary productivity at the sea surface.

10.4 Gravity core Fr10/95 GC5

The species *C. wuellerstorfi* and *B. aculeata* displayed the highest percentages among the benthic foraminiferal fauna during two different periods of the last 35 Kyrs (figure 10.5a). *C. wuellerstorfi* dominated from 35 Kyr BP until 18 Kyr BP and *B. aculeata* dominated from 18 Kyr BP until 4 Kyr BP.

As for gravity core *Fr10-95 GC17*, the late MIS3 and early MIS2 for *Fr10/95 GC5* are characterised by the dominance of *C. wuellerstorfi*. As previously discussed, this species should indicate an environment where the sporadic amount of organic matter was laterally advected by active bottom currents. The peaks displayed by the AR curve of the opportunistic species *E. exigua* (see sections 5 and 6) (figure 10.5b) corroborate the idea of pulsed inputs of organic matter in an oligotrophic environment. Environmental conditions more suitable for suspension feeders are also confirmed by the reduced percentages of infaunal taxa (figure 9.7). This period seems to be characterised by an increased importance of bottom current activity. The *C. wuellerstorfi* $\delta^{13}C$ curve (figure 10.3) displayed values consistently higher than those recorded for the LGM. The percentage of *N. dutertrei* showed values similar to those recorded for the late Holocene (Martinez et al., 1999) and the same is valid for the BFAR (figure 10.5b). These data do not substantiate increased productivity at the sea surface, compared to the Present. At 18 Kyr BP, *C. wuellerstorfi* was replaced by *B. aculeata* (figure 10.5a). This last taxon is at Present correlated with low diversity and relatively high phosphate-concentration in the water (Table 4.4) with periodic inputs of organic matter to the sea floor (see sections 5 and 6). The appearance of *B.*

aculeata coincided with an increase of the accumulation rate of *E. exigua* (figure 10.5b). *E. exigua* maintained high AR values for the time during which *B. aculeata* displayed high percentages (20-54 %), suggesting that the presence of this latter species coincided with conditions of increased organic matter supply. Between 20 and 5 Kyr BP, the high values of BFAR (figure 10.5b) indicate conditions of enhanced export of organic matter to the sea floor. Analyses on Recent and living (stained) benthic foraminifera show a relationship between the abundance of *B. aculeata*, the sediment organic carbon content (Collins, 1989; Mackensen et al., 1993; Miao and Thunell, 1993; Rathburn and Corliss, 1994) and shallow oxygen penetration within the sediment (Miao and Thunell, 1996). The distribution of *B. aculeata* also correlates with high organic-carbon flux (>2 gC/m^2yr) in the Atlantic and Southern Oceans (Altenbach et al. 1999; Altenbach, personal communication). As discussed earlier, the increased BFAR and *E.exigua* AR point to an increased amount of "food" reaching the sea floor. The organic matter oxidation could have then induced oxygen depletion at the sea floor and in the sediment pore-water, thus creating the ideal conditions for *B. aculeata* to thrive. A correlation between *B. aculeata* relative abundance (%) and high carbon-flux rates during the past has been reported from the South China Sea, the Sulu Sea and the eastern Indian Ocean (Wells et al., 1994; Miao and Thunell, 1996; Jian et al., 1999; Jian et al., 2001). An enhanced food supply to the sea floor could have been caused by two phenomena. For the period related to the LGM, the South Java Upwelling System was more efficient (see section 10.6) (Martinez et al., 1999; Takahashi and Okada, 2000). This could have determined increased organic matter supply to the sea floor and together with the Banda Sea's high productivity (see section 10.5) (Barawjdjaia et al., 1993; Spooner et al., *submitted*), a higher carbon-flux rate at the sea floor, off the north coast of Western Australia would have occurred. Increased productivity during the LGM in the Timor Sea was also suggested by Müller and Opdyke (2000). The mass accumulation rate of organic carbon measured for this core (Maeda, 2003), was higher at the LGM compared to late MIS3 – early MIS2, further supporting the idea of increased productivity at the sea surface. As discussed in section 10.1.3, the low $\delta^{13}C$ of *C. wuellerstorfi* during the LGM can be associated with a reduced deep-water circulation, which in turn could have caused low-oxygen conditions. The faunal characteristics related to the assemblage dominated by this species indicate low diversity and high dominance, pointing towards low-oxygen conditions (Lutze and Coulbourn, 1983; Denne and Sen Gupta, 1991; Sen Gupta and Machain-Castillo, 1993; Jannik et al., 1998; den Dulk, 2000), similar to what was seen for gravity core *Fr10/95 GC17*. From the data obtained from *Fr10/95 GC5*, it is possible to extrapolate that a less ventilated environment ($\delta^{13}C$ of *C. wuellerstorfi*) and an increased amount of organic matter (*E. exigua* AR and BFAR) at the sea floor could have created favourable conditions for *B. aculeata*. After the LGM, the persistent low values of $\delta^{13}C$ of *C. wuellerstorfi*, the high percentage of *B. aculeata*, the high values of *E. exigua* AR and BFAR could be the consequence of another process. From 14 Kyr BP until 5 Kyr BP this region was characterised by substantial summer rains (Veeh et al., 2000; van der Kaars and De Deckker, 2002). The consequent increased fluvial discharge, with more nutrients injected into the sea, would have favoured phytoplankton blooms. This hypothesis is further supported by the values measured for the mass accumulation rate of the organic carbon (Maeda, 2003). At the transition between MIS2 and MIS1, a peak for this parameter is paralleled by the highest percentages of *B. aculeata* (figure 10.5a). The percentage of *N. dutertrei*, which was already high during the LGM, also reached the highest values during this period, thus indicating a more productive nutricline (Martinez et al., 1998b). For the last 5 Kyrs, the benthic foraminiferal fauna was characterised by high diversity (figure 9.7) and no particular taxon seemed to dominate the assemblage. The species characterised by the highest percentages during this period were *C. wuellerstorfi*, *G. subglobosa* and *E. exigua* (see Appendix A3), suggesting prevalent oligotrophic conditions. The BFAR values were similar to those recorded between 35 and 18 Kyr BP (figure 10.5b). The high value displayed by the $\delta^{13}C$ of *C. wuellerstorfi*, the low percentage of *N. dutertrei* (Martinez et al., 1999) and the low mass-accumulation-rate of organic carbon (Maeda, 2003), would suggest conditions of reduced carbon-flux to the sea floor; this being the lowest recorded of the last 35 Kyrs.

10.5 Piston core SHI9016

Two species, *B. aculeata* and *C. wuellerstorfi*, dominated the faunal assemblage during the last 62 Kyrs. *B. aculeata* characterised the benthic foraminiferal assemblage from 62 until 15 Kyr BP and *C. wuellerstorfi* dominated from 15 Kyr BP until the Present.

The high percentage of *B. aculeata* (figure 10.5a) indicates extremely favourable environmental conditions for this species during the period in which it dominated the foraminiferal assemblage. The BFAR and the accumulation rates of *E. exigua* and *U. proboscidea* were higher than today, suggesting conditions of increased "food" availability at the sea floor (figure 10.5b) for MIS3 and MIS2. The past situation in the Banda Sea was quite different from today, with more arid conditions causing a reduction in rainfall (Barmawidjaja et al., 1993; van der Kaars and Dam, 1995) . The excess of evaporation over precipitation engendered conditions of higher sea-surface salinity (Martinez et al., 1997; Martinez et al., 1998b; De Deckker et al., 2002; van der Kaars and De Deckker, 2002). In this situation, the absence of a freshwater cap allowed a shoaling of the thermocline, with a consequent extension of the Deep Chlorophyll Maximum (DCM) in shallower waters, thus enhancing primary productivity (Barmawidjaja et al., 1993; Spooner et al. et al., *submitted*). This change was paralleled by increased *N. dutertrei* percentages (Barmawidjaja et al., 1993; Spooner et al. et al., *submitted*). The cause of higher productivity could have been the intensified vertical advection of Banda Sea intermediate waters, due to a strengthened Southeastern Monsoon (Spooner et al., *submitted*), or the influx of a nutrient-enriched Pacific Water (Barmawidjaja et al., 1993). The prevailing eastward direction of the South Java Current during this period (Gingele et al., 2002) and the contemporaneous increased productivity in the southern South China Sea (Wang et al., 1999; Jian et al., 2001) indicate an intensified Northwestern Monsoon for this period. The influx of a nutrient-enriched Pacific Water is a more likely possibility, considering that during glacial stages productivity increased in the Western Pacific (Herguera and Berger, 1991; Burke et al., 1993; Herguera and Berger, 1994) and that Banda Sea waters and Pacific Intermediate waters also displayed a similar evolution during glacial and interglacial times (Ahmad et al., 1995). Another source of nutrients could have been the sediment transported to the sea by winds or by rivers (Martinez et al., 1998b) from the emerged shelf of the Java Sea (Hantoro, 1997). Between 62 and 15 Kyr BP, the high AR of *U. proboscidea* (figure 10.5b), which today is also associated with oxygen-depleted environments (see sections 5 and 6), would also indicate a less ventilated environment. The flux of organic matter to the sea floor and its oxidation could have led to oxygen depletion at the sea floor. The high dominance level (figure 9.11), which characterises the assemblage dominated by *B. aculeata*, as discussed before, would suggest this scenario. Another cause for a reduced oxygenation could have been a reduced deep-water circulation, as the interpretation of the *C. wuellerstorfi* $\delta^{13}C$ signal in the eastern Indian Ocean would indicate. A less active circulation at this site during MIS2 and part of MIS3 is also suggested by sedimentological analysis (Gingele et al., 2001). It is possible that the increased input of organic matter in an already poorly-ventilated environment, similar to what seen for *Fr10/95 GC5* during the LGM, created favourable conditions for *B. aculeata*. This taxon was replaced by the suspension feeder species *C. wuellerstorfi*, at 15 Kyr BP. The high percentage of this species during the last 15 Kyrs (figure 10.5a) could indicate a reduced flux of organic matter to the sea floor, accompanied by a strengthening of the bottom currents. According to the results presented in section 6, the absence of *E. exigua* would indicate a reduced amount of organic matter at the sea floor and the constant decrease of *U. proboscidea* AR would correspond to conditions of low carbon-flux rate and increased ventilation (figure 10.5b). The BFAR calculated for this period was 2-3 times lower than that recorded during the previous 45 Kyrs (figure 10.5b). This change coincides with the onset of the last deglaciation and the climatic shift towards conditions similar to modern ones (van der Kaars and Dam, 1997). Coinciding with this climatic change, the sea level rose, submerging the Indonesian platforms (Chappell et al., 1996) and precipitation increased (Martinez et al., 1997; Martinez et al., 1998b; De Deckker et al., 2002; van der Kaars and De Deckker, 2002). Under these conditions, the formation of a freshwater cap, due to the excess of rainfall over evaporation, caused the deepening of the DCM and the consequent reduction of productivity at the sea surface (Barmawidjaja et al., 1993). The occurrence of this phenomenon is also confirmed by the decrease of *N. dutertrei* percentages, recorded for this site from 15 Kyr BP until today (Spooner et al., *submitted*). At the same time, productivity in the Western Pacific diminished compared to the glacial period, reducing the nutrients content of the Pacific waters entering the Indonesian Archipelago (Herguera and Berger, 1991; Burke et al., 1993;

Herguera and Berger, 1994). The presence of more intense bottom currents is indicated not only by the lower *U. proboscidea* AR, but also by higher silt sedimentation relative to clay (Gingele et al., 2001).

10.6 Piston Core BAR9403

The benthic foraminifera species *O. t. umbonatus*, *E. exigua*, *B. aculeata* and *C. wuellerstorfi*, characterised the benthic foraminiferal fauna at different times during the last 33 Kyrs.

O. t. umbonatus was the most abundant species until 26 Kyr BP (figure 10.5a). The study of the core tops associated this species with a deep and cold environment, characterised by a low carbon-flux rate (Table 4.4). The percentage for this taxon, close to 30%, during this period, would indicate conditions of low productivity at the sea surface as also suggested by BFAR (figure 10.5b). Circulation offshore Java and Sumatra was different at that time: sea-surface currents, under the influence of strengthened Northwestern Monsoon (Gingele et al., 2002), and intermediate waters were characterised by a prevalent eastward flow. Under these conditions, the upwelling, which at Present is associated with the Southeastern Monsoon and the westward flow of the SJC, would have been suppressed or greatly reduced. The isotopic signal (low $\delta^{13}C$ of *C. wuellerstorfi*) can then be attributed to enhanced stratification of the water column, which allowed the bloom of the giant diatom *Ethmodiscus rex* (De Deckker and Gingele, 2001; Gingele et al., 2002). The situation changed at 26 Kyr BP, when *O. t. umbonatus* was replaced by *B. aculeata*, which dominated the benthic foraminiferal assemblage between 26 and 15 Kyr BP, reaching percentages close to 50 % (figure 10.5a). Similarly to *B. aculeata*, another species, *E. exigua*, showed increased percentage at this time. As discussed in sections 5 and 6, the distribution of this species outlines the preference of this taxon for a deep environment, with pulsed fluxes of organic matter. The high BFAR (figure 10.5b) values would suggest an increased input of organic matter to the sea floor for this period. High carbon-flux rate is also suggested by the increased AR of *U. proboscidea*, (figure 10.5b). This species would also indicate reduced oxygen levels (see sections 5 and 6) and together with the low $\delta^{13}C$ of *C. wuellerstorfi*, would suggest a reduced deep-water circulation. Towards the LGM, the monsoonal climate changed, with the weakening of the Northwestern Monsoon and the strengthening of the Southeastern Monsoon (Wang et al., 1999; Jian et al., 2001; Gingele et al., 2002). This, combined with the absence of the low-saline water cap (present today) (Martinez et. al, 1999), caused an increase of the intensity of the South Java Upwelling System (Martinez et al., 1999; Muller and Opdyke, 2000; Takahashi and Okada, 2000; Gingele et al., 2002). The *E. exigua* percentage peak would also suggest increased inputs of organic matter from the sea surface. The high *U. proboscidea* AR corroborates this hypothesis and indicates an enhanced flux of organic matter to the sea floor. As seen for the other cores, the *B. aculeata* bloom coincided with increased food supply and low-oxygen levels at the sea floor. The reduced percentage of *E. exigua* after 20 Kyr BP may be seen as the consequence of competition between these two species, which, in the presence of constant and significant amount of organic matter, would favour *B. aculeata*. This latter aspect can be related to the fact that in the presence of a high organic-matter oxidation-rate, oxygen depletion at the sea floor would occur. Together with a reduction of deep-waters circulation, oxygen depletion could have played a major role in limiting *E. exigua*, thereby favouring *B. aculeata*. Low oxygen conditions are also suggested by the high value of dominance (D), which, during this period, reached the highest values recorded for the entire core (figure 9.15). At the same time, the high percentage of infaunal taxa (figure 9.14), which at Present are correlated with high carbon-flux rate and low-oxygen levels (see sections 5 and 6), would support this hypothesis. Around 15 Kyr BP, *O. t. umbonatus* and *C. wuellerstorfi* became the most important species (figure 10.5a). The environmental interpretation of these taxa has been already discussed, as together they would indicate a more oligotrophic environment characterised by intense bottom currents. Different factors substantiate this interpretation: low *E. exigua* and *U. proboscidea* AR (figure 10.5b), the constant decrease of BFAR (figure 10.5b) and the low percentage of infaunal taxa (figure 9.15) (indicating an environment more suitable for suspension feeders). The opening of the Sunda Strait, due to sea-level rise and the increased precipitation (Ganssen et al., 1988; van der Kaars and Dam, 1995), contributed to an injection of less saline water into the SJC path, inducing a low-salinity water cap, which reduced the effectiveness of the South Java Upwelling System (Martinez et al., 1999). During the last 5 Kyrs, *B. aculeata*, first and *E. exigua*, later, replaced the *O. t. umbonatus* – *C. wuellerstorfi* dominated assemblages. Again, this would suggest an increased food supply to the sea floor. However, the

BFAR does not fully corroborate this interpretation, or at least point to a small increase compared to the one recorded for the past. This slight productivity variation at the sea surface can be associated with a reduced precipitation over the Australasian region during the last 5 Kyrs, compared to the period from 14 to 5 Kyr BP (Ganssen et al., 1988; van der Kaars and De Deckker, 2002). A similar event could have also taken place in this area, by reducing the low-salinity water cap importance over the South Java Upwelling System region and favouring a minimal primary productivity enhancement at the sea surface.

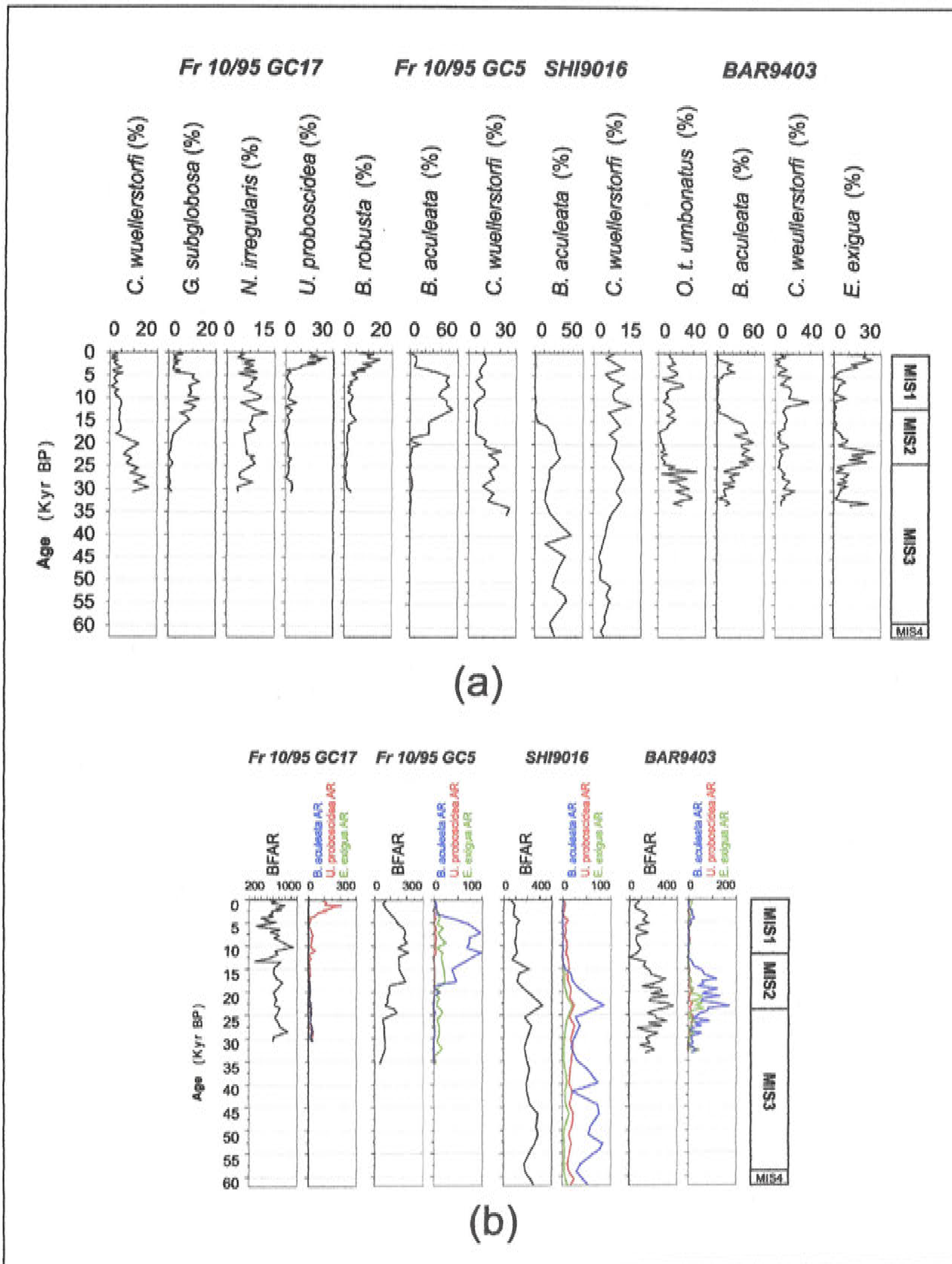

Fig. 10.5 – **(a) Downcore variations in relative abundance (%) of dominant benthic foraminiferal species and (b) downcore variations in benthic foraminiferal accumulation rates (BFAR) and accumulation rates (AR) of *B. aculeata*, *U. proboscidea*, *E. exigua*for the four studied cores.**

10.7 The Palaeoceanography of the eastern Indian Ocean during the Late Quaternary

The samples analysed in this study allow the reconstruction of the palaeoceanographic evolution of the eastern Indian Ocean covering the last 60 Kyrs. The correlation between the variation of the benthic foraminifera faunal patterns, the $\delta^{13}C$ of *C. wuellerstorfi*, the BFAR and the accumulation rates of *B. aculeata*, *E. exigua* and *U. proboscidea* have been interpreted as the consequence of important oceanographic and climatic changes, which took place in this region over time

10.7.1 62 – 35 Kyr BP

For the period between 62 and 35 Kyr BP, the available data allow the reconstruction of the environmental evolution of the Banda Sea (*SHI9016*). During this time, a benthic foraminiferal assemblage dominated by *B. aculeata* indicates conditions of enhanced productivity at the sea surface and increased organic matter flux to the sea floor accompanied by possibly reduced ventilation. Enhanced organic matter supply could have been determined by the influx of nutrient-enriched Pacific waters into the Indonesian Achipelago and/or an increased sediment contribution from the nearby emerged land.

10.7.2 35 – 15 Kyr BP

Between 35 and 15 Kyr BP (figure 10.6), while in the Banda Sea conditions were similar to those for the previous 25 Kyrs, a different situation existed along the western Australian coast. Here, conditions of lower productivity (compared to the Banda Sea) and active bottom (*Fr10/95 GC5*) and intermediate (*Fr10/95 GC17*) currents were indicated by the presence of *C. wuellerstorfi*. Offshore Java and Sumatra (*BAR9403*), a more stratified water column and a less active South Java Upwelling System determined conditions of scarce circulation at the sea floor and reduced carbon-flux rate. In this type of environment an assemblage dominated *O. t.*

umbonatus thrived until 26 Kyr BP. At the transition between MIS2 and MIS3, the Southeastern Monsoon intensification and the increased effectiveness of the South Java Upwelling System determined conditions of high productivity at the sea surface. Enhanced organic matter flux to the sea floor and the consequent oxygen depletion favoured *B. aculeata* and *E. exigua* blooms. A reduction of oxygen levels, due to a reduced circulation and organic matter oxidation, probably caused the disappearance of *E. exigua* and favoured *B. aculeata*. Approaching the LGM (figure 10.7), off the north coast of Western Australian the influence of a more efficient South Java Upwelling System, together with reduced deep-water circulation were indicated by the high percentage of *B. aculeata*. Off the west coast of Western Australia, two low-food tolerant species replaced *C. wuellerstorfi*: *N. irregularis* and *G. subglobosa*. Arid conditions over the region caused a considerable reduction of nutrient input to the sea. At intermediate depths (1000 m), the circulation intensity was more vigorous than at the present and the AAIW front was located further north (~20°S).

10.7.3 15 – 5 Kyr BP

At 15 Kyr BP (figure 10.8), important changes are recorded at all the core sites, except for *Fr10/95 GC17*. A wetter climate, accompanied by an increased riverine discharge and sea-level rise, led to the formation of a freshwater cap over the Indonesian region, thus deepening the thermocline and reducing the productivity level in the Banda Sea and the intensity of the South Java Upwelling System, offshore Java and Sumatra. In these areas, *B. aculeata* was replaced by *C. wuellerstorfi* and by *O. t. umbonatus* and *C. wuellerstorfi*, respectively. This replacement indicates conditions of reduced food supply to the sea floor and more intense deep-water circulation. Off the west coast of Western Australia, a presumed similar freshwater cap, might have deepened the nutricline, precluding any possibility of enhanced productivity. Low food supply conditions were still indicated by the presence of *N. irregularis* and *G. subglobosa*. Off the north coast of Western Australia, the injection of nutrients into the sea by rivers increased productivity and enhanced the carbon-flux rate. These conditions favoured *B. aculeata*, which displayed high percentages after 15 Kyr BP only for this site.

10.7.4 5 Kyr BP – Present

The reduction in precipitation, during the last 5 Kyrs (figure 10.9), caused shoaling of the nutricline off Java and Sumatra and induced increased fertility in that area. This was accompanied by increased percentages of *B. aculeata*, first, and *E. exigua*, later. Rainfall reduction and the LC, well established along its modern pattern, determined conditions of low productivity off the north coast of Western Australia. A more stratified water column and an increased influence of IIW, over the AAIW, created conditions of low dissolved-oxygen concentrations off the west coast of Western Australia as indicated by the dominance by *U. proboscidea* and *B. robusta*.

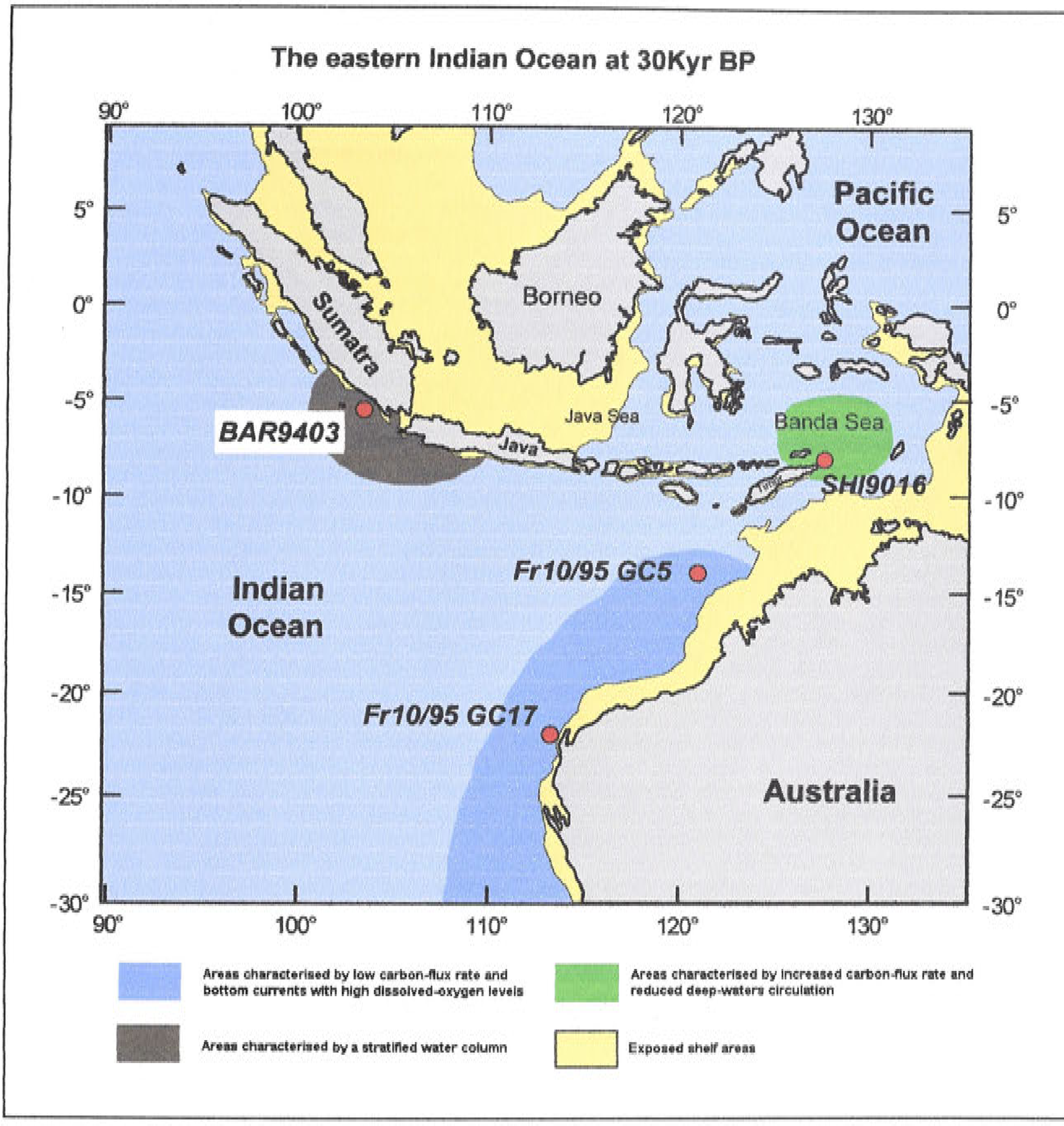

Fig. 10.6 – **The situation of the eastern Indian Ocean at 30 Kyr BP.**
The Banda Sea was characterised by the influx of more nutrients-enriched Pacific waters which, with the absence of the freshwater cap at the sea surface and a shallower thermocline, determined conditions of increased carbon-flux rate to the sea floor. The oxidation of the organic matter, together with reduced deep-water circulation, reduced oxygen levels, created favourable conditions for *B. aculeata*. Offshore Java and Sumatra a more stratified water column and prevailing NE Monsoon inhibited the South Java Upwelling System, determining conditions of reduced carbon-flux to the sea floor and favouring the presence of *O. t. umbonatus*.
Offshore Western Australia, active and oxygenated bottom-waters and low carbon-flux rate at the sea floor were indicated by the presence of *C. wuellerstorfi*.

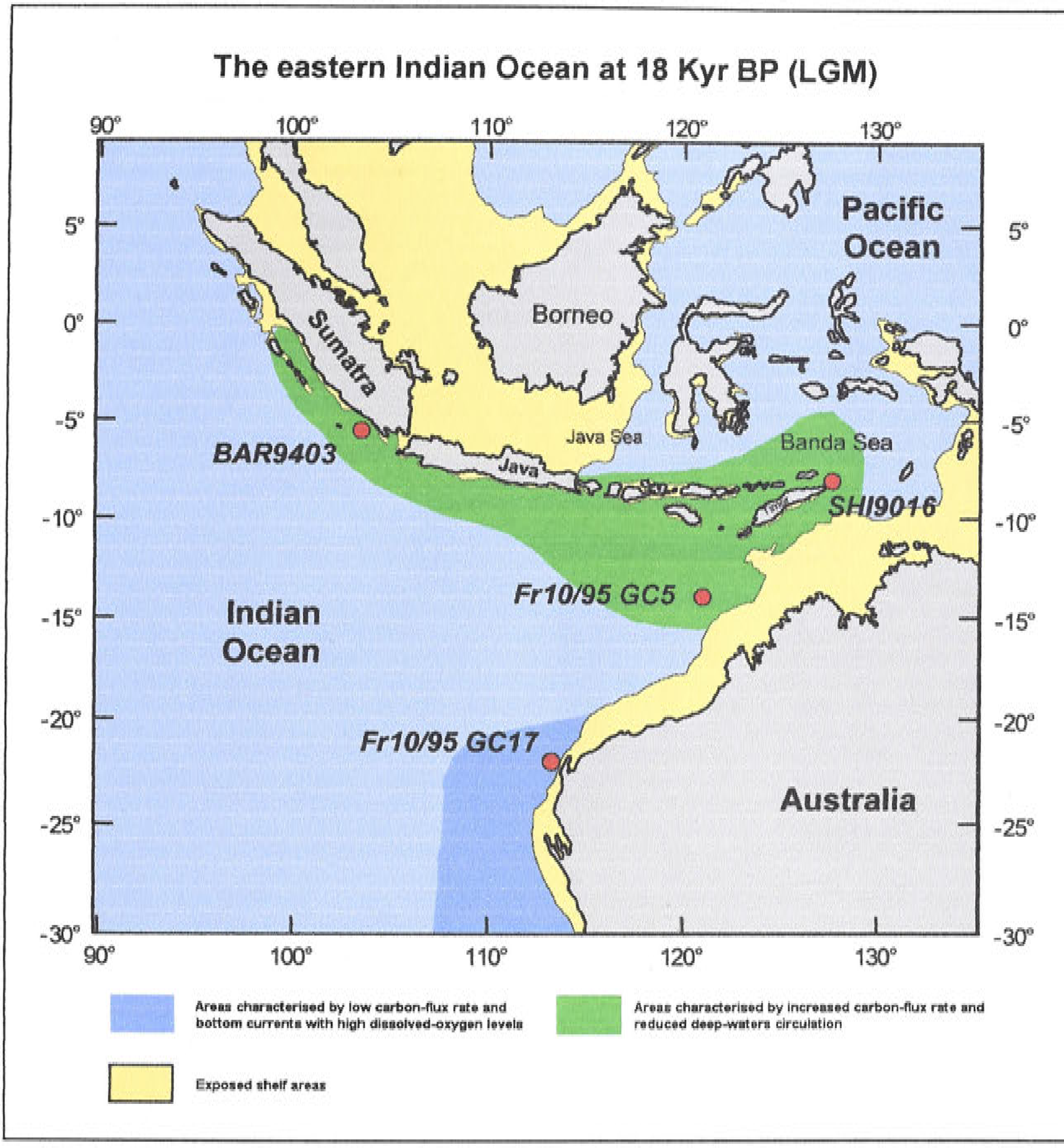

Fig. 10.7 – **The situation of the eastern Indian Ocean at 18 Kyr BP.**
Conditions of increased carbon-flux rate at the sea floor were maintained in the Banda Sea, while offshore Java and Sumatra the increased effectiveness of the South Java Upwelling System, determined a carbon-flux rate increase at the sea floor, as indicated by the presence of *B. aculeata* and *E. exigua*. The oxygen depletion, due to the reduced deep-water circulation and the organic matter oxidation, favoured *B. aculeata*, while *E. exigua* disappeared.
The influence of the higher productivity over the Indonesian region determined increased carbon-flux rate off the north coast of Western Australia. This and the reduced deep-water circulation created optimal conditions for *B. aculeata*. Off the west coast of Western Australia, high-oxygen levels were indicated by *N. irregularis*, which with *G. subglobosa* replaced *C. wuellerstorfi*, due to a further organic matter supply reduction, probably the consequence of arid conditions over the continent. The AAIW influence was recorded up to 20°S.

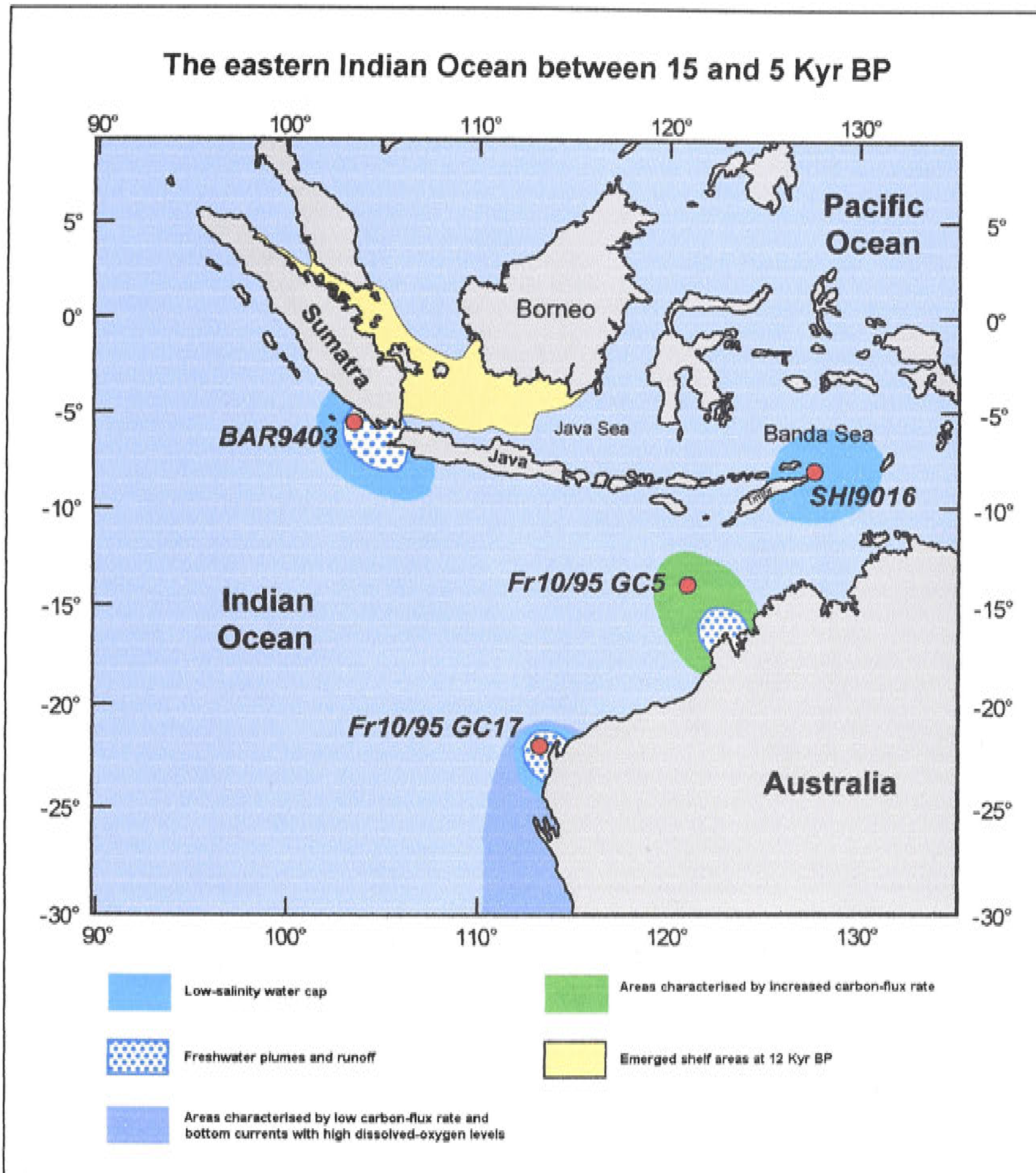

Fig. 10.8 – **The situation for the eastern Indian Ocean between 15 and 5 Kyr BP.**
The presence of a low-salinity water cap due to increased rainfall determined conditions of reduced carbon-flux rate at the sea floor in the Banda Sea and offshore Java and Sumatra. Also, increased deep-waters circulation characterised these two regions. These two conditions are suggested by the presence of *C. wuellerstorfi* and *O. t. umbonatus*. Similarly a low-salinity water cap was present off the west coast of Western Australia, where *N. irregularis* and *G. subglobosa* still dominated the benthic foraminiferal fauna. The increased riverine runoff favoured increased carbon-flux rate, offshore northern coast of Western Australia, as *B. aculeata* was still present with high percentages.

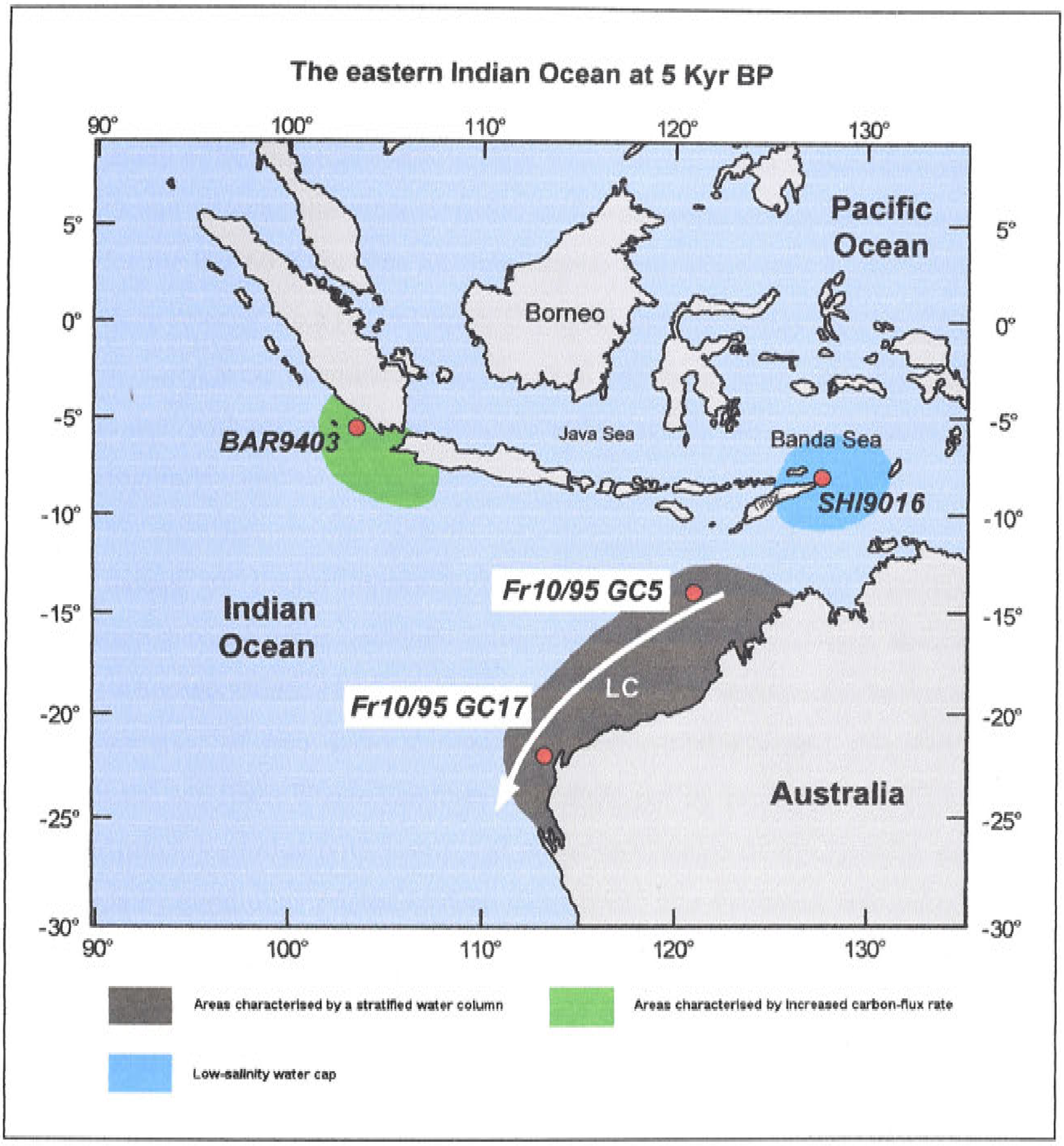

Fig. 10.9 – **The situation for the eastern Indian Ocean at 5 Kyr BP.**
The reduction of precipitation allowed a slight increase of productivity offshore Java and Sumatra, as indicated by *E. exigua*. In the Banda Sea the prevailing influence of bottom currents is indicated by *C. wuellerstorfi*. Offshore Western Australia a more stratified water column was probably caused by the presence of the low-salinity Leeuwin Current (LC), which suppressed the increased productivity north of Western Australia and caused oxygen-levels reduction, off the west coast of Western Australia, were *U. proboscidea* and *B. robusta* become the dominant species.

11. Conclusions

The study of benthic foraminifera from four selected cores collected in the eastern Indian Ocean allowed the reconstruction of the palaeoceanographic evolution of the region for the last 60 Kyrs. The benthic foraminifera fauna, BFAR, the accumulation rate of three selected taxa (*B. aculeata*, *E. exigua* and *U. proboscidea*) and the $\delta^{13}C$ of *C. wuellerstorfi* were examined. The observed variations of trends of all the proxies correlate well with the palaeoceanographic and palaeoclimatological changes reported for this region.

By means of Factor Analysis (Principal Components), the species whose distribution through time could be interpreted as indicative of past environmental changes were identified. The distribution of these species appeared to be controlled by the co-variance of two factors: organic-matter availability and dissolved-oxygen levels at the sea floor. These variables are influenced by processes related to the sea surface (primary productivity levels and presence/absence of low-salinity water cap) as well as by conditions related to deep circulation. The increased amount of organic matter at the sea floor and its oxidation causes oxygen depletion. In the presence of a poorly ventilated environment, this further oxygen depletion can have a relevant impact for the ecosystem at the sea floor. On the other hand, in a scarcely oxygenated environment organic matter can be better preserved, becoming a longer-term "food" resource for the meiofauna.

Different faunal patterns were observed at different depths:

1) below 1800 m, *B. aculeata* and *E. exigua* were correlated with conditions of increased organic matter supply to the sea floor. Competition and reduced dissolved-oxygen levels (due to a reduced deep-water circulation and organic-matter oxidation) favoured *B. aculeata* and caused *E. exigua* to disappear, while in the presence of pulsed inputs of organic matter, but without significant oxygen depletion, *E. exigua* prevailed. The species *C. wuellerstorfi* and *O. t. umbonatus* thrived in oligotrophic conditions. *C. wuellerstorfi* also indicated increased deep-water circulation and increased oxygenation;

2) for depths ~1000 m and south of 20°S, *C. wuellerstorfi* indicates oligotrophic conditions where reduced amounts of organic matter were laterally advected by active bottom currents, characterised by high dissolved-oxygen levels. The species *G. subglobosa* and *N. irregularis* were associated with an extreme low carbon-flux rate and high dissolved-oxygen levels. This last condition was probably related to an increased influence of AAIW. *U. proboscidea* and *B. robusta* became abundant in the presence of low dissolved-oxygen levels and a more stratified water column.

The $\delta^{13}C$ of *C. wuellerstorfi* confirms the presence of an hydrological front in the Indian Ocean during the LGM:

(1) below 1800 m, the $\delta^{13}C$ of *C. wuellerstorfi* followed a pattern similar to the one observed elsewhere in the Indian Ocean, showing a depletion >0.32‰ during the LGM. This would indicate conditions of reduced deep-water circulation;
(2) at ~1000 m, the $\delta^{13}C$ of *C. wuellerstorfi* depletion was <0.32‰, at the LGM. This is in agreement with the isotopic signal recorded from other parts of the Indian Ocean and would indicate a more active intermediate-water circulation.

High values of BFAR indicate conditions of enhanced organic matter supply to the sea floor. The accumulation rates of *B. aculeata*, *E. exigua* and *U. proboscidea* allowed to identify periods characterised by increased organic matter supply and reduced oxygen levels (*U. proboscidea*)

These observations led to identify important differences between the actual situation of the eastern Indian Ocean and past oceanographic and climate changes reported for this region:

- a link between the processes taking place at the sea floor and the climatic changes recorded for the region during the past was found. Precipitation levels determined the presence/absence of a low-salinity water cap at the sea surface [with a consequent deepening or shoaling of the thermocline (Banda Sea)] and controlled the amount of nutrients injected into the sea by rivers (off the north coast of Western Australia). The presence of a low-salinity layer also reduced the intensity of the South Java Upwelling System. These factors affected productivity levels and organic matter supply at the sea floor influencing the distribution of benthic foraminifera. Also, monsoonal wind-regimes controlled the intensity of the South Java Upwelling System and hence productivity levels over that area.

- As indicated above, the $\delta^{13}C$ of *C. wuellerstorfi* appeared to be controlled by intermediate- and deep-water circulations. The results obtained suggest more active circulation for intermediate depths (~1000 m) and reduced circulation below 1800 m during the LGM. Conditions of more/less active circulation controlled dissolved-oxygen levels, thus affecting the benthic foraminiferal fauna.
- During the LGM, off the west coast of Western Australia, productivity did not increase. This is indicated by: (a) a benthic foraminiferal assemblage dominated by *G. subglobosa* and *N. irregularis*, (b) the $\delta^{13}C$ of *C. wuellerstorfi* depletion, which was lower than the one expected for this period, and (c) the BFAR pattern, which was characterised by values similar to the Present. This scenario would have been the consequence of more arid conditions, with a reduced amount of nutrients injected into the ocean by rivers, and a steric southward-flow along Australian coasts (this latter was engendered by an increased intensity of the South Java Upwelling System).
- Today the occurrence of *N. irregularis* mirrors the distribution of AAIW in the eastern Indian Ocean and porcellaneous taxa are correlated with low-salinity and high dissolved-oxygen levels. The high percentages of these taxa recorded off the west coast of Western Australia suggest an increased influence of AAIW at latitudes north of 20°S for the LGM. The replacement of the assemblage dominated by *N. irregularis* and *G. subglobosa* by the assemblage dominated by *U. proboscidea* and *B. robusta*, at ~5 Kyr BP would indicate an increased influence of the oxygen-depleted IIW and a more stratified water column, due to the presence of the LC.
- The productivity of the Banda Sea was higher during the past, compared to the present, as suggested the by the high BFAR and high percentages of *B. aculeta*. This species was also favoured by the oxidation of organic matter and reduced deep-water circulation (low values of $\delta^{13}C$ of *C. wuellerstorfi*), which led to low dissolved-oxygen levels conditions at the sea floor.
- The high percentages of *B. aculeata* and *E. exigua* recorded off Java and Sumatra during the LGM indicate a more intense South Java Upwelling System and increased organic matter supply to the sea floor. Conditions of reduced oxygen levels

determined by the oxidation of the organic matter and reduced deep-water circulation favoured *B. aculeata*, which prevailed over *E. exigua*.

12. General conclusions

The aim of this research was to define the potential use of benthic foraminifera from the eastern Indian Ocean in order to reconstruct the palaeoceanographic evolution of this region during the Late Quaternary. This work consisted of two major parts:

(1) the analysis of Recent benthic foraminifera present in 57 core tops collected from the eastern Indian Ocean and the study of the relationships between their distribution and the environmental variables measured for this region. These environmental variables were related to the water masses described for this region (depth, temperature, salinity, oxygen levels, pressure) and nutrient levels (phosphate and nitrate concentrations). Possible links between primary-productivity levels at the sea surface and the benthic foraminifera distribution were also investigated by calculating the carbon-flux rate at the sea floor using Suess (1980) and Berger and Wefer (1990) formulae;

(2) the study of the benthic foraminifera faunal content of four cores (*Fr10/95 GC17*, *Fr10/95 GC5*, *B9403* and *SHI9016*) collected from this region. The information acquired about the distribution of Recent foraminifera, together with the isotopic record of $\delta^{13}C$ of *C. wuellerstorfi* and the BFAR, were used to interpret the observed faunal changes displayed by the benthic foraminifera species. This approach permitted an understanding the processes, which may have led to such modifications, and the reconstruction of the palaeoceanographic evolution of the eastern Indian Ocean for the last 60 Kyrs.

12.1 The study of Recent benthic foraminifera

The analysis of benthic foraminifera from 57 core-tops samples allowed the identification of the environmental variables that influence their distribution (sections 5 and 6). The distribution of Recent benthic foraminifera from the eastern Indian Ocean appeared to be controlled by depth, as the first axes of both DCA and CCA indicated. Many of the measured environmental variables proved to be correlated with depth and therefore the depth-related benthic foraminifera distribution was interpreted as the consequence of the co-variance of different factors: temperature, carbon flux, salinity, dissolved oxygen and phosphate. In accordance with this, the species *O. t. umbonatus*, *P. murrhina* and *E. exigua* are typical of deep (>2000 m), cold, well oxygenated and oligotrophic environments, where pulsed fluxes of organic matter associated with seasonal events are exploited by *E. exigua*. At depths <2000 m, where temperature and carbon-flux rate are higher, two species show higher percentages: *C. pseudoungerianus* and *N. irregularis*. This latter taxon is also strongly correlated with high dissolved-oxygen levels and low salinity. Its distribution mirrors the distribution of AAIW for this region.

The distribution of two other taxa, *U. proboscidea* and *B. aculeata*, is not correlated with depth, but is controlled by other factors. *U. proboscidea* is related to low dissolved-oxygen levels and high carbon-flux rate. The relationship between the distribution of this species and low-oxygen concentration is associated with the oxygen depletion caused by oxidation of the organic matter and the presence of oxygen-depleted water masses (IIW and NIIW). *B. aculeata* is correlated with high phosphate concentrations of the water and high dominance. These two characteristics have been interpreted as related to the presence of organic matter and to an opportunistic behaviour.

The study of the distribution of infaunal, agglutinated and porcellaneous species outlined links between two of these groups and the environmental variables considered. Infaunal species are correlated with increasing carbon-flux rate and low dissolved-oxygen levels, while the porcellaneous taxa are correlated with low salinity and high dissolved-oxygen levels.

12.2 The study of the cores: benthic foraminifera

The availability of organic matter and oxygen levels at the sea floor influenced the distribution of benthic foraminifera in the eastern Indian Ocean (section 10). The four selected cores provided information about benthic foraminifera faunal changes relative to the last 60 Kyrs. These variations proved to be correlated with the environmental and climatic changes already reported for this region (variations of precipitation levels, monsoonal-winds intensity, intermediate- and bottom-waters circulations). The faunal changes observed for the region followed different patterns, depending on the depth of the cores. For depths >1800 m, *B. aculeata* displayed high percentages during periods of increased organic matter supply and reduced deep-water circulation. South of Java and Sumatra, in the early phase of increased productivity, *E. exigua* was also present, but oxygen depletion (due to organic matter oxidation and reduced ventilation) caused this species to disappear. During periods characterised by oligotrophic conditions, the benthic foraminiferal fauna was dominated by *O. t. umbonatus* and in presence of active deep-water circulation, also by *C. wuellerstorfi*. For depths <1800 m, south of 20°S, *C. wuellerstorfi* indicated oligotrophic conditions and active bottom currents. *N. irregularis* and *G. subglobosa* characterised periods of extremely reduced organic-matter supply and increased influence of AAIW north of 22°S. *U. proboscidea* and *B. robusta* were associated with reduced oxygen levels, due to a more stratified water column, for the presence of the LC along is modern pattern, and the presence of the oxygen depleted IIW, south of 22°S.

The isotopic record of $\delta^{13}C$ of *C. wuellerstorfi* gave indications about the circulation at the sea floor for the past. The values measured for this region follow the trend recorded for the eastern Indian Ocean during the last glacial phase. While a general depletion of 0.32‰ is expected for that period, the depletion recorded for the cores under the influence of deep waters is higher, indicating a reduced deep-water circulation (Duplessy et al., 1989). On the other hand, at intermediate depths (*Fr10/95 GC17*), the depletion recorded for the LGM is <0.32‰, suggesting a more active intermediate-water circulation (Duplessy et al., 1989).

The benthic foraminifera faunal patterns, together with the $\delta^{13}C$ of *C. wuellerstorfi*, the BFAR and the accumulation rates of *B. aculeata*, *E. exigua* and *U. proboscidea* allowed to reconstruct the palaeoceanographic evolution of the eastern Indian Ocean for the Late Quaternary (section 10.6).

12.3 The study of the cores: eastern Indian Ocean palaeoceanography during the Late Quaternary

During the Late Quaternary, the situation over the eastern Indian Ocean was different from today. Due to more arid conditions, between 60 and 15 Kyr BP, the low-salinity water cap, which today occupies the topmost part of the water column, was absent. This caused a shoaling of the nutricline and favoured conditions of increased productivity in the Banda Sea. During the LGM, the intensity of the Southeastern Monsoon increased, causing the productivity to increase offshore Java and Sumatra and off the north coast of Western Australia. These primary productivity changes were paralleled by a reduction of deep-water circulation, which favoured conditions of low-oxygen levels in deep environments. Between 15 and 5 Kyr BP, increased precipitation levels and the consequent formation of a low-salinity water cap determined low-productivity conditions offshore Java and Sumatra and in the Banda Sea. On the other hand, the nutrients injected into the ocean by rivers, fostered productivity off the north coast of Western Australia. For the last 5 Kyrs, reduced productivity levels, compared to the past, characterised the Banda Sea and the ocean off the north coast of Western Australia, while a slight increase of South Java Upwelling System intensity was recorded.

Productivity levels off the west coast of Western Australia remained low during the last 30 Kyrs. At the same time, important changes of the intermediate waters and surface-current circulation were recorded. Prevailing high dissolved-oxygen conditions were maintained in this area from 30 until 5 Kyr BP. A more active intermediate-water circulation was present at the LGM, when AAIW front was located north of 22°S. During the last 5 Kyrs, the oxygen-depleted IIW become more influent over this area and a stratified water column was the consequence of the LC, well along its modern pattern.

12.4 The study of the cores: faunal turnover

The choice of cores for palaeoceanographic analyses was based on the information acquired about the distribution of Recent benthic foraminifera (PART I). In order to investigate possible variations of carbon-flux rate during the past, cores depth had to be within the range of 2000 m, as today this is the depth at which the faunal species correlated with oligotrophic conditions are replaced by species correlated to high carbon-flux rate. The benthic foraminifera trends recorded for the past 60 Kyrs indicated that this supposed faunal change did not take place. Instead, due to increased carbon-flux rate and reduced oxygen levels, *B. aculeata* became the most important species between 1800 and 2500 m. Studies from the Pacific and Atlantic Oceans indicate *Uvigerina* spp. as a typical species from areas characterised by enhanced productivity (Lutze and Colburn, 1983; Loubere, 1991; Altenbach et al., 1999). This observation would suggest that palaeoceanographic studies from the eastern Indian Ocean should consider *B. aculeata* as indicative of periods characterised by increased input of organic matter to the sea floor accompanied by reduced oxygen levels. This result is in agreement with those obtained by Loubere (1998), who outlined significant differences between Pacific and NW Indian Ocean faunas below 2000 m, with the Pacific high-productivity species *U. peregrina* becoming less important in the NW Indian Ocean assemblages, due to the high seasonality characterising this area.

12.5 Future research

The study of Recent benthic foraminifera from the eastern Indian Ocean proved to be important for gathering information that can then be applied in palaeoceanographic studies. The use of core-tops allowed the analysis of the relationships between benthic foraminifera distribution, water masses, nutrients concentration and carbon-flux rate.

Studies on living (Rose-Bengal stained) specimens have shown how other factors also control the distribution of these microorganisms (Jorissen et al., 1995; Van der Zwaan et al., 1999; Murray, 2001). The use of box cores and multicorers has proved to be one of the best procedure for obtaining samples for the study of the ecology of benthic foraminifera (Jannik et al., 1998; Kuhnt et al., 1999; Wollenburg and Kuhnt, 2000; Heinz et al., 2001). These coring devices allow the recovery of the undisturbed sediment-water interface and the overlying bottom water. Samples recovered following this procedure would allow direct measurements of the characteristics of the water above the sediment (temperature, oxygen concentration, $\delta_{SW}{}^{13}C$, etc...). Furthermore, data about the vertical benthic foraminifera distribution within the sediment need to be acquired. The identification of infaunal species made in this research was based on observation of living (Rose-Bengal stained) specimens from other parts of the oceans. The infaunal species percentage trend has provided useful information about changes of the oxygen levels and carbon-flux rates during the past. A definition of benthic foraminifera microhabitat based on direct observations from the eastern Indian Ocean would improve the quality and the accuracy of such palaeoenvironmental interpretation.

Box cores and multicorers also allow the analysis of pore-water properties, such as the oxygen concentration. These data would provide an estimate of the sediment-oxygenated layer thickness. Direct analysis of the sediment could then focus on the granulometry, total carbon and organic carbon content.

A better understanding of the ecology of benthic foraminifera from the eastern Indian Ocean will be a fundamental step for any future palaeoceanographic research, which will include the analysis of these microrganisms.

For future palaeoceanographic research the study of more cores collected from offshore Java and Sumatra is recommended, as more palaeoceanographic studies, based on benthic foraminifera from that area, are needed. Generally, a larger number of cores collected from the eastern Indian Ocean and longer sediment-records should be investigated in order to understand analogies and differences between the LGM and the Penultimate Glaciation. Cores collected at depths > and < 2000 m would allow the reconstruction of palaeoenvironmental conditions for bathyal and abyssal settings, which, as shown in this thesis, followed different patterns through time. Cores collected at intermediate depths, south and north of 22°S, should be recovered in order to investigate the northward shift of the AAIW, which took place a the LGM. Furthermore, the analysis of the $\delta^{13}C$ of *C. wuellerstorfi* from more cores, would allow an increase in the accuracy of the calculated mean I-G $\delta^{13}C$ difference for the eastern Indian Ocean.

As discussed in section 11, benthic foraminifera have proved to be a reliable palaeoceanographic tool, but in this case their faunal changes were affected by the co-variance of the carbon-flux rate and the dissolved-oxygen level. The combined analysis of benthic foraminifera and proxies $CaCO_3$ and C_{org} MARs (as seen for gravity core *Fr10/95 GC5*) would probably help to better define the links between faunal changes and eventual past variations of primary productivity levels.

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APPENDICES

TAXONOMIC REFERENCES

Agglutinated species listed in alphabetical order

Alveolophragmium scitulum (Brady) = *Alveolophragmum scitulum* (Brady), Barker, 1960, p. 70, pl. 34, figs. 11, 12; this thesis pl. 2, fig. 12

Alveolophragmium subglobosum (G. O. Sars) = *Alveolophragmium subglobosum* (G. O. Sars), Barker, 1960, p. 70, pl. 34, fig. 7, 8, 10, 14; this thesis pl. 2, fig. 5

Ammobaculites agglutinans (d'Orbigny) = *Haplophragmium agglutinans* (d'Orbigny), Brady, 1884, p. 301, pl. 32, figs, 19, 20, 24-26; *Ammobaculites agglutinans* (d'Orbingy), Barker, 1960, p. 66, pl. 32, figs. 19-21, 24-26; Hess, 1998, p. 55, fig. 4; this thesis pl. 1 fig. 14

Ammodiscus incertus (d'Orbigny) = *Ammodiscus incertus* (d'Orbigny), Barker, 1960, p. 78, pl. 38, fig. 1a, b; Ingle et al., 1980, p.131, pl. 9, fig. 9; this thesis pl. 2, fig. 10

Ammolagena clavata (Parker & Jones) = *Ammolagena clavata* (Parker & Jones), Barker, 1960, p. 84, pl. 41, figs. 12-16; this thesis pl. 2, figs. 1, 2

Cystammina pauciloculata (Brady) = *Trochammina pauciloculata* Brady, Brady, 1884, p. 344, pl. 41, figs. 1, 2; *Cystammina pauciloculata* (Brady), Barker, 1960, p. 84, pl. 41, fig. 1, 2; this thesis pl. 2, figs. 3

Dorothia scabra (Brady) = *Dorothia scabra* (Brady), Barker, 1960, p. 90, pl. 44, figs. 12, 13; Boltovskoy, 1978, p. 158, pl. 3, fig. 32; this thesis pl. 3, fig. 10

Eggerella bradyi (Cushman) = *Verneuilina pygmaea* (Egger), Brady, 1884, p. 385, pl. 47, figs. 4-7; *Eggerella bradyi* (Cushman), Wells et al., 1994, p. 192, pl. 1, figs. 11, 16; this thesis pl. 3, fig. 3

Eggerella propinqua (Brady) = *Verneuilina propinqua* Brady, Ellis and Messina, 1940, p. 23841, figs. 8-14; *Eggerella propinqua* (Brady), Barker, 1960, p. 96, pl. 47, figs. 8-12; this thesis pl. 3, fig. 2

Eggerella scabra (Williamson) = *Eggerella scabra* (Williamson), Barker, 1960, p. 96, pl. 47, figs. 15-17; this thesis pl. 3, fig. 4

Glomospira charoides (Jones & Parker) = *Glomospira charoides* (Jones & Parker), Barker, 1960, p. 78, pl. 38, figs. 10-16; this thesis pl. 2, fig. 7

Glomospira gordialis (Jones & Parker) = *Glomospira gordialis* (Jones & Parker), Barker, 1960, p. 78, pl. 38; Hess, 1998, p. 61, pl. 6, fig. 1; this thesis pl. 2, fig. 8

Hyperammina friablis Brady = *Hyperamina friabilis* Brady, Barker, 1960, p. 46, pl. 23, figs. 1-3, 5, 6; this thesis pl. 1, fig. 3

Karreriella bradyi (Cushman) = *Guadryna pupoides* d'Orbigny, Brady, 1884, p. 378, pl. 46, figs. 1-4; *Karreriella bradyi* (Cushman), Van Marle, 1988, p. 147, pl. 5, figs. 23, 24; this thesis pl. 3, fig. 7

Karreriella novanglie (Cushman) = *Karreriella novanglie* (Cushamn), Barker, 1960, p. 94, pl. 46, figs. 8-10; Hess, 1998, p. 63, pl. 8, fig. 7; this thesis pl. 3, fig. 8

Karrerulina apicularis (Cushman) = *Guadryna siphonella* Reuss, Brady, 1884, p. 382, pl. 46, figs. 17-19; *Karrerulina apicularis* (Cushman), Barker, 1960, p. 94, pl. 46, figs. 17-19; Sven, 1992, p.25, pl. 3, fig. 4; Hess, 1998, p. 64, pl. 8, fig. 1; this thesis pl. 3, fig 6

Involutina intermedia (Höglund) = *Involutina intermedia* (Höglund)?, Barker, 1960, p.78, pl. 38, fig. 4; this thesis pl. 3, fig. 1

Martinottiella communis (d'Orbigny) = *Clavulina communis* d'Orbigny, Brady, 1884, p. 394, pl. 48, figs. 1-13; *Martinottiella communis* (d'Orbigny), Barker, 1960, p. 98, pl. 48, figs. 1, 2, 5; this thesis pl. 3, fig. 12

Martinottiella communis (d'Orbigny) var. *perparva* (Cushman) = *Listarella communis* (d'Orbigny) var. *perparva* Cushman, Ellis and Messina, 1940, p. 11182, fig. 5a, b; *Martinottiella communis* (d'Orbigny) var. *perparva* (Cushman) [according to Barker (1960)] this thesis pl. 3, fig. 11

Praemassilina arenaria (Brady) = *Praemassilina arenaria* (Brady), Barker, 1960, p. 16, pl. 8, fig 12a, b: this thesis pl. 4, fig. 2

Psammopshaera parva Flint = *Psammosphaera parva* Flint, Barker, 1960, pl. 36, pl. 18, figs. 2-4; this thesis pl. 2, fig. 6

Pseudoguadryna atlantica (Bailey) = *Pseudoguadryna atlantica* (Bailey), Wells et al., 1994, p. 192, pl. 1, figs. 2, 6; this thesis pl.3 fig. 9

Recurvoides sp. this thesis pl.2, fig. 11

Reophax bacillaris Brady = *Reophax bacillaris* Brady, Barker, 1960, p. 62, pl. 30, figs. 23, 24: this thesis pl. 1, fig. 5

Reophax difflugiformis Brady = *Reophax difflugiformis* Brady, Barker, 1960, p. 62, pl. 30, fig. 1-4; Hess, 1998, p. 67, pl. 2, figs. 7-9; this thesis pl. 1, fig. 6

Reophax distans Brady = *Reophax distans* Brady, Brady, 1884, p. 296, pl. 31, figs. 18-22; Barker, 1960, p. 64, pl. 31, figs. 18-22; this thesis pl. 1, fig. 7

Reophax nodulous Brady = *Reophax nodulosa* Brady, Brady, 1884, p. 294, pl. 31, figs. 1-9; *Reophax nodulosus* Brady, Barker, 1960, p. 64, pl. 31, figs. 1-9; this thesis pl. 1, fig. 8

Reophax pilulifer Brady = *Reophax pilulifer* Brady, Barker, 1960, p. 62, pl. 30, figs. 18-20; this thesis pl. 1, fig. 12

Reophax scorpiurus Monfort = *Reophax scorpiurus* Monfort, Brady, 1844, p. 291, pl. 30, figs. 12-13; Barker, 1960, p. 62, pl. 30, figs, 12, 14-17; Hess, 1998, p. 68, pl. 3, fig. 10; this thesis pl. 1, fig. 10

Reophax sp. this thesis pl. 1, fig. 11

Reophax spiculifer Brady = *Reophax spiculifera* Brady, Brady, 1884, p. 295, pl. 31, figs. 16,17; *Reophax spiculifer* Brady, Barker, 1960, p. 64, pl. 31, figs. 16, 17; Hess, 1998, p. 68, pl. 3, figs. 3; this thesis pl. 1, fig. 9

Rhabdammina abyssorum M. Sars = *Rhabdammina abyssorum* M. Sars, Brady, 1884, p. 266-268, pl. 21, figs. 1-8, 10-13; Barker, 1960, p. 42, pl. 21, figs. 1-13: this thesis pl. 1 fig. 1

Rhizammina algaeformis Brady = *Rizhammina algaeformis* Brady, Brady, 1884, p. 274-277, pl. 28, figs. 1-12; Sven, 1992, p. 36, pl. 1, fig. 1; this thesis pl. 1, fig. 2

Saccammina sphaerica Sars = *Saccammina sphaerica* Sars, Brady, 1884, p. 253-255, pl. 18, figs. 11-15; Barker, 1960, p. 36, pl. 18, figs. 11-15, 17; this thesis pl. 1, fig. 14

Saccorhiza ramosa (Brady) = *Hyperammina ramosa* Brady, Brady, 1884, p. 261, pl. 23, figs. 15-19; *Saccorhiza ramosa* (Brady), Barker, 1960, p. 46, pl. 23, figs. 15-19; this thesis pl. 1, fig. 4

Sigmoilopsis schlumbergeri (Silvesrti) = *Planispira celata* (Costa), Brady, 1884, p. 197, pl. 8, figs. 1-4; *Sigmoilopsis schlumbergeri* (Silvestri), Wells et al., 1994, p. 195, pl. 2, fig. 7; this thesis pl. 6, fig. 3

Siphotextularia catenata (Cushman) = *Textularia catenata* (Cushman), Ellis and Messina, 1940, p. 21646, figs. 39a, b, 40; *Siphotextularia catenata* (Cushman), Corliss, 1979, p.5, pl. 1, fig. 7; this thesis pl. 3, fig. 13

Siphotextularia curta (Cushman) = *Siphotextularia curta* (Cushman), Hermelin, 1989, p.31, pl. 1, fig. 4; this thesis, pl. 3., fig. 14

Textularia agglutinans d'Orbigny = *Textularia agglutinans* d'Orbigny, Brady, 1884, p.363, pl. 43, figs. 1-3; Barker, 1960, p. 88, pl. 43, figs. 1-3; this thesis pl. 3, fig. 15

Textularia lateralis Lalicker = *Textularia lateralis* Lalicker, Wells et al., 1994, p.192, pl. 1, figs. 3, 4, 7, 8; this thesis pl. 4, fig. 1

Textularia lythostrota (Schwager) = *Textularia lythostrota* (Schwager), Hermelin, 1989, p. 30, pl. 1, figs. 2-5; this thesis pl. 3, fig.5

Textularia pseudogramen Chapman & Parr = *Textularia pseudogramen* Chapman & Parr, Parker, 1960, p. 88, pl. 43, figs. 9-10; Van Marle, 1988, p. 139, pl. 1, fig. 14; this thesis pl. 3, fig. 16

Throcammina globigeriniformis (Parker & Jones) = *Haplophragmium globigeriniformis* (Parker & Jones), Brady, 1884, p.312, pl. 35, fig. 10; *Trochammina* ex gr. *globogeriniformis* (Parker & Jones), Hess, 1998, p. 73, pl. 7, figs. 1-3; this thesis pl. 2, fig. 9

Thurammina papillata Brady = *Thurammina papillata* Brady, Barker, 1960, p. 74, pl. 36, figs. 7-18; this thesis pl. 2, fig. 4

Calcareous species listed in alphabetical order

Allomorphina pacifica Cushman & Todd = *Allomorphina pacifica* Cushamn & Todd, Hermelin, p. 76, pl. 14, figs. 1, 2; this thesis pl. 12, figs. 1, 2

Amphicoryna scalaris (Batsch) = *Amphicoryna scalaris* (Batch), Barker, 1960, p. 134, pl. 63, figs. 28-31; Van Marle, 1988, p. 145, pl. 4, fig. 22; this thesis pl. 8, fig. 7

Anomalina globulosa (Chapman & Parr) = *Anomalina globulosa* (Chapman & Parr), Barker, 1960, p. 117, pl. 94, figs. 4, 5; this thesis pl. 14, figs. 10, 11

Astrononion echolsi Kennet = *Astrononion echolsi* Kennet, Anderson, 1975, p.94, pl. 11, fig.4; Corliss, 1979, p.8, pl. 3, figs. 16-17; Mead, 1985, p.235, pl. 4, figs. 3, 4; this thesis pl. 10, fig. 1

Bolivina albatrossi Cushman = *Bolivina albatrossi* Cushman, Pflum and Frerichs, 1976, p. 110, pl. 1, figs. 5, 6; Sven, 1992, p. 40, pl. 5, fig. 2; this thesis pl. 6, fig. 5

Bolivina robusta Brady = *Bolivina robusta* Brady, Cushman, 1942, p.17, pl. 2 fig. 2; Van Marle, 1988, p. 139, pl. 1, fig. 26; Hess, 1998, p. 76, pl. 10, fig. 3; this thesis pl. 6, fig. 6

Bolivina seminuda Cushman = *Bolivina pseudopunctata* Höglund, Phleger et al., 1953, p. 36, pl. 7, figs. 20, 21; *Bolivina seminuda* Cushman, Cushman, 1942, p. 26, pl. 7 fig. 6; Hermelin, 1989, p. 60, pl. 10, figs. 17, 18; this thesis pl. 6, fig. 8

Bolivinita quadrilatera (Schwager) = *Textularia quadrilatera* (Schwager), Brady, 1884, p.358, pl. 42, figs. 8-12; *Bolivinita quadrilatera* (Schwager), Cushman, 1942, p. 2, pl. 1, figs. 1-4; Barker, 1960, p. 86, pl. 42, figs. 8-12; this thesis pl. 6, figs. 9, 10

Brizalina semilineata Belford = *Brizalina semilineata* Belford, Van Marle, 1988, p. 147, pl. 5, figs. 7, 8; this thesis pl. 6, fig. 7

Bulimina aculeata d'Orbigny = *Bulimina aculeata* d'Orbigny, Brady, 1884, p. 406, pl. 51, figs. 7-9; Van Marle, 1988, p. 147, pl. 5, fig. 17; Sven, 1992, p. 45, pl. 5, fig. 9a, b; den Dulk, 2000, p. 167, pl. 2, figs. 2, 3; this thesis pl. 6, fig. 11

Bulimina alazanensis Cushman = *Bulimina alazanensis* Cushman, den Dulk, p. 167, pl. 2, fig. 5; Hess, 1998, p. 76, pl. 10, fig. 10; this thesis pl. 6, fig. 13

Bulimina costata d'Orbigny = *Bulimina costata* d'Orbigny, Barker, 1960, p. 104, pl. 51, figs. 11, 13; this thesis pl. 6, fig. 12

Bulimina marginata d'Orbigny = *Bulimina marginata* d'Orbigny, Brady, 1884, p. 405, pl. 51, figs. 3-5; Murray, 1971, p.119, pl. 19; this thesis pl.6, fig.14

Cassidulina crassa d'Orbigny = *Cassidulina crassa* d'Orbigny, Brady, 1884, p. 429, pl. 54, figs 4, 5; Boltovsky, 1978, p. 154, pl. 2, fig. 19; Van Marle, 1991, p. 9, figs. 13-15; this thesis pl. 10, figs. 7, 10

Cassidulina laevigata d'Orbigny = *Cassidulina laevigata* d'Orbigny var. *carinata* Silvestri, Barker, 1960, p. 110, pl. 54, figs. 2, 3; *Cassidulina laevigata* d'Orbigny, Hess, 1998, p. 77, pl. 13, fig. 8; this thesis pl. 10, figs. 8, 9

Cassidulina reflexa Galloway & Wissler = *Cassidluina reflexa* Galloway & Wissler, Phleger et al., 1953, p. 45-46, pl. 10, figs. 6, 7; this thesis pl. 11, figs. 9, 10

Ceratobulimina pacifica Cushman & Harris = *Bulimina contraria* Brady (not Reuss), Brady, 1884, p. 409, pl. 54, fig. 18a, b; *Ceratobulimina pacifica* Cushman & Harris, Cushman and Harris, 1937, p. 176, pl. 29, fig. 9a-c; Van Marle, 1988, p. 143, pl. 3, figs. 21-23; this thesis pl. 11, figs. 5, 6

Chilostomella oolina Schwager = *Chilostomella oolina* Schwager, Barker, 1960, p. 114, pl. 55, figs. 12-14, 17, 18; Ingle et al., 1980, p. 132, pl. 6, figs. 9, 10; Van Marle, 1991, p. 128, pl. 10, figs. 12, 13; this thesis pl. 11, fig. 4

Cibicidoides bradyi (Trauth) = *Cibicides bradyi* (Trauth), Barker, 1960, p.196, pl. 95, fig. 5a-c; Pflum and Frerichs, 1976, p.114, pl. 3, figs. 6, 7; den Dulk, 2000, p. 168, pl. 6, fig. 2a, b; *Cibicidoides bradyi* (Trauth), Corliss, 1979, p. 9, pl.3, figs. 1-3; Hermelin, 1989, p. 85, pl. 17, figs. 2-4; this thesis pl. 14, figs. 4, 5

Cibicidoides kullenbergi Parker = *Cibicides kullenbergi* Parker, Phleger et al., 1953, p. 49, pl. 11, figs. 7, 8; Pflum and Frerichs, 1976, p. 112, pl. 2, figs. 6-8; *Cibcidoides kullenbergi* (Parker), Corliss, 1979, p. 10, pl. 3, figs. 4-6; this thesis pl. 14, fig. 3

C. kullenbergi is characterised by a biconvex test. The centre of the umbilical side is flat or slightly depressed. The periphery is marked by the thickening of chambers wall.

Cibicidoides pseudoungerianus (Cushman) = *Truncatulina ungeriana* d'Orbigny, Brady, 1884, p. 664, pl. 94, fig. 9; *Cibicides pseudoungerianus* (Cushman), Barker, 1960, p. 194, pl. 94, fig. 9; *Cibicidoides* cf. *pseudoungerianus* (Cushman), Pflum and Frerichs, p. 112, pl. 2, fig. 9, p. 114, pl. 3, figs. 1, 2; *Cibicdoides pseudoungerianus* (Cushman), Hess, 1998, p. 78, pl. 16, figs. 1, 2; this thesis pl. 14, figs. 1, 2

C. pseudoungerianus is characterised by a biconvex test, with chambers slightly depressed towards the margin; the umbilical side is characterised by the presence of a convex umbonal plug in the central area and the periphery is strongly keeled.

Cibicidoides robertsonianus (Brady) = *Truncatulina robertsoniana* Brady, 1884, p. 664, pl. 95, fig. 4; *Cibicides robertsonianus* (Brady), Pflum and Frerichs, 1976, p. 114, pl. 3, figs. 3-5; *Cibicidoides robertsonianus* (Brady), van Morkhoven et al., 1986, p. 41, pl. 11, fig. 1a-c; this thesis pl. 14, figs. 6, 9

Cibicidoides wuellerstorfi (Schawager) = *Planulina wuellerstorfi* (Schwager), Phleger et al., 1953, p. 49, pl. 11, figs. 1, 2; *Cibicides wuellerstorfi* (Schwager), Boltovskoy, 1978, pl. 3, fig. 19-21, *Cibicidoides wuellerstorfi* (Schwager), Hess, 1998, p. 78, pl. 16, figs. 5-7; this thesis pl. 14, figs. 7, 8

Cornuspira involvens (Reuss) = *Cornuspira involvens* (Reuss), Barker, 1960, p. 22, pl. 11, figs. 1-3; this thesis pl. 5, fig. 13

Cymbaloporretta squammosa (d'Orbigny) = *Cymbaloporretta squammosa* (d'Orbigny), Barker, 1960, p. 210, pl. 102, fig. 13; this thesis pl. 12, figs. 9, 12

Dentalina communis (d'Orbigny) = *Nodosaria (Dentalina) communis* d'Orbigny, Brady, 1884, p. 504, pl. 62, figs. 19-22; *Dentalina communis* (d'Orbigny), Barker,1960, p. 130, pl. 62, figs. 21, 22; Boltovskoy, 1978, p. 157,pl. 3, fig. 3; Hess, 1998, p. 79, pl. 11, fig. 13; this thesis, pl. 7, fig. 12

Dentalina guttifera d'Orbigny = *Dentalina guttifera* d'Orbigny, Barker, 1960, p. 130,pl. 62, figs. 10-12; this thesis pl. 8, fig. 1

Dentalina intorta (Dervieux) = *Dentalina intorta* (Dervieux), Barker,1960, p. 131, pl. 62, figs. 27-31; Hess, 1998, p. 79, pl. 11, figs. 12, 14; this thesis pl. 8, fig. 2

Dentalina subsoluta (Cushman) = *Nodosaria (Dentalina) subsoluta* Reuss, Brady, 1884, p.503, pl. 62, figs. 13-16; *Dentalina subsoluta* (Cushman), Barker, 1960, p.130, pl. 62, figs. 13-16; this thesis pl. 8, fig. 5

Discopulvinulina subbertheloti (Cushman) = *Discorbina bertheloti* (d'Orbigny), Brady, 1884, p. 650, pl. 89, fig. 10a, b; *Discorbis subbertheloti* (Cushman), Barker, p. 184, pl. 89, fig. 10a-c; this thesis pl. 12, figs., 4, 5

Ehrenbergina trigona Goës = *Ehrenbergina serrata* (Reuss), Brady, 1884, p. 434, pl. 55, figs. 2, 3; *Ehrenbergina trigona* Goës, Phleger et al. 1953, p. 46, pl. 10, figs. 12, 13; this thesis pl. 8, figs. 3, 4

Epistominella exigua (Brady) = *Pulvinulina exigua* Brady, Brady 1884, p. 696, pl. 103, figs. 13, 14; *Epistominella exigua* (Brady), Phleger et al., 1953, p. 43., pl. 9, figs. 35, 36; den Dulk, 2000, p. 169, pl. 7, fig. 4a-b; this thesis pl. 11, figs. 11-14

Epistominella umbonifera (Cushman) = *Truncatulina pygmaea* Hantker, Brady, p. 666, pl. 95, figs. 9, 10; *Epistominella* (?) *umbonifera* (Cushman), Phleger et al., 1953, p. 43, pl. 9, figs. 33, 34; *Epistominella umbonifera* (Cushman), Corliss, 1979, p. 7, pl. 2, figs. 10-12; this thesis pl. 11, figs. 7, 8

Fissurina cf. *marginata* (Montagu) = *Fissurina marginata* (Montagu), Hermelin, 1989, p. 48, pl. 7, figs. 1, 2; this thesis pl. 8, fig. 15

Fissurina orbignyana Seguenza = *Lagena orbignyana* (Seguenza), Cushman, 1933, pl. 6, figs. 7, 8, 11; *Fissurina orbignyana* (Seguenza), Barker, 1960, p. 124, pl. 59, figs. 18, 20; this thesis pl. 9, fig. 1

Fissurina seminiformis (Schwager) = *Fissurina seminiformis* (Schwager), Barker, 1960, p. 124, pl. 9, figs. 28-30; this thesis pl. 9, fig. 2

Fissurina submarginata (Boomgart) = *Fissurina submarginata* (Boomgart), Barker, 1960, p. 124, pl. 59, figs. 21, 22; this thesis pl. 9, fig. 3

Fursenkoina bradyi (Cushman) = *Virgulina bradyi* Cushman, Phleger et al. 1953, p. 115, pl. 24, fig. 1; this thesis pl. 7, fig. 9

Fursenkoina earlandi (Parr) = *Fursenkoina earlandi* (Parr), Violanti, 2000, p. 485, pl. 3, fig. 5; this thesis pl. 7, fig. 10

Fursenkoina fusiformis (Parr) = *Fursenkoina fusiformis* (Parr), Violanti, 2000, p. 485, pl. 3, fig. 7; this thesis, pl. 7, fig. 11

Gavelinopsis lobatulus (Parr) = *Discorbina isabelleana* Brady (not d'Orbigny), Brady, 1884, p. 646, pl. 88, fig. 1; *Gavelinopsis lobatulus* (Parr), Barker, 1960, p. 182, pl. 88, fig. 1; Van Marle, 1991, p. 151, pl. 14, figs, 10-12; this thesis pl. 12, figs. 7, 8

Globobulimina affinis (d'Orbigny) = *Globobulimina affinis* (d'Orbigny), Hess, 1998, p. 81, pl. 10, fig. 13; this thesis pl. 6, fig. 15

Globobulimina pacifica Cushman = *Globobulimina pacifica* Cushman, Ingle et al., 1980, p. 136, pl. 2, figs. 7, 8; Van Marle, 1991, p. 90, pl. 5, figs. 11, 12; this thesis pl. 6 fig. 16

Globocassidulina elegans (Sidebottom) = *Globocassidulina elegans* (Sidebottom), Hess, 1998, p. 81, pl. 13, fig. 13; this thesis pl. 11, figs. 1, 2

Globocassidulina subglobosa (Brady) = *Cassidulina subglobosa* Brady, Brady, 1884, p. 430, pl. 54, fig. 17; *Globocassidulina subglobosa* (Brady), Van Marle, 1988, p. 143, pl. 5, fig. 22; Van Marle, 1991, p. 120, pl. 10, figs. 10, 11; Hess, 1998, p. 81, pl. 13, fig. 14; this thesis pl. 11, fig. 3

Globulina minta (Roemer) = *Globulina minuta* (Romer), Barker, 1960, p. 148, pl. 71, figs. 15, 16; this thesis pl. 9, fig. 7

Gyroidinodes polius (Phleger & Parker) = *Eponides polius* Phleger & Parker, Phleger et al, 1953, p. 21, pl. 11, figs. 1, 2; *Gyroidina polia* (Phleger & Parker), den Dulk, 2000, p. 170, pl. 8, fig. 3a-c; *Gyroidinoides polius* (Phleger & Parker), Mead, 1985, p.238, pl. 5, figs.4-7; this thesis pl. 13, fig 3, 6

Gyroidinoides altiformis (Stewart & Stewart) = *Gyroidina soldanii* d'Orbigny var. *altiformis* Stewart & Stewart, Stewart and Stewart, 1930, p. 67, pl. 9, fig. 2; *Gyroidinoides soldanii* (d'Orbigny), Jones, 1994, p. 106, pl. 107, fig. 6a-c; this thesis pl. 13, figs. 4, 5

G. altiformis is considered a *Gyroidinoides* according to the criterion already followed by Corliss (1979), since *Gyroidinoides* has "*...an extensive interio-marginal aperture, which extends from the umbilicus to the peripehry, with umbilical flaps that do not attach below...*", while *Gyroidina*, according to d'Orbigny, has a small aperture close to the periphery.

Gyroidinoides lamarckianus (d'Orbingy) = *Gyroidina lamarckiana* (d'Orbigny), Phleger et al. 1953, p. 41, pl. 8, figs. 33, 34; Hess, 1998, p. 82, pl. 15, figs. 7-9; this thesis pl. 13, fig. 9

G. lamarckianus, similarly to *G. altiformis* is considered a *Gyroidinoides* (see above).

Hanzawaia nipponica Asano = *Hanzawiaia nipponica* Asano, Van Marle, 1988, p. 145, pl. 1, figs. 19-20; Van Marle , 1991, p. 137, pl. 12, figs. 3-7; this thesis pl. 12, figs. 3, 6

Hauerinella inconstans (Brady) = *Hauerinella inconstans* (Brady), Barker, 1960, p. 24, pl. 12, figs. 5, 7, 8; this thesis pl. 6, fig. 2

Hyalinea balthica (Shröter) = *Hyalinea balthica* (Shröter), den Dulk, 2000, p. 170, pl. 4, fig. 9a, b; this thesis pl. 13, fig. 7

Lagena gracillima (Seguenza) = *Lagena gracillima* (Seguenza), Barker, 1960, p. 116, pl.

56, figs. 19-26; this thesis pl. 8, fig. 8

Lagena laevis (Montagu) = *Lagena laevis* (Montagu), Cushman, 1933, pl. 4, fig. 5a, b; Barker, 1960, p. 118, pl. 57, figs. 14, 15, 16, 17, ?18; this thesis pl. 8, fig. 12

Lagena stelligera Brady = *Lagena stelligera* Brady, Barker, 1960, p. 119, pl. 57, figs. 35, 36; this thesis pl. 8, fig. 13

Lagena striata (d'Orbigny) = *Lagena striata* (d'Orbigny), Cushman, 1930, p. 32, pl. 8, fig. 8a, b; Barker, 1960, p. 118, pl. 57, figs. 22, 24; this thesis pl. 8, fig. 14

Laticarinina pauperata (Parker & Jones) = *Pulvinulina pauperata* Parker & Jones, Brady, 1884, p. 696, pl. 104, figs. 3-11; *Laticarinina halophora* (Stache), Barker, p. 214, pl. 104, figs. 3, 11; *Laticarinina puperata* (Parker & Jones), Boltovskoy, 1978, p. 162, pl. 4, fig. 32; Van Marle, 1991, p. 153, pl. 15, figs. 13-15; this thesis pl. 14, fig. 12

Lenticulina calcar (Linnaeus) = *Cristellaria calcar* (Linnaeus), Brady, 1884, p. 550, pl. 70, figs. 9-12; *Lenticulina calcar* (Linnaeus), Jones, 1994, p. 81, pl. 70, figs. 9-12; this thesis pl. 9, fig. 11

Lenticulina gibba (d'Orbingy) = *Cristellaria gibba* d'Orbigny, Brady, 1884, p. 546, pl. 69, figs. 8, 9; *Lenticulina gibba* (d'Orbigny), Van Marle, 1988, p. 145, pl. 1, fig. 21; Hess, 1998, p. 85, pl. 13, fig. 1; this thesis pl. 9, fig. 9

Lenticulina iota (Cushman) = *Cristellaria cultrata* Brady (not De Monfort), Brady, 1884, p. 550, pl. 70, figs. 4-6; *Lenticulina iota* (Cushman), Barker, 1960, pl. 70, figs. 4-6; this thesis pl. 9, fig. 10

Lenticulina paeregrina (Schwager) = *Cristellaria variablis* Reuss, Brady, 1884, p. 541, pl. 68, figs. 11-16; *Lenticulina paeregrina* (Schwager), Barker, 1960, p. 144, pl. 68, figs. 11-16; this thesis pl. 9, fig. 8

Lenticulina rotulata (Lamarck) = *Cristellaria rotulata* (Lamarck), Brady, 1884, p. 547, pl. 69, fig. 13; *Lenticulina thalmanni* Hessland, Barker, 1960, p. 144, pl. 69, fig. 13; this thesis pl. 9, fig 12

Melonis barleeanum (Williamson) = *Gavelinonion barleeanum* (Williamson), Barker, 1960, p. 224, pl. 109, figs. 8, 9; *Melonis barleeanum* (Williamson), Corliss, 1979, p. 10, pl. 5, figs. 7, 8; Wells et al., 1994, p. 197, pl. 3, figs. 11, 12; Hess, 1998, p. 84, pl. 13, fig. 5; this thesis pl. 10, figs. 3, 4

Melonis pompilioides (Fitcher & Moll) = *Nonionina pompilioides* (Fitcher & Moll), Brady, 1884, p. 727, pl. 109, figs. 10, 11; *Melonis pompilioides* (Fitcher & Moll), Ingle et al., 1980, p. 142, pl. 9, figs. 14, 15; Van Marle, 1991, p. 187, pl. 20, figs. 4-6; this thesis pl. 10, figs. 5, 6

Miliolinella oblonga (Montagu) = *Miliolinella* (?) *oblonga* (Montagu), Barker, 1960, p. 10, pl. 5, fig. 4a, b; this thesis pl. 5, figs, 7, 8

Nodosaria radicula (Linnaeus) = *Nodosaria radicula* (Linnaeus), Barker, 1960, p. 128, pl. 61, figs. 28-31; this thesis pl. 8, fig. 6

Nonionella turgida (Williamson) = *Noninella turgida* (Williamson), Violanti, 2000, p. 487, pl. 5; this thesis pl. 10, fig. 2

Nummoloculina contraria (d'Orbigny) = *Nummolculina contraria* (d'Orbigny), Barker, 1960, p. 4, pl. 2, figs. 1-3; this thesis pl. 4, fig. 3

Nummoloculina irregularis (d'Orbigny) = *Biloculina irregularis* d'Orbigny, Brady, 1884, p. 140, pl. 1, figs. 17, 18; *Nummolculina irregularis* (d'Orbigny), Barker, 1960, p. 2, pl. 1, figs. 17, 18; Van Marle, 1991, p. 68, pl. 4, fig.3; Sven, 1992, p. 77, pl. 4, fig. 14; this thesis pl. 4, figs. 4, 5

Oolina globosa (Montagu) = *Oolina globosa* (Montagu), Barker, 1960, p. 114, pl. 56, figs. 1-3; this thesis pl. 9, fig. 4

Oridorsalis tener umbonatus (Reuss) = *Pulvinulina umbonata* (Reuss), Brady, 1884, p. 695, pl. 105, fig. 2; *Oridorsalis tener* (Brady) var. *umbonatus* (Reuss), Boltovskoy, 1978, p. 162, pl. 5, figs. 5, 6; *Oridorsalis umbonatus* (Reuss), Van Marle, 1988, p. 148, pl. 3, figs. 10, 15; *Oridorsalis tener umbonatus* (Reuss), Pflum and Frerichs, 1976, p.120, pl. 6, figs. 5-7; this thesis pl. 12, figs. 10, 11

Osangularia cultur (Parker & Jones) = *Truncatulina culter* (Parker & Jones), Brady, 1884, p. 668, pl. 96, fig. 3; *Osangularia culter* (Parker & Jones), Van Marle, 1988, p. 148, pl. 2, figs. 18-20; *Osangularia cultur* (Parker & Jones), Wells et al., 1994, p. 199, pl. 4, fig. 3; this thesis pl. 11, figs. 12, 13

Planulina ariminensis d'Orbigny = *Planulina ariminensis* d'Orbigny, Barker, 1960, p. 192, pl. 93, figs. 10, 11; van Morkhoven et al., 1986, p. 38, pl. 10, figs. 1-4; this thesis pl. 13, fig. 8

Parafissurina lateralis (Cushman) = *Parafissurina lateralis* (Cushman), Barker, 1960, p. 116, pl. 56, figs, 17, 18; Jones, 1984, p. 128, pl. 6, figs. 11, 12; Van Marle, 1991, p. 24, pl. 2, fig. 18; this thesis pl. 9, fig. 13

Parafissurina sp. this thesis pl. 9, fig. 14

Pullenia bulloides (d'Orbingy) = *Pullenia sphaeroides* (d'Orbigny), Brady, 1884, p. 615, pl. 84, figs, 12, 13; *Pullenia bulloides* (d'Orbigny), Hess, 1998, p. 87, pl. 13, figs. 9, 10; this thesis pl. 10, figs. 11, 12

Pullenia quinqueloba (Reuss) = *Pullenia quinqueloba* (Reuss), Brady, 1884, p. 617, pl. 84, figs. 14, 15; Van Marle, 1988, p. 148, pl. 3, fig. 5; Hess, 1998, p. 87, pl. 13, figs. 11, 12; this thesis pl. 10, fig. 13

Pyrgo comata (Brady) = *Pyrgo comata* (Brady), Barker, 1960, p. 6, pl. 3, fig. 9a, b; this thesis pl. 4, fig. 6

Pyrgo depressa (d'Orbigny) = *Biloculina depressa* d'Orbigny, Brady, 1884, p. 145, pl. 2, fig. 12, 16; *Pyrgo depressa* (d'Orbigny), Wells et al., 1994, p. 195, pl. 2, figs. 3, 6; this thesis pl. 4, figs. 7, 8

Pyrgo elongata (d'Orbigny) = *Biliculina elongata* d'Orbigny, Brady, 1884, p. 144, pl. 2, fig. 9; *Pyrgo elongata* (d'Orbigny), Barker, 1960, p. 4, pl. 2, fig. 9a, b; this thesis pl. 4, fig. 10

Pyrgo laevis Defrance = *Pyrgo laevis* Defrance, Barker, 1960, p. 4, pl. 2, figs. 13, 14; this thesis pl. 4, fig. 12

Pyrgo murrhina (Schwager) = *Pyrgo murrhina* (Schwager), van Morkhoven et al., 1986, p. 50, pl. 15, figs. 1, 2; Hess, 1998, p. 88, pl. 9, fig. 1; this thesis pl. 5, figs. 1, 2

Pyrgo serrata (L.W. Bailey) = *Pyrgo serrata* (L.W. Bailey), Barker, 1960, p. 6, pl. 3, fig. 3a-c; this thesis pl. 4, fig. 9

Pyrulina extensa (Cushman) = *Pyrulina extensa* (Cushman), Cushman, 1933, p. 39, pl. 9, fig. 12; this thesis pl. 9, fig. 6

Pyrulina fusiformis (Roemer) = *Pyrulina fusiformis* (Roemer), Barker, 1960, p. 148, pl. 71, figs. 17-19; this thesis pl. 9, fig. 5

Quinqueloculina lamarckiana d'Orbigny = *Miliolina cuvieriana* d'Orbigny, Brady, 1884, p. 162, pl. 5, fig. 12; *Quinqueloculina lamarckiana* d'Orbigny, Jones, 1994, p. 21, pl. 5, fig. 12; this thesis pl. 5, figs. 11, 12

Quinqueloculina seminulum (Linnaeus) = *Miliolina seminulum* (Linnaeus), Brady, 1884, p. 157, pl. 5, fig. 6; *Quinqueloculina seminulum* (Linnaeus), Van Marle, 1991, p. 65, pl. 3, figs. 11-13; this thesis pl. 5, fig. 10

Quinqueloculina venusta Karrer = *Miliolina venusta* (Karrer), Brady, 1884, p. 162, pl. 5 fig. 5; *Quinqueloculina venusta* Karrer, Boltovskoy, 1978, p. 167, pl. 6, figs. 32-33; this thesis pl. 5, fig. 9

Quinqueloculina sp. this thesis pl. 5, fig. 6

Rectobolivina columellaris (Brady) = *Sagrina columellaris* Brady, Brady, 1884, p. 581, pl. 75, figs. 15-17; *Rectobolivina columellaris* (Brady), Van Marle, 1991, p. 94, pl. 6, figs. 12, 13; this thesis pl. 8, fig. 9

Rectobolivina dimorpha (Parker & Jones) = *Sagrina dimorpha* Parker & Jones, Brady, 1884, p. 582, pl. 76, figs. 1-3; *Rectobolivina dimorpha* (Parker & Jones), Van Marle, 1988, p. 148, fig. 2; this thesis pl. 8, fig. 10

Rectoglandulina comatula (Cushman) = *Rectoglandulina comatula* (Cushman), Barker, 1960, p. 134, pl. 64, figs. 1-5; this thesis pl. 8., fig. 11

Sphaeroidina bulloides d'Orbigny = *Sphaeroidina bulloides* d'Orbigny, Hess, 1998, p. 90, pl. 9, fig. 14; this thesis 6, fig. 4

Spiroloculina communis Cushman & Todd = *Spiroloculina communis* Cushman & Todd, Barker, 1960, p. 20, pl. 10, figs. 3, 4; this thesis pl. 4, fig. 1

Triloculina subvalvularis Parr = *Triloculina subvalvularis* Parr, Barker, 1960, p. 8, pl. 4, figs. 4, 5; this thesis pl. 5, fig. 3

Trioculina tricarinata d'Orbigny = *Triloculina tricarinata* d'Orbigny, Van Marle, 1988, p. 149,pl. 4, fig. 24; Hermelin, 1989, p. 38, pl. 3, figs. 6, 7; this thesis pl. 5, figs. 4, 5

Uvigerina peregrina Cushman = *Uvigerina pygmaea* Brady (not d'Orbigny), Brady, 1884, p. 575, pl. 74, figs. 11, 12; *Uvigerina peregrina* Cushman, Boltovskoy, 1978, p. 171, pl. 8, fig. 4; Ingle et al., 1980, p. 146, pl. 3, fig. 6; Wells et al., 1994, p. 199, pl. 4, figs. 12, 13; this thesis pl. 7, figs. 1-4

Uvigerina porrecta Brady = *Uvigerina porrecta* Brady, Brady, 1884, p. 274, pl. 8, figs. 15-16; Boltovskoy, 1978, p. 171, pl. 8, fig. 20; this thesis pl. 7, fig. 8

Uvigerina proboscidea Schwager = *Uvigerina proboscidea* Schwager, Boltovskoy, p. 171, pl. 8, figs. 22, 23; Van Marle, 1991, p. 106, pl. 8, figs. 12-14; Wells et al., 1994, p. 199, pl. 4, figs. 9, 10, 14; this thesis pl. 7, figs. 5-7

Valvulineria sp. this thesis pl. 13, figs. 1, 2

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PLATE I

1. *Rhabdammina abyssorum* M. Sars; sample Fr.2-3; 0-1 cm; scale bar 500 μm

2. *Rhizammina algaeformis* Brady; sample Fr 2-25; 0-1 cm; scale bar; scale bar 1000 μm

3. *Hyperammina friabilis* Brady; sample Fr 1-16; 0-1 cm; scale bar 500 μm

4. *Saccorhiza ramosa* (Brady); sample Fr1-17; 0-1 cm; scale bar 500 μm

5. *Reophax bacillaris* Brady; sample B9412; 0-2 cm; scale bar 100 μm

6. *Reophax difflugiformis* Brady; sample Fr 1-19; 0-1 cm; scale bar 500 μm

7. *Reophax distans* Brady; sample Fr 2-17; 0-1 cm; scale bar 500 μm

8. *Reophax nodulosus* Brady; sample Fr 2-19; 0-1 cm; scale bar 1500 μm

9. *Reophax spiculifer* Brady; sample Fr1-27; 0-1 cm; scale bar 100 μm

10. *Reophax scorpiurus* Monfort; sample Fr1-25; 0-1 cm; scale bar 300 μm

11. *Reophax sp.*; sample Fr1-25; 0-1 cm; scale bar 250 μm

12. *Reophax pilulifer* Brady; sample Fr1-27; 0-1 cm; scale bar; 500 μm

13. *Ammobaculites agglutinans* (d'Orbigny); sample Fr1-19; 0-1 cm; scale bar 250 μm

14. *Sacammina sphaerica* Sars; sample Fr2-16; 0-1 cm; scale bar 200 μm

PLATE I

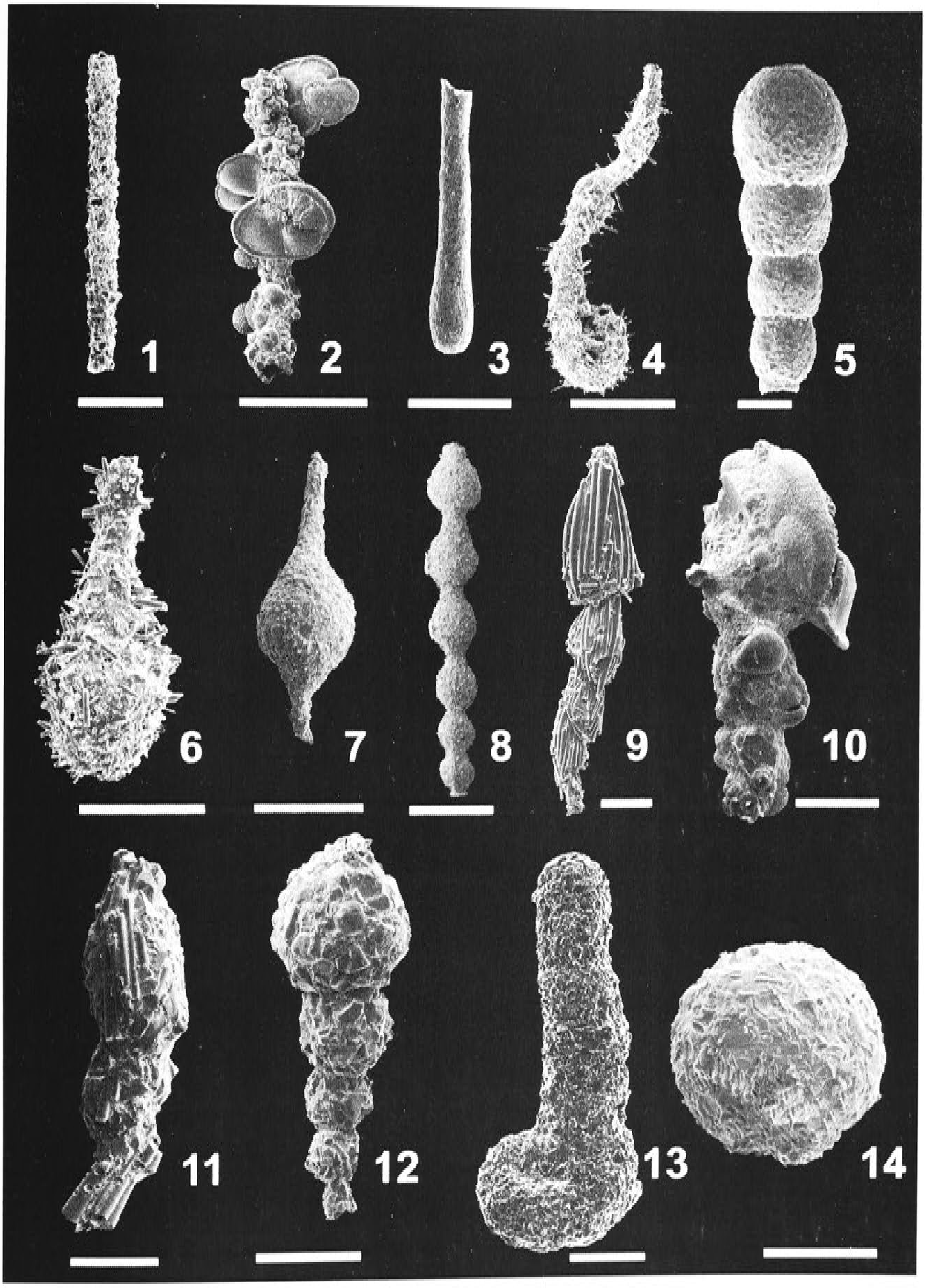


PLATE II

1, 2. *Ammolagena clavata* (Parker & Jones)

1. sample Fr 2-19; 0-1 cm; specimen attached to a *G. menardii* test; scale bar 500 μm
2. sample B9437; 0-2 cm; specimen attached to a *P. murrhina* test; scale bar 500 μm

3. *Cystammina pauciloculata* (Brady); sample Fr1-15; 0-1 cm; scale bar 200 μm

4. *Thurammina papillata* Brady; sample Fr2-1; 0-1 cm; scale bar 500 μm

5. *Alveolophragmium subglobosum* (G. O. Sars); sample Fr2-3; 0-1 cm; scale bar 500 μm

6. *Psammosphaera parva* Flint; sample Fr1-17; 0-1 cm; scale bar 400 μm

7. *Glomospira charoides* (Jones & Parker); sample Fr2-1; 0-1 cm; scale bar 200 μm

8. *Glomospira gordialis* (Jones & Parker); sample Fr1-10; 0-1 cm; scale bar 200 μm

9. *Throcammina globigeriniformis* (Parker & Jones); sample Fr1-17; 0-1 cm; scale bar 700 μm

10. *Ammodiscus incertus* (d'Orbigny); sample Fr2-1; 0-1 cm; scale bar 200 μm

11. *Recurvoides* sp.; sample Fr2-3; 0-1 cm; scale bar 500 μm

12. *Alveolophragmium scitulum* (Brady); sample Fr2-7; 0-1 cm; scale bar 500 μm

PLATE II

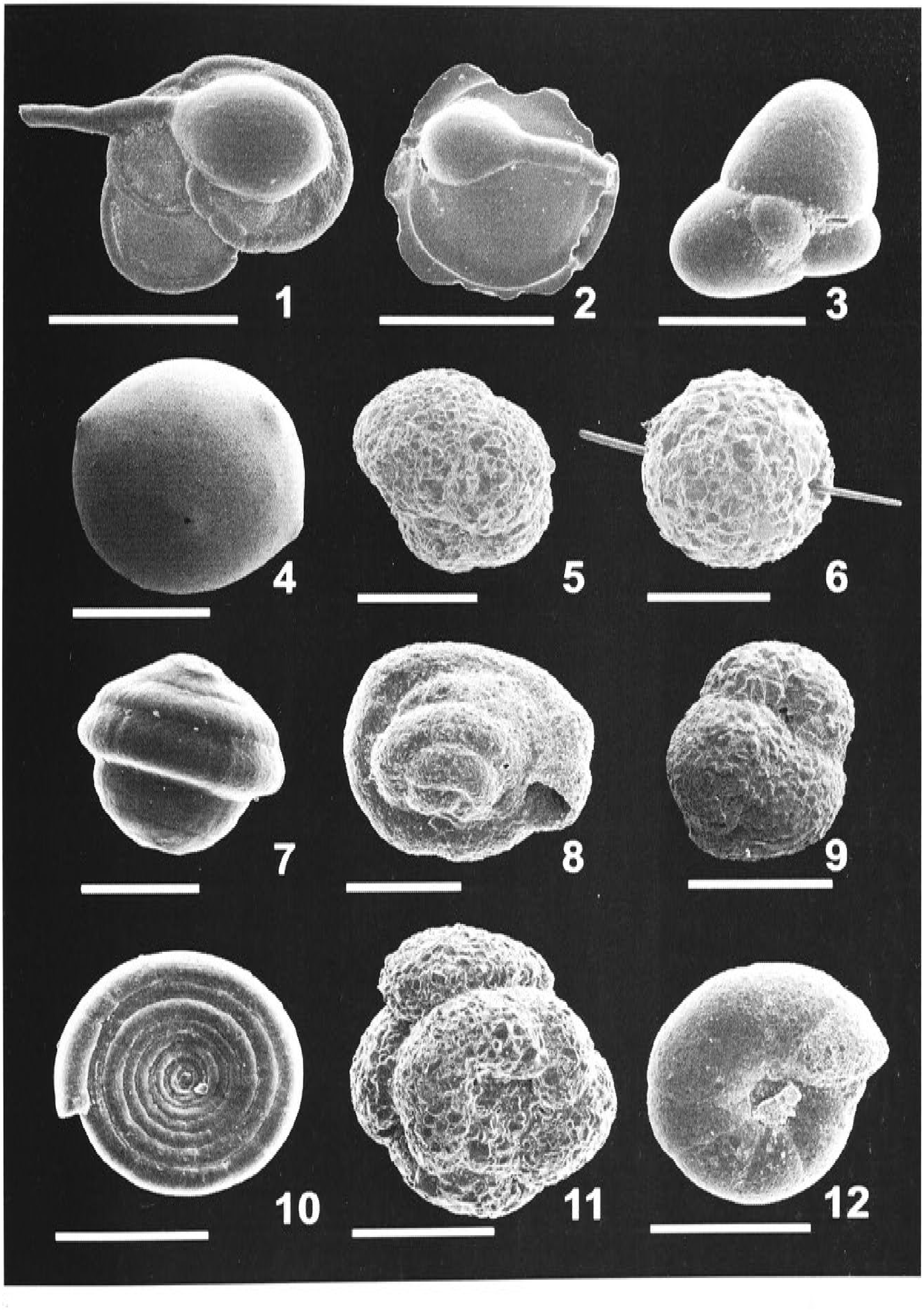


PLATE III

1. *Involutina intermedia* (Höglund); sample S9011; 0-2 cm; scale bar 1000 µm

2. *Eggerella propinqua* (Bardy); sample Fr2-7; 0-1 cm; scale bar 500 µm

3. *Eggerella bradyi* (Cushman); sample Fr1-15; 0-1 cm; scale bar 500 µm

4. *Eggerella scabra* (Williamson); sample Fr1-17; 0-1 cm; scale bar 100 µm

5. *Textularia lythostrota* (Schwager); sample Fr1-14; 0-1 cm; scale bar 400 µm

6. *Karrerulina apicularis* (Cushman); sample Fr2-27; 0-1 cm; scale bar 200 µm

7. *Karreriella bradyi* (Cushman); sample Fr1-15; 0-1 cm; scale bar 200 µm

8. *Karreriella novanglie* (Cushman); sample Fr1-17; 0-1 cm; scale bar 200 µm

9. *Pseudoguadrina atlantica* (Bailey); sample Fr1-15; 0-1 cm; scale bar 500 µm

10. *Dorothia scabra* (Brady); sample Fr1-14; 0-1 cm; scale bar 500 µm

11. *Martinottiella communis* (d'Orbigny) var. *perparva* (Cushman); sample S9024; 0-2 cm; scale bar 300 µm

12. *Martinottiella communis* (d'Orbigny); sample S9040; 0-2 cm; scale bar 300 µm

13. *Siphotextularia catenata* (Cushman); sample Fr2-15; 0-1 cm; scale bar 300 µm

14. *Siphotextularia curta* (Cushman); sample Fr1-15; 0-1 cm; scale bar 400 µm

15. *Textularia agglutinans* d'Orbigny; sample Fr2-16; 0-1 cm; scale bar 250 µm

16. *Textularia pseudogramen* Chapman & Parr; sample Fr2-28; 0-1 cm; scale bar 300 µm

PLATE III

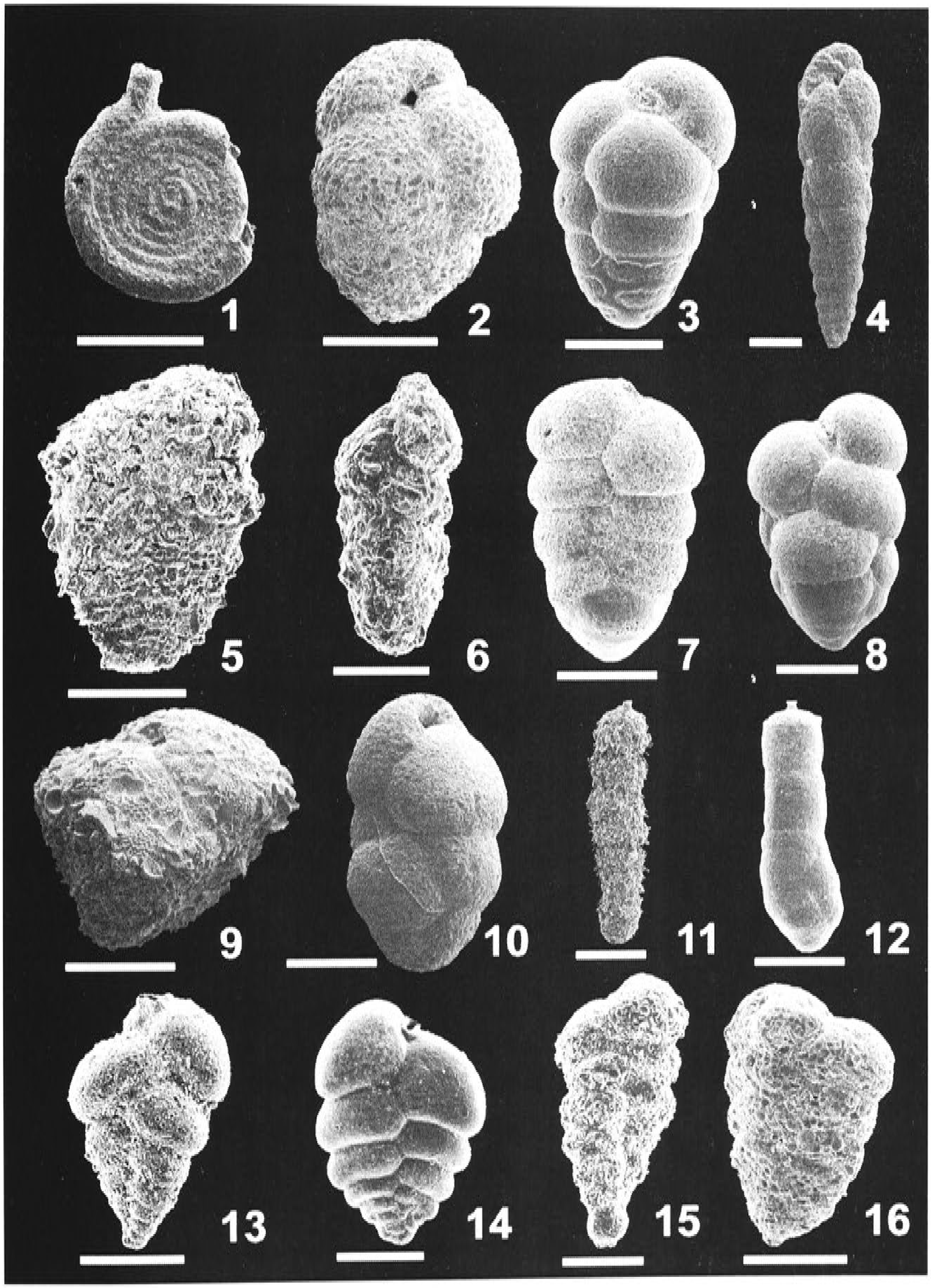


PLATE IV

1. *Textularia lateralis* Lalicker; sample Fr 1-14; 0-1 cm; scale bar 500 μm

2. *Praemassilina arenaria* (Brady); sample Fr 2-4; 0-1 cm; scale bar 1000 μm

3. *Nummoloculina contraria* (d'Orbigny); sample Fr 1-29; 0-1 cm; scale bar 300 μm

4, 5. *Nummolculina irregularis* (d'Orbigny)

    4. sample Fr 2-4; 0-1 cm; scale bar 100 μm

    5. sample Fr 2-4, 0-1 cm; scale bar 100 μm

6. *Pyrgo comata* (Brady); sample 2-5; 0-1 cm; scale bar 400 μm

7, 8. *Pyrgo depressa* (d'Orbigny)

    7. sample Fr2-12; 0-1 cm; scale bar 500 μm

    8. sample Fr 1-14; 0-1 cm; scale bar 500 μm

9. *Pyrgo serrata* (L.W. Bailey); sample Fr 1-21; 0-1 cm; scale bar; 400 μm

10, 11. *Pyrgo elongata* (d'Orbigny)

    10. sample Fr 2-4; 0-1 cm; scale bar 250 μm

    11. sample Fr 2-4; 0-1 cm; scale bar 250 μm

12. *Pyrgo laevis* Defrance; sample Fr-15; 0-1 cm; scale bar 400 μm

PLATE IV

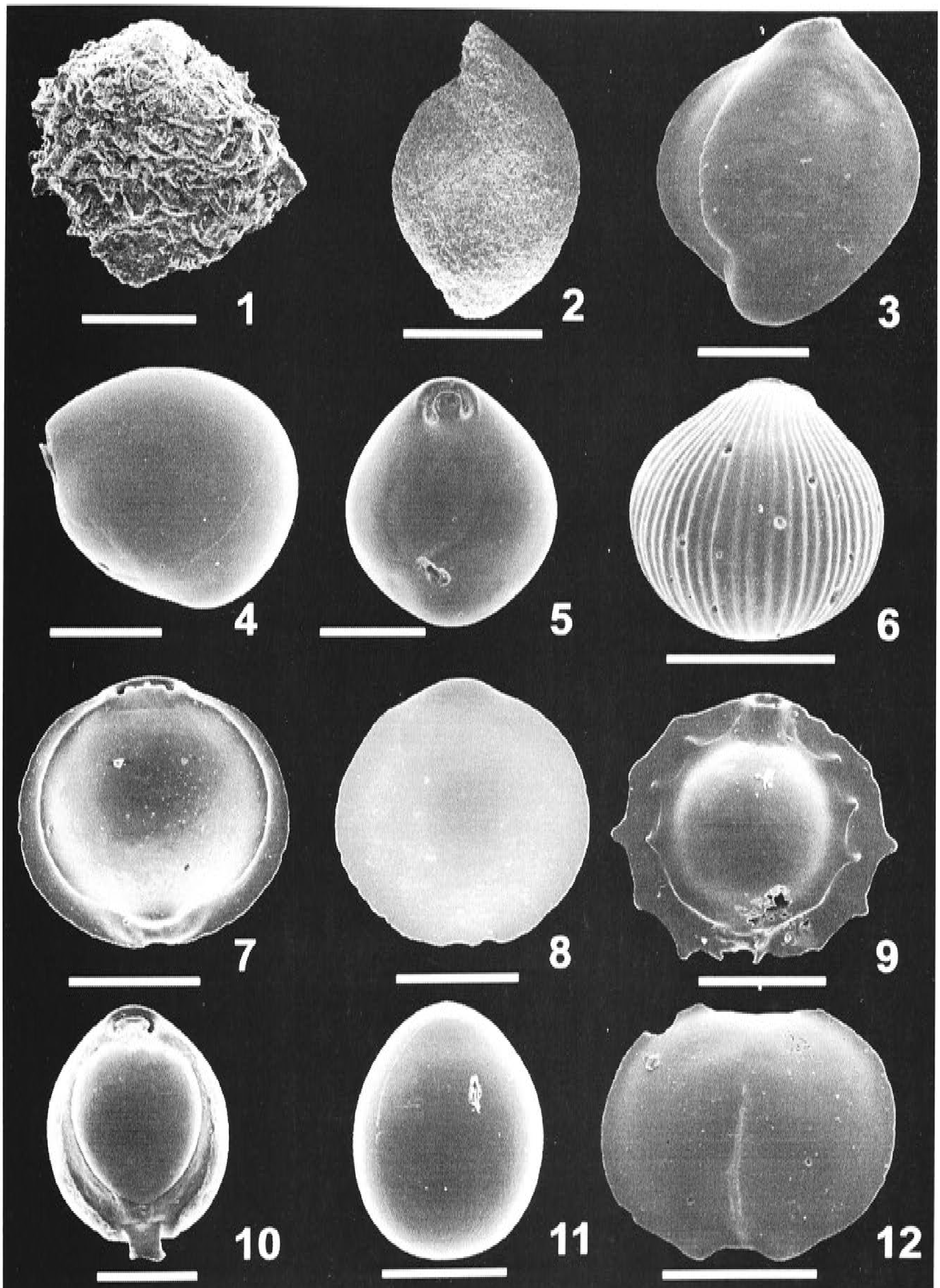


PLATE V

1, 2. *Pyrgo murrhina* (Schwager)

1. sample Fr 1-5; 0-1 cm; scale bar 400 µm

2. sample Fr 1-5; 0-1 cm; scale bar; ventral view 400 µm

3. *Triloculina subvalvularis* Parr; sample Fr 2-4; 0-1 cm; scale bar 300 µm

4, 5. *Triloculina tricarinata* d'Orbigny

4. sample Fr 1-17; 0-1 cm; scale bar 100 µm

5. sample Fr1-7; 0-1 cm; scale bar 100 µm

6. *Quinqueloculina* sp.; sample Fr 1-16; 0-1 cm; scale bar 100 µm

7, 8. *Miliolinella oblonga* (Montagu)

7. sample Fr 2-5; 0-1 cm; scale bar 200 µm

8. sample Fr 2-5; 0-1 cm; scale bar 200 µm

9. *Quinqueloculina venusta* Karrer; sample Fr 2-14; 0-1 cm; scale bar 300 µm

10. *Quinquelocuina seminulum* (Linnaeus); sample Fr 1-17; 0-1 cm; scale bar 300 µm

11,12. *Quinqueloculina lamarckiana* d'Orbigny

11. sample Fr 1-13; 0-1 cm; scale bar 400 µm

12. sample Fr 1-7; 0-1 cm; scale bar 300 µm

13. *Cornuspira involvens* (Reuss); sample Fr 2-4; 0-1 cm; scale bar 400 µm

PLATE V

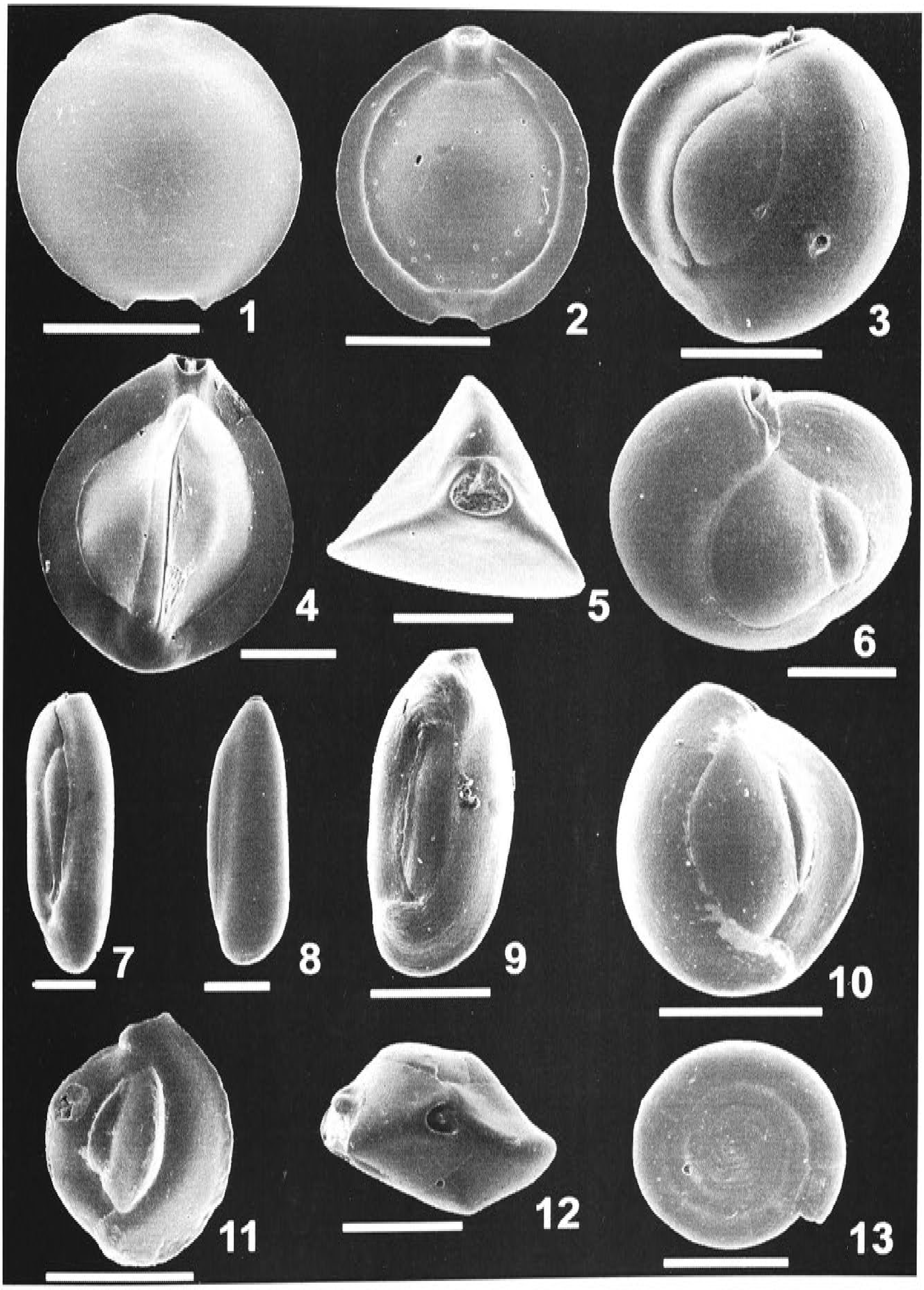


PLATE VI

1. *Spiroloculina communis* Cushman & Todd; sample Fr 2-5; 0-1 cm; scale bar 200 µm

2. *Hauerinella inconstans* (Brady); sample Fr 1-7; 0-1 cm; scale bar 250 µm

3. *Sigmoilopsis schlumbergeri*(Silvestri); sample Fr 1-23; 0-1 cm; scale bar 300 µm

4. *Sphaeroidina bulloides* d'Orbigny; sample Fr 2-2; 0-1 cm; scale bar 300 µm

5. *Bolivina albatrossi* Cushman; Fr 1-17; 0-1 cm; scale bar 200 µm

6. *Bolivina robusta* Brady; Fr 1-17; 0-1 cm; scale bar 200 µm

7. *Brizalina semilineata* Belford; Fr 1-12; 0-1 cm; scale bar 200 µm

8. *Bolivina seminuda* Cushman; Fr 1-17; 0-1 cm; scale bar 200 µm

9, 10. *Bolivinita quadrilatera* (Schwager)

  9. sample Fr 2-4; 0-1 cm; scale bar 250 µm

  10. sample S9024; 0-2 cm; scale bar 250 µm

11. *Bulimina aculeata* d'Orbigny; B9442; 0-2 cm; scale bar 250 µm

12. *Bulimina costata* d'Orbigny; Fr 1-19; 0-1 cm; scale bar 200 µm

13. *Bulimina alazanensis* Cushman; Fr 2-20; 0-1 cm; scale bar 100 µm

14. *Bulimina marginata* d'Orbigny; S9040; 0-2 cm; scale bar 200 µm

15. *Globobulimina affinis* (d'Orbigny); Fr 2-5; 0-1 cm; scale bar 500 µm

16. *Globobulimina pacifica* Cushman; Fr 2-4; 0-1 cm; scale bar 500 µm

PLATE VI

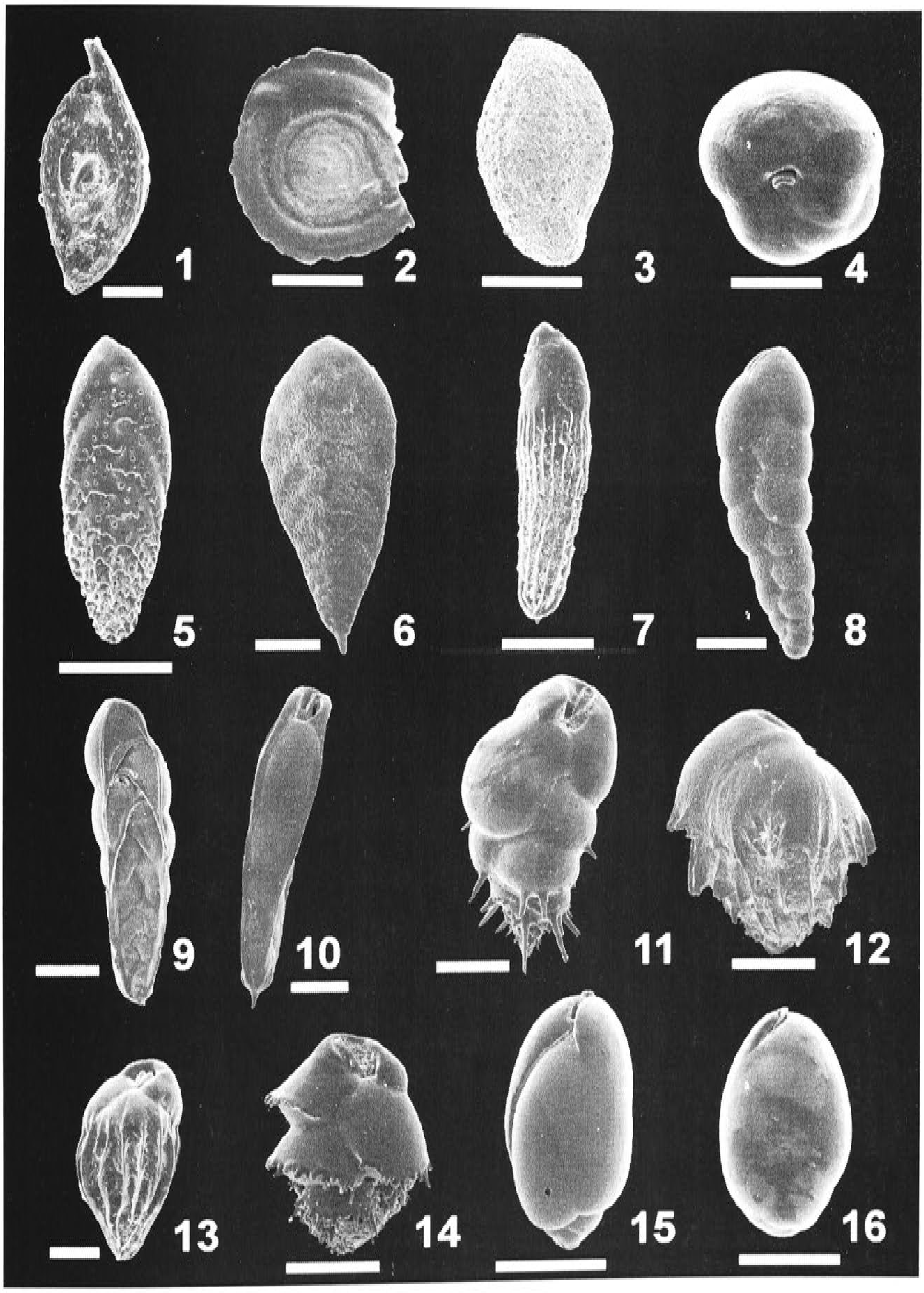


PLATE VII

1-4. *Uvigerina peregrina* Cushman

1. sample Fr 1-21; 0-1 cm; scale bar 500 μm

2. sample Fr 2-12, 0-1 cm; scale bar 500 μm

3. sample B9412; 0-2 cm; scale bar 500 μm

4. sample B9438; 0-2 cm; scale bar 500 μm

5-7. *Uvigerina proboscidea* Schwager

5. sample Fr 2-20; 0-1 cm; scale bar 200 μm

6. sample Fr 1-7; 0-1 cm; scale bar 200 μm

7. sample Fr 2-21; 0-1 cm; scale bar 200 μm

8. *Uvigerina porrecta* Brady; sample S9024; 0-2 cm; scale bar 200 μm

9. *Fursenkoina bradyi* (Cushman); sample Fr 1-11; 0-1 cm; scale bar 250 μm

10. *Fursenkoina earlandi* (Parr); sample Fr 2-2; 0-1 cm; scale bar 300 μm

11. *Fursenkoina fusiformis* (Parr); sample S9024; 0-2 cm; scale bar 250 μm

12. *Dentalina communis* (d'Orbigny); sample Fr1-16; 0-1 cm; scale bar 500 μm

PLATE VII

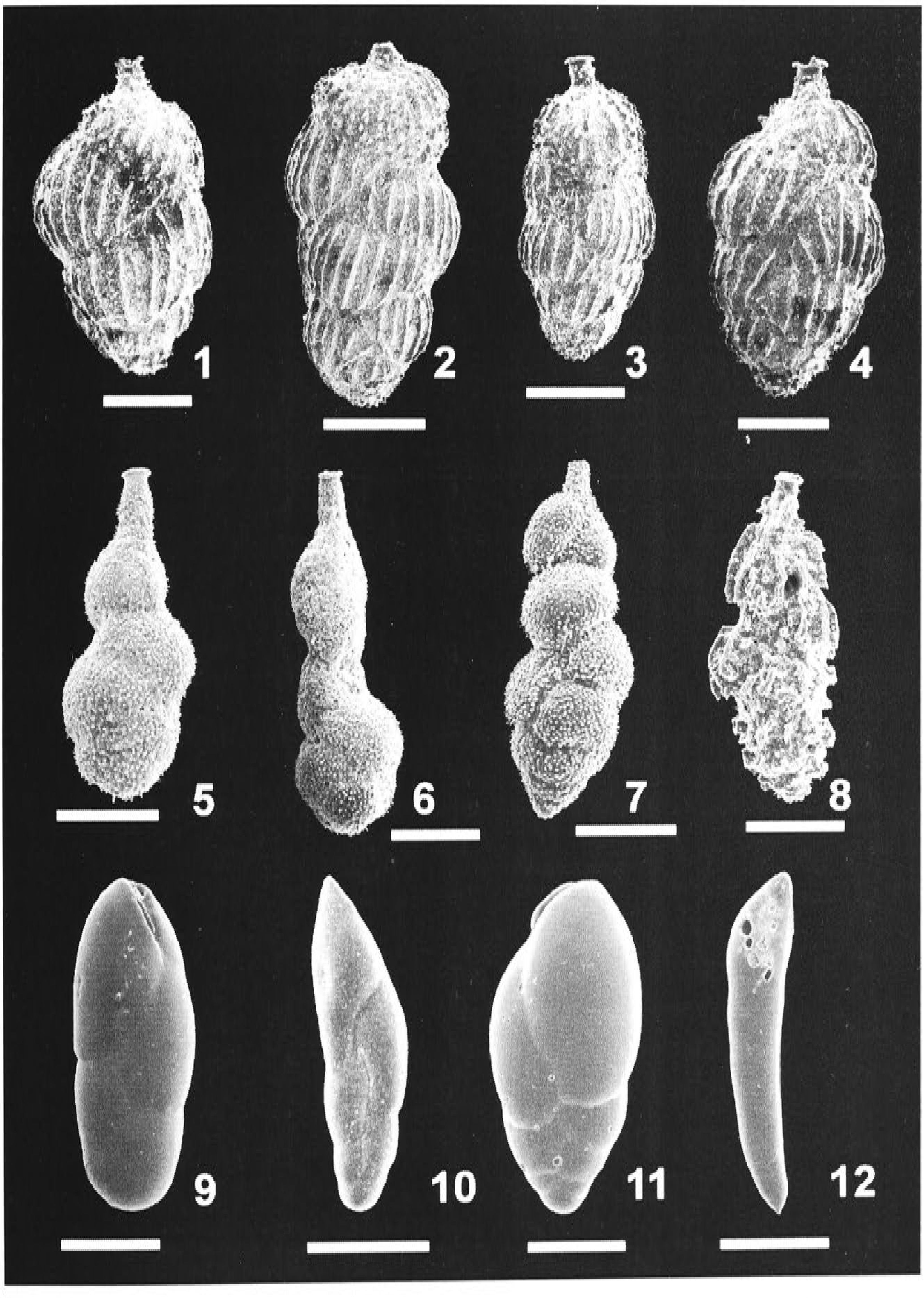


PLATE VIII

1. *Dentalina guttifera* d'Orbigny; sample Fr1-27; 0-1 cm; scale bar 300 μm

2. *Dentalina intorta* (Dervieux); sample B9437; 0-2 cm; scale bar 500 μm

3, 4. *Ehrenbergia trigona* Göes

    3. sample Fr 1-21; 0-1 cm; scale bar 200 μm

    4. sample Fr 1-21; 0-1 cm; scale bar 200 μm

5. *Dentalina subsoluta* (Cushman); sample Fr 1-15; 0-1 cm; scale bar 300 μm

6. *Nodosaria radicula* (Linnaeus); sample Fr 1-10; 0-1 cm; scale bar 100 μm

7. *Amphicroyna scalaris* (Batsch); sample Fr 2-4; 0-1 cm; scale bar 100 μm

8. *Lagena gracillima* (Seguenza); sample Fr 2-4; 0-1 cm; scale bar 200 μm

9. *Rectoboivina columellaris* (Brady); sample Fr 2-5; 0-1 cm; scale bar 500 μm

10. *Rectobolivina dimorpha* (Parker & Jones); sample B9441; 0-2 cm; scale bar 200 μm

11. *Rectoglandulina comatula* (Cushman); sample Fr 2-11; 0-1 cm; scale bar 200 μm

12. *Lagena laevis* (Montagu); sample Fr 2-5; 0-1 cm; scale bar 300 μm

13. *Lagena stelligera* Brady; sample Fr 1-15; 0-1 cm; scale bar 200 μm

14. *Lagena striata* (d'Orbigny); sample Fr 2-2; 0-1 cm; scale bar 300 μm

15. *Fissurina* cf. *marginata* (Montagu); sample Fr 1-15; 0-1 cm; scale bar 500 μm

PLATE VIII

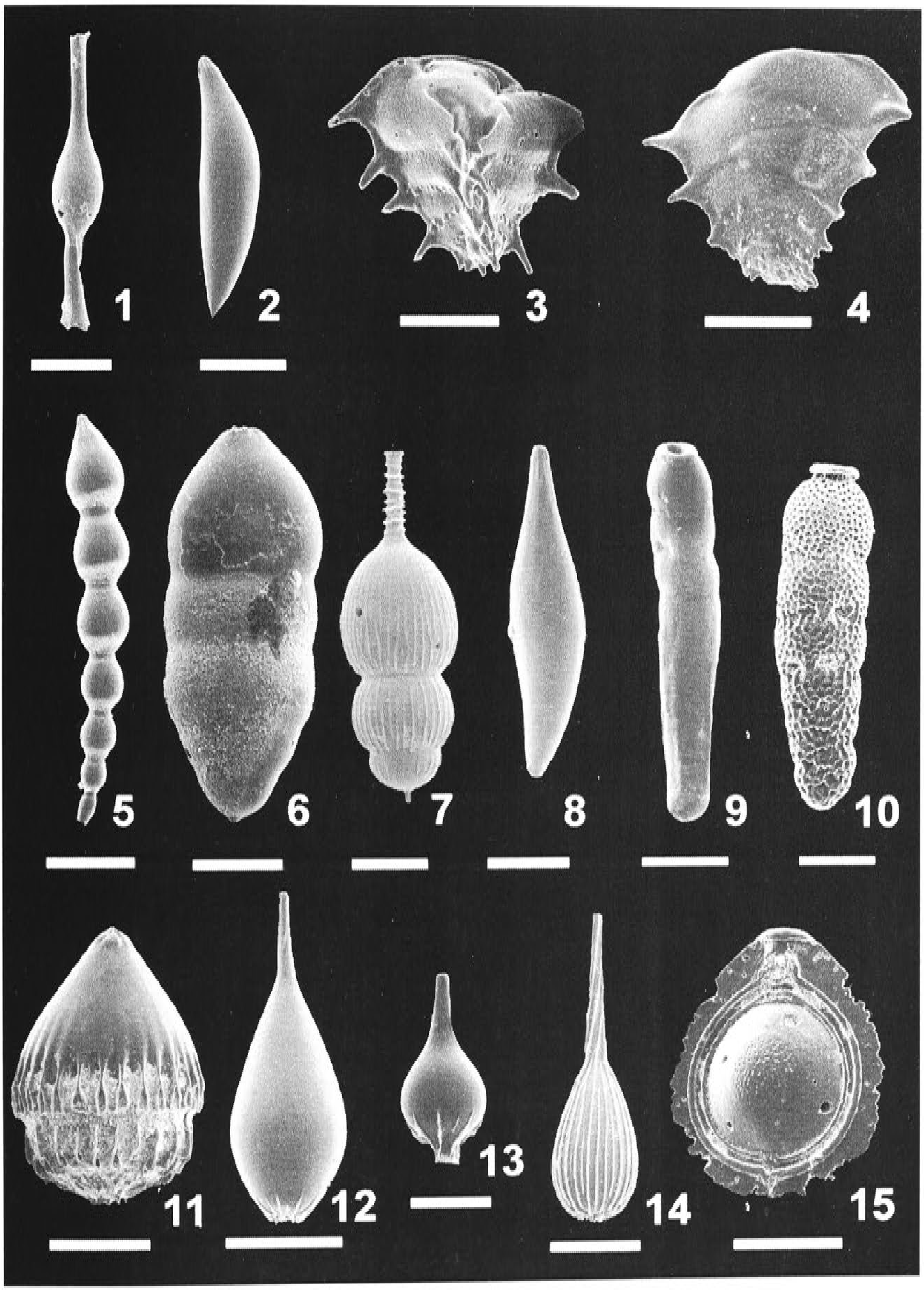


PLATE IX

1. *Fissurina orbignyana* Seguenza; sample Fr 1-24; 0-1 cm; scale bar 500 μm

2. *Fissurina seminiformis* (Schwager); sample Fr 2-11; 0-1 cm; scale bar 500 μm

3. *Fissurina submarginata* (Boomgrat); sample Fr 1-27; 0-1 cm; scale bar 200 μm

4. *Oolina globosa* (Montagu); sample Fr 2-11; 0-1 cm; scale bar 200 μm

5. *Pyrulina fusformis* (Roemer); sample Fr 2-21; 0-1 cm; scale bar 300 μm

6. *Pyrulina extensa* (Cushman); sample Fr 2-20; 0-1 cm; scale bar 300 μm

7. *Globulina minuta* (Roemer); sample Fr 2-19; 0-1 cm; scale bar 300 μm

8. *Lenticulina paeregrina* (Schwager); sample Fr 1-17; 0-1 cm; scale bar 200 μm

9. *Lenticulina gibba* (d'Orbigny); sample Fr 2-5; 0-1 cm; scale bar 250 μm

10. *Lenticulina iota* (Cushman); sample Fr 1-14; 0-1 cm; scale bar 200 μm

11. *Lenticulina calcar* (Linnaeus); sample Fr 1-14; 0-1 cm; scale bar 300 μm

12. *Lenticulina rotulata* (Lamarck); sample B9452; 0-2 cm; scale bar 1000 μm

13. *Parafissurina lateralis* Cushman; sample Fr 2-24; 0-1 cm; scale bar 250 μm

14. *Parafissurina* sp.; sample Fr 1-20; 0-1 cm; scale bar 200 μm

PLATE IX

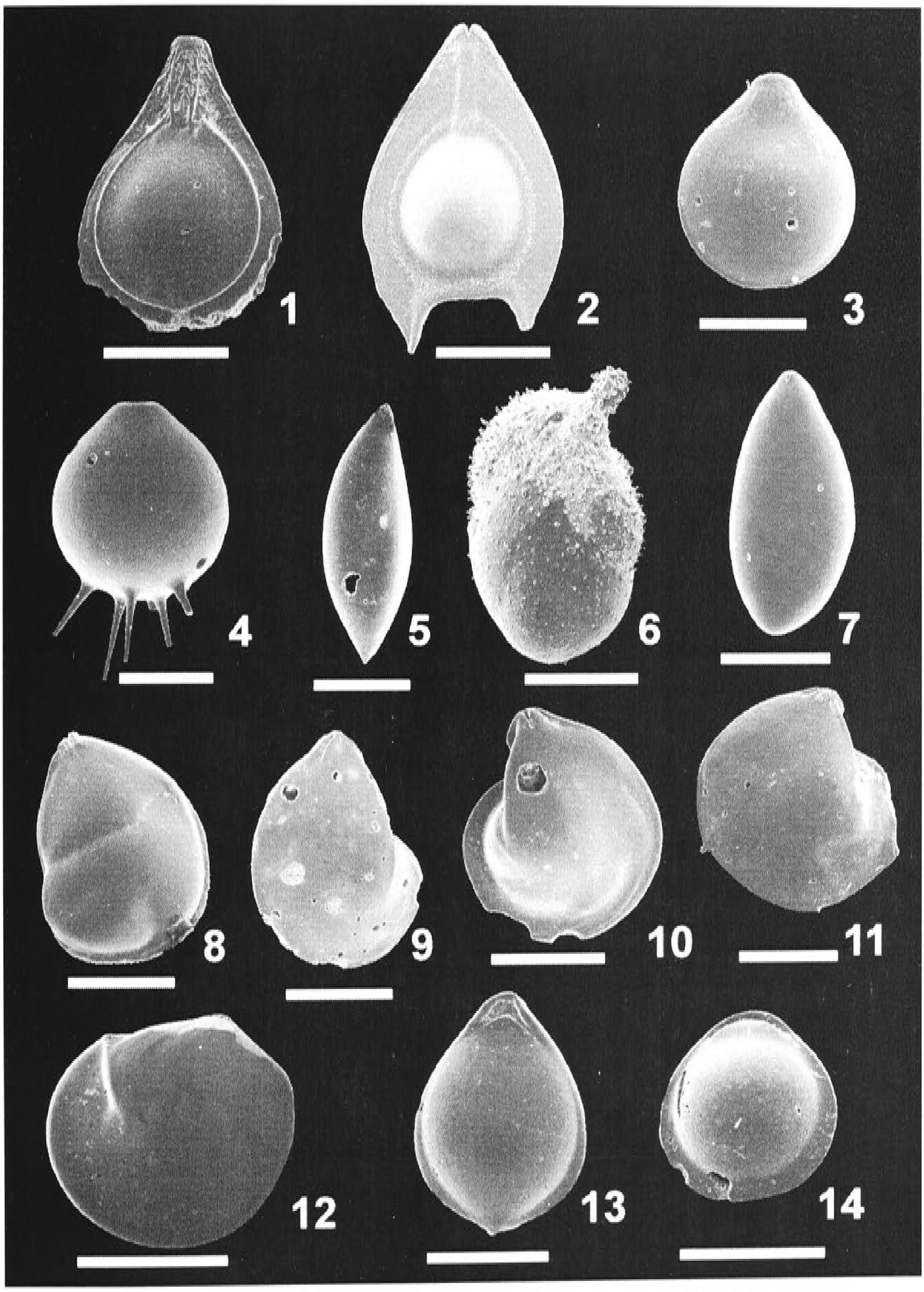


PLATE X

1. *Astrononion echolsi* Kennet; sample Fr 2-5; 0-1 cm; scale bar 200 µm

2. *Nonionella turgida* (Williamson); sample Fr 2-5; 0-1 cm; scale bar 300 µm

3, 4. *Melonis barleeanum* (Williamson)

   3. sample Fr 1-21; 0-1 cm; scale bar 150 µm

   4. sample Fr 1-11; 0-1 cm; scale bar 200 µm

5, 6. *Melonis pompilioides* (Fitcher & Moll)

   5. sample Fr 2-12; 0-1 cm; scale bar 200 µm

   6. sample Fr 2-10; 0-1 cm; scale bar 200 µm

7, 10. *Cassidulina crassa* d'Orbigny;

   7. sample Fr 1-14; 0-1 cm; scale bar 150 µm

   10. sample Fr 1-17; 0-1 cm; scale bar 100 µm

8,9. *Cassidulina laevigata* d'Orbigny

   8. sample Fr 1-25; 0-1 cm; scale bar 150 µm

   9. sample Fr 1-25; 0-1 cm; scale bar 150 µm

11, 12. *Pullenia bulloides* (d'Orbigny)

   11. sample Fr 1-13; 0-1 cm; scale bar 200 µm

   12. sample Fr 1-14; 0-1 cm; scale bar 200 µm

13. *Pullenia quinqueloba* (Reuss); sample Fr 2-23; 0-1 cm; scale bar 100 µm

PLATE X

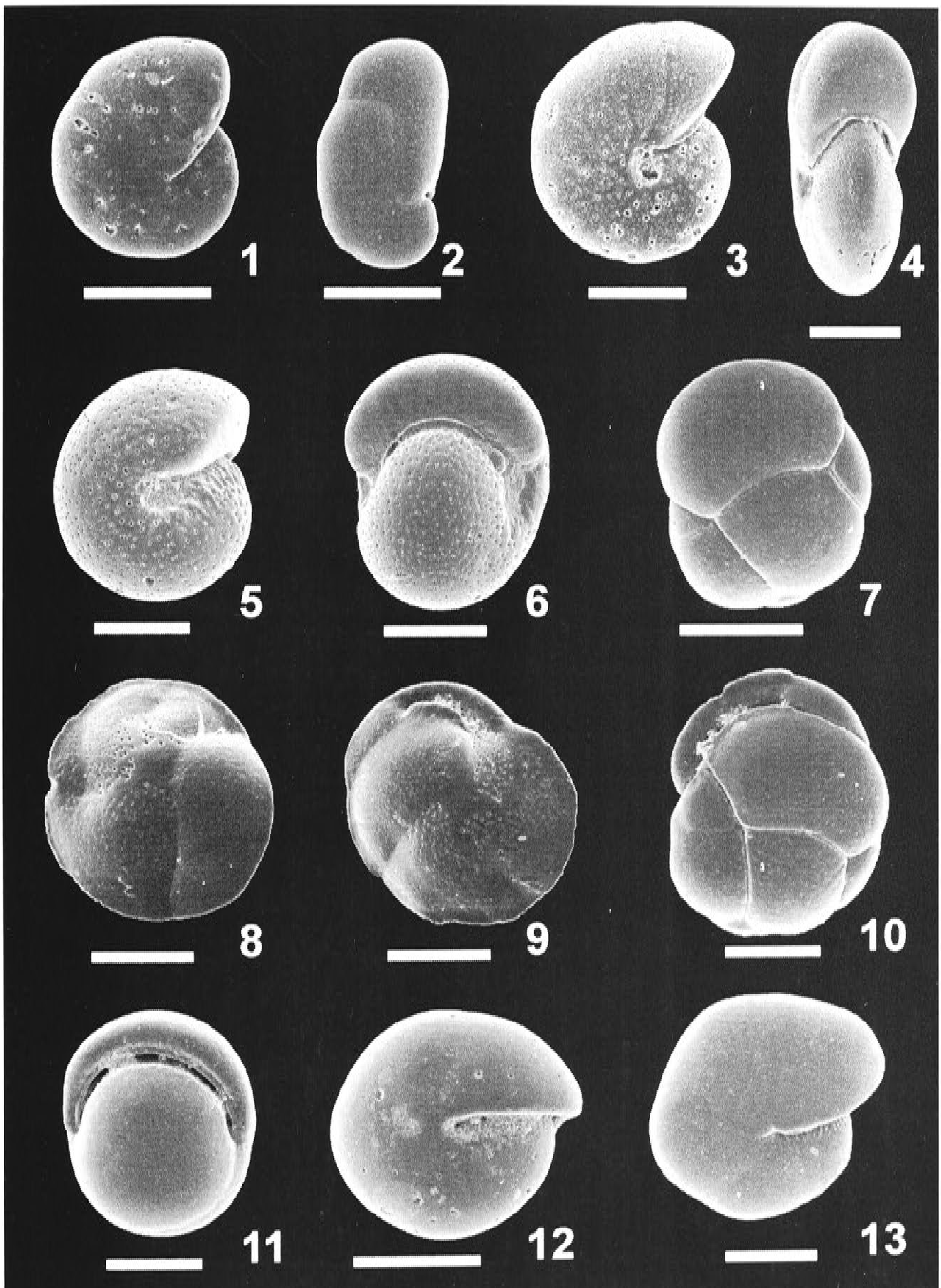


PLATE XI

1, 2. *Globocassidulina elegans* (Sidebottom)

1. sample Fr 2-24; 0-1 cm; scale bar 200 μm

2. sample Fr 1-19; 0-1 cm; scale bar 200 μm

3. *Globocassidulina subglobosa* (Brady); sample Fr 2-20; 0-1 cm; scale bar 300 μm

4. *Chilostomella oolina* Schwager; sample Fr 1-7; 0-1 cm; scale bar 200 μm

5, 6. *Ceratobulimina pacifica* Cushman & Harris

5. sample Fr 1-5; 0-1 cm; scale bar 200 μm

6. sample Fr 1-5; 0-1 cm; scale bar 300 μm

7, 8. *Epistominella umbonifera* (Cushman)

7. sample Fr 2-14; 0-1 cm; scale bar 300 μm

8. sample Fr 2-14; 0-1 cm; scale bar 300 μm

9, 10. *Cassidulina reflexa* Galloway & Wissler

9. sample Fr 2-1; 0-1 cm; scale bar 300 μm

10. sample Fr 2-9; 0-1 cm; scale bar 250 μm

11, 14. *Epistominella exigua* (Brady)

11. sample Fr 2-14; 0-1 cm; scale bar 200 μm

14. sample Fr 2-14; 0-1 cm; scale bar 200 μm

12, 13. *Osangularia cultur* (Parker & Jones)

12. sample Fr 1-17; 0-1 cm; scale bar 200 μm

13. sample Fr 1-29; 0-1 cm; scale bar 200 μm

PLATE XI

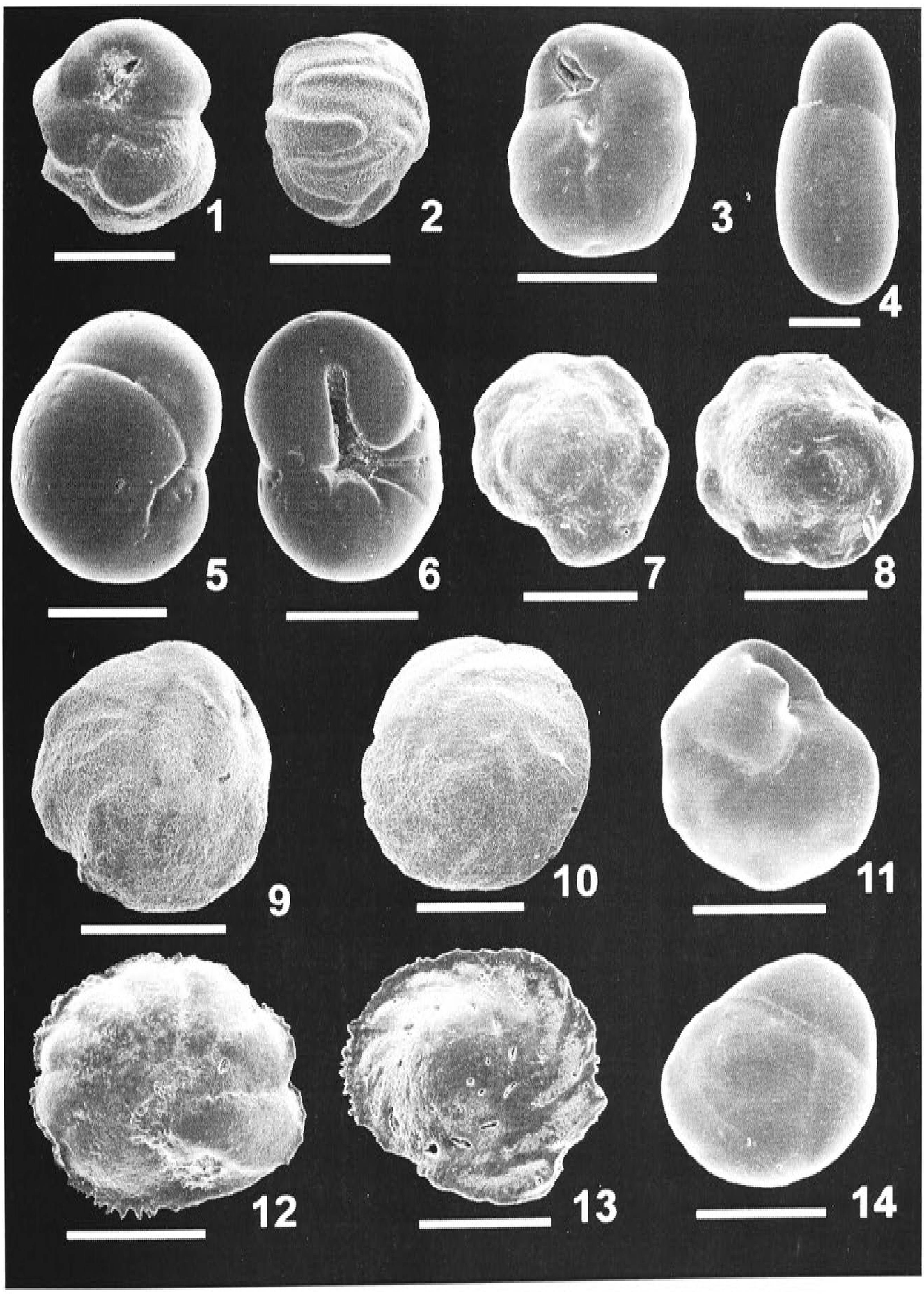


PLATE XII

1, 2. *Allomorphina pacifica* Cushman & Todd

1. sample Fr 1-19; 0-1 cm; scale bar 250 μm

2. sample Fr 2-1; 0-1 cm; scale bar 200 μm

3, 6. *Hanzawaia nipponica* Asano

3. sample Fr 1-21; 0-1 cm; scale bar 200 μm

6. sample Fr 1-26; 0-1 cm; scale bar 200 μm

4, 5. *Discopulvinulina subbertheloti* (Cushman)

4. sample Fr 2-4; 0-1 cm; scale bar 200 μm

5. sample Fr 1-21; 0-1 cm; scale bar 200 μm

7,8. *Gavelinopsis lobatulus* (Parr)

7. sample Fr 1-29; 0-1 cm; scale bar 300 μm

8. sample Fr 2-10; 0-1 cm; scale bar 300 μm

9, 12. *Cymbaloporretta squammosa* (d'Orbigny)

9. sample Fr 1-25; 0-1 cm; scale bar 200 μm

12. sample 2-5; 0-1 cm; scale bar 150 μm

10, 11. *Oridorsalis tener umbonatus* (Reuss)

10. sample Fr 1-29; 0-1 cm; scale bar 250 μm

11. sample Fr 2-3; 0-1 cm; scale bar 250 μm

PLATE XII

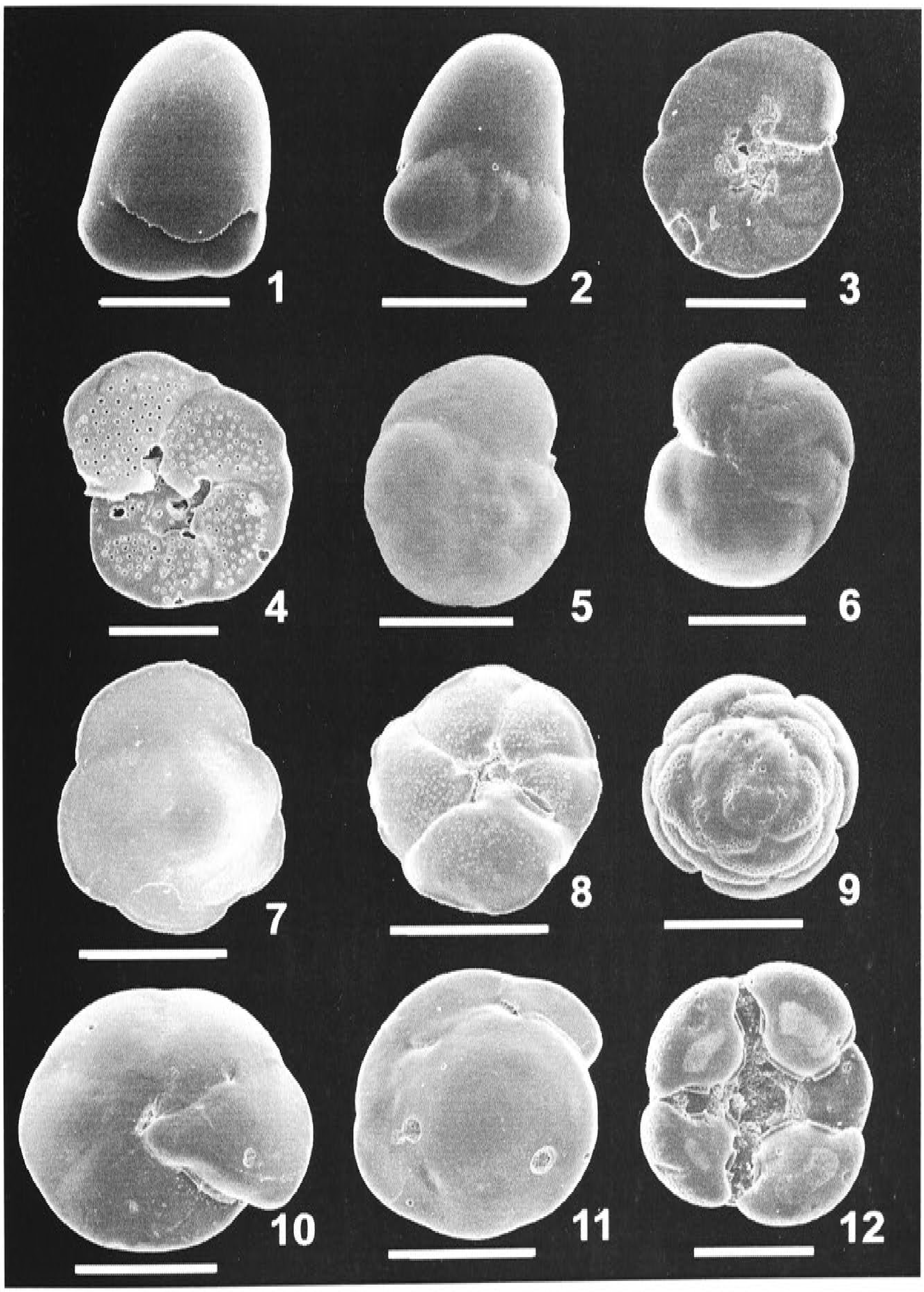


PLATE XIII

1, 2. *Valvulineria* sp.

1. sample Fr 1-25; 0-1 cm; scale bar 150 μm

2. sample Fr 1-29; 0-1 cm; scale bar 200 μm

3, 6. *Gyroidinoides polius* (Phleger & Parker)

3. sample Fr 1-23; 0-1 cm; scale bar 200 μm

6. sample Fr 2-7; 0-1 cm; scale bar 200 μm

4, 5. *Gyroidinoides altiformis* (Stewart & Stewart)

4. sample Fr 1-14; 0-1 cm; scale bar 150 μm

5. sample Fr 2-4; 0-1 cm; scale bar 200 μm

7. *Hyalinea balthica* (Shröter); sample S9024; 0-2 cm; scale bar 300 μm

8. *Planulina ariminensis* (d'Orbigny); sample S9040; 0-2 cm; scale bar 200 μm

9. *Gyroidinoides lamarckianus* (d'Orbigny); sample Fr 2-12; 0-1 cm; scale bar 300 μm

PLATE XIII

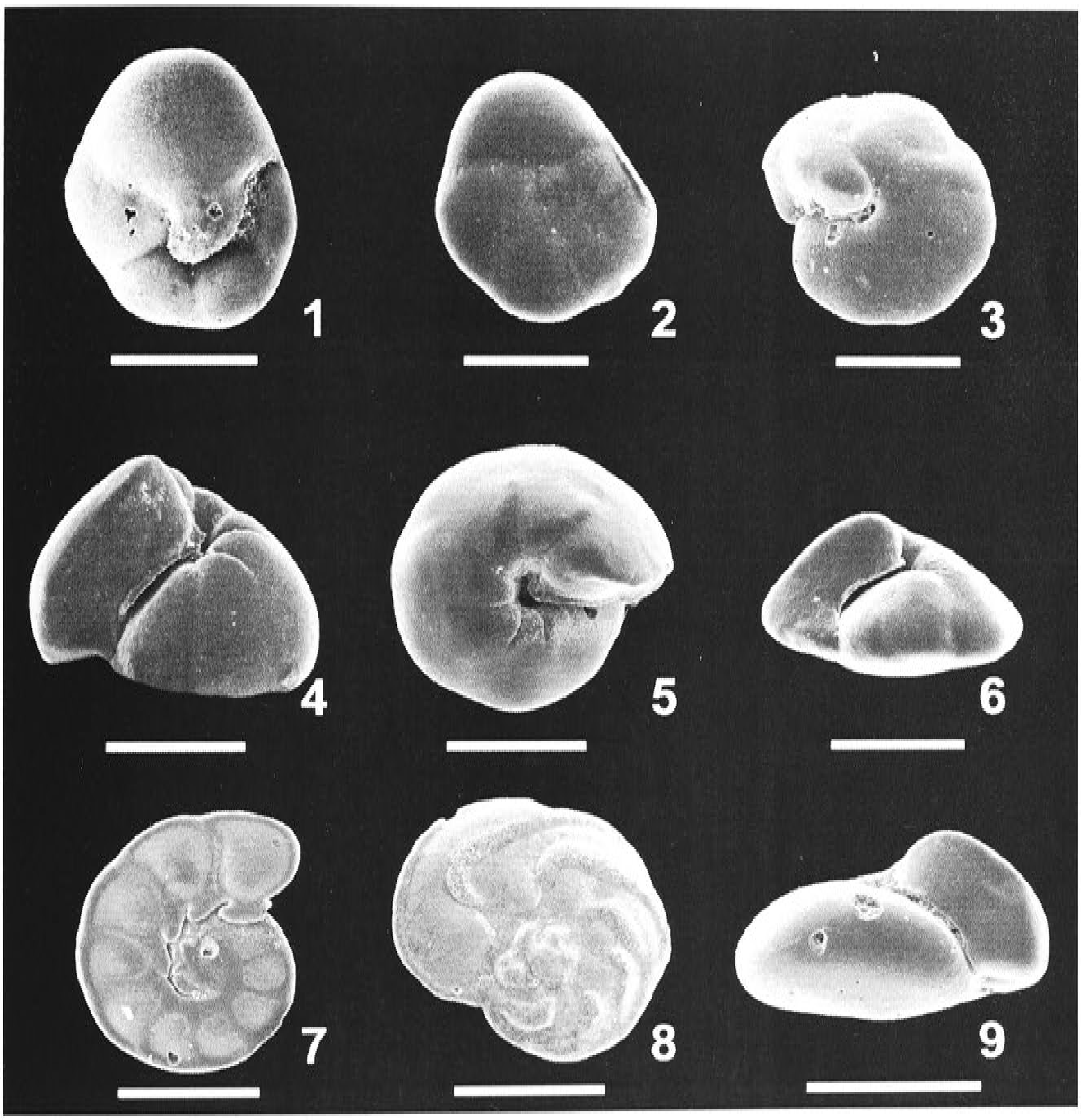


PLATE XIV

1, 2. *Cibicidoides pseudoungerianus* (Cushman)

1. sample Fr 2-4; 0-1 cm; scale bar 400 μm

2. sample Fr 1-26; 0-1 cm; scale bar 400 μm

3. *Cibicidoides kullenbergi* Parker

3. sample Fr 1-5; 0-1 cm; scale bar 250 μm

4, 5. *Cibicidoides bradyi* (Trauth)

4. sample Fr 1-29; 0-1 cm; scale bar 200 μm

5. sample Fr 1-13; 0-1 cm; scale bar 200 μm

6, 9. *Cibicidoides robertsonianus* (Brady)

6. sample Fr 2-12; 0-1 cm; scale bar 200 μm

9. sample Fr 1-29; 0-1 cm; scale bar 200 μm

7, 8. *Cibicidoides wuellerstorfi* (Schwager)

7. sample Fr 1-29; 0-1 cm; scale bar 500 μm

8. sample Fr 1-4; 0-1 cm; scale bar 200 μm

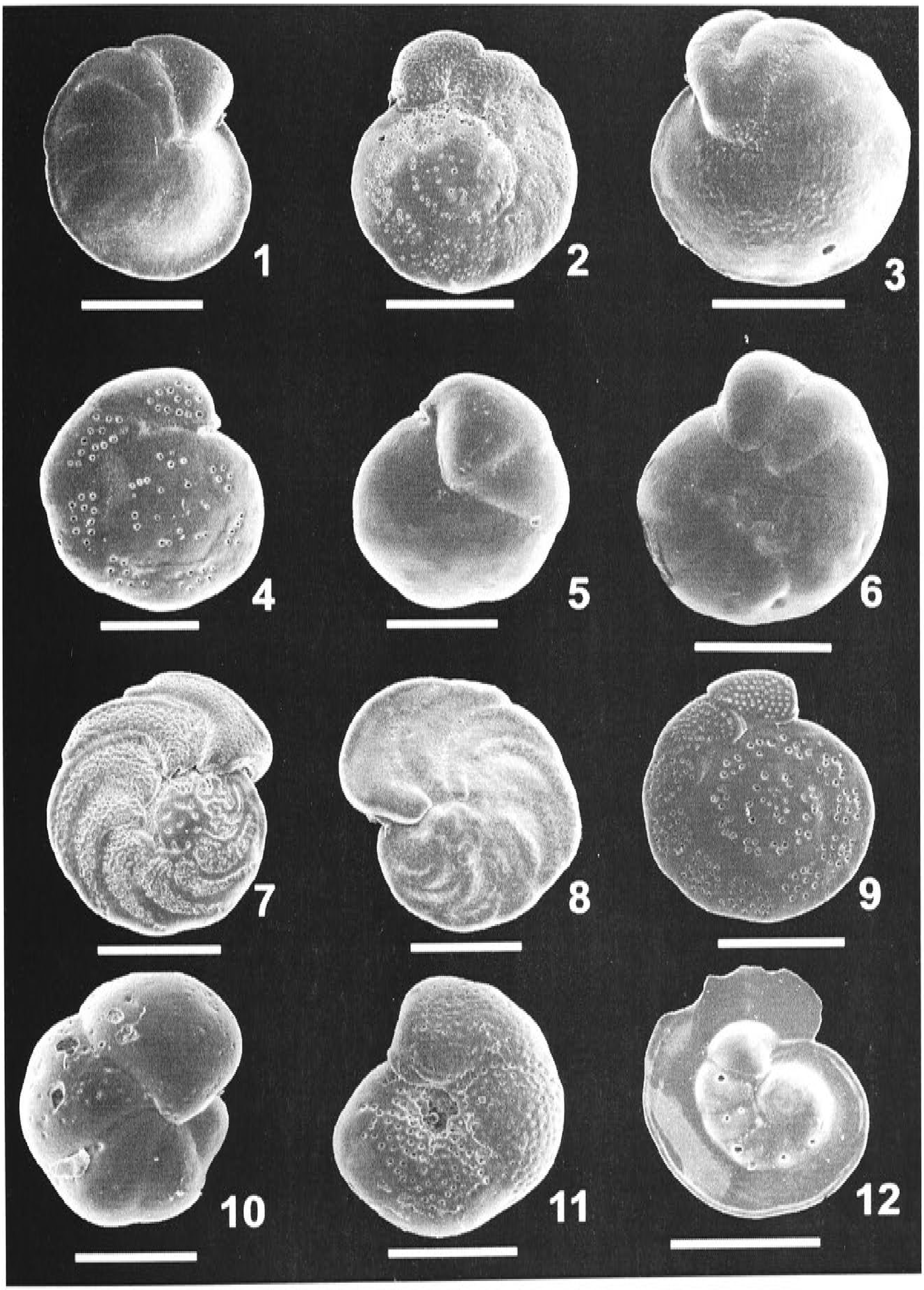
10, 11. *Anomalina globulosa* (Chapman & Parr)

10. sample Fr 1-24; 0-1 cm; scale bar 250 μm

11. sample Fr 1-28; 0-1 cm; scale bar 200 μm

12. *Laticarinina pauperata* (Parker & Jones); sample Fr 2-12; 0-1 cm; scale bar 600 μm

PLATE XIV



APPENDIX A1

Counts data of benthic foraminifera from the core-top samples. Numbers are given as percentage of the total number of specimens in each sample.

Species	Code	Fr1-5	Fr1-7	Fr1-10	Fr1-11	Fr1-12	Fr1-13	Fr1-14	Fr1-15	Fr1-16	Fr1-17	Fr1-18	Fr1-19	Fr1-20	Fr1-21	Fr1-22	Fr1-23	Fr1-24	Fr1-25	Fr1-26
Allomorphina pacifica	Allpa	-	-	-	0,49	-	-	0,22	-	-	0,32	-	0,33	-	-	-	-	-	-	-
Alveolophragmium crassimargo	Alvcr	-	-	-	-	-	-	0,22	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium ringens	Alvri	-	-	-	0,49	-	0,66	0,22	-	-	0,32	-	-	-	-	-	-	-	0,33	-
Alveolophragmium scitulum	Alvsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium subglobosum	Alvug	-	-	1,10	-	0,45	-	0,43	0,23	-	1,29	-	-	1,14	-	-	-	-	-	1,12
Alveolophragmium wiesneri	Alvwi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites agglutinans	Abag	-	-	0,55	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-	-
Ammobaculites intermedius	Abin	-	-	-	-	-	-	-	-	-	-	-	-	1,14	-	-	1,05	-	-	-
Ammobaculites sp.	Absp	-	-	-	-	0,45	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodiscus incertus	Adsin	-	-	-	-	-	-	-	-	-	-	1,41	-	-	-	-	-	-	-	-
Ammodiscus pacificus	Adspa	-	-	0,55	-	0,45	-	-	-	-	0,96	-	-	-	-	-	2,11	-	-	0,75
Ammolagena clavata	Amlc	-	-	-	0,49	-	0,66	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammomarginulina foliaceus	Afol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphistegina lessonii	Aphle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna proxima	Amphpx	-	-	-	-	-	-	0,22	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna scalris	Amphsl	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	0,63	1,28	3,85	3,43	0,89	3,31	-	1,36	3,58	-	-	0,99	-	-	-	1,05	-	-	0,75
Astacolus crepidulus	Atacre	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Astacolus insolitus	Atains	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astrononion echlosi	Astrech	3,77	-	-	0,98	0,45	0,66	2,16	1,02	1,28	0,32	-	0,66	7,95	2,81	0,74	-	-	2,01	0,75
Astrononion stelligerum	Astrst	-	-	-	-	-	-	-	-	-	-	-	-	-	1,12	-	-	-	-	-
Bigenerina nodosaria	Bino	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Bolivina albatrossi	Bolab	-	-	-	-	-	-	-	0,11	-	0,32	-	-	-	-	-	-	-	-	-
Bolivina decussata	Bolde	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina pseudoplicata	Bolpse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	-	-	-	0,66	5,19	0,45	2,56	5,79	1,41	-	-	-	-	-	-	-	-
Bolivina seminuda	Bolsem	-	0,26	-	2,45	0,45	0,66	0,43	0,11	-	-	-	0,66	2,27	-	0,74	-	-	0,33	1,12
Bolivina spissa	Boliss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivinita quadrilatera	Blql	-	-	-	-	-	-	-	-	-	0,96	-	-	-	-	-	-	-	-	-
Brizalina dilatata	Brdi	-	-	-	0,49	0,45	0,66	2,81	-	0,26	6,43	1,41	-	1,14	-	0,74	-	-	-	-
Brizalina semilineata	Brsem	0,63	0,26	-	2,94	6,25	-	-	-	-	-	-	-	-	-	-	-	-	-	0,75
Brizalina sp,	Brsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	3,84	-	2,45	1,34	0,66	0,65	3,63	0,26	-	-	-	-	1,12	-	-	-	-	0,37
Bulimina alazanensis	Bualz	-	1,29	-	4,90	4,02	0,66	0,22	0,34	-	0,32	-	8,58	-	0,56	0,74	6,32	-	-	3,00
Bulimina costata	Buco	-	0,77	0,55	-	0,45	0,66	1,08	1,02	0,77	0,32	1,41	4,62	-	-	0,74	-	-	0,67	1,12
Bulimina gibba	Bugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina marginata	Buma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina striata	Bustr	-	-	-	-	-	-	-	-	-	-	-	-	1,14	-	-	-	1,37	-	-
Buliminella elegantissima	Bumel	-	0,77	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Buliminella sp.	Bumsp	0,63	1,79	-	-	-	-	0,22	0,34	-	-	-	-	-	-	0,74	-	-	0,33	-
Cancris oblungus	Canob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Cassidulina carinata	Casri	-	1,53	-	0,49	0,45	-	0,22	0,45	0,26	-	-	1,65	-	-	1,48	1,05	6,85	6,35	4,87
Cassidulina crassa	Cascr	1,26	-	-	-	-	-	1,52	0,23	0,26	1,29	2,82	0,33	2,27	-	-	-	-	-	-
Cassidulina laevigata carinata	Casslc	-	-	-	1,47	0,89	-	-	-	-	-	-	2,97	-	-	-	1,05	-	-	-
Ceratobulimina pacifica	Cerpa	7,55	1,28	4,40	2,45	2,23	-	2,16	2,04	1,28	2,57	2,82	0,33	1,14	-	2,22	8,42	-	-	0,37
Chilostomella oolina	Chol	-	2,56	-	-	-	-	0,43	0,11	-	2,25	-	-	-	-	-	-	-	1,00	-
Cibicides lobatulus	Clob	0,63	-	-	0,49	-	-	-	0,11	-	-	-	0,33	-	-	-	-	-	1,00	-
Cibicidoides bradyi	Cibr	1,89	1,53	1,10	2,45	1,79	2,65	2,91	2,38	5,63	3,54	4,23	1,98	5,68	2,81	5,19	4,21	-	3,68	3,75
Cibicidoides kullnbergi	Ciku	1,89	1,02	1,65	-	0,89	1,99	4,33	3,06	5,63	2,25	2,82	3,30	4,55	1,69	4,44	-	-	3,68	3,75
Cibicidoides pseudoungerianus	Cipse	1,26	-	-	-	0,45	3,31	0,87	-	1,79	0,96	2,82	-	6,82	0,56	5,19	1,05	1,37	2,34	0,75
Cibicidoides robertsonianus	Cirob	3,14	-	-	0,49	-	-	0,22	1,59	1,28	0,32	1,41	-	-	1,12	-	-	1,37	1,00	0,37
Cibicidoides ungerianus	Ciung	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Cibcidoides wuellerstorfi	Ciwul	9,43	5,37	5,49	2,94	5,36	5,30	8,44	9,19	6,39	2,57	5,63	6,60	2,27	3,37	8,89	3,16	2,74	6,02	1,50
Cibicidoides sp.	Cisp	1,26	0,77	-	0,49	0,89	-	0,65	-	0,26	-	-	-	-	0,56	-	1,05	-	1,00	0,75
Cornuspira carinata	Coca	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	0,74	-	-	-	-
Cornuspira involvens	Coin	-	0,77	-	-	-	-	-	-	-	0,32	-	-	-	0,56	-	-	-	-	0,37
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspiroides primitivus	Cappr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	0,37
Cyclammina cancellata	Cyca	2,52	-	0,55	-	-	1,32	0,43	-	0,26	0,32	1,41	0,33	1,14	-	-	-	-	-	-
Cystammina pauciloculata	Cyspa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina advena	Dead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	0,26	0,55	-	0,43	0,66	-	0,45	0,51	-	-	-	-	-	-	-	-	-	0,37
Dentalina filiformis	Defi	-	-	-	-	-	-	0,22	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina guttifera	Degu	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	0,22	-	-	-	-	-	-	-	-	1,05	-	-	-
Dentalina intorta	Detor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Fr1-27	Fr1-29	Fr1-29	Fr2-1	Fr2-2	Fr2-3	Fr2-4	Fr2-5	Fr2-7	Fr2-9	Fr2-10	Fr2-11	Fr2-12	Fr2-13	Fr2-14	Fr2-15	Fr2-16	Fr2-17	Fr2-19
Allomorphina pacifica	Allpa	-	-	0,23	0,38	-	-	-	-	-	-	-	-	0,14	-	-	-	-	-	-
Alveolophragmium crassimargo	Alvcr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium ringens	Alvri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium scitulum	Alvsi	-	-	-	-	-	-	-	-	0,63	-	-	-	-	-	-	-	-	-	-
Alveolophragmium subglobosum	Alvug	-	-	0,68	1,88	0,61	6,25	-	-	1,26	-	0,69	0,38	-	-	0,18	1,18	-	-	-
Alveolophragmium wiesneri	Alvwi	-	-	-	-	-	-	-	-	0,63	-	-	-	-	-	-	-	-	-	-
Ammobaculites agglutinans	Abag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites intermedius	Abin	-	-	0,23	0,38	-	-	0,30	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites sp.	Absp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodiscus incertus	Adsin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodiscus pacificus	Adspa	-	-	-	1,50	-	-	-	-	-	-	0,68	-	-	-	-	-	-	-	-
Ammolagena clavata	Amlc	-	-	0,23	1,13	-	-	-	-	-	-	-	-	-	-	-	-	1,75	1,00	1,43
Ammomarginulina foliaceus	Afol	-	-	-	-	-	-	-	-	0,63	-	-	-	-	-	-	-	-	-	-
Amphistegina lessonii	Aphle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna proxima	Amphpx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna scalris	Amphsl	-	-	-	-	-	-	0,15	0,19	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	-	2,02	0,45	1,88	-	0,89	0,30	0,39	3,14	1,09	2,04	1,92	0,41	2,20	-	1,18	-	1,00	1,43
Astacolus crepidulus	Atacre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astacolus insolitus	Atains	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astrononion echlosi	Astrech	5,99	-	3,15	2,26	2,44	4,46	1,21	2,92	-	0,55	-	-	0,14	4,40	0,71	-	0,88	3,00	-
Astrononion stelligerum	Astrst	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Bigenerina nodosaria	Bino	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina albatrossi	Bolab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina decussata	Bolde	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina pseudoplicata	Bolpse	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina seminuda	Bolsem	-	2,02	0,45	-	-	-	0,30	0,78	-	-	-	-	-	-	0,18	-	-	1,00	-
Bolivina spissa	Boliss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Bolivinita quadrilatera	Blql	1,20	2,02	-	-	-	-	6,53	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina dilatata	Brdi	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina semilineata	Brsem	-	-	-	0,75	-	-	-	0,19	-	-	-	0,38	-	-	-	-	0,88	-	-
Brizalina sp.	Brsp	-	-	0,45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	8,08	-	-	-	-	-	-	-	-	-	-	0,55	-	-	-	7,02	1,00	-
Bulimina alazanensis	Bualz	-	-	0,23	1,50	1,22	-	0,91	0,19	1,89	2,73	0,69	0,77	0,55	-	0,18	-	0,88	4,00	1,43
Bulimina costata	Buco	-	-	-	1,13	-	-	0,15	0,19	-	-	-	-	1,23	-	-	-	-	1,00	-
Bulimina gibba	Bugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina marginata	Buma	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Bulimina striata	Bustr	-	-	-	-	-	-	-	-	-	-	-	-	0,27	-	-	-	-	1,00	-
Buliminella elegantissima	Bumel	0,60	1,01	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella sp.	Bumsp	-	-	-	-	-	-	-	0,39	-	-	-	-	-	-	-	-	-	-	-
Cancris oblungus	Canob	-	-	0,69	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina carinata	Casri	1,80	3,03	3,83	0,38	-	-	0,61	0,39	-	1,64	0,68	0,38	2,86	-	-	-	-	2,00	-
Cassidulina crassa	Cascr	-	3,03	1,13	0,38	-	-	0,30	-	0,63	-	-	0,38	-	-	-	-	-	-	-
Cassidulina laevigata carinata	Casslc	-	-	-	3,38	-	-	-	-	-	2,19	1,36	2,69	2,05	-	-	-	-	-	-
Ceratobulimina pacifica	Cerpa	-	-	1,59	2,63	-	-	0,76	-	1,26	-	0,68	0,77	1,23	-	-	-	0,88	-	-
Chilostomella oolina	Chol	-	1,01	-	-	-	-	0,76	4,67	-	-	-	-	-	-	0,54	-	-	-	-
Cibicides lobatulus	Clob	0,60	1,01	1,35	-	-	-	0,46	0,58	-	-	-	0,39	0,14	-	-	-	-	1,00	-
Cibicidoides bradyi	Cibr	5,39	3,03	5,86	0,75	1,22	2,68	2,43	3,31	4,40	0,55	4,08	0,36	0,27	4,40	0,18	4,71	0,88	2,00	2,86
Cibicidoides kullnbergi	Ciku	4,19	3,03	4,05	0,75	0,61	2,68	5,61	1,17	1,89	0,55	3,40	0,77	0,82	4,40	-	2,35	1,75	2,00	2,86
Cibicidoides pseudoungerianus	Cipse	8,98	1,01	1,35	-	-	-	3,03	5,64	-	-	-	-	-	2,20	-	-	-	-	-
Cibicidoides robertsonianus	Cirob	0,60	-	1,80	-	0,61	2,68	0,91	0,19	1,26	-	1,36	0,38	0,41	-	-	1,18	0,88	-	2,86
Cibicidoides ungerianus	Ciung	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibcidoides wuellerstorfi	Ciwul	0,60	-	1,58	0,38	-	0,89	1,06	0,39	2,52	19,67	5,44	21,15	35,74	7,69	6,79	8,24	6,14	4,00	4,29
Cibicidoides sp.	Cisp	1,20	-	2,70	-	1,22	-	4,40	1,75	-	-	-	-	-	1,10	-	-	-	-	-
Cornuspira carinata	Coca	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Cornuspira involvens	Coin	-	1,01	0,90	-	-	-	0,15	0,39	-	-	-	-	-	-	-	-	-	-	-
Cornuspira sp.	Cosp	-	1,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspiroides primitivus	Cappr	-	-	-	-	-	-	-	0,39	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	-	1,13	0,38	-	-	0,15	1,95	-	-	-	-	-	-	-	-	-	-	-
Cyclammina cancellata	Cyca	0,60	-	0,90	0,38	0,61	0,89	-	-	1,89	-	2,72	-	-	-	-	1,18	-	-	2,86
Cystammina pauciloculata	Cyspa	-	-	0,23	-	-	3,57	-	-	0,63	-	-	-	-	-	-	-	-	-	-
Dentalina advena	Dead	-	-	0,68	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	0,38	-	-	-	0,19	-	0,55	-	-	0,27	1,10	0,71	-	-	-	-
Dentalina filiformis	Defi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina guttifera	Degu	0,60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina intorta	Detor	-	-	-	-	-	0,89	-	-	0,63	-	0,68	-	-	-	-	-	-	-	-

Species	Code	Fr2-20	Fr2-21	Fr2-23	Fr2-24	Fr2-25	Fr2-26	B9407	B9412	B9436	B9437	B9438	B9440	B9441	B9442	S9011	S9024	S9039	S9040	S9045
Allomorphina pacifica	Allpa	-	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium crassimargo	Alvcr	-	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium ringens	Alvri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium scitulum	Alvsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium subglobosum	Alvug	-	0,85	-	0,63	-	-	-	-	-	0,35	-	-	-	-	-	-	1,32	-	1,03
Alveolophragmium wiesneri	Alvwi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites agglutinans	Abag	-	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites intermedius	Abin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Ammobaculites sp.	Absp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodiscus incertus	Adsin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodiscus pacificus	Adspa	-	-	-	-	-	-	-	2,60	-	-	-	-	-	-	-	-	2,63	-	-
Ammolagena clavata	Amlc	0,56	-	-	-	-	-	-	-	-	0,35	-	-	-	-	-	-	-	-	-
Ammomarginulina foliaceus	Afol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphistegina lessonii	Aphle	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Amphicoryna proxima	Amphpx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna scalris	Amphsl	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	0,39	-	-	-
Anomalina globulosa	Aaglob	0,56	4,27	8,11	4,23	3,66	5,84	0,25	1,30	-	0,69	0,34	5,56	-	-	2,42	-	1,32	-	-
Astacolus crepidulus	Atacre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astacolus insolitus	Atains	0,28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astrononion echlosi	Astrech	0,28	0,85	-	0,63	1,05	0,73	0,25	-	1,97	-	-	2,22	-	-	-	-	1,32	-	-
Astrononion stelligerum	Astrst	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bigenerina nodosaria	Bino	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina albatrossi	Bolab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	0,80	-
Bolivina decussata	Bolde	1,12	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina pseudoplicata	Bolpse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,21	1,18	-	-	-
Bolivina seminuda	Bolsem	0,28	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,03
Bolivina spissa	Boliss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivinita quadrilatera	Blql	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,59	-	1,60	-
Brizalina dilatata	Brdi	-	-	-	-	-	-	-	-	-	-	-	1,11	-	-	0,61	-	-	3,20	-
Brizalina semilineata	Brsem	-	-	-	0,42	0,52	-	-	-	-	-	-	-	-	0,96	-	-	-	-	-
Brizalina sp,	Brsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	-	8,11	9,94	3,66	2,19	-	-	-	-	-	-	1,74	50,96	-	3,92	1,32	6,40	9,28
Bulimina alazanensis	Bualz	3,37	2,56	1,35	2,54	4,19	2,19	-	1,30	0,99	1,73	-	1,11	-	-	0,61	-	-	-	6,19
Bulimina costata	Buco	-	-	1,35	-	-	3,65	-	-	-	-	-	-	-	1,92	0,61	-	1,32	6,40	-
Bulimina gibba	Bugi	-	-	-	-	-	0,73	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina marginata	Buma	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	0,39	-	11,20	-
Bulimina striata	Bustr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella elegantissima	Bumel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella sp.	Bumsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cancris oblungus	Canob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina carinata	Casri	0,28	-	2,70	0,85	1,05	-	-	1,30	-	0,35	-	3,33	0,87	-	1,21	0,78	2,63	1,60	1,03
Cassidulina crassa	Cascr	-	-	-	-	-	-	-	-	0,49	0,35	-	-	0,87	-	-	0,39	-	-	-
Cassidulina laevigata carinata	Casslc	-	-	1,35	0,21	-	1,46	-	-	-	4,15	-	-	-	-	0,61	-	-	-	-
Ceratobulimina pacifica	Cerpa	-	-	2,70	0,63	1,05	0,73	-	1,30	-	0,35	-	1,11	2,61	-	1,82	2,75	-	-	-
Chilostomella oolina	Chol	-	-	-	-	-	-	-	-	0,99	-	-	2,22	-	2,88	-	2,75	-	-	-
Cibicides lobatulus	Clob	-	-	-	-	0,52	0,73	-	-	0,99	0,35	-	-	-	-	-	1,18	-	-	-
Cibicidoides bradyi	Cibr	-	-	-	0,42	0,52	0,73	-	6,49	1,97	0,69	1,01	4,44	5,22	-	4,85	1,57	1,32	-	6,19
Cibicidoides kullnbergi	Ciku	0,56	0,85	2,70	0,85	1,57	0,73	-	5,19	0,99	2,42	3,36	6,67	1,74	0,96	1,21	0,39	3,95	-	2,06
Cibicidoides pseudoungerianus	Cipse	-	-	-	-	-	-	-	-	0,49	0,35	-	3,33	0,87	-	2,42	2,35	-	7,20	-
Cibicidoides robertsonianus	Cirob	-	0,85	-	0,42	1,05	-	-	1,30	-	0,69	-	-	-	-	-	-	-	-	-
Cibicidoides ungerianus	Ciung	-	-	-	-	-	-	-	1,30	-	-	0,34	-	-	-	-	-	-	-	-
Cibcidoides wuellerstorfi	Ciwul	3,65	4,27	8,11	4,02	2,62	5,11	-	5,19	0,99	3,46	3,36	5,56	1,74	-	2,42	4,71	6,58	2,40	7,22
Cibicidoides sp.	Cisp	0,28	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	1,32	2,40	-
Cornuspira carinata	Coca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspira involvens	Coin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspiroides primitivus	Cappr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyclammina cancellata	Cyca	-	0,85	-	0,21	0,52	0,73	0,25	1,30	1,48	-	0,34	-	-	-	-	-	-	-	2,06
Cystammina pauciloculata	Cyspa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina advena	Dead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	-	-	-	0,25	-	-	-	0,34	-	0,87	-	-	-	-	-	-
Dentalina filiformis	Defi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina guttifera	Degu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina intorta	Detor	-	-	-	-	-	-	-	-	-	0,35	-	-	-	-	-	-	-	-	-

Species	Code	Frl-5	Frl-7	Frl-10	Frl-11	Frl-12	Frl-13	Frl-14	Frl-15	Frl-16	Frl-17	Frl-18	Frl-19	Frl-20	Frl-21	Frl-22	Frl-23	Frl-24	Frl-25	Frl-26
Dentalina neugeboreni	Deneu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Deasub	-	-	-	-	-	-	0,22	-	0,26	-	-	0,66	-	-	-	-	-	-	0,37
Dentalia sp.	Desp	0,63	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina araucana	Dspara	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina subbertheloti	Dspber	-	-	-	-	-	-	-	0,11	-	-	-	-	-	1,12	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia exilis	Doex	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Dorthia pseudoturris	Doptr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia scabra	Dosc	-	-	-	-	-	-	-	-	0,26	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	1,26	1,02	1,10	0,49	-	-	0,43	0,34	0,26	0,32	-	0,66	1,14	-	2,22	1,05	2,74	1,00	0,75
Eggerella propinqua	Egpr	-	-	-	-	-	0,66	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella scabra	Eggsc	-	-	-	-	-	-	-	1,02	0,26	-	-	0,33	-	-	-	-	-	-	-
Eggerella sp.	Eggsp	-	0,26	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	0,33	-
Ehrenbergina trigona	Ehtr	1,26	2,05	9,34	-	-	2,65	3,68	2,38	7,16	0,96	-	-	1,14	20,22	4,44	-	-	0,33	-
Elphidium crispum	Elcr	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	0,75
Elphidium incertum	Elin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,37
Elphidium macellum	Elma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Epistominella exigua	Epex	3,14	0,77	-	2,45	5,80	2,65	-	0,23	-	-	1,41	0,66	1,14	0,56	0,74	-	-	-	0,37
Epistominella umbonifera	Exum	-	-	-	-	-	-	0,22	-	-	0,32	-	-	4,55	-	4,44	-	-	0,33	-
Eponides regularis	Epre	-	-	0,55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides tumiduls	Eptum	-	-	-	-	0,45	-	0,22	-	0,26	-	-	-	-	-	-	-	-	-	-
Eponides sp.	Epsp	-	-	-	-	-	-	-	-	-	-	-	0,66	-	-	0,74	-	-	-	-
Fissurina alveolata	Fisal	-	0,26	0,55	0,49	0,45	-	0,43	0,68	-	-	-	0,33	-	-	-	-	-	-	-
Fissurina auriculata	Fisaur	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Fissurina bradyi	Fisbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina clathrata	Fiscl	-	-	-	-	-	-	-	-	-	-	-	-	-	1,12	0,74	-	-	-	-
Fissurina crebra	Fiscrbr	-	0,26	-	0,98	-	-	-	-	-	-	-	0,66	1,14	0,56	-	3,16	-	-	0,37
Fissurina fimbriata	Fisfi	-	-	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina kerguelensis	Fiske	-	-	-	-	0,89	-	-	-	-	-	-	0,33	-	-	-	-	-	0,33	6,74
Fissurina marginata	Fisma	0,63	1,02	-	0,98	1,34	-	0,87	0,57	0,51	-	-	0,99	1,14	1,12	1,48	-	-	0,33	0,37
Fissurina orbignyana	Fisor	-	-	0,55	1,47	0,89	1,32	0,22	0,34	-	-	1,41	0,66	-	1,12	0,74	1,05	1,37	0,33	-
Fissurina semimarginata	Fissem	-	-	-	-	0,89	0,66	-	0,45	-	-	-	0,33	-	-	-	-	-	-	0,37
Fissurina seminiformis	Fismnf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina submarginata	Fissub	-	0,77	1,10	-	1,79	-	-	0,57	0,26	-	1,41	0,66	-	0,56	-	1,05	-	0,33	-
Fissurina trigono-margnata	Fistrma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Fissurina wiesneri	Fiswie	-	-	-	-	-	-	0,43	-	0,26	-	-	-	-	-	-	1,05	-	-	-
Fissurina sp.	Fissp	0,63	1,28	-	0,98	0,45	0,66	-	0,79	1,02	-	-	0,66	-	0,56	0,74	3,16	-	0,67	1,87
Frondicularia kiensis	Froke	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina bradyi	Furbr	-	-	-	0,98	-	-	-	0,11	-	-	-	0,66	-	-	-	-	-	-	-
Fursenkoina davisii	Furda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina earlandi	Furea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	-	0,26	-	0,49	-	-	-	-	0,26	-	-	0,99	-	-	-	-	-	-	-
Fursenkoina punctata	Furpu	-	-	-	-	-	-	-	-	-	-	1,41	-	-	-	-	-	-	-	-
Fursenkoina sp.	Fursp	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Gavelinopsis lobatulus .	Galo	-	3,07	1,10	-	-	2,65	0,65	1,36	0,26	3,22	1,41	-	2,27	-	-	-	2,74	2,34	-
Globobulimina affinis	Glaf	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	-	-	-	-	-	-	-	-	-	0,96	-	-	-	-	-	-	-	-	-
Globobulimina pupioides	Glpu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globocassidulina elegans	Glcel	0,63	-	0,55	1,96	0,89	0,66	-	-	-	-	-	0,33	-	-	-	1,05	-	-	-
Globocassidulina subglobosa	Glcsb	11,32	2,05	2,75	11,76	11,16	1,99	11,26	5,68	5,37	3,54	7,04	3,96	4,55	0,56	5,19	8,42	19,18	8,03	2,25
Globulina gibba	Gbugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globulina minuta	Gbumi	-	-	-	0,98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glomospira gordialis	Glmgo	-	-	0,55	-	-	-	0,22	0,23	-	-	-	-	-	-	-	-	-	-	-
Glomospira charoides	Glmch	-	-	0,55	0,49	1,34	0,66	0,43	-	0,51	0,32	-	-	-	-	-	1,05	-	1,67	0,75
Guttulina pacifica	Gupa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidina cf. gemma	Gige	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	1,89	-	-	-	-	1,99	0,22	0,45	-	-	-	-	-	-	-	-	1,37	-	0,75
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	0,98	-	-	0,22	0,45	0,26	-	-	-	-	-	-	-	1,37	0,33	2,25
Gyroidinoides orbicularis	Gyror	-	0,77	0,55	1,47	-	2,65	1,30	0,57	1,79	2,57	-	0,99	-	-	0,74	-	-	-	1,87
Gyroidinoides polius	Gyrpo	0,63	-	-	0,49	-	0,66	-	0,91	0,26	-	-	0,33	-	-	0,74	1,05	-	-	-
Gyroidinoides soldanii	Gyrso	0,63	1,79	3,30	-	1,34	1,99	2,81	1,25	3,07	1,93	7,04	3,63	3,41	1,69	0,74	2,11	5,48	1,34	4,87
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	0,22	0,11	-	-	-	0,33	-	-	-	-	-	-	0,37
Halophragmoides canariensis	Halcn	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	0,63	0,26	0,55	-	-	-	0,22	-	-	-	-	-	-	1,69	-	-	-	0,33	0,75
Hauerinella incostans	Hurin	-	2,81	-	-	-	-	-	0,11	-	0,64	-	-	-	0,56	0,74	-	-	0,67	0,37
Hoeglundina elegans	Hoel	1,89	8,44	9,34	5,39	7,59	1,99	1,95	7,26	3,84	0,96	1,41	5,61	1,14	1,12	2,22	1,05	1,37	-	8,99
Hyalinea balthica	Hyba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,37
Hyperammina cylindrica	Hypcy	-	-	0,55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyperammina friabilis	Hypfri	-	-	-	0,49	-	0,66	-	-	0,26	-	-	-	-	-	-	-	-	0,33	-
Hyperammina malvolensis	Hypma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Fr1-27	Fr1-28	Fr1-29	Fr2-1	Fr2-2	Fr2-3	Fr2-4	Fr2-5	Fr2-7	Fr2-9	Fr2-10	Fr2-11	Fr2-12	Fr2-13	Fr2-14	Fr2-15	Fr2-16	Fr2-17	Fr2-19
Dentalina neugeboreni	Deneu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Deasub	-	-	-	-	-	-	-	0,39	-	-	-	-	-	-	-	-	-	-	-
Dentalia sp.	Desp	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina araucana	Dspara	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina subbertheloti	Dspber	-	-	-	0,38	-	-	0,30	0,97	-	-	-	-	-	-	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Dorothia exilis	Doex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorthia pseudoturris	Doptr	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia scabra	Dosc	-	1,01	0,23	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	-	2,02	0,23	0,75	4,27	-	0,15	1,17	1,26	0,55	1,36	0,77	0,95	1,10	0,36	-	3,51	-	-
Eggerella propinqua	Egpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella scabra	Eggsc	-	-	0,45	-	-	-	-	-	1,26	0,55	-	-	0,14	-	-	-	-	-	-
Eggerella sp.	Eggsp	-	-	-	-	-	-	-	-	0,63	-	-	-	-	-	-	-	-	-	-
Ehrenbergina trigona	Ehtr	-	1,01	-	-	-	-	0,30	-	-	-	-	-	0,14	-	-	-	-	-	-
Elphidium crispum	Elcr	-	-	1,13	1,13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elphidium incertum	Elin	-	-	0,23	-	-	-	-	0,39	-	-	-	-	-	-	-	-	-	-	-
Elphidium macellum	Elma	0,60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella exigua	Epex	-	-	-	1,13	19,51	4,46	-	-	-	2,73	7,48	1,92	1,36	4,40	33,21	24,71	5,26	3,00	11,43
Epistominella umbonifera	Exum	2,40	-		-	-	-	0,76	0,39	-	0,55	-	0,38	0,14	-	22,32	-	-	-	-
Eponides regularis	Epre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides tumiduls	Eptum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides sp.	Epsp	-	-	-	0,38	-	-	-	-	-	-	-	-	-	-	0,18	-	-	-	-
Fissurina alveolata	Fisal	-	-	-	-	0,61	0,89	-	-	0,63	0,55	-	1,15	0,41	-	-	-	-	-	1,43
Fissurina auriculata	Fisaur	-	-		-	-	-	-	-	-	-	-	0,38	-	-	-	-	-	-	-
Fissurina bradyi	Fisbr	-	-		-	-	-	-	-	-	0,55	-	-	-	-	-	-	-	-	-
Fissurina clathrata	Fiscl	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina crebra	Fiscrbr	-	-	0,45	0,38	0,61	0,89	0,30	0,39	-	-	2,72	-	0,95	-	-	1,18	-	-	-
Fissurina fimbriata	Fisfi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina kerguelensis	Fiske	-	-	0,23	-	-	-	-	-	0,63	-	-	-	-	-	-	-	-	-	-
Fissurina marginata	Fisma	0,60	1,01	1,13	0,75	0,61	2,68	0,46	0,78	-	0,55	-	-	0,14	1,10	0,18	-	-	2,00	-
Fissurina orbignyana	Fisor	-	1,01	0,68	-	1,22	0,89	-	-	-	0,55	-	1,15	0,95	-	-	-	1,75	-	-
Fissurina semimarginata	Fissem	0,60	-	-	0,38	-	0,89	-	-	0,63	-	-	-	-	-	-	1,18	-	-	-
Fissurina seminiformis	Fismnf	-	-	-	-	-	-	-	-	-	1,09	-	1,54	-	-	-	-	-	-	-
Fissurina submarginata	Fissub	-	1,01	-	-	-	1,79	-	0,19	0,63	0,55	-	-	-	1,10	0,54	-	-	-	-
Fissurina trigono-margnata	Fistrma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina wiesneri	Fiswie	0,60	-	-	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina sp.	Fissp	-	-	0,23	1,50	1,22	0,89	-	0,19	0,63	1,64	3,40	0,77	1,50	-	-	1,18	-	-	-
Frondicularia kiensis	Froke	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina bradyi	Furbr	-	-	-	-	1,22	-	-	-	-	0,55	-	0,38	0,27	-	-	-	-	-	-
Fursenkoina davisii	Furda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina earlandi	Furea	-	-	-	-	0,61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	-	-	0,23	-	2,44	-	-	-	-	-	-	-	-	-	-	1,18	-	1,00	-
Fursenkoina punctata	Furpu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina sp.	Fursp	-	-	-	-	0,61	-	-	-	-	-	-	-	-	-	-	1,18	-	-	-
Gavelinopsis lobatulus	Galo	1,80	-	2,70	-	-	-	1,67	1,75	-	-	0,68	-	-	-	-	-	-	-	-
Globobulimina affinis	Glaf	-	-	-	-	-	-	0,15	0,39	-	-	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	-	-	-	-	-	-	1,82	0,97	-	-	-	-	-	-	-	-	-	-	-
Globobulimina pupioides	Glpu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globocassidulina elegans	Glcel	-	-	-	-	-	-	-	-	-	-	-	-	0,14	-	-	-	-	-	-
Globocassidulina subglobosa	Glcsb	4,79	3,03	4,05	10,53	5,49	5,36	7,13	2,33	3,14	4,92	2,72	6,54	7,09	6,59	2,14	3,53	7,02	11,00	2,86
Globulina gibba	Gbugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globulina minuta	Gbumi	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	1,43
Glomospira gordialis	Glmgo	-	-	-	-	-	0,89		-	-	-	-	-	-	-	-	-	-	-	-
Glomospira charoides	Glmch	-	-	0,23	2,63	-	0,89	-	-	2,52	-	-	-	-	-	-	-	-	1,00	1,43
Guttulina pacifica	Gupa	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Gyroidina cf. gemma	Gige	-	-	-	-	0,61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	0,60	-	-	0,36	-	-	-	0,19	-	0,55	0,68	-	0,41	-	0,18	-	1,75	-	-
Gyroidinoides lamarckianus	Gyrlmk	-	2,02	6,76	7,52	-	1,79	0,61	0,19	0,63	0,55	0,68	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	0,60	-	0,45	1,13	0,61	-	2,73	0,19	2,52	0,55	2,04	-	0,14	1,10	0,89	1,18	0,98	-	4,29
Gyroidinoides polius	Gyrpo	-	-	0,68	0,38	2,44	2,68	-	-	1,99	1,64	4,08	1,54	1,50	1,10	0,54	-	-	2,00	-
Gyroidinoides soldanii	Gyrso	4,19	-	1,58	4,14	1,22	0,89	2,43	2,14	1,89	2,19	4,08	0,38	1,50	1,10	0,18	-	1,75	1,00	-
Gyroidinoides sp.	Gyrsp	-	-	-	0,75	-	-	0,15	-	1,26	-	-	-	-	-	-	-	-	-	-
Halophragmoides canariensis	Halcn	-	-	-	-	-	-	-	-	0,63	-	-	0,38	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	0,75	-	-	0,61	0,97	-	-	-	-	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	-	-	1,35	-	-	-	0,61	1,36	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	2,40	-	-	1,50	1,83	0,89	3,95	0,58	0,63	-	-	0,38	0,55	-	-	-	-	1,00	-
Hyalinea balthica	Hyba	0,60	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Hyperammina cylindrica	Hypcy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyperammina friabilis	Hypfri	-	-	0,23	-	-	-	-	-	0,63	-	0,68	0,38	-	-	-	-	0,88	-	1,43
Hyperammina malvolensis	Hypma	-	-	-	-	-	-	-	-	0,63	-	-	-	-	-	-	-	-	-	-

Core-tops Species %

Species	Code	Fr2-20	Fr2-21	Fr2-23	Fr2-24	Fr2-25	Fr2-26	B9407	B9412	B9436	B9437	B9438	B9440	B9441	B9442	S9011	S9024	S9039	S9040	S9045
Dentalina neugeboreni	Deneu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,32	-	-
Dentalina subsoluta	Deasub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalia sp.	Desp	-	-	-	-	-	-	-	-	-	-	-	1,11	0,87	-	-	-	-	-	-
Discopulvinulina araucana	Dspara	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina subbertheloti	Dspber	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia exilis	Doex	-	-	-	0,42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorthia pseudoturris	Doptr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia scabra	Dosc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	2,53	3,42	1,35	0,85	1,05	0,73	0,49	1,30	2,96	1,38	1,34	1,11	-	-	0,61	0,39	1,32	2,40	2,06
Eggerella propinqua	Egpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella scabra	Eggsc	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Eggerella sp.	Eggsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ehrenbergina trigona	Ehtr	-	2,56	-	0,63	1,05	-	-	-	2,46	-	0,34	-	-	-	3,03	-	-	-	-
Elphidium crispum	Elcr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elphidium incertum	Elin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elpnidium macellum	Elma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella exigua	Epex	2,53	4,27	2,70	0,85	3,66	5,11	6,88	3,90	19,21	4,50	22,82	1,11	-	2,88	0,61	-	17,11	-	-
Epistominella umbonifera	Exum	-	1,71	-	-	-	-	1,23	-	0,49	1,38	1,34	-	0,87	-	-	-	-	-	-
Eponides regularis	Epre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Eponides tumiduls	Eptum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides sp.	Epsp	-	-	2,70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina alveolata	Fisal	-	-	1,35	0,21	1,57	0,73	-	1,30	-	-	-	-	-	-	-	-	-	-	-
Fissurina auriculata	Fisaur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,32	-	-
Fissurina bradyi	Fisbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Fissurina clathrata	Fiscl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina crebra	Fiscrbr	0,56	-	-	0,42	-	1,46	0,25	-	0,49	0,35	-	-	-	-	-	-	-	0,80	1,03
Fissurina fimbriata	Fisfi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina kerguelensis	Fiske	-	0,85	-	0,21	-	-	-	1,30	0,49	0,35	-	-	-	-	-	-	-	-	-
Fissurina marginata	Fisma	0,28	-	1,35	0,42	1,05	2,92	-	-	-	1,38	-	1,11	1,74	0,96	3,03	3,14	-	0,80	1,03
Fissurina orbignyana	Fisor	-	1,71	2,70	0,42	0,52	2,19	0,25	-	0,49	0,35	0,67	-	-	-	1,82	0,78	-	-	1,03
Fissurina semimarginata	Fissem	-	-	-	0,21	-	-	-	-	0,49	-	1,01	-	-	-	-	0,78	-	-	-
Fissurina seminiformis	Fismnf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina submarginata	Fissub	-	2,56	-	1,48	1,05	0,73	-	-	0,99	0,35	1,68	1,11	-	0,96	-	-	1,32	-	1,03
Fissurina trigono-margnata	Fistrma	-	-	-	-	-	-	-	-	-	0,35	-	-	-	-	-	-	-	-	-
Fissurina wiesneri	Fiswie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Fissurina sp.	Fissp	1,12	-	-	0,63	-	0,73	-	1,30	1,97	1,38	1,01	-	-	-	-	0,39	-	-	-
Frondicularia kiensis	Froke	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Fursenkoina bradyi	Furbr	0,28	-	-	0,21	-	0,73	-	-	-	-	-	-	-	0,96	-	-	-	-	-
Fursenkoina davisii	Furda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,03
Fursenkoina earlandi	Furea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	-	-	-	0,63	-	-	-	-	0,49	-	-	-	-	-	0,61	0,78	-	-	1,03
Fursenkoina punctata	Furpu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina sp.	Fursp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gavelinopsis lobatulus	Galo	-	-	-	-	-	-	-	-	0,49	-	-	6,67	4,35	-	-	-	-	-	-
Globobulimina affinis	Glaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,35	1,32	1,60	-
Globobulimina pupioides	Glpu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,57	-	-	-
Globocassidulina elegans	Glcel	-	-	-	1,48	1,57	1,46	-	-	-	-	-	-	-	-	-	-	-	-	-
Globocassidulina subglobosa	Glcsb	29,49	7,69	6,76	9,51	28,80	10,95	79,61	5,19	22,17	32,53	13,09	11,11	7,93	0,96	3,64	1,96	1,32	5,60	6,19
Globulina gibba	Gbugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,03
Globulina minuta	Gbumi	-	-	1,35	-	0,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glomcspira gordialis	Glmgo	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	-	-	-	-
Glomospira charoides	Glmch	-	-	-	-	0,52	-	0,25	1,30	0,99	0,35	0,34	-	-	0,96	-	-	2,63	-	4,12
Guttulina pacifica	Gupa	-	-	-	-	-	-	-	-	-	0,35	-	-	-	-	-	-	-	-	-
Gyroidina cf. gemma	Gige	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	-	-	-	0,63	1,57	-	-	-	-	-	-	1,11	0,97	-	2,42	0,39	-	-	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	0,21	-	-	0,25	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	1,12	3,42	-	0,85	1,05	-	0,25	1,30	2,46	0,69	0,67	2,22	9,87	0,96	-	-	-	-	-
Gyroidinoides polius	Gyrpo	2,53	1,71	-	-	-	-	0,74	-	3,94	1,73	3,02	-	0,87	-	-	-	-	-	-
Gyroidinoides soldanii	Gyrso	1,12	7,69	2,70	0,63	2,09	2,19	0,25	-	-	0,69	1,68	-	2,61	-	3,03	1,96	3,95	0,80	3,09
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-	1,11	-	-	-	-	-	-	-
Halophragmoides canariensis	Halcn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Hauerinella incostans	Hurin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	0,84	6,84	4,05	6,34	2,09	6,57	-	1,30	-	1,38	1,34	13,33	1,74	0,96	0,61	2,75	-	0,80	-
Hyalinea balthica	Hyba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,53	-	5,60	-
Hyperammina cylindrica	Hypcy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyperammina friabilis	Hypfri	-	0,85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyperammina malvolensis	Hypma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Frl-5	Frl-7	Frl-10	Frl-11	Frl-12	Frl-13	Frl-14	Frl-15	Frl-16	Frl-17	Frl-18	Frl-19	Frl-20	Frl-21	Frl-22	Frl-23	Frl-24	Frl-25	Frl-26
Karreriella apicularis	Karap	-	-	-	-	-	0,66	0,22	-	0,26	1,29	-	-	-	-	-	-	-	0,67	-
Karreriella bradyi	Karbr	0,63	-	1,10	-	-	0,66	1,30	0,91	0,51	0,96	1,41	-	2,27	2,81	2,22	1,05	2,74	0,67	0,75
Karreriella novangliae	Karno	-	-	1,10	-	-	-	-	0,34	1,02	-	-	0,66	-	-	-	-	-	-	-
Involutina tenuis	Inte	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena acuticostata	Laatu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena advena	Laadv	-	-	-	-	-	-	-	-	0,26	-	-	-	-	-	0,74	-	-	0,33	-
Lagena elegantissima	Laele	-	-	-	0,98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena favoso-punctata	Lafvp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena feildeniana	Lafld	-	0,51	-	-	-	0,66	0,43	0,11	-	-	-	-	-	-	-	-	-	-	-
Lagena formosa	Lafor	0,63	0,77	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	1,37	-	0,37
Lagena gracilis	Lagra	-	-	-	-	-	-	-	0,11	-	0,32	-	-	-	-	-	-	-	-	-
Lagena gracillima	Lagml	-	-	-	-	-	-	-	-	-	-	1,41	-	-	-	-	-	-	-	-
Lagena hispida	Lahis	-	-	-	-	-	-	-	-	-	-	-	-	1,14	-	-	-	-	-	-
Lagena hispidula	lahpd	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Lagena laevis	Lalvs	-	-	0,55	1,47	1,79	0,66	1,30	0,34	0,51	-	-	0,66	-	-	0,74	1,05	-	0,33	0,37
Lagena meridionalis	Lamer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena plumigera	Laplu	0,63	-	-	-	-	-	0,22	0,23	-	-	-	-	-	-	-	-	-	0,33	-
Lagena radiato-marginata	Larmg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Lagena stelligera	Lastg	-	-	-	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-	-
Lagena striata	Lastr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,37	-	-
Lagena sulcata	Lasul	-	0,26	-	-	0,45	-	0,22	0,11	-	-	-	-	-	-	-	-	-	-	-
Lagena truncata	Latru	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena sp.	Lasp	-	0,51	-	0,98	0,45	-	-	0,23	-	0,32	-	-	-	-	-	-	-	0,33	0,37
Laticarinina pauperata	Ltpa	0,63	-	1,65	0,98	0,45	1,99	-	1,59	0,51	0,64	-	1,32	1,14	-	-	1,05	1,37	0,33	0,75
Lenticulina atlantica	Leat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina calcar	Leca	-	-	-	-	-	-	0,22	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina cultur	Lecl	-	0,51	-	-	-	-	0,43	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina gibba	Legi	-	-	-	-	0,45	0,66	-	0,23	0,26	0,96	-	-	1,14	0,56	-	-	1,37	0,33	-
Lenticulina limbosa	Leli	-	-	-	-	-	-	0,22	-	-	-	1,41	-	-	-	-	-	-	-	-
Lenticulina orbicularis	Leor	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Lenticulina peregrina	Lepe	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Lenticulina rotulata	Lero	-	-	-	-	-	-	0,43	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina vortex	Levo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina sp.	Lesp	-	-	-	-	-	0,66	-	-	0,26	-	-	-	-	-	-	-	-	-	-
Litotuba lituiformis	Lbli	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Loxostomum karrerianum	Lxka	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loxostomum limbatum	Lxli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina glabara	Magl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina obesa	Maob	0,63	0,51	0,55	-	0,89	0,66	1,08	0,23	0,26	-	-	-	-	0,56	-	-	-	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,37
Marginulina sp.	Masp	-	-	0,55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Marsipella elongata	Mrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,74	-	-	-	-
Martinottiella communis	Mtcom	-	-	-	-	-	-	0,22	0,11	-	0,32	-	-	-	-	-	-	-	-	-
Martinottiella perparva	Mtpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melonis barleeanum	Meba	1,26	0,51	0,55	0,98	-	3,97	1,30	1,82	2,05	0,32	9,86	0,99	4,55	2,81	0,74	-	-	2,01	1,50
Melonis pompilioides	Mepo	0,63	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	0,67	-
Miliolinella oblonga	Miob	-	1,02	-	-	0,45	-	-	0,23	-	0,32	-	-	-	-	-	-	-	1,00	-
Miliolinella subrotunda	Misb	1,26	1,02	-	-	-	-	0,43	0,11	-	0,64	-	-	-	-	-	-	-	0,33	-
Neoconorbina terquemi	Nete	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria calomorpha	Ndca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria inflexa	Ndix	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	0,55	-	-	-	0,22	-	-	-	-	-	1,14	-	-	-	1,37	-	0,37
Nodosaria simplex	Ndspx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonion germanicum	Noge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonion sp.	Nosp	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Nonionella bradyi	Nnbr	-	-	-	0,98	-	-	0,87	-	-	-	-	-	-	-	-	-	-	-	0,37
Nonionella iridea	Nnir	-	0,77	-	-	0,45	-	0,22	0,11	0,51	-	-	-	-	0,56	-	-	-	-	0,37
Nonionella turgida	Nntu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	0,26	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	-	1,53	-	-	-	-	0,22	0,11	-	-	-	-	-	0,56	1,48	-	1,37	-	1,12
Nummoloculina irregularis	Numir	-	1,53	-	-	-	-	-	0,57	-	3,22	-	-	-	-	-	-	-	4,01	1,12
Oolina apiculata	Ooap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina desmophora	Oode	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina exagona	Ooex	-	-	-	-	-	-	0,22	0,11	-	-	-	-	-	-	-	-	-	-	-
Oolina felsinea	Oofe	-	0,26	-	1,47	0,45	-	0,22	-	-	-	-	-	-	-	-	-	-	-	-
Oolina globosa	Oogl	1,26	0,26	0,55	0,98	0,45	-	-	0,11	0,26	-	-	-	-	-	-	1,05	1,37	-	-
Oolina melo	Oome	-	-	-	-	-	-	0,43	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Fr1-27	Fr1-28	Fr1-29	Fr2-1	Fr2-2	Fr2-3	Fr2-4	Fr2-5	Fr2-7	Fr2-9	Fr2-10	Fr2-11	Fr2-12	Fr2-13	Fr2-14	Fr2-15	Fr2-16	Fr2-17	Fr2-19
Karreriella apicularis	Karap	0,60	-	0,90	2,26	0,61	1,79	-	-	3,14	1,64	0,68	0,38	-	-	-	1,18	-	2,00	-
Karreriella bradyi	Karbr	-	-	-	-	-	-	0,61	1,36	-	1,09	-	0,77	0,68	-	-	-	-	-	-
Karreriella novangliae	Karno	-	-	-	0,38	-	-	-	0,19	-	-	-	0,38	-	-	-	-	-	-	-
Involutina tenuis	Inte	-	-	-	0,38	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Lagena acuticostata	Laatu	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Lagena advena	Laadv	-	-	-	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena elegantissima	Laele	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena favoso-punctata	Lafvp	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena feildeniana	Lafld	-	-	0,23	-	-	-	-	0,78	-	0,55	-	-	-	2,20	-	1,18	-	-	-
Lagena formosa	Lafor	-	1,01	-	0,75	-	0,89	-	0,19	-	0,55	1,36	1,54	-	-	-	-	-	-	-
Lagena gracilis	Lagra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena gracillima	Lagml	-	-	0,23	0,38	0,61	-	0,15	0,58	0,63	0,55	1,36	-	-	-	-	-	-	-	-
Lagena hispida	Lahis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,18	-	-	-	1,43
Lagena hispidula	lahpd	-	-	-	-	-	-	-	-	-	0,55	-	0,38	0,41	1,10	0,18	-	-	-	1,43
Lagena laevis	Lalvs	-	1,01	0,68	0,75	1,22	1,79	-	0,39	-	-	2,04	1,15	0,41	-	-	-	-	-	-
Lagena meridionalis	Lamer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena plumigera	Laplu	-	-	0,45	-	-	-	-	-	-	-	-	0,38	0,41	-	-	-	-	-	-
Lagena radiato-marginata	Larmg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena stelligera	Lastg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena striata	Lastr	-	1,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena sulcata	Lasul	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Lagena truncata	Latru	-	-	-	-	-	-	-	-	-	-	-	0,38	-	-	-	-	-	-	-
Lagena sp.	Lasp	-	-	-	-	-	-	-	-	-	-	-	0,77	-	1,10	-	-	-	-	-
Laticarinina pauperata	Ltpa	-	-	0,23	0,38	3,05	3,57	-	0,58	0,63	3,28	4,08	2,31	0,95	-	-	3,53	2,63	-	5,71
Lenticulina atlantica	Leat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina calcar	Leca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina cultur	Lecl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina gibba	Legi	-	-	-	0,38	-	0,89	0,15	0,78	-	0,55	0,68	0,38	0,55	-	0,36	1,18	-	-	-
Lenticulina limbosa	Leli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina orbicularis	Leor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina peregrina	Lepe	-	-	-	-	-	-	0,15	0,39	-	-	-	-	-	-	-	-	-	-	-
Lenticulina rotulata	Lero	-	-	-	-	-	-	-	-	-	-	-	-	0,14	-	-	-	-	-	-
Lenticulina vortex	Levo	0,60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina sp.	Lesp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Litotuba lituiformis	Lbli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loxostomum karrerianum	Lxka	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loxostomum limbatum	Lxli	-	-	-	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina glabara	Magl	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Marginulina obesa	Maob	-	-	0,45	-	-	0,89	0,15	0,78	-	-	0,68	-	0,27	-	-	1,18	-	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	0,63	-	0,68	-	0,14	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	1,43
Marsipella elongata	Mrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Martinottiella commmunis	Mtcom	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Martinottiella perparva	Mtpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melonis barleeanum	Meba	7,78	5,05	2,25	2,26	0,61	-	4,86	3,31	2,52	0,55	-	-	4,64	-	1,43	-	4,39	-	-
Melonis pompilioides	Mepo	-	-	-	0,75	-	-	-	-	-	-	1,36	6,92	-	-	5,00	-	-	-	-
Miliolinella oblonga	Miob	1,20	-	1,13	-	-	0,89	1,06	2,72	-	-	-	-	-	-	0,18	-	-	-	-
Miliolinella subrotunda	Misb	0,60	-	0,23	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Neoconorbina terquemi	Nete	-	-	0,90	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Nodosaria calomorpha	Ndca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria inflexa	Ndix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria simplex	Ndspx	-	-	-	-	-	-	-	-	-	-	-	-	0,14	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonion germanicum	Noge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonion sp.	Nosp	-	-	-	-	-	-	-	-	-	0,55	-	-	-	1,10	-	1,18	-	-	2,86
Nonionella bradyi	Nnbr	0,60	1,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	-
Nonionella iridea	Nnir	-	-	0,23	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Nonionella turgida	Nntu	-	3,03	0,45	-	-	-	0,15	1,95	-	-	-	-	-	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	0,38	-	-	0,61	0,39	-	-	-	-	-	-	-	-	-	-	1,43
Nummoloculina contraria	Numco	0,60	1,01	0,68	-	-	-	0,91	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	3,38	1,13	-	-	5,16	7,39	-	-	-	-	-	-	-	-	-	-	-
Oolina apiculata	Ooap	-	1,01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina desmophora	Oode	-	-	-	-	-	-	-	-	-	-	-	-	-	1,10	-	-	-	-	-
Oolina exagona	Ooex	-	-	-	-	-	-	-	0,39	-	-	-	-	-	-	-	-	-	-	-
Oolina felsinea	Oofe	-	-	0,23	0,38	-	-	-	-	-	-	-	0,38	0,14	-	0,18	-	-	1,00	1,43
Oolina globosa	Oogl	-	-	-	0,75	-	1,79	-	0,39	-	1,64	-	0,77	0,41	-	0,36	1,18	1,75	1,00	-
Oolina melo	Oome	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Fr2-20	Fr2-21	Fr2-23	Fr2-24	Fr2-25	Fr2-26	B9407	B9412	B9436	B9437	B9438	B9440	B9441	B9442	S9011	S9024	S9039	S9040	S9045
Karreriella apicularis	Karap	-	-	-	-	-	-	-	1,30	-	-	-	-	-	-	0,61	-	2,63	-	2,06
Karreriella bradyi	Karbr	0,84	0,85	1,35	1,48	0,52	-	0,25	1,30	0,49	-	0,67	-	-	-	1,21	-	-	-	-
Karreriella novangliae	Karno	0,56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Involutina tenuis	Inte	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena acuticostata	Laatu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena advena	Laadv	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena elegantissima	Laele	-	-	-	-	-	0,73	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena favoso-punctata	Lafvp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena feildeniana	Lafld	-	-	-	-	-	-	-	-	0,49	0,35	-	-	-	-	-	-	-	-	-
Lagena formosa	Lafor	-	0,85	-	0,21	-	0,73	-	-	0,49	0,35	-	-	0,87	-	0,61	-	-	0,80	-
Lagena gracilis	Lagra	-	-	-	0,42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena gracillima	Lagml	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Lagena hispida	Lahis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena hispidula	lahpd	0,56	-	-	0,21	-	-	-	-	0,99	0,35	0,67	-	-	-	-	-	-	-	-
Lagena laevis	Lalvs	0,84	0,85	-	0,42	-	-	0,25	-	-	1,04	1,01	1,11	0,87	-	-	0,39	1,32	-	-
Lagena meridionalis	Lamer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	0,39	-	-	-
Lagena plumigera	Laplu	-	0,85	-	0,21	-	-	0,25	-	-	-	-	-	-	-	-	-	-	-	-
Lagena radiato-marginata	Larmg	-	-	-	-	-	-	-	1,30	-	-	-	-	-	-	-	-	-	-	-
Lagena stelligera	Lastg	-	-	-	0,63	-	0,73	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena striata	Lastr	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	0,78	-	-	-
Lagena sulcata	Lasul	0,28	-	-	-	-	-	-	-	0,99	-	-	-	0,87	-	-	-	-	0,80	-
Lagena truncata	Latru	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena sp.	Lasp	-	-	-	-	-	-	-	-	0,49	-	-	-	1,74	-	0,61	0,39	-	-	-
Laticarinina pauperata	Ltpa	-	1,71	-	1,90	0,52	-	-	3,90	0,49	0,35	-	-	-	0,96	0,61	0,39	1,32	-	4,12
Lenticulina atlantica	Leat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Lenticulina calcar	Leca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina cultur	Lecl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina gibba	Legi	0,28	0,85	-	0,63	-	-	0,25	1,30	0,49	-	0,34	1,11	1,74	-	0,61	0,78	-	0,80	-
Lenticulina limbosa	Leli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina orbicularis	Leor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina peregrina	Lepe	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	1,21	0,39	-	-	-
Lenticulina rotulata	Lero	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Lenticulina vortex	Levo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina sp.	Lesp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	1,60	-
Litotuba lituiformis	Lbli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loxostomum karrerianum	Lxka	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,80	-
Loxostomum limbatum	Lxli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina glabara	Magl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina obesa	Maob	0,28	-	-	0,63	0,52	0,73	-	-	-	-	-	-	0,87	-	-	-	1,32	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	0,42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsipella elongata	Mrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Martinottiella commmunis	Mtcom	-	-	-	-	-	-	-	1,30	-	-	-	-	-	-	2,42	3,92	-	1,60	1,03
Martinottiella perparva	Mtpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,78	-	-	-
Melonis barleeanum	Meba	-	-	-	0,42	-	0,73	-	1,30	-	-	3,36	4,44	-	5,77	1,82	4,31	1,32	1,60	2,06
Melonis pompilioides	Mepo	-	-	-	-	-	-	0,25	-	-	0,35	-	-	-	-	-	-	-	-	-
Miliolinella oblonga	Miob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella subrotunda	Misb	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Neoconorbina terquemi	Nete	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Nodosaria calomorpha	Ndca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Nodosaria inflexa	Ndix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	0,52	-	-	-	-	-	-	-	0,87	-	-	0,39	-	-	-
Nodosaria simplex	Ndspx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	0,52	-	-	1,30	-	-	-	-	-	-	-	-	-	-	-
Nonion germanicum	Noge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,57	-	-	-
Nonion sp.	Nosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella bradyi	Nnbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella iridea	Nnir	-	-	-	-	-	-	-	-	-	-	-	-	1,74	-	-	-	-	0,80	-
Nonionella turgida	Nntu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina apiculata	Ooap	-	-	-	-	-	-	-	-	-	0,69	-	-	-	-	-	-	-	-	-
Oolina desmophora	Oode	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina exagona	Ooex	-	-	-	-	-	-	-	-	-	-	0,34	-	-	-	-	-	-	-	-
Oolina felsinea	Oofe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina globosa	Oogl	0,28	0,85	1,35	0,42	0,52	1,46	-	-	0,49	0,35	1,01	-	-	-	-	0,39	1,32	-	1,03
Oolina melo	Oome	-	-	-	-	0,52	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Frl-5	Frl-7	Frl-10	Frl-11	Frl-12	Frl-13	Frl-14	Frl-15	Frl-16	Frl-17	Frl-18	Frl-19	Frl-20	Frl-21	Frl-22	Frl-23	Frl-24	Frl-25	Frl-26
Oolina ovum	Ooov	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-	2,74	-	-
Oolina seminuda	Oose	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina striato-puncata	Oosp	-	-	-	-	-	0,66	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina torquata	Ootq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina sp.	Oosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oridorsalis tener stellatus	Orts	-	-	-	-	0,45	-	0,22	0,11	-	0,64	-	-	-	-	-	-	-	0,33	0,75
Oridorsalis tener umbonatus	Ortu	5,66	2,30	2,75	5,88	4,91	5,30	1,95	3,86	2,81	1,61	1,41	6,60	-	2,25	5,19	9,47	1,37	3,01	3,00
Oridorsalis sp.	Orsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Osangularia cultur	Oscu	3,14	4,86	4,40	0,49	0,89	1,99	3,68	4,09	3,58	3,86	-	4,62	2,27	0,56	6,67	1,05	5,48	3,68	4,12
Parafissurina lateralis	Pala	-	-	-	-	0,45	-	-	-	0,77	-	1,41	0,66	1,14	0,56	-	-	-	0,33	-
Parafissurina sp.	Pasp	0,63	0,51	-	0,49	-	-	-	0,11	-	-	-	0,66	-	-	-	1,05	-	0,33	-
Parafrondicularia sp.	Prsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,74	-	-
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,37
Pelosina rotundata	Pero	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Planulina ariminensis	Plar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurostomella alternans	Psal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,74	-	-	-	-
Pleurostomella sp.	Pssp	-	-	-	-	0,45	0,66	-	-	-	-	-	-	-	-	-	-	-	-	-
Praemassillina arenaria	Paear	-	-	0,55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	4,40	4,60	2,20	4,90	4,91	3,97	3,46	3,06	1,28	0,96	1,41	2,64	3,41	0,56	3,70	3,16	-	3,01	0,37
Pullenia osloensis	Puos	-	-	-	-	-	-	-	0,11	-	-	-	-	2,27	-	-	-	-	-	-
Pullenia quadrilobata	Pu4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia quinqueloba	Pu5	0,63	0,51	1,10	0,98	0,45	1,32	2,16	0,68	1,28	0,96	4,23	0,33	1,14	-	-	1,05	-	1,34	0,75
Pullenia simplex	Pusi	-	0,77	-	-	-	-	0,22	-	-	-	-	-	1,14	-	-	-	-	-	-
Pullenia subcarinata	Pusbc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia sp.	Pusp	-	-	-	-	-	-	0,22	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	1,26	3,07	0,55	0,98	0,45	2,65	0,87	1,59	2,05	0,32	4,23	0,66	1,14	4,49	1,48	2,11	-	1,67	1,12
Pyrgo eleongata	Pyel	-	-	-	-	-	0,66	-	-	-	0,32	1,41	-	-	2,25	0,74	-	-	1,00	0,37
Pyrgo laevis	Pylae	-	-	-	-	-	-	-	0,11	-	-	-	0,33	-	-	-	-	-	-	-
Pyrgo lucernula	Pylu	-	-	-	-	0,45	0,66	0,22	0,11	-	-	-	-	1,14	-	-	-	-	-	0,37
Pyrgo murrhina	Pyu	1,89	1,79	2,75	2,45	2,23	0,66	2,16	1,48	0,51	0,96	-	3,63	2,27	-	1,49	1,05	-	3,01	4,87
Pyrgo serrata	Pyse	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-	-	-	-
Pyrgo vespertilio	Pyve	-	-	-	-	-	0,66	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Pyrgo sp.	Pysp	1,26	-	-	-	-	-	0,43	0,11	-	-	-	-	-	-	-	-	-	-	-
Pyrgoella sphera	Pgyf	-	1,28	-	-	-	-	-	0,11	-	0,64	-	-	2,27	3,37	1,48	-	2,74	1,67	1,87
Pyrgoella sp.	Pgysp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina angusta	Pyra	-	-	-	0,49	0,89	0,66	-	-	-	-	-	-	-	-	-	-	-	-	0,37
Pyrulina extensa	Pyrex	-	-	-	-	-	-	0,22	0,11	-	-	-	-	-	-	-	1,05	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	0,49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	-	-	-	0,51	-	-	-	-	-	-	-	1,37	0,33	0,37
Quinqueloculina cf. auberiana	Quau	-	0,26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina contorta	Quco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina granulo-costata	Qugc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina inmata	Quin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	0,63	1,02	0,55	-	-	1,32	-	0,23	-	-	-	-	-	1,69	0,74	-	-	0,33	-
Quinqueloculina seminulum	Qusem	0,63	1,28	2,75	1,96	3,57	2,65	0,65	3,86	1,02	2,25	1,41	2,31	1,14	5,06	2,22	4,21	2,74	2,01	2,25
Quinquqloculina stelligera	Qutg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	1,89	-	0,55	-	1,34	-	-	-	-	-	-	-	-	2,25	-	1,05	1,37	-	-
Quinqueloculina sp.	Qusp	0,63	-	-	0,49	-	-	-	-	0,26	-	-	0,33	-	1,69	-	-	-	-	-
Rectobolivina columellaris	Reco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	0,33	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina cf. rotundata	Rgro	-	-	-	-	-	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina torrida	Rgto	-	-	-	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	-	-
Recurvoides turbunatis	Rctu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax bacillaris	Reoba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax difflugiformis	Reodif	-	-	-	-	-	-	-	-	-	-	-	0,66	-	-	-	-	-	-	-
Reophax distans	Reostn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Reophax guttifer	Roegu	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	-	-	-	-	0,45	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	-	-	0,55	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Reophax scorpius	Reosc	-	-	-	-	-	-	-	-	-	-	1,41	-	-	-	-	-	-	0,67	-
Reophax spiculifer	Reoplf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,37	0,67	-
Reophax sp.	Reosp	-	-	-	0,49	0,45	0,66	0,22	0,11	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella spinulosa	Rllsp	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdammina abyssorum	Rhay	-	-	-	0,49	-	-	-	0,11	0,26	0,32	-	0,33	1,14	-	-	1,05	-	0,33	-
Rhizammina algaeformis	Rial	-	-	0,55	0,49	0,45	0,66	-	0,11	0,26	-	1,41	0,33	-	-	0,74	-	-	0,33	0,37

Species	Code	Fr1-27	Fr1-28	Fr1-29	Fr2-1	Fr2-2	Fr2-3	Fr2-4	Fr2-5	Fr2-7	Fr2-9	Fr2-10	Fr2-11	Fr2-12	Fr2-13	Fr2-14	Fr2-15	Fr2-16	Fr2-17	Fr2-19
Oolina ovum	Ooov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina seminuda	Oose	-	-	-	-	-	-	-	-	-	-	0,68	-	-	1,10	0,36	-	-	-	-
Oolina striato-puncata	Oosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina torquata	Ootq	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	1,43
Oolina sp.	Oosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oridorsalis tener stellatus	Orts	-	-	0,23	0,75	1,22	-	0,46	-	0,63	1,09	0,68	0,77	0,14	-	-	-	-	-	-
Oridorsalis tener umbonatus	Ortu	-	3,03	1,80	3,38	4,88	8,04	2,43	0,58	9,43	9,64	2,72	11,54	7,64	9,89	5,89	3,53	16,67	3,00	4,29
Oridorsalis sp.	Orsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Osangularia cultur	Oscu	2,99	2,02	2,93	0,75	-	-	0,91	0,39	-	0,55	-	0,77	0,82	-	-	-	1,75	2,00	-
Parafissurina lateralis	Pala	0,60	2,02	-	0,38	-	0,89	-	0,58	1,89	-	-	0,77	0,27	-	-	-	-	2,00	-
Parafissurina sp.	Pasp	-	-	0,45	-	0,61	-	-	0,39	1,89	1,64	-	1,54	0,14	-	0,54	-	0,88	-	-
Parafrondicularia sp.	Prsp	4,19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pelosina rotundata	Pero	-	-	-	-	0,61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planulina ariminensis	Plar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurostomella alternans	Psal	-	-	-	-	-	-	-	-	-	-	0,68	-	0,14	-	-	-	-	-	1,43
Pleurostomella sp.	Pssp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Praemassillina arenaria	Paear	0,60	-	-	-	-	-	0,15	-	0,63	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	1,80	-	4,50	0,75	1,22	3,57	2,58	0,78	6,92	7,65	4,08	3,08	1,23	1,10	4,29	3,53	3,51	1,00	2,86
Pullenia osloensis	Puos	0,60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia quadrilobata	Pu4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia quinqueloba	Pu5	1,80	-	0,90	1,13	1,22	1,79	1,82	3,11	3,14	3,83	2,72	2,31	1,09	1,10	-	3,53	2,63	1,00	4,29
Pullenia simplex	Pusi	-	1,01	-	-	0,61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia subcarinata	Pusbc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia sp.	Pusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	-	1,01	0,45	0,75	-	-	0,76	0,78	-	1,64	-	0,38	0,41	1,10	0,18	-	0,88	2,00	1,43
Pyrgo eleongata	Pyel	0,60	-	0,90	-	-	-	1,52	0,58	-	-	-	-	-	-	-	-	-	-	-
Pyrgo laevis	Pylae	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo lucernula	Pylu	2,40	-	0,23	1,13	-	-	0,15	0,39	0,63	-	-	0,38	0,41	1,10	0,54	3,53	-	-	-
Pyrgo murrhina	Pyu	1,20	8,08	0,23	2,63	5,49	7,14	1,52	1,56	1,89	4,92	6,12	2,69	2,05	10,99	5,89	5,88	6,14	10,00	8,57
Pyrgo serrata	Pyse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,88	-	-
Pyrgo vespertilio	Pyve	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	-	1,01	-	-	-	-	0,30	0,19	-	-	-	0,38	-	-	0,19	-	0,88	-	-
Pyrgoella sphera	Pgyf	4,79	4,04	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Pyrgoella sp.	Pgysp	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina angusta	Pyra	-	-	-	-	-	-	-	0,19	1,26	0,55	0,68	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	-	-	-	-	0,61	-	-	-	-	-	-	-	-	1,10	0,18	-	-	-	1,43
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	0,19	0,63	-	0,68	-	-	-	-	-	-	-	-
Pyrulina gutta	Pyrgu	-	1,01	-	0,38	1,22	0,89	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina cf. *auberiana*	Quau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina contorta	Quco	-	-	1,13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina granulo-costata	Qugc	0,60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina inmata	Quin	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	0,60	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum	Qusem	2,40	2,02	1,13	2,63	1,83	1,79	4,40	1,95	3,14	1,09	6,12	1,54	1,09	3,30	0,36	1,18	-	2,00	-
Quinquqloculina stelligera	Qutg	-	-	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	-	1,01	0,45	1,13	-	0,89	0,15	-	-	-	-	-	-	-	0,71	1,18	-	-	1,43
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina columellaris	Reco	-	-	-	-	-	-	0,15	0,19	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	4,86	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	-	-	-	-	0,38	-	-	-	-	-	-	-
Rectoglandulina cf. *rotundata*	Rgro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina torrida	Rgto	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recurvoides turbunatis	Rctu	-	-	-	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax bacillaris	Reoba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,89	-	1,43
Reophax difflugiformis	Reodif	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax distans	Reostn	-	-	-	-	0,61	1,79	-	-	0,63	-	-	-	-	-	-	-	0,88	2,00	-
Reophax guttifer	Roegu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,43
Reophax nodulosus	Reono	-	-	-	-	-	0,89	-	-	0,63	-	-	-	-	-	-	-	-	-	1,43
Reophax pilulifer	Reopi	0,60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax scorpius	Reosc	-	-	-	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	-	1,43
Reophax spiculifer	Reoplf	-	1,01	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax sp.	Reosp	-	-	-	0,38	0,61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	1,20	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella spinulosa	Rllsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdammina abyssorum	Rhay	-	-	0,23	0,38	0,61	0,89	-	0,19	-	-	0,68	0,38	-	-	-	1,18	0,88	1,00	1,43
Rhizammina algaeformis	Rial	0,60	-	-	-	0,61	-	-	0,19	-	-	-	-	0,14	-	-	-	0,88	1,00	1,43

Species	Code	Fr2-20	Fr2-21	Fr2-23	Fr2-24	Fr2-25	Fr2-26	B9407	B9412	B9436	B9437	B9439	B9440	B9441	B9442	S9011	S9024	S9039	S9040	S9045
Oolina ovum	Ooov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina seminuda	Oose	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,03
Oolina striato-puncata	Oosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina torquata	Ootq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oolina sp.	Oosp	0,28	-	-	-	-	-	-	-	1,48	-	-	-	-	-	-	-	1,32	-	-
Oridorsalis tener stellatus	Orta	-	-	1,35	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Oridorsalis tener umbonatus	Ortu	5,34	3,42	6,76	2,11	3,66	3,65	0,49	10,39	3,94	5,54	6,38	3,33	1,74	12,50	4,24	0,78	11,84	0,80	2,06
Oridorsalis sp.	Orsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,60	-
Osangularia cultur	Oscu	1,12	-	4,05	6,77	4,71	2,19	-	-	-	1,04	-	2,22	6,96	-	3,03	-	-	-	1,03
Parafissurina lateralis	Pala	-	-	-	0,42	-	-	0,49	-	-	-	-	-	-	-	0,61	-	-	-	-
Parafissurina sp.	Pasp	1,40	-	1,35	0,63	0,52	-	0,25	-	-	-	-	-	-	-	-	-	-	-	-
Parafrondicularia sp.	Prsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pelosina rotundata	Pero	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planulina ariminensis	Plar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	0,80	-
Pleurostomella alternans	Psal	-	-	-	0,42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurostomella sp.	Pssp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Praemassillina arenaria	Paear	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	6,46	6,84	2,70	2,11	1,57	6,57	1,23	5,19	2,46	4,15	1,68	2,22	1,74	-	9,70	8,24	1,32	2,40	4,12
Pullenia osloensis	Puos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,03
Pullenia quadrilobata	Pu4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Pullenia quinqueloba	Pu5	0,84	0,85	1,35	1,90	-	2,19	1,23	1,30	1,97	1,04	4,03	1,11	5,22	-	1,21	1,57	3,95	-	-
Pullenia simplex	Pusi	-	-	1,35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia subcarinata	Pusbc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	-	-	-	-
Pullenia sp.	Pusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	0,84	1,71	-	0,21	0,52	0,73	-	2,60	0,49	0,35	0,67	1,11	-	-	0,61	1,57	2,63	-	1,03
Pyrgo eleongata	Pyel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo laevis	Pylae	-	-	-	-	-	-	-	-	0,49	-	-	-	-	-	-	-	-	-	-
Pyrgo lucernula	Pylu	-	-	1,35	-	-	-	-	-	0,49	-	-	-	-	-	-	-	-	-	1,03
Pyrgo murrhina	Pyu	9,83	6,84	1,35	2,96	3,14	3,65	1,72	-	8,37	9,00	18,46	1,11	4,35	2,88	-	-	2,63	-	10,31
Pyrgo serrata	Pyse	-	-	-	-	-	-	-	1,30	-	-	-	-	-	0,96	-	-	-	-	-
Pyrgo vespertilio	Pyve	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	0,28	-	-	-	-	-	0,25	-	0,49	-	-	-	-	-	-	0,39	-	-	-
Pyrgoella sphera	Pgyf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgoella sp.	Pgysp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina angusta	Pyra	0,84	-	-	0,21	-	0,73	-	-	-	-	0,34	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	0,28	1,71	-	-	-	-	-	-	0,49	-	0,34	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	0,85	-	-	-	0,73	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina cf. auberiana	Quau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina contorta	Quco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina granulo-costata	Qugc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina inmata	Quin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	-	-	-	-	-	-	1,30	0,49	-	-	-	-	-	0,61	-	-	-	-
Quinqueloculina seminulum	Qusem	1,40	0,85	1,35	2,54	2,09	4,38	-	1,30	0,49	2,08	0,67	-	-	-	-	0,39	-	-	2,06
Quinquqloculina stelligera	Qutg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	-	0,85	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina columellaris	Reco	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	0,39	-	0,80	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	-	-	-	1,74	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	-	-	0,35	-	-	-	-	-	-	-	-	-
Rectoglandulina cf. rotundata	Rgro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina torrida	Rgto	-	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Recurvoides turbunatis	Rctu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax bacillaris	Reoba	-	-	-	-	-	-	-	1,30	-	-	-	-	-	-	-	-	-	-	-
Reophax difflugiformis	Reodif	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax distans	Reostn	-	-	-	-	-	-	0,25	1,30	-	-	-	-	0,87	-	0,61	-	1,32	-	-
Reophax guttifer	Roegu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	-	0,85	-	0,21	-	-	0,25	1,30	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax scorpius	Reosc	-	-	-	-	0,52	0,73	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax spiculifer	Reoplf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax sp.	Reosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,32	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella spinulosa	Rllsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdammina abyssorum	Rhay	-	-	-	-	-	-	0,25	1,30	-	0,35	-	-	0,87	-	0,61	-	1,32	-	1,03
Rhizammina algaeformis	Rial	0,28	0,85	-	0,21	0,52	0,73	-	-	-	-	-	-	-	-	0,61	-	-	-	-

Species	Code	Frl-5	Frl-7	Frl-10	Frl-11	Frl-12	Frl-13	Frl-14	Frl-15	Frl-16	Frl-17	Frl-18	Frl-19	Frl-20	Frl-21	Frl-22	Frl-23	Frl-24	Frl-25	Frl-26
Robertina oceanica	Rboc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,74	-	-	-	-
Robertina tasmanica	Rbta	-	2,05	1,10	-	-	-	0,87	0,79	-	0,32	-	-	-	-	2,22	1,05	1,37	1,00	0,37
Robertinoides brady	Robbr	-	1,02	-	-	-	0,66	-	-	0,26	-	-	-	-	-	-	-	-	-	-
Rosalina concinna	Rsco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Rosalina globularis	Rsgl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saccamina sphaerica	Sasp	-	-	0,55	-	-	-	-	0,11	-	-	-	-	-	-	-	-	-	0,33	-
Saccorhiza ramosa	Scra	-	-	0,55	-	0,45	0,66	0,22	0,11	0,26	0,32	-	-	-	-	-	1,05	-	-	-
Sagrinella sp.	Sgr	-	-	-	-	-	-	-	0,91	-	-	-	-	-	-	-	-	-	-	0,37
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	0,63	1,28	1,10	0,49	0,45	3,97	0,65	2,27	3,07	0,64	1,41	1,32	2,27	0,56	2,96	4,21	-	0,67	0,37
Siphoeggerella siphonella	Sphsph	-	-	-	-	-	-	-	-	0,26	-	-	-	-	-	-	-	-	-	-
Siphonina bardyana	Siphbr	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	0,51	-	0,49	0,45	0,66	-	0,34	0,51	0,32	-	0,33	-	1,12	-	2,11	-	-	0,75
Siphotextularia curta	Stxcu	-	0,77	-	-	-	-	0,65	-	0,77	0,32	2,82	-	-	-	-	-	-	-	-
Siphotextularia sp.	Stxsp	-	-	-	-	-	0,66	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	-	-	-	-	-	-	-	0,23	1,53	0,96	-	-	-	-	-	2,11	-	1,00	-
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	-	0,55	-	-	-	-	0,23	-	-	-	-	-	-	-	-	-	0,33	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,37	0,33	-
Spiroloculina tenuis	Srten	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuiseptata	Srspt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Stainforthia concava	Stfcnv	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-	-	-	-
Technitella bradyi	Tchb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,37	-	-
Technitella legumen	Tchle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia agglutinans	Txag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia conica	Txco	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	-	-	-	-	-	-	1,69	-	-	-	-	-
Textularia lateralis	Txlat	-	1,28	0,55	-	-	-	0,87	1,02	0,77	-	-	-	-	1,69	-	-	-	-	-
Textularia lythostrota	Txlyt	0,63	-	-	-	-	-	0,87	0,11	1,28	-	-	-	-	3,93	-	-	-	1,00	-
Textularia porrecta	Txpo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	-	0,26	-	-	-	-	-	0,23	-	-	-	-	-	-	-	-	-	0,67	-
Textularia sp.	Txsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thurammina papillata	Thpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolypammina schaudinni	Tosch	-	-	0,55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolypammina sp.	Tosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina angulosa	Tfan	-	0,26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina cuneata	Trcu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina dubia	Trdu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina insignis	Trin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	1,79	-	-	-	-	-	-	-	0,32	-	-	-	1,12	-	-	1,37	-	-
Triloculina tricarinata	Trtr	-	1,79	-	0,98	-	-	0,22	0,11	0,51	1,93	-	0,33	-	-	-	-	1,37	1,34	2,25
Triloculina trigonula	Trgo	0,63	0,51	-	-	-	-	0,22	-	-	-	-	0,33	-	-	-	-	2,74	-	0,75
Triloculina sp.	Trsp	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-	-	-	-
Trochammina inflata	Trhin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina globigeriniformis	Trhgl	-	-	0,55	-	-	0,66	0,22	-	3,07	0,64	-	-	-	-	-	1,05	-	-	0,37
Trochammina pigmaea	Trhpi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina quadricamerata	Trhq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina sp.	Trhsp	-	-	-	-	-	-	-	-	0,26	-	-	-	-	-	-	1,05	-	-	-
Uvigerina hispida	Uvhi	-	0,51	0,55	-	-	-	-	0,23	0,51	0,64	1,41	-	1,14	0,56	-	-	-	-	-
Uvigerina peregrina	Uvpe	-	0,77	12,64	0,98	1,34	6,62	1,73	6,02	4,35	0,96	1,41	8,91	3,41	4,49	-	-	6,85	1,00	1,87
Uvigerina porrecta	Uvpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	3,14	2,05	-	2,45	1,79	0,66	3,25	3,41	1,79	15,11	9,45	1,98	-	-	2,96	-	-	1,34	-
Uvigerina sp.	Uvsp	-	-	1,10	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-	-
Vaginulinopsis sublegumen	Vgsleg	-	-	0,55	-	-	-	0,22	0,11	0,26	-	-	-	1,14	-	-	-	-	-	0,37
Vaginulinopsis tasmanica	Vgsta	-	-	-	0,49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulinopsis sp.	Vgssp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvulineria araucana	Vlva	-	0,51	-	-	-	-	0,22	0,23	0,26	-	-	-	-	-	-	-	-	2,01	-
Virgulina rotundata	Virtnf	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-	-	-	-	-
Vulvulina pennatula	Vuvpe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Fr1-27	Fr1-28	Fr1-29	Fr2-1	Fr2-2	Fr2-3	Fr2-4	Fr2-5	Fr2-7	Fr2-9	Fr2-10	Fr2-11	Fr2-12	Fr2-13	Fr2-14	Fr2-15	Fr2-16	Fr2-17	Fr2-19
Robertina oceanica	Rboc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	0,60	1,01	1,13	0,38	-	-	1,06	2,53	-	-	-	-	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Rosalina concinna	Rsco	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Rosalina globularis	Rsgl	-	-	-	1,13	-	-	-	0,97	-	-	-	-	-	-	-	-	-	-	-
Saccamina sphaerica	Sasp	-	-	-	-	-	-	-	-	0,63	-	-	-	-	-	-	-	1,75	1,00	-
Saccorhiza ramosa	Scra	0,60	-	0,23	0,38	-	-	-	0,19	0,63	-	-	-	-	-	-	-	-	1,00	-
Sagrinella sp.	Sgr	-	-	-	-	-	-	-	-	-	-	-	-	0,41	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	0,60	-	0,45	1,50	-	0,89	0,61	0,19	0,63	-	-	0,38	0,27	-	-	-	-	-	-
Siphoeggerella siphonella	Sphsph	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphonina bardyana	Siphbr	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	0,60	-	0,23	-	-	-	-	-	2,52	-	1,36	0,77	1,09	1,10	0,54	5,88	-	-	-
Siphotextularia curta	Stxcu	-	-	0,68	-	-	-	-	0,58	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia sp.	Stxsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,43
Sphaeroidina bulloides	Sbull	-	-	0,68	0,38	3,05	2,68	1,06	4,28	4,40	0,55	2,04	-	0,27	1,10	-	1,19	3,51	1,00	1,43
Spiroloculina communis	Srcom	1,20	-	0,23	-	-	-	0,15	0,39	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	0,60	-	-	-	-	-	0,30	0,19	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	-	-	0,45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuiseptata	Srspt	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,71	-	-	-	-
Stainforthia concava	Stfcnv	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella bradyi	Tchb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella legumen	Tchle	-	-	0,23	-	-	-	-	0,19	0,63	-	-	-	-	-	-	-	-	1,00	-
Textularia agglutinans	Txag	-	-	-	-	-	-	-	-	1,26	-	-	-	-	2,20	1,43	-	-	-	-
Textularia conica	Txco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	1,80	1,01	-	-	-	-	0,15	0,58	-	-	-	-	-	-	-	-	-	-	-
Textularia lateralis	Txlat	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	0,45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia porrecta	Txpo	-	-	-	-	0,61	-	-	-	-	-	-	-	-	-	-	-	-	-	1,43
Textularia pseudogramen	Txpgr	-	3,03	-	-	-	-	0,30	1,17	-	-	-	-	0,14	-	-	-	-	-	-
Textularia sp.	Txsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,19	-	-	-
Thurammina papillata	Thpa	-	-	-	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolypammina schaudinni	Tosch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolypammina sp.	Tosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina angulosa	Tfan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	0,58	-	-	-	-	-	-	-	-	-	-	-
Triloculina cuneata	Trcu	-	-	0,68	-	-	-	0,30	0,39	-	-	-	-	-	-	-	-	-	-	-
Triloculina dubia	Trdu	-	-	0,23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina insignis	Trin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	1,01	0,45	-	-	-	0,61	0,39	-	-	-	-	-	-	-	-	-	-	-
Triloculina tricarinata	Trtr	-	-	1,35	4,51	-	-	1,21	2,92	-	0,55	0,68	-	-	-	0,18	-	-	1,00	-
Triloculina trigonula	Trgo	-	3,03	-	-	-	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Triloculina sp.	Trsp	-	1,01	-	-	0,61	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-
Trochammina inflata	Trhin	-	-	-	0,38	-	-	-	-	1,26	-	-	-	-	-	-	-	-	-	-
Trochammina globigeriniformis	Trhgl	-	-	-	1,13	0,61	-	-	0,19	0,63	-	-	0,38	-	-	-	-	1,75	-	-
Trochammina pigmaea	Trhpi	-	-	-	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina quadricamerata	Trhq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina sp.	Trhsp	-	-	0,45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina hispida	Uvhi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	-
Uvigerina peregrina	Uvpe	-	3,03	1,13	-	6,71	-	0,15	0,39	-	3,28	1,36	1,54	3,82	8,79	-	-	-	-	-
Uvigerina porrecta	Uvpr	-	-	0,23	-	-	-	-	-	-	0,55	-	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	2,40	1,01	-	0,75	6,71	-	0,61	1,95	0,63	0,55	-	4,23	3,82	3,30	-	2,35	1,75	16,00	-
Uvigerina sp.	Uvsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulinopsis sublegumen	Vgsleg	-	-	0,23	0,38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulinopsis tasmanica	Vgsta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulinopsis sp.	Vgssp	-	-	-	-	-	-	0,15	-	-	-	-	-	-	-	-	-	-	-	-
Valvulineria araucana	Vlva	-	-	1,35	-	-	-	-	0,78	-	-	-	-	-	-	-	-	-	-	-
Virgulina rotundata	Virtnf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vulvulina pennatula	Vuvpe	-	-	-	-	-	-	0,30	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	Fr2-20	Fr2-21	Fr2-23	Fr2-24	Fr2-25	Fr2-26	B9407	B9412	B9436	B9437	B9438	B9440	B9441	B9442	S9011	S9024	S9039	S9040	S9045
Robertina oceanica	Rboc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	0,21	0,52	-	-	-	-	-	-	1,11	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosalina concinna	Rsco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosalina globularis	Rsgl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saccamina sphaerica	Sasp	-	-	-	-	-	-	-	-	-	0,35	-	-	0,87	-	-	-	-	-	-
Saccorhiza ramosa	Scra	-	-	-	-	-	-	-	-	-	-	-	-	0,87	0,96	1,21	-	2,63	-	1,03
Sagrinella sp.	Sgr	1,97	-	-	0,42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	0,35	-	1,11	-	-	-	0,39	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	-	-	1,35	0,42	-	-	-	6,49	-	-	-	-	-	2,88	-	0,39	2,63	1,60	1,03
Siphoeggerella siphonella	Sphsph	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphonina bardyana	Siphbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	-	-	0,42	1,57	0,73	-	1,30	-	-	-	-	0,87	1,92	-	-	-	-	-
Siphotextularia curta	Stxcu	0,84	0,85	-	-	-	-	-	-	-	-	-	1,11	-	-	-	-	-	-	-
Siphotextularia sp.	Stxsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	0,84	4,27	-	0,42	0,52	2,19	-	-	0,99	-	-	-	-	-	-	-	-	-	-
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	-	-	-	-	-	0,25	-	-	-	-	-	-	-	-	1,57	-	-	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuiseptata	Srspt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	0,21	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Stainforthia concava	Stfcnv	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella bradyi	Tchb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella legumen	Tchle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia agglutinans	Txag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia conica	Txco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lateralis	Txlat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	0,39	-	-	-
Textularia lythostrota	Txlyt	-	-	-	0,42	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Textularia porrecta	Txpo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Textularia sp.	Txsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,80	-
Thurammina papillata	Thpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolypammina schaudinni	Tosch	-	-	-	-	-	-	-	1,30	-	-	-	-	-	-	-	-	-	-	-
Tolypammina sp.	Tosp	-	-	-	-	-	0,73	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina angulosa	Tfan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-
Triloculina cuneata	Trcu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina dubia	Trdu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina insignis	Trin	-	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina tricarinata	Trtr	1,12	-	-	-	-	-	-	-	-	-	-	1,11	1,74	-	-	-	-	-	-
Triloculina trigonula	Trgo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,61	1,18	-	-	-
Triloculina sp.	Trsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina inflata	Trhin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina globigeriniformis	Trhgl	-	0,85	-	-	0,52	-	0,25	-	-	0,35	0,34	-	-	0,96	-	-	-	-	-
Trochammina pigmaea	Trhpi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina quadricamerata	Trhq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,32	-	-
Trochammina sp.	Trhsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,03
Uvigerina hispida	Uvhi	-	-	-	-	0,52	-	-	-	-	-	-	-	-	-	-	-	-	4,00	-
Uvigerina peregrina	Uvpe	1,69	-	9,46	5,50	3,66	-	-	1,30	-	2,42	0,34	-	2,61	1,92	-	0,39	-	4,00	3,09
Uvigerina porrecta	Uvpr	1,12	-	-	1,27	-	1,46	-	-	-	0,69	-	-	-	-	0,61	1,18	-	-	-
Uvigerina proboscidea	Uvprob	5,62	0,85	-	5,92	1,57	1,46	0,25	1,30	-	2,06	-	-	7,83	0,96	20,00	8,24	-	12,00	-
Uvigerina sp.	Uvsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,80	-
Vaginulinopsis sublegumen	Vgsleg	-	-	-	0,21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulinopsis tasmanica	Vgsta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulinopsis sp.	Vgssp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvulineria araucana	Vlva	-	-	-	0,85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Virgulina rotundata	Virtnf	-	-	-	-	-	-	-	-	-	-	-	-	0,87	-	-	-	-	-	-
Vulvulina pennatula	Vuvpe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,39	-	-	-

APPENDIX A2

Counts data of benthic foraminifera from *Fr10/95 GC17* samples. Numbers are given as percentage of the total number of specimens in each sample.

Fr10/95 GC17 Species %

Species	Code	0-1 cm	3-4 cm	5-6 cm	9-10 cm	13-14 cm	17-18 cm	21-22 cm	25-26 cm	29-30 cm	33-34 cm	37-38 cm	41-42 cm	45-46 cm	49-50 cm	53-54 cm	57-58 cm
Allomorphina pacifica	Allpa	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium ringens	Alvri	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium subglobosum	Alvug	1,29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites sp.	Absp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,62	-
Ammodiscus incertus	Adsin	0,96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia beccarii	Ambe	-	-	-	-	-	0,40	-	0,39	-	-	-	0,49	0,73	0,56	0,62	0,45
Amphicoryna scalris	Amphsl	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna sp.	Amphsp	-	-	-	0,40	-	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	-	0,35	-	1,59	-	0,40	-	0,39	-	1,46	-	-	0,73	0,56	1,87	1,35
Astacolus crepidulus	Atacre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astrononion echolsi	Astrech	0,32	-	-	0,79	0,37	-	1,32	-	1,58	0,98	1,63	2,44	2,92	2,89	3,61	4,36
Astrononion stelligerum	Astrst	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bigenerina nodosaria	Bino	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina albatrossi	Bolalb	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	5,79	12,50	9,69	1,32	9,56	14,68	13,66	11,37	7,54	11,17	9,24	5,29	8,76	2,89	4,82	3,59
Bolivina seminuda	Bolsem	-	-	-	-	-	-	0,45	-	-	0,49	-	0,49	0,73	0,56	-	-
Bolivinita quadrilatera	Blql	0,96	0,35	1,25	-	-	-	0,45	-	-	0,49	-	1,44	0,73	-	1,25	0,90
Brizalina dilatata	Brdi	6,44	3,47	5,61	3,57	2,57	5,56	1,32	3,53	4,22	2,91	2,72	1,92	6,57	2,89	1,87	4,36
Brizalina semilineata	Brsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina sp.	Brsp	-	-	-	-	-	-	-	0,39	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina alazanensis	Bualz	0,32	-	-	0,40	-	0,40	-	-	1,53	0,49	-	1,44	-	1,12	0,62	-
Bulimina costata	Buco	0,32	0,35	-	1,19	-	0,79	0,45	0,39	2,15	-	2,17	2,88	0,73	1,12	1,87	0,45
Bulimina marginata	Buma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella elegantissima	Bumel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella sp.	Bumsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina carinata	Casri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina crassa	Cascr	1,29	0,35	-	1,59	0,37	1,19	0,45	0,39	0,53	0,98	0,54	0,49	-	-	-	1,79
Ceratobulimina pacifica	Cerpa	2,57	1,42	2,48	2,39	5,15	2,78	3,84	5,98	1,53	0,49	4,35	5,29	3,65	4,49	2,50	4,93
Chilostomella oolina	Chol	2,26	1,39	-	1,19	1,13	0,40	1,32	0,78	1,53	0,49	-	-	-	0,56	0,62	0,45
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	3,54	3,13	3,57	3,97	3,68	3,57	2,23	3,53	3,52	4,37	4,89	5,29	6,57	1,11	7,23	5,38
Cibicidoides kullenbergi	Ciku	2,26	0,69	1,25	0,79	0,37	0,79	-	1,97	-	0,98	0,54	2,44	0,73	2,25	-	0,90
Cibicidoides pseudoungerianus	Cipse	0,96	3,47	4,59	5,16	4,41	2,39	2,64	1,57	3,16	3,40	4,35	2,88	5,84	6,74	4,82	4,93
Cibicidoides robertsonianus	Cirob	0,32	-	-	-	-	0,79	-	-	0,53	0,98	-	0,96	0,73	-	0,62	0,45
Cibicidoides wuellerstorfi	Ciwul	2,57	3,13	1,25	3,17	0,74	1,98	3,84	1,97	2,51	2,91	4,89	3,85	1,46	2,25	5,42	3,14
Cibicidoides sp.	Cisp	-	0,35	0,51	0,40	-	-	-	-	-	-	-	-	-	-	1,87	0,90
Cornuspira carinata	Coca	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-	-	-
Cornuspira involvens	Coin	0,32	-	-	-	-	-	0,45	1,18	1,53	-	-	-	-	-	-	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspiroides primitivus	Csppr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	-	-	-	-	-	-	0,39	-	-	-	0,49	-	-	-	0,90
Cyclammina cancellata	Cyca	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	0,45
Dentalina filiformis	Defi	-	-	-	0,40	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	2,55	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Deasub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	-	-	-	0,40	-	-	0,45	-	0,53	-	-	-	-	-	-	-
Discopulvinulina araucana	Dspara	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina subbertheloti	Dspber	-	-	0,51	0,40	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia exilis	Doex	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	0,32	0,35	-	0,40	0,37	-	-	-	1,53	0,49	-	0,49	1,46	1,12	-	-
Eggerella scabra	Eggsc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella sp.	Eggsp	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ehrenbergina trigona	Ehtr	0,96	0,69	2,55	0,40	0,74	1,19	-	0,78	4,52	4,27	4,35	4,88	2,92	3,38	2,50	3,59
Elphidium crispum	Elcr	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elphidium incertum	Elin	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-	-	-
Epistominella umbonifera	Exum	0,32	1,74	0,51	0,40	-	-	0,45	1,18	0,53	0,49	-	1,92	0,73	1,12	1,15	0,45
Eponides regularis	Epre	-	0,35	-	-	-	-	1,32	-	-	-	-	-	-	-	-	-
Eponides tumiduls	Eptum	-	1,39	1,25	0,40	-	-	-	-	-	-	-	-	-	-	-	-
Eponides sp.	Epsp	-	-	-	-	0,37	-	-	-	-	-	-	-	-	-	-	-

Fr10/95 GC17 Species %

Species	Code	61-62 cm	65-66 cm	69-70 cm	73-74 cm	77-78 cm	81-82 cm	85-86 cm	89-90 cm	93-94 cm	97-98 cm	101-102 cm	105-106 cm	109-110 cm	113-114 cm	117-118 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	0,47	-	0,36	0,32	-	0,29	-	0,49	-	0,36
Alveolophragmium ringens	Alvri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium subglobosum	Alvug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites sp.	Absp	-	-	-	0,88	0,42	-	1,27	-	-	-	-	-	-	-	-
Ammodiscus incertus	Adsin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia beccarii	Ambe	-	0,50	-	0,44	0,42	-	0,42	0,36	-	-	-	0,28	-	-	0,36
Amphicoryna scalris	Amphsl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna sp.	Amphsp	-	0,50	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	0,93	0,50	0,53	0,88	-	0,47	0,42	0,72	0,96	1,83	-	0,28	0,49	0,91	-
Astacolus crepidulus	Atacre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astrononion echolsi	Astrech	3,74	2,46	2,13	2,65	1,69	2,84	0,42	3,62	1,59	0,91	1,12	2,78	2,94	2,74	1,44
Astrononion stelligerum	Astrst	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bigenerina nodosaria	Bino	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina albatrossi	Bolalb	-	-	-	-	-	-	0,42	-	-	-	-	0,28	-	-	-
Bolivina robusta	Bolro	5,56	2,46	3,19	1,77	2,12	2,34	1,69	3,62	3,16	1,83	2,25	2,50	2,46	3,35	5,54
Bolivina seminuda	Bolsem	-	0,82	-	0,88	0,42	-	-	-	-	-	0,29	0,28	-	-	-
Bolivinita quadrilatera	Blql	-	1,64	1,64	0,88	-	0,47	0,42	1,87	1,59	1,37	1,97	2,22	3,43	3,49	2,59
Brizalina dilatata	Brdi	5,56	5,33	2,66	2,65	1,27	0,47	2,12	1,45	0,32	-	-	1,39	0,98	0,91	2,17
Brizalina semilineata	Brsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina sp.	Brsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	-	-	-	-	-	-	-	-	-	-	0,28	-	0,35	-
Bulimina alazanensis	Bualz	-	0,50	-	-	-	0,47	-	-	-	0,46	0,29	0,83	0,49	2,74	0,72
Bulimina costata	Buco	-	1,23	-	1,33	-	0,47	2,12	0,36	0,64	-	0,29	0,56	-	-	-
Bulimina marginata	Buma	-	-	0,53	-	-	0,47	0,42	-	-	-	-	-	-	0,35	-
Buliminella elegantissima	Bumel	-	-	-	0,44	-	-	-	-	-	-	-	0,28	-	0,35	-
Buliminella sp.	Bumsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina carinata	Casri	-	-	-	-	-	-	-	0,36	-	-	-	-	0,49	-	0,72
Cassidulina crassa	Cascr	-	0,50	-	-	-	-	0,42	-	-	-	-	-	-	-	-
Ceratobulimina pacifica	Cerpa	4,63	4,58	3,19	4,42	5,58	3,27	4,24	1,45	2,87	1,37	2,89	3,56	2,46	2,74	2,53
Chilostomella oolina	Chol	-	-	-	-	-	0,93	-	-	0,32	-	1,44	1,39	1,97	2,13	1,83
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	0,56	-	-	0,35	-
Cibicidoides bradyi	Cibr	7,47	7,79	5,85	7,52	8,58	7,48	6,36	4,35	2,55	2,74	2,89	2,50	1,48	2,74	3,97
Cibicidoides kullenbergi	Ciku	0,93	2,57	1,60	1,33	2,12	2,34	4,24	2,54	0,96	2,74	3,93	1,39	0,49	1,22	1,86
Cibicidoides pseudoungerianus	Cipse	2,78	3,69	3,19	3,97	2,12	4,26	4,24	5,72	1,92	4,57	4,21	3,56	4,41	2,44	1,44
Cibicidoides robertsonianus	Cirob	-	1,23	1,64	1,33	0,42	1,42	0,42	1,45	0,64	1,83	-	0,28	-	0,70	1,44
Cibicidoides wuellerstorfi	Ciwul	1,85	3,28	2,13	0,88	2,12	3,74	2,12	2,90	4,46	5,23	4,78	3,89	4,41	3,96	3,97
Cibicidoides sp.	Cisp	-	-	1,64	-	0,42	-	0,42	-	1,27	-	-	1,11	0,49	1,22	-
Cornuspira carinata	Coca	-	-	-	-	-	-	-	-	-	0,46	-	-	-	-	-
Cornuspira involvens	Coin	-	-	-	-	-	0,47	0,42	-	-	-	0,29	0,28	0,49	0,91	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	0,28	-	-	-
Cornuspiroides primitivus	Csppr	-	-	-	-	-	0,47	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	-	-	-	0,85	1,42	-	0,36	0,64	-	-	-	1,48	0,35	-
Cyclammina cancellata	Cyca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	0,93	-	-	-	0,42	-	-	-	-	-	0,29	-	-	-	-
Dentalina filiformis	Defi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Deasub	-	-	-	-	0,42	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	-	-	0,53	0,44	-	-	-	-	-	0,46	0,84	0,28	-	-	-
Discopulvinulina araucana	Dspara	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina subbertheloti	Dspber	-	-	1,64	-	-	-	0,42	-	0,32	-	0,84	-	0,98	-	-
Dorothia bradyana	Dobr	-	-	-	-	0,85	-	-	-	0,64	-	0,29	-	-	-	-
Dorothia exilis	Doex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	-	0,50	1,64	0,44	0,42	-	-	1,87	0,32	-	-	-	-	0,70	-
Eggerella scabra	Eggsc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella sp.	Eggsp	-	0,50	-	-	-	-	-	-	-	-	-	-	-	-	-
Ehrenbergina trigona	Ehtr	0,93	1,23	0,53	0,88	0,85	1,87	0,85	2,54	0,64	3,65	1,97	-	2,94	0,35	1,44
Elphidium crispum	Elcr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elphidium incertum	Elin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella umbonifera	Exum	0,93	-	2,13	0,44	0,42	1,42	0,42	1,87	0,96	-	0,29	0,83	0,98	-	0,36
Eponides regularis	Epre	-	-	0,53	-	-	-	-	-	0,32	-	-	-	-	-	-
Eponides tumiduls	Eptum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides sp.	Epsp	-	1,23	-	-	-	-	-	-	-	-	-	-	-	-	-

Fr10/95 GC17 Species %

Species	Code	121-122 cm	125-126 cm	127-128 cm	133-134 cm	137-138 cm	141-142 cm	145-146 cm	149-150 cm	153-154 cm	157-158 cm	161-162 cm	165-166 cm	169-170 cm	173-174 cm	177-178 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium ringens	Alvri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alveolophragmium subglobosum	Alvug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites sp.	Absp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammodiscus incertus	Adsin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia beccarii	Ambe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna scalris	Amphsl	-	-	-	-	0,32	-	-	-	-	0,32	-	-	-	-	-
Amphicoryna sp.	Amphsp	-	-	-	-	-	-	0,29	-	-	-	-	0,27	-	0,33	-
Anomalina globulosa	Aaglob	0,72	0,72	0,19	0,33	-	-	-	-	-	0,32	0,32	-	0,34	-	-
Astacolus crepidulus	Atacre	-	-	-	-	-	-	0,29	-	-	-	-	-	-	-	-
Astrononion echolsi	Astrech	0,97	1,79	1,36	1,28	1,86	0,83	0,88	0,31	0,58	0,95	0,32	1,87	-	0,33	2,55
Astrononion stelligerum	Astrst	-	-	-	-	-	-	-	-	0,19	-	-	-	-	-	-
Bigenerina nodosaria	Bino	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina albatrossi	Bolalb	-	0,36	-	0,33	-	0,28	1,17	0,31	0,39	0,32	0,32	0,54	-	-	-
Bolivina robusta	Bolro	1,93	2,16	1,36	1,28	1,55	1,42	1,17	0,62	1,16	0,95	0,95	0,54	1,22	1,33	2,67
Bolivina seminuda	Bolsem	1,45	0,72	0,19	0,64	-	-	0,29	-	-	-	0,32	-	-	-	0,64
Bolivinita quadrilatera	Blql	2,90	3,94	0,98	0,96	-	0,63	0,59	0,31	1,16	0,95	0,95	0,82	0,68	0,33	0,32
Brizalina dilatata	Brdi	1,28	-	0,39	0,33	-	0,28	-	-	0,19	-	-	-	-	-	-
Brizalina semilineata	Brsem	-	-	0,39	-	-	-	-	-	-	-	-	-	-	0,33	-
Brizalina sp.	Brsp	-	-	0,78	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	0,24	0,36	1,17	1,63	0,62	3,33	1,17	2,49	3,18	2,54	2,22	3,27	3,40	2,33	4,78
Bulimina alazanensis	Bualz	3,38	1,43	14,17	0,33	-	0,28	-	-	0,39	0,32	-	-	-	-	0,32
Bulimina costata	Buco	-	2,16	0,19	0,33	0,32	0,42	1,76	0,93	0,97	-	0,32	0,27	1,22	0,33	1,27
Bulimina marginata	Buma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella elegantissima	Bumel	0,48	0,72	1,55	0,33	-	-	0,88	0,62	1,16	0,95	0,32	0,27	0,34	0,33	-
Buliminella sp.	Bumsp	-	-	-	0,33	-	-	-	-	-	-	-	-	-	-	-
Cassidulina carinata	Casri	0,24	-	0,58	0,33	-	0,83	0,88	-	1,94	0,95	0,32	0,82	0,68	0,33	0,32
Cassidulina crassa	Cascr	0,24	-	0,19	-	-	-	-	0,31	-	-	-	-	-	-	-
Ceratobulimina pacifica	Cerpa	2,42	2,87	0,78	1,63	1,55	0,63	1,76	1,25	1,94	0,95	-	1,63	1,82	2,00	0,96
Chilostomella oolina	Chol	1,45	-	-	-	1,86	1,42	0,59	1,25	0,19	-	0,32	0,27	0,91	0,67	1,27
Cibicides lobatulus	Clob	-	-	-	0,33	-	0,83	0,59	0,93	-	-	0,95	0,54	1,82	-	0,96
Cibicidoides bradyi	Cibr	1,93	1,79	1,94	2,24	1,86	2,78	2,35	3,12	2,71	2,54	2,22	2,17	0,91	1,00	2,23
Cibicidoides kullenbergi	Ciku	1,28	2,16	1,94	2,88	1,86	2,78	2,35	1,56	1,55	3,17	2,53	2,17	0,68	0,33	0,32
Cibicidoides pseudoungerianus	Cipse	1,70	2,16	0,58	1,63	2,80	3,13	2,35	2,49	2,71	4,13	2,85	4,62	2,74	8,00	4,78
Cibicidoides robertsonianus	Cirob	2,90	0,36	0,98	-	0,62	1,25	0,29	-	0,58	0,32	0,63	0,27	0,34	1,33	0,64
Cibicidoides wuellerstorfi	Ciwul	4,84	5,18	2,91	12,18	7,76	6,42	8,54	9,35	7,36	12,63	9,18	14,95	1,33	16,33	9,67
Cibicidoides sp.	Cisp	0,48	0,72	1,94	1,63	0,93	-	0,59	0,62	1,16	-	0,95	-	-	1,33	0,64
Cornuspira carinata	Coca	-	-	-	0,33	-	-	-	-	0,19	-	-	-	-	-	-
Cornuspira involvens	Coin	-	0,36	0,78	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspiroides primitivus	Csppr	0,24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	0,48	-	-	-	-	-	0,29	-	-	-	0,32	0,27	-	-	0,32
Cyclammina cancellata	Cyca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	0,24	0,36	0,19	-	0,32	-	-	-	-	0,32	-	-	-	-	-
Dentalina filiformis	Defi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Deasub	0,24	-	-	-	-	0,28	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	0,24	0,36	-	0,33	-	-	-	-	-	-	-	-	-	1,00	-
Discopulvinulina araucana	Dspara	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-	-
Discopulvinulina subbertheloti	Dspber	-	0,72	-	-	-	-	-	-	1,36	0,63	0,32	-	-	-	0,32
Dorothia bradyana	Dobr	-	-	0,39	0,64	0,93	-	0,29	0,93	0,78	1,59	1,58	1,36	2,13	2,67	1,27
Dorothia exilis	Doex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	0,24	0,36	0,58	0,33	0,32	0,42	-	-	-	-	0,95	-	-	0,67	0,64
Eggerella scabra	Eggsc	-	-	-	-	-	0,28	-	-	-	-	-	-	-	-	-
Eggerella sp.	Eggsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ehrenbergina trigona	Ehtr	3,86	6,91	5,63	12,50	15,22	16,42	1,85	5,92	5,62	6,98	7,91	7,69	5,17	3,67	4,78
Elphidium crispum	Elcr	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-	-
Elphidium incertum	Elin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella umbonifera	Exum	0,24	0,36	0,58	0,33	-	-	0,29	-	0,78	-	-	-	-	-	-
Eponides regularis	Epre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides tumiduls	Eptum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eponides sp.	Epsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Fr10/95 GC17 Species %

Species	Code	0-1 cm	3-4 cm	5-6 cm	9-10 cm	13-14 cm	17-18 cm	21-22 cm	25-26 cm	29-30 cm	33-34 cm	37-38 cm	41-42 cm	45-46 cm	49-50 cm	53-54 cm	57-58 cm
Fissurina spp.	Fispp	-	1,39	1,54	0,79	0,37	0,79	0,88	0,39	1,53	1,94	0,54	1,44	3,65	1,12	0,62	0,90
Fursenkoina davisii	Furda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina earlandi	Furea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	0,32	0,69	2,48	-	0,74	-	0,45	0,39	0,53	0,49	-	-	-	-	1,25	-
Fursenkoina sp.	Fursp	0,32	-	-	-	-	-	-	-	-	-	-	-	0,73	-	-	-
Gavelinopsis lobatulus	Galo	3,22	1,39	1,54	1,59	1,13	1,19	2,64	0,39	-	4,37	-	3,37	0,73	2,69	1,87	2,70
Globobulimina affinis	Glaf	0,32	-	0,51	-	-	-	-	-	-	-	-	-	-	-	-	0,90
Globobulimina notovata	Glno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	0,96	-	0,51	-	0,74	-	-	-	-	-	-	-	-	0,56	-	-
Globocassidulina subglobosa	Glcsb	3,54	6,25	2,55	3,57	2,94	2,39	4,85	2,75	4,22	2,43	2,17	1,92	5,19	2,89	7,23	1,76
Glomospira charoides	Glmch	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	-	0,35	-	-	-	-	-	0,39	-	-	-	-	-	-	-	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	2,57	0,69	0,51	2,39	3,39	1,19	0,45	0,78	3,16	1,46	0,54	1,44	2,19	2,89	3,61	1,35
Gyroidinoides polius	Gyrpo	-	-	-	-	-	-	-	-	-	-	2,72	-	-	-	-	-
Gyroidinoides soldanii	Gyrso	1,93	2,83	1,54	1,98	1,13	0,40	1,76	1,57	0,53	1,46	-	1,44	0,73	2,69	1,25	3,14
Gyroidinoides sp.	Gyrsp	-	0,35	-	0,40	-	-	-	-	-	-	-	0,49	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	0,64	-	-	-	0,37	-	0,45	-	0,53	-	0,54	-	0,73	-	1,25	-
Hoeglundina elegans	Hoel	0,96	-	2,55	2,39	3,39	3,57	0,45	4,31	-	0,98	2,72	0,96	-	1,12	3,12	0,45
Karreriella bradyi	Karbr	0,96	-	-	0,79	-	-	0,45	0,78	1,58	-	0,54	1,44	-	1,12	-	0,45
Karreriella novangliae	Karno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karrerulina apicularis	Karap	1,29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena spp.	Laspp	0,96	1,39	-	0,40	0,37	1,98	0,45	1,16	1,58	-	-	1,44	-	0,56	0,62	2,70
Laticarinina pauperata	Ltpa	0,64	-	1,25	-	-	-	0,45	-	-	-	-	0,49	-	1,12	0,62	-
Lenitculina spp.	Lespp	1,68	1,39	1,54	1,98	1,13	0,40	0,88	-	0,53	0,98	0,54	0,96	2,19	-	1,25	0,45
Marginulina obesa	Maob	-	-	-	0,40	-	-	-	0,39	0,53	0,49	0,54	0,96	0,73	-	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	0,32	0,69	0,51	-	-	-	0,88	0,39	-	-	1,87	-	-	-	-	0,45
Melonis barleeanum	Meba	0,32	0,69	0,51	1,98	0,37	0,40	2,64	2,35	1,58	3,88	0,54	1,44	1,46	-	1,87	0,90
Melonis pompilioides	Mepo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella oblonga	Miob	0,32	-	-	0,40	-	1,19	-	0,78	2,15	-	2,17	2,44	-	-	-	2,24
Miliolinella subrotunda	Misb	0,64	-	0,51	0,40	-	-	0,45	0,78	-	-	-	0,49	-	-	-	-
Nodosaria inflexa	Ndix	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	0,45	0,39	-	-	0,54	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella bradyi	Nnbr	-	-	-	-	0,37	-	-	-	-	-	-	0,49	1,46	0,56	-	0,45
Nonionella iridea	Nnir	-	-	-	-	0,37	-	-	-	0,53	-	-	-	-	-	-	-
Nonionella turgida	Nntu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,62	-
Nummoloculina contraria	Numco	-	-	-	-	-	-	-	-	0,53	-	0,54	0,49	0,73	1,12	0,62	-
Nummoloculina irregularis	Numir	3,86	5,56	4,59	3,57	5,15	4,76	8,82	6,27	5,53	8,25	7,65	5,29	8,29	9,56	3,61	4,93
Oolina spp.	Oospp	-	1,42	0,51	-	0,37	-	-	0,39	0,53	-	-	0,49	-	-	-	-
Oridorsalis tener stellatus	Orts	0,64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oridorsalis tener umbonatus	Ortu	1,68	2,83	1,54	3,17	0,74	2,78	0,45	1,97	2,15	1,46	2,72	1,92	0,73	2,89	1,25	1,79
Osangularia cultur	Oscu	3,86	2,44	3,61	2,76	2,57	2,39	3,52	2,35	-	3,40	0,54	2,88	2,19	1,69	4,62	3,14
Parafissurina spp.	Paspp	-	-	-	0,40	0,74	0,40	0,45	-	0,53	0,49	-	-	1,46	0,56	-	0,45
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Praeglobobulimina subspinescens	Paesb	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-	-	-
Praemassillina arenaria	Paear	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	0,96	-	0,51	1,59	-	5,95	0,45	2,35	1,53	0,98	1,87	0,96	-	1,12	0,62	1,35
Pullenia quinqueloba	Pu5	0,96	1,39	0,51	0,79	0,37	1,19	-	1,97	1,53	1,46	1,87	-	-	1,12	0,62	0,45
Pyrgo comata	Pyco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	0,32	0,35	1,54	-	1,48	1,98	0,88	0,39	1,58	0,49	0,54	0,96	0,73	1,69	0,62	0,45
Pyrgo elongata	Pyel	0,32	1,42	-	0,79	1,48	-	0,88	0,78	-	0,49	2,17	0,96	1,46	1,69	1,87	1,35
Pyrgo lucernula	Pylu	-	-	-	-	-	-	-	-	-	-	0,54	-	-	-	-	-
Pyrgo murrhina	Pyu	0,96	0,69	0,51	1,19	0,37	0,79	0,88	2,35	1,53	2,43	3,27	0,96	2,92	1,12	1,25	0,45
Pyrgo serrata	Pyse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo vespertilio	Pyve	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	-	-	-	-	-	-	0,45	-	1,53	-	-	-	-	-	-	-

Species	Code	61-62 cm	65-66 cm	69-70 cm	73-74 cm	77-78 cm	81-82 cm	85-86 cm	89-90 cm	93-94 cm	97-98 cm	101-102 cm	105-106 cm	109-110 cm	113-114 cm	117-118 cm
Fissurina spp.	Fispp	1,85	0,82	2,13	0,44	1,27	0,93	0,85	1,87	0,64	-	0,29	0,56	1,48	0,91	0,72
Fursenkoina davisii	Furda	-	-	-	-	-	-	-	-	0,32	0,46	1,12	1,39	-	0,70	1,83
Fursenkoina earlandi	Furea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	0,93	1,64	-	-	0,85	0,47	-	0,36	-	0,91	0,56	0,83	2,46	1,52	2,17
Fursenkoina sp.	Fursp	-	-	-	-	-	-	-	-	-	-	-	-	-	0,70	-
Gavelinopsis lobatulus	Galo	1,85	0,82	1,64	3,54	2,54	1,42	1,27	3,99	1,27	1,83	0,84	3,33	1,48	2,44	1,44
Globobulimina affinis	Glaf	-	0,50	-	-	-	-	-	1,87	-	-	-	-	-	-	-
Globobulimina notovata	Glno	-	-	-	-	-	0,47	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	-	0,50	0,53	-	-	-	-	-	-	0,91	-	-	-	-	0,36
Globocassidulina subglobosa	Glcsb	1,19	13,11	1,16	6,85	9,32	9,35	9,75	8,70	13,38	6,85	11,52	9,72	4,92	7,62	9,25
Glomospira charoides	Glmch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	-	-	-	-	-	-	-	-	-	-	-	-	-	0,35	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	0,53	-	-	-	-	-	0,64	-	0,56	-	-	-	0,36
Gyroidinoides orbicularis	Gyror	1,85	0,82	2,13	2,21	2,54	2,34	1,69	2,90	3,53	2,28	1,97	1,67	3,43	2,74	0,72
Gyroidinoides polius	Gyrpo	-	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-
Gyroidinoides soldanii	Gyrso	1,85	0,50	1,60	2,21	2,12	1,42	0,85	2,17	0,32	1,83	0,29	1,94	1,48	1,22	1,44
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	0,36	-	-	-	-	-	0,35	-
Hauerinella incostans	Hurin	-	-	-	-	0,42	-	0,42	1,67	1,27	-	1,44	0,28	0,98	0,91	2,17
Hoeglundina elegans	Hoel	1,85	-	2,66	1,33	2,12	0,47	0,42	1,45	1,59	0,91	1,97	2,78	2,94	1,83	4,69
Karreriella bradyi	Karbr	-	0,50	-	-	-	0,47	-	0,72	0,64	1,37	0,29	0,56	-	-	-
Karreriella novangliae	Karno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karrerulina apicularis	Karap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena spp.	Laspp	2,78	0,82	1,64	0,44	0,85	1,42	1,27	0,72	0,32	-	0,29	-	-	0,35	0,36
Laticarinina pauperata	Ltpa	-	1,23	-	0,44	-	0,47	0,42	1,87	0,32	-	-	-	0,98	0,70	0,72
Lenitculina spp.	Lespp	-	0,50	2,13	0,44	0,85	0,47	0,42	0,72	-	0,91	1,44	1,67	0,49	0,70	0,36
Marginulina obesa	Maob	-	-	-	0,44	0,85	0,47	-	-	-	0,91	0,56	-	-	-	0,36
Marginulina subullata	Masub	0,93	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	-	-	1,60	-	-	0,47	2,12	-	0,64	-	0,56	-	-	-	-
Melonis barleeanum	Meba	-	0,82	-	1,33	-	0,47	0,85	1,81	1,92	1,37	1,44	2,50	1,48	2,74	1,44
Melonis pompilioides	Mepo	-	-	-	-	4,66	-	-	-	2,23	0,46	1,69	1,39	1,97	1,52	1,83
Miliolinella oblonga	Miob	0,93	1,64	0,53	0,44	0,85	0,47	-	0,36	2,23	1,37	2,53	1,67	0,98	1,83	1,86
Miliolinella subrotunda	Misb	-	-	-	-	-	-	-	0,36	-	-	-	-	-	0,70	0,36
Nodosaria inflexa	Ndix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-
Nodosaria sp.	Ndsp	0,93	-	-	-	-	-	-	-	0,32	-	-	-	-	0,35	-
Nonionella bradyi	Nnbr	-	-	-	-	0,42	-	0,85	0,36	-	-	-	-	-	0,35	-
Nonionella iridea	Nnir	-	-	0,53	-	-	-	-	-	-	0,46	-	-	-	-	-
Nonionella turgida	Nntu	-	-	-	-	-	-	-	-	-	-	-	-	0,49	0,35	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	1,85	0,82	4,26	2,65	0,42	-	0,85	1,87	0,32	0,46	1,44	0,83	-	0,91	1,83
Nummoloculina irregularis	Numir	9,26	7,79	7,98	7,80	5,58	5,67	8,58	1,87	1,60	4,57	7,22	9,17	12,75	7,93	7,94
Oolina spp.	Oospp	-	0,50	-	-	0,42	-	0,42	0,36	-	-	0,29	-	-	-	-
Oridorsalis tener stellatus	Orts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oridorsalis tener umbonatus	Ortu	3,74	1,64	3,19	1,33	1,27	1,42	3,39	1,45	0,96	1,83	2,53	1,67	-	1,52	3,25
Osangularia cultur	Oscu	0,93	2,46	4,79	3,97	3,39	2,84	2,97	1,81	1,27	4,57	1,44	4,17	2,94	3,35	2,53
Parafissurina spp.	Paspp	-	-	-	0,88	0,42	0,47	0,85	-	0,32	-	0,29	0,28	0,49	0,91	-
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Praeglobobulimina subspinescens	Paesb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Praemassillina arenaria	Paear	-	0,50	-	-	-	-	-	-	-	0,46	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	0,93	1,23	-	0,88	1,69	0,93	1,27	1,45	2,55	0,91	3,65	1,11	0,98	1,52	1,44
Pullenia quinqueloba	Pu5	-	2,49	-	1,77	1,69	1,42	0,42	2,17	1,27	2,28	-	1,39	1,49	0,35	1,44
Pyrgo comata	Pyco	-	-	-	-	-	-	-	-	-	-	-	-	-	0,35	-
Pyrgo depressa	Pyde	0,93	0,82	1,64	0,88	1,27	0,47	0,85	-	0,64	1,83	1,44	0,56	0,49	0,91	1,63
Pyrgo elongata	Pyel	1,85	0,50	0,53	0,44	1,27	0,93	1,27	0,72	2,87	0,91	0,84	0,56	0,49	1,52	0,72
Pyrgo lucernula	Pylu	-	0,50	-	-	-	-	-	-	0,32	0,46	0,29	-	-	-	0,72
Pyrgo murrhina	Pyu	0,93	1,23	1,60	0,44	2,12	2,34	1,27	2,17	3,82	3,20	1,69	1,11	2,46	2,13	2,53
Pyrgo serrata	Pyse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo vespertilio	Pyve	-	-	-	-	-	0,47	0,42	-	-	-	-	0,28	-	-	-
Pyrgo sp.	Pysp	-	-	0,53	-	-	-	-	-	0,64	-	-	-	-	-	-

Species	Code	121-122 cm	125-126 cm	127-128 cm	133-134 cm	137-138 cm	141-142 cm	145-146 cm	149-150 cm	153-154 cm	157-158 cm	161-162 cm	165-166 cm	169-170 cm	173-174 cm	177-178 cm
Fissurina spp.	Fispp	0,72	0,36	2,34	1,92	2,48	1,25	1,17	4,36	1,36	1,59	4,11	1,92	1,82	1,67	1,92
Fursenkoina davisii	Furda	0,97	1,79	-	-	-	-	-	-	0,19	-	-	-	-	-	-
Fursenkoina earlandi	Furea	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	0,48	0,36	0,19	0,33	0,32	0,42	0,59	0,93	0,19	-	0,63	0,27	2,13	1,00	1,27
Fursenkoina sp.	Fursp	-	-	-	0,33	-	-	-	-	-	-	-	0,27	-	-	0,32
Gavelinopsis lobatulus	Galo	3,38	2,59	2,52	0,33	2,48	3,54	0,59	0,31	2,97	0,95	1,27	3,53	1,22	0,33	1,59
Globobulimina affinis	Glaf	-	-	-	-	0,62	-	-	-	-	0,32	-	-	0,34	0,67	-
Globobulimina notovata	Glno	-	-	-	0,33	0,32	-	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	-	-	0,39	0,64	-	0,63	-	-	-	-	0,32	0,27	0,34	0,33	-
Globocassidulina subglobosa	Glcsb	6,28	3,94	2,52	1,28	1,24	-	0,59	0,62	2,13	0,63	0,63	0,54	1,22	0,33	1,59
Glomospira charoides	Glmch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	-	-	0,19	-	0,62	-	-	-	0,19	-	-	-	-	-	-
Gyroidinoides lamarckianus	Gyrlmk	-	0,36	-	-	-	-	0,29	-	0,35	-	-	0,27	-	-	0,64
Gyroidinoides orbicularis	Gyror	2,66	1,43	0,39	-	-	0,42	0,88	-	-	0,63	0,95	-	0,34	0,33	-
Gyroidinoides polius	Gyrpo	0,72	-	-	0,64	0,32	0,63	0,29	0,31	0,78	0,32	-	0,27	-	0,33	0,32
Gyroidinoides soldanii	Gyrso	-	1,43	0,39	-	0,93	0,28	0,59	0,93	0,58	0,63	4,11	0,54	0,34	-	0,32
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	0,72	-	-	-	0,62	0,28	-	0,31	0,58	-	0,63	-	-	0,33	0,32
Hauerinella incostans	Hurin	0,48	1,75	1,17	0,64	3,42	2,92	1,76	3,74	3,49	1,27	2,22	1,36	1,22	0,67	1,27
Hoeglundina elegans	Hoel	5,31	5,73	3,69	6,74	6,83	5,00	5,87	5,30	3,29	4,13	4,11	6,79	5,17	2,67	3,82
Karreriella bradyi	Karbr	0,72	1,79	-	0,64	1,55	2,50	0,88	0,62	0,97	0,95	0,95	1,36	1,82	1,67	1,59
Karreriella novangliae	Karno	-	-	-	-	-	-	-	-	0,97	-	-	-	-	-	-
Karrerulina apicularis	Karap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena spp.	Laspp	-	0,36	1,94	2,56	1,55	1,67	2,53	0,62	-	-	0,63	0,54	0,68	0,33	1,59
Laticarinina pauperata	Ltpa	0,24	0,36	0,78	0,96	0,62	1,42	0,29	0,62	0,58	-	0,95	1,36	0,68	0,33	0,96
Lenitculina spp.	Lespp	0,97	-	0,98	-	0,32	-	-	0,31	0,39	0,63	-	0,82	-	-	0,32
Marginulina obesa	Maob	0,24	-	0,78	0,33	-	0,28	0,29	-	0,19	-	-	-	0,34	0,33	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	0,31	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	0,24	-	0,19	-	-	-	-	0,31	0,19	0,32	0,32	-	0,34	0,33	-
Melonis barleeanum	Meba	3,38	1,75	1,55	0,64	0,32	2,29	0,59	-	0,78	0,95	0,95	0,82	0,34	-	0,96
Melonis pompilioides	Mepo	0,97	1,79	0,19	0,33	-	-	0,59	-	-	-	-	0,27	-	-	-
Miliolinella oblonga	Miob	0,24	1,75	1,17	1,63	3,16	0,42	1,17	0,93	1,94	1,59	0,63	0,54	0,68	0,33	-
Miliolinella subrotunda	Misb	0,24	0,36	-	0,33	-	-	0,29	0,31	0,58	-	0,32	0,27	-	-	0,32
Nodosaria inflexa	Ndix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	0,48	-	0,19	-	-	-	-	0,31	-	-	-	-	0,34	-	0,32
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella bradyi	Nnbr	1,28	-	0,19	0,64	-	0,28	-	-	-	0,63	-	0,54	-	-	-
Nonionella iridea	Nnir	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella turgida	Nntu	-	-	0,39	0,64	0,32	1,42	0,29	0,62	0,19	0,32	-	0,54	0,34	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	1,93	1,43	1,55	0,64	0,62	1,42	1,47	1,25	0,78	0,95	-	0,54	0,68	1,00	0,64
Nummoloculina irregularis	Numir	7,25	8,97	5,63	6,90	6,21	6,46	8,54	7,48	8,91	6,67	4,11	4,77	6,27	3,33	3,53
Oolina spp.	Oospp	-	-	-	-	0,32	0,28	-	-	-	-	-	-	0,34	-	-
Oridorsalis tener stellatus	Orts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oridorsalis tener umbonatus	Ortu	0,72	0,72	2,14	1,28	1,24	1,42	1,47	0,62	0,97	0,95	1,59	0,82	0,91	0,33	1,59
Osangularia cultur	Oscu	4,59	1,79	5,24	1,28	0,93	1,25	0,88	0,62	1,36	1,59	1,59	1,36	0,34	-	1,59
Parafissurina spp.	Paspp	0,24	-	0,19	0,33	-	-	-	-	1,36	0,32	-	-	-	0,33	0,32
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,32
Praeglobobulimina subspinescens	Paesb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Praemassillina arenaria	Paear	-	-	0,19	-	-	-	-	-	0,19	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	1,28	1,43	0,39	1,28	1,24	1,67	0,88	1,56	1,94	1,27	1,58	1,67	1,82	1,33	1,27
Pullenia quinqueloba	Pu5	0,72	0,72	1,36	0,96	-	1,46	-	0,31	1,36	1,27	-	-	0,34	0,33	-
Pyrgo comata	Pyco	-	-	-	-	-	0,28	0,29	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	1,70	1,79	0,78	0,96	-	1,25	0,88	0,31	0,97	0,63	0,32	1,87	1,22	2,00	-
Pyrgo elongata	Pyel	0,97	1,43	0,58	0,96	0,62	1,25	0,59	1,87	0,39	1,59	0,32	0,82	1,52	1,00	0,32
Pyrgo lucernula	Pylu	0,48	-	0,19	-	0,93	0,42	0,29	0,93	0,39	0,32	0,63	-	0,34	0,33	-
Pyrgo murrhina	Pyu	0,24	2,16	0,39	0,96	0,62	0,63	1,17	1,87	0,78	-	2,65	0,27	1,92	2,33	1,59
Pyrgo serrata	Pyse	-	-	-	-	0,32	0,28	-	-	0,19	0,63	-	-	-	0,33	0,32
Pyrgo vespertilio	Pyve	-	-	0,39	0,33	-	0,63	-	-	0,19	-	-	-	0,34	-	0,32
Pyrgo sp.	Pysp	0,24	-	-	-	-	-	-	-	-	-	-	-	0,34	-	0,32

Species	Code	0-1 cm	3-4 cm	5-6 cm	9-10 cm	13-14 cm	17-18 cm	21-22 cm	25-26 cm	29-30 cm	33-34 cm	37-38 cm	41-42 cm	45-46 cm	49-50 cm	53-54 cm	57-58 cm
Pyrulina cylindroides	Pycl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	-	0,35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-
Quinqueloculina lamarckiana	Qulk	-	-	0,51	-	-	-	-	-	-	-	-	0,49	-	-	-	-
Quinqueloculina seminulum	Qusem	2,26	3,13	1,25	3,17	5,15	3,17	0,88	3,14	2,15	3,88	2,72	0,96	1,46	2,89	0,62	2,24
Quinqueloculina venusta	Quve	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,45
Reophax guttifer	Roegu	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdammina abyssorum	Rhay	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizammina algaeformis	Rial	-	-	-	0,40	0,37	-	-	-	0,53	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	0,32	0,69	1,25	0,79	-	0,40	0,45	0,76	1,58	0,49	0,54	0,49	1,46	0,56	1,87	0,90
Robertinoides brady	Robbr	-	-	0,51	-	-	-	-	-	-	-	-	-	-	-	-	-
Saccorhiza ramosa	Scra	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sagrinella sp.	Sgr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	0,78	-	-	-	-	-	0,56	-	0,45
Sigmoilopsis schlumbergeri	Sgmsch	0,64	-	1,25	0,40	0,74	-	0,45	0,78	0,53	1,94	1,87	0,49	1,46	1,12	2,50	2,24
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	0,32	-	-	-	-	0,40	-	0,39	-	-	0,54	-	1,46	0,56	-	-
Siphotextulariz curta	Stxcu	0,32	-	-	-	-	0,40	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	0,96	4,51	5,12	5,16	2,94	-	6,17	7,84	4,22	3,40	7,69	4,33	5,19	3,38	5,42	1,79
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	-	-	-	-	-	-	-	-	-	-	-	0,73	-	-	-
Spiroloculina elevata	Srele	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-	-	-
Spiroloculina tenuiseptata	Srspt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,90
Stainforthia complanata	Stfco	0,32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella bradyi	Tchb	-	0,69	-	0,40	-	-	-	-	-	-	-	-	-	-	-	-
Textularia agglutinans	Txag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lateralis	Txlat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia porrecta	Txpo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,45
Textularia pseudogramen	Txpgr	-	1,74	0,51	0,40	0,37	0,40	-	-	-	0,49	0,54	0,49	0,73	0,56	-	0,45
Textularia sp.	Txsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,62	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina cuneata	Trcu	-	-	-	-	-	-	0,45	-	-	-	-	-	-	0,56	-	-
Triloculina insignis	Trin	-	0,35	1,25	-	-	0,79	0,45	-	0,53	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	0,32	0,35	0,51	-	1,84	0,40	0,45	-	-	2,43	-	1,44	2,19	0,56	0,62	0,45
Triloculina tricarinata	Trtr	1,93	1,42	1,54	0,79	1,13	1,59	-	0,78	2,51	0,98	1,63	0,96	-	-	1,87	1,79
Triloculina trigonula	Trgo	-	0,35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina sp.	Trsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,45
Trochammina globigeriniformis	Trhgl	0,64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	0,96	3,47	1,25	0,79	1,48	1,59	0,45	-	0,53	0,49	1,87	0,49	0,73	0,56	1,25	0,90
Uvigerina porrecta	Uvpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	15,76	16,32	19,90	14,29	26,13	19,84	22,26	13,33	19,60	1,19	9,76	6,25	0,73	3,38	2,50	1,35
Uvigerina sp.	Uvsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulina spinigera	Vasin	-	-	-	-	0,37	-	-	-	-	-	-	-	-	-	-	-
Vaginulina subelegans	Vasub	-	-	-	-	-	-	-	-	-	-	-	0,49	-	-	-	-
Valvulineria sp.	Vlsp	-	-	-	-	-	-	-	-	0,53	-	-	-	-	-	-	-

Species	Code	61-62 cm	65-66 cm	69-70 cm	73-74 cm	77-78 cm	81-82 cm	85-86 cm	89-90 cm	93-94 cm	97-98 cm	101-102 cm	105-106 cm	109-110 cm	113-114 cm	117-118 cm
Pyrulina cylindroides	Pycl	-	-	-	-	-	0,47	-	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	0,50	-	-	-	-	-	-	0,32	-	0,29	-	-	0,35	0,36
Quinqueloculina seminulum	Qusem	1,85	1,64	2,66	3,54	0,85	2,84	2,12	2,17	3,82	2,74	3,65	2,22	2,94	1,52	1,44
Quinqueloculina venusta	Quve	-	-	0,53	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,36
Rectobolivina dimorpha	Redi	-	-	-	0,44	-	-	-	-	-	-	-	0,56	-	0,35	0,72
Reophax guttifer	Roegu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhabdammina abyssorum	Rhay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizammina algaeformis	Rial	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	0,93	1,23	-	0,44	1,27	-	1,27	1,87	2,23	2,74	1,69	0,83	1,97	0,70	1,83
Robertinoides brady	Robbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,36
Saccorhiza ramosa	Scra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sagrinella sp.	Sgr	-	-	-	-	-	0,47	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	1,85	2,49	1,64	1,33	0,85	0,47	2,12	0,36	1,92	-	1,44	0,83	-	1,83	1,83
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	-	-	-	-	-	0,85	0,72	-	-	-	-	-	-	-
Siphotextularia curta	Stxcu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	1,85	1,64	1,60	4,87	3,39	5,14	2,54	1,81	1,59	4,20	1,97	1,67	2,94	2,13	2,17
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	0,82	-	-	-	-	-	-	-	-	0,56	0,28	-	-	-
Spiroloculina elevata	Srele	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	0,50	-	-	0,42	-	-	0,36	-	0,46	0,29	-	-	-	-
Spiroloculina tenuiseptata	Srspt	-	-	-	0,44	-	-	-	-	-	-	-	0,28	-	0,35	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella bradyi	Tchb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia agglutinans	Txag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	-	-	-	-	0,56	-	-	-
Textularia lateralis	Txlat	-	-	-	-	-	-	0,42	-	-	-	0,56	0,28	-	0,35	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,36
Textularia porrecta	Txpo	0,93	-	-	0,44	0,42	-	0,85	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	0,93	0,50	0,53	0,89	-	-	0,42	-	0,64	1,37	1,44	1,39	1,97	1,22	1,83
Textularia sp.	Txsp	-	-	1,64	-	-	-	-	-	-	-	1,12	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina cuneata	Trcu	-	-	-	-	-	-	-	-	-	0,46	-	-	-	-	-
Triloculina insignis	Trin	-	-	-	0,44	-	-	-	-	0,32	0,46	-	-	-	0,35	-
Triloculina subvalvularis	Trsu	1,85	0,82	0,53	0,89	0,85	0,47	1,27	1,45	0,32	1,83	1,12	0,28	1,97	0,35	-
Triloculina tricarinata	Trtr	4,63	0,50	1,64	0,88	-	0,47	-	1,45	1,27	2,26	1,97	2,22	1,97	3,66	1,83
Triloculina trigonula	Trgo	-	-	-	-	-	-	0,42	-	-	-	0,29	-	-	-	-
Triloculina sp.	Trsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trochammina globigeriniformis	Trhgl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	0,93	1,64	2,66	5,75	7,23	1,75	6,78	1,81	1,27	3,20	1,69	2,78	0,49	-	1,44
Uvigerina porrecta	Uvpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	0,93	2,46	3,72	3,54	4,24	3,27	3,39	2,17	1,92	6,85	0,29	3,89	2,46	0,91	2,53
Uvigerina sp.	Uvsp	-	-	-	0,44	-	-	-	-	-	-	-	-	-	-	-
Vaginulina spinigera	Vasin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulina subelegans	Vasub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvulineria sp.	Vlsp	0,93	-	-	-	-	-	-	0,36	-	-	-	0,28	0,49	0,70	0,72

Species	Code	121-122 cm	125-126 cm	127-128 cm	133-134 cm	137-138 cm	141-142 cm	145-146 cm	149-150 cm	153-154 cm	157-158 cm	161-162 cm	165-166 cm	169-170 cm	173-174 cm	177-178 cm
Pyrulina cylindroides	Pycl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	-	0,39	0,33	0,32	-	-	0,62	0,39	-	0,32	0,27	0,68	0,33	0,64
Quinqueloculina seminulum	Qusem	3,15	2,87	3,69	2,24	2,48	3,75	4,99	2,49	2,33	3,49	2,53	3,53	3,40	3,00	2,23
Quinqueloculina venusta	Quve	-	-	-	-	0,32	-	0,29	-	-	0,32	-	-	0,34	0,33	-
Quinqueloculina sp.	Qusp	-	-	0,78	-	-	-	0,29	-	-	0,32	0,32	-	0,34	-	0,96
Rectobolivina dimorpha	Redi	0,24	-	1,17	0,96	-	-	0,88	-	-	-	0,32	-	-	-	-
Reophax guttifer	Roegu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	0,29	-	-	-	-	-	-	-	-
Rhabdammina abyssorum	Rhay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhizammina algaeformis	Rial	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	1,28	2,87	1,17	0,64	0,32	0,28	0,88	1,25	1,36	0,63	0,32	1,36	0,68	0,67	-
Robertinoides brady	Robbr	-	-	-	-	-	0,28	-	-	-	-	-	-	-	-	-
Saccorhiza ramosa	Scra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sagrinella sp.	Sgr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	0,33	-	-	-	-	-	0,32	-	0,27	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	0,72	2,87	1,17	1,28	1,24	0,42	0,88	0,31	0,76	-	0,63	0,82	1,82	1,00	0,96
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-	0,34	-	-
Siphotextularia catenata	Stxca	0,24	-	0,39	0,33	-	-	-	0,62	0,58	-	1,58	0,27	0,34	0,67	-
Siphotextularia curta	Stxcu	-	-	-	-	-	0,28	-	0,31	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	0,48	1,79	-	2,24	3,16	3,33	2,35	1,56	1,94	2,54	3,80	0,82	2,43	1,67	1,27
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-
Spiroloculina depressa	Srdep	-	0,36	-	-	-	0,42	-	0,31	0,19	-	-	0,54	-	-	-
Spiroloculina elevata	Srele	0,24	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	0,36	-	0,64	-	-	-	-	-	-	-	-	-	0,67	0,32
Spiroloculina tenuiseptata	Srspt	-	-	0,19	-	-	-	0,29	-	-	-	-	-	-	-	0,32
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Technitella bradyi	Tchb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia agglutinans	Txag	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Textularia goesii	Txoes	-	-	0,19	-	-	-	-	-	-	-	-	-	1,82	1,00	0,64
Textularia lateralis	Txlat	-	0,36	0,19	0,33	-	-	0,59	1,25	0,58	-	1,27	0,27	0,91	0,33	-
Textularia lythostrota	Txlyt	-	-	-	-	0,62	0,28	0,29	0,93	0,58	1,27	0,63	1,92	0,34	1,33	0,96
Textularia porrecta	Txpo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	0,48	1,75	0,58	0,96	1,24	0,63	1,47	0,62	0,97	0,63	1,58	1,36	2,74	1,33	1,59
Textularia sp.	Txsp	-	0,36	-	-	0,32	0,28	-	-	0,78	-	-	-	-	-	0,32
Trifarina bradyi	Tfbr	-	-	0,19	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina cuneata	Trcu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina insignis	Trin	-	-	-	-	0,32	-	-	0,31	-	-	0,32	-	-	-	-
Triloculina subvalvularis	Trsu	0,97	0,36	1,17	1,63	0,93	0,28	1,17	0,62	1,16	1,59	0,63	0,82	1,82	1,33	0,96
Triloculina tricarinata	Trtr	1,93	0,36	2,34	0,64	1,55	0,63	2,35	2,19	1,16	1,27	0,95	1,92	0,68	1,00	2,23
Triloculina trigonula	Trgo	-	-	-	-	0,32	-	-	-	-	-	-	-	0,34	-	-
Triloculina sp.	Trsp	-	-	-	-	-	-	-	-	-	-	-	-	0,34	-	-
Trochammina globigeriniformis	Trhgl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	0,97	0,72	0,78	3,25	3,73	2,29	4,69	1,28	3,88	1,16	7,28	8,15	6,38	11,00	8,92
Uvigerina porrecta	Uvpr	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-	-
Uvigerina proboscidea	Uvprob	1,93	0,72	0,98	2,24	1,55	1,88	1,76	3,74	1,74	2,54	2,22	0,54	3,95	4,33	3,82
Uvigerina sp.	Uvsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,32
Vaginulina spinigera	Vasin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vaginulina subelegans	Vasub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvulineria sp.	Vlsp	-	-	-	-	-	0,28	0,59	0,62	0,78	0,95	0,95	0,27	-	-	-

APPENDIX A3

Counts data of benthic foraminifera from *Fr10/95 GC5* samples. Numbers are given as percentage of the total number of specimens in each sample.

Species	Code	0-1 cm	5-6 cm	9-10 cm	13-14 cm	17-18 cm	21-22 cm	25-26 cm	29-30 cm	33-34 cm	37-38 cm	41-42 cm	45-46 cm	49-50 cm	53-54 cm	57-58 cm	61-62 cm
Allomorphina pacifica	Allpa	-	-	-	0,66	-	-	-	-	-	-	-	-	-	-	0,33	-
Anomalina globulosa	Aaglob	0,63	-	-	0,66	-	-	-	-	-	-	-	-	-	-	-	-
Astacolus crepidulus	Atacre	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astrononion echolsi	Astrech	3,80	2,67	8,36	7,28	6,74	4,55	4,40	4,12	1,85	3,31	4,55	4,11	1,26	5,89	7,60	9,22
Bolivina seminuda	Bolsem	-	-	-	-	0,52	-	-	0,69	0,37	-	-	-	-	0,41	0,33	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	-	-	0,37	-	0,45	-	-	-	-	-
Brizalina semilineata	Brsem	0,63	-	0,89	0,66	1,36	-	-	-	0,37	-	-	-	-	-	-	-
Brizalina sp.	Brsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	8,00	8,36	5,96	32,12	48,64	45,79	49,48	4,59	36,75	46,36	46,52	53,14	24,48	24,92	3,29
Bulimina costata	Buco	-	-	0,89	-	-	1,82	1,47	1,37	0,74	-	1,36	0,63	0,42	1,24	1,65	1,32
Bulimina marginata	Buma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buliminella sp.	Bumsp	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina crassa	Cascr	1,27	-	-	-	-	-	-	-	-	-	-	-	-	-	1,32	-
Cassidulina laevigata	Caslae	-	-	-	-	1,36	0,45	0,37	1,72	0,37	1,99	2,27	1,27	0,84	1,66	2,31	0,66
Ceratobulimina pacifica	Cerpa	7,59	8,00	6,25	1,32	4,15	0,45	-	0,34	0,37	-	0,45	0,32	-	-	0,33	-
Chilostomella oolina	Chol	-	1,33	0,89	-	-	2,73	3,66	6,87	15,87	9,63	6,82	7,91	6,28	9,54	2,97	5,26
Cibicides lobatulus	Clob	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	1,90	5,33	5,36	7,95	5,70	-	0,37	0,34	-	0,99	0,45	0,32	0,84	-	0,67	1,32
Cibicidoides kullenbergi	Ciku	1,90	-	-	1,99	-	-	-	-	-	-	-	-	-	-	0,67	-
Cibicidoides pseudoungerianus	Cipse	1,27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides robertsonianus	Cirob	3,16	1,33	0,89	0,66	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides wuellerstorfi	Ciwul	9,49	1,67	1,71	7,95	6,74	8,18	4,76	6,87	1,33	9,93	5,45	3,16	5,29	4,98	4,95	8,55
Cibicidoides sp.	Cisp	1,27	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-
Cyclammina cancellata	Cyca	2,53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	-	-	-	-	-	-	-	-	0,32	-	-	0,67	-
Dentalina sp.	Desp	1,90	-	-	-	-	0,45	-	-	-	-	-	-	-	-	0,33	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	1,27	-	0,89	-	-	-	0,37	-	-	0,33	0,45	0,32	-	-	0,33	0,66
Ehrenbergina trigona	Ehtr	1,27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella exigua	Epex	3,16	6,67	5,36	11,26	9,33	4,55	1,99	4,47	8,49	12,58	5,00	8,54	1,46	14,18	12,21	15,79
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	0,37	-	-	-	-	-	-	-
Fissurina spp.	Fispp	1,27	2,67	5,36	5,30	1,55	1,00	0,73	-	0,37	0,99	2,27	-	0,84	1,66	4,62	0,66
Fursenkoina bradyi	Furbr	-	-	-	-	-	-	-	-	-	-	-	0,32	-	-	-	-
Fursenkoina fusiformis	Furfs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,67	-
Globobulimina affinis	Glaf	-	-	-	-	0,52	1,36	0,37	-	0,37	0,33	0,45	-	0,42	0,41	-	0,66
Globobulimina pacifica	Glpa	-	-	-	-	-	1,00	0,37	0,34	0,37	0,33	0,45	0,32	-	-	-	-
Globocassidulina elegans	Glcel	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globocassidulina subglobosa	Glcsb	11,39	-	6,25	4,64	5,18	3,18	1,99	0,69	0,74	1,66	1,82	1,27	0,42	1,24	1,98	3,29
Globulina minuta	Gbumi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glomospira charoides	Glmch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	1,90	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	-	-	3,57	-	2,73	1,00	1,83	0,69	0,74	0,66	-	-	0,42	0,83	-	0,66
Gyroidinoides polius	Gyrpo	0,63	-	-	0,66	-	-	-	-	-	-	-	-	-	-	-	1,32
Gyroidinoides soldanii	Gyrso	0,63	-	0,89	-	-	-	-	-	-	-	-	-	-	-	1,65	-
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	1,90	4,00	5,36	2,65	1,36	1,00	0,37	1,39	-	0,99	0,45	0,32	0,42	1,24	1,00	2,63
Karreriella bradyi	Karbr	0,63	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-

Species	Code	65-66 cm	69-70 cm	73-74 cm	77-78 cm	81-82 cm	85-86 cm	89-90 cm	93-94 cm	97-98 cm	101-102 cm	105-106 cm	109-110 cm	113-114 cm	117-118 cm	121-122 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	-	-	-	-	0,77	-
Anomalina globulosa	Aaglob	-	-	-	-	-	-	-	-	-	-	0,70	-	-	-	-
Astacolus crepidulus	Atacre	-	-	0,72	-	-	-	1,47	-	-	-	-	-	-	-	-
Astrononion echolsi	Astrech	8,52	6,27	6,52	4,65	8,70	5,66	8,95	3,67	2,36	7,75	12,59	14,79	1,00	1,77	1,13
Bolivina seminuda	Bolsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	0,52	-	-	-	-	-	-	-	-
Brizalina semilineata	Brsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina sp.	Brsp	-	-	-	-	0,72	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	1,42	12,41	2,90	2,33	1,45	-	0,52	2,29	-	2,82	3,50	0,59	1,76	0,77	1,27
Bulimina costata	Buco	2,13	2,76	4,35	3,18	3,62	-	1,47	-	2,36	1,48	2,80	1,78	1,76	0,77	-
Bulimina marginata	Buma	-	-	-	-	0,72	-	-	-	-	-	-	-	-	-	-
Buliminella sp.	Bumsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina crassa	Cascr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina laevigata	Caslae	2,13	0,69	2,17	0,78	3,62	2,83	1,58	1,38	3,15	5,63	2,98	2,96	2,35	3,77	-
Ceratobulimina pacifica	Cerpa	2,84	-	0,72	-	-	-	1,47	0,46	-	-	0,70	-	-	1,54	-
Chilostomella oolina	Chol	1,64	3,45	5,72	13,95	13,43	1,38	3,66	6,42	14,97	2,11	0,70	-	1,76	2,38	7,59
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	0,79	1,38	2,17	-	-	1,89	0,52	-	1,57	-	2,98	1,78	0,59	0,77	-
Cibicidoides kullenbergi	Ciku	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides pseudoungerianus	Cipse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides robertsonianus	Cirob	0,79	0,69	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides wuellerstorfi	Ciwul	11,35	9,66	12,32	2,93	13,43	16,38	18,32	18,87	13,39	16,20	10,00	15,98	12,35	26,15	24,56
Cibicidoides sp.	Cisp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyclammina cancellata	Cyca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	0,69	0,72	0,78	-	-	-	-	-	-	-	-	-	0,77	-
Dentalina sp.	Desp	-	-	-	-	-	-	-	0,46	-	0,74	0,70	-	-	-	-
Dorothia bradyana	Dobr	-	-	0,72	-	-	-	-	-	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	-	-	-	-	0,72	-	0,52	0,46	-	-	-	0,59	-	0,77	-
Ehrenbergina trigona	Ehtr	-	-	-	-	-	-	-	-	-	-	-	-	0,59	-	-
Epistominella exigua	Epex	5,67	14,48	7,25	14,73	8,70	9,43	1,99	13,76	12,60	19,15	19,58	9,47	24,76	4,62	8,87
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina spp.	Fispp	6,38	9,66	5,80	3,88	2,90	4,72	5,24	4,13	6,30	2,82	1,40	4,73	5,29	3,85	2,53
Fursenkoina bradyi	Furbr	-	-	-	-	-	-	-	-	0,79	-	-	0,59	0,59	-	-
Fursenkoina fusiformis	Furfs	-	-	-	-	-	-	1,47	-	-	-	-	-	-	-	-
Globobulimina affinis	Glaf	-	-	1,45	-	2,90	0,94	-	-	0,79	-	0,70	0,59	-	-	1,27
Globobulimina pacifica	Glpa	-	-	-	-	-	-	-	0,46	-	-	2,98	-	-	-	-
Globocassidulina elegans	Glcel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Globocassidulina subglobosa	Glcsb	7,92	2,76	2,90	1,55	1,45	-	0,52	0,46	0,79	0,74	0,70	-	1,76	-	-
Globulina minuta	Gbumi	-	-	-	-	-	-	-	0,46	-	-	-	-	-	-	-
Glomospira charoides	Glmch	-	-	-	-	-	-	-	0,46	-	-	-	-	-	-	-
Gyroidinoides altiformis	Gyral	-	-	-	-	0,72	-	-	0,46	-	-	0,70	-	-	0,77	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	-	-	1,89	-	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	1,42	-	2,17	1,55	1,45	-	0,52	0,92	-	2,11	-	2,37	1,76	3,77	-
Gyroidinoides polius	Gyrpo	-	0,69	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides soldanii	Gyrso	0,79	0,69	-	-	0,72	-	0,52	-	0,79	-	-	-	-	-	-
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	0,79	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	2,13	0,69	1,45	3,89	1,45	3,77	2,94	4,13	2,36	1,48	1,40	2,37	1,76	3,77	1,27
Karreriella bradyi	Karbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	0-1 cm	5-6 cm	9-10 cm	13-14 cm	17-18 cm	21-22 cm	25-26 cm	29-30 cm	33-34 cm	37-38 cm	41-42 cm	45-46 cm	49-50 cm	53-54 cm	57-58 cm	61-62 cm
Lagena spp.	Laspp	1,27	2,67	1,79	0,66	1,36	-	0,73	0,69	1,17	0,33	-	-	0,42	0,41	-	0,66
Laticarinina pauperata	Ltpa	0,63	2,67	0,89	0,66	1,55	-	-	-	-	-	-	-	0,42	0,41	-	1,32
Lenticulina spp.	Lespp	-	-	-	-	0,52	-	-	-	-	-	-	-	-	-	-	-
Marginulina obesa	Maob	0,63	-	-	-	-	-	0,37	-	-	-	-	-	0,42	0,41	0,33	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	0,37	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	-	0,32	-	-	0,33	-
Martinottiella communis	Mtcom	-	-	-	-	-	-	-	-	-	0,33	-	0,32	-	-	-	-
Martinottiella perparva	Mtpr	-	-	-	-	0,52	-	-	-	-	-	-	-	-	-	-	-
Melonis barleeanum	Meba	1,27	-	-	-	-	-	-	0,34	0,37	0,33	0,45	0,32	-	0,41	1,00	0,66
Melonis pompilioides	Mepo	0,63	-	-	-	-	0,45	1,47	0,34	0,37	1,99	0,45	0,63	1,67	0,83	0,67	0,66
Miliolinella oblonga	Miob	-	-	0,89	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella subrotunda	Misb	1,27	-	-	-	-	0,45	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-
Nonion sp.	Nosp	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	1,79	0,66	0,52	1,00	0,37	0,34	-	0,33	0,45	0,32	0,84	0,41	-	0,66
Oolina spp.	Oospp	1,27	-	0,89	-	0,52	1,00	-	-	-	-	-	1,27	-	2,75	1,65	0,66
Oridorsalis tener umbonatus	Ortu	5,70	1,67	4,46	9,93	6,74	10,00	8,42	7,94	2,95	6,62	4,55	6,96	5,29	7,54	11,22	17,76
Oridorsalis sp.	Orsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Osangularia cultur	Oscu	3,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parafissurina spp.	Paspp	0,63	-	-	-	-	0,45	0,37	1,39	0,74	-	2,27	0,95	1,26	1,66	1,65	1,32
Parafrondicularia sp.	Prsp	-	-	-	-	-	-	-	-	-	0,33	-	-	-	-	-	-
Pullenia bulloides	Pubu	4,43	4,00	0,89	1,32	-	1,36	-	0,69	2,21	-	1,82	1,27	-	0,41	0,33	1,32
Pullenia quinqueloba	Pu5	-	1,33	-	0,66	0,52	0,45	0,37	-	1,17	-	-	0,32	-	4,98	2,31	-
Pullenia sp.	Pusp	1,27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	-	1,33	-	3,97	0,52	-	-	-	-	-	-	0,32	-	-	1,00	-
Pyrgo lucernula	Pylu	1,90	-	-	-	-	-	-	-	-	0,33	0,45	-	0,42	-	0,67	-
Pyrgo murrhina	Pyu	-	2,67	2,68	1,99	1,36	2,27	4,29	4,82	1,85	2,98	3,18	4,11	2,93	5,39	2,31	8,55
Pyrgo vespertilio	Pyve	1,27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	-	-	-	-	-	-	-	0,34	1,17	0,33	0,45	0,63	-	-	0,33	0,66
Pyrulina fusiformis	Pyrf	-	-	-	0,66	-	-	-	-	-	-	-	0,32	-	-	-	-
Quinqueloculina inmata	Quin	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum	Qusem	-	2,67	1,79	3,31	-	-	0,37	0,34	-	-	0,45	1,58	0,84	0,83	1,00	-
Quinquqloculina stelligera	Qutg	1,90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	0,63	2,67	0,89	3,31	1,55	0,45	0,37	-	0,37	-	-	0,32	0,84	2,75	0,33	1,32
Quinqueloculina sp.	Qusp	-	-	-	-	0,52	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Robertinoides brady	Robbr	-	-	1,79	3,31	0,52	0,45	-	0,34	-	0,66	-	-	-	-	-	-
Saracenaria italica	Sarit	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	-	-	-	-	-	-	0,73	-	0,37	-	-	-	0,42	0,41	0,67	3,29
Siphoeggerella siphonella	Sphsph	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	1,33	0,89	-	0,52	-	0,37	-	-	-	-	-	0,42	0,41	-	-
Siphotextularia curta	Stxcu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	-	8,00	7,14	6,62	2,73	1,00	1,99	1,39	0,74	-	5,00	-	0,42	0,41	-	0,66
Textularia lateralis	Txlat	0,63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	-	-	-	-	-	0,34	-	-	-	-	-	-	0,33	1,32
Triloculina tricarinata	Trtr	0,63	-	1,79	0,66	0,52	0,45	-	0,34	-	-	-	-	-	-	0,33	-
Uvigerina peregrina	Uvpe	-	-	-	0,66	0,52	1,00	1,47	1,39	1,48	2,32	1,82	2,53	3,35	2,75	0,67	3,29
Uvigerina porrecta	Uvpr	3,16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	-	9,33	0,89	1,99	2,60	0,45	2,56	0,69	2,21	1,66	1,00	1,90	0,42	1,66	1,00	0,66
Uvigerina sp.	Uvsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,33	-
Valvulineria sp.	Vlsp	-	-	-	-	-	-	-	0,34	-	-	0,45	-	-	-	-	-

Species	Code	65-66 cm	69-70 cm	73-74 cm	77-78 cm	81-82 cm	85-86 cm	89-90 cm	93-94 cm	97-98 cm	101-102 cm	105-106 cm	109-110 cm	113-114 cm	117-118 cm	121-122 cm
Lagena spp.	Laspp	0,79	0,69	0,72	0,78	0,72	0,94	-	0,46	-	0,74	1,40	0,59	1,76	-	1,27
Laticarinina pauperata	Ltpa	-	0,69	1,45	-	-	-	0,52	-	0,79	2,11	-	-	0,59	-	-
Lenticulina spp.	Lespp	-	-	-	-	0,72	-	0,52	0,46	-	1,48	0,70	0,59	-	-	-
Marginulina obesa	Maob	-	-	-	0,78	-	-	-	-	-	0,74	-	-	-	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	-	-	0,72	-	0,72	-	-	-	-	-	-	-	-	0,77	-
Martinottiella perparva	Mtpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melonis barleeanum	Meba	-	-	-	-	-	-	1,47	-	-	1,48	-	1,18	-	-	-
Melonis pompilioides	Mepo	-	2,69	0,72	2,33	2,17	1,89	1,58	1,38	0,79	-	1,40	2,37	0,59	3,85	2,53
Miliolinella oblonga	Miob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella subrotunda	Misb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonion sp.	Nosp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	-	-	0,72	-	-	-	-	0,74	-	-	-	-	-
Oolina spp.	Oospp	-	0,69	-	-	-	1,89	-	-	-	-	-	0,59	1,76	1,54	-
Oridorsalis tener umbonatus	Ortu	12,77	9,66	11,59	8,53	1,14	1,38	8,38	12,84	13,39	11,97	11,19	15,98	5,29	6,92	12,66
Oridorsalis sp.	Orsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Osangularia cultur	Oscu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parafissurina spp.	Paspp	0,79	-	3,62	0,78	1,45	0,94	1,47	2,29	0,79	1,48	3,50	0,59	0,59	2,38	-
Parafrondicularia sp.	Prsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	1,42	-	-	-	-	1,89	0,52	0,46	0,79	-	0,70	-	1,18	4,62	1,27
Pullenia quinqueloba	Pu5	-	-	-	-	-	-	0,52	-	-	1,48	-	2,37	0,59	0,77	-
Pullenia sp.	Pusp	-	1,38	0,72	-	0,72	-	-	-	-	-	-	-	1,18	0,77	-
Pyrgo depressa	Pyde	0,79	1,38	0,72	0,78	-	-	-	-	-	-	-	-	-	0,77	-
Pyrgo lucernula	Pylu	-	-	-	-	-	-	-	0,46	-	-	-	-	-	-	-
Pyrgo murrhina	Pyu	5,67	6,90	5,72	6,22	3,62	7,55	14,14	14,68	11,81	8,46	5,59	9,47	11,76	5,38	1,13
Pyrgo vespertilio	Pyve	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	0,79	-	-	-	0,72	-	2,94	0,92	0,79	0,74	-	2,96	1,76	1,54	3,80
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina inmata	Quin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum	Qusem	1,42	0,69	2,90	-	0,72	1,89	3,14	0,92	2,36	-	-	0,59	-	0,77	-
Quinquqloculina stelligera	Qutg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	-	-	-	0,78	0,72	-	1,47	0,46	-	-	0,70	0,59	-	-	-
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	0,46	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	-	-	-	-	-	-	-	-	2,11	0,70	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	0,79	-	0,72	-	-	0,94	0,52	0,92	-	-	0,70	-	-	-	1,27
Siphoeggerella siphonella	Sphsph	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia curta	Stxcu	-	-	-	-	-	-	-	-	-	-	-	-	0,59	-	-
Sphaeroidina bulloides	Sbull	2,13	2,69	2,17	0,78	2,17	1,89	-	0,46	1,57	-	2,98	1,18	-	0,77	1,27
Textularia lateralis	Txlat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	0,72	-	-	-	-	-	-	0,74	-	-	-	-	-
Triloculina tricarinata	Trtr	1,42	-	-	0,78	-	-	-	-	-	0,74	-	0,59	-	-	-
Uvigerina peregrina	Uvpe	5,67	6,27	5,90	4,65	6,52	11,33	5,24	2,75	3,94	2,82	6,99	1,18	3,53	2,38	6,33
Uvigerina porrecta	Uvpr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	2,13	0,69	2,90	0,79	2,17	0,94	1,47	0,92	-	-	2,80	0,59	1,76	3,77	2,53
Uvigerina sp.	Uvsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valvulineria sp.	Vlsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX A4

Counts data of benthic foraminifera from *SHI9016* samples. Numbers are given as percentage of the total number of specimens in each sample.

Species	Code	0-1 cm	4-5 cm	8-9 cm	12-13 cm	16-17 cm	22-23 cm	26-27 cm	32-33 cm	36-37 cm	42-43 cm	46-47 cm	52-53 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	0,55	-	-
Amphicoryna sp.	Amphsp	-	-	-	0,55	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	-	-	0,86	0,55	-	0,56	0,73	0,77	-	0,55	0,68	2,77
Astrononion echolsi	Astrech	-	0,78	6,34	2,73	2,89	2,82	2,92	4,62	4,38	1,62	-	2,46
Bolivina albatrossi	Bolalb	-	-	-	-	-	0,56	-	-	-	-	-	-
Bolivina robusta	Bolro	-	3,13	1,72	0,55	1,69	0,56	-	0,77	0,73	-	-	-
Bolivina seminuda	Bolsem	-	-	-	-	-	-	-	-	-	-	-	0,38
Bolivina sp.	Bolsp	-	-	-	-	-	0,56	-	-	-	-	-	-
Bolivinita quadrilatera	Blql	-	-	-	-	-	-	-	-	-	-	-	0,38
Brizalina dilatata	Brdi	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina semilineata	Brsem	-	-	-	-	0,56	-	-	-	-	0,55	1,35	0,62
Brizalina sp.	Brsp	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	-	-	-	-	-	-	-	-	0,73	-	-	2,77
Bulimina alazanensis	Bualz	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina costata	Buco	-	-	1,72	2,73	1,69	3,39	2,19	0,77	2,19	3,24	2,73	1,54
Buliminella elegantissima	Bumel	-	-	-	0,55	-	-	-	-	-	-	2,27	1,85
Cassidulina crassa	Cascr	-	2,33	0,86	-	-	-	-	-	-	-	-	-
Cassidulina laevigata	Caslae	1,33	2,33	2,59	2,19	1,69	0,56	1,46	3,85	2,19	2,73	4,55	2,77
Cassidulina reflexa	Cassre	-	-	-	-	-	-	-	-	-	-	-	-
Ceratobulimina pacifica	Cerpa	2,67	0,78	1,72	2,19	2,25	3,39	1,46	3,77	0,73	3,78	2,27	1,85
Chilostomella oolina	Chol	-	4,65	3,45	1,64	6,74	2,26	9,49	2,38	3,65	7,57	4,73	0,92
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	2,67	5,43	1,72	5,46	2,89	3,39	5,19	2,38	1,46	1,62	4,73	2,46
Cibicidoides kullenbergi	Ciku	1,33	1,55	0,86	2,19	0,56	2,82	-	-	4,38	1,82	-	0,38
Cibicidoides pseudoungerianus	Cipse	4,00	1,55	0,86	2,19	2,25	3,95	0,73	3,85	2,19	3,78	0,68	1,54
Cibicidoides robertsonianus	Cirob	-	-	-	-	0,56	-	2,92	0,77	-	-	-	0,62
Cibicidoides wuellerstorfi	Ciwul	6,67	3,88	9,48	3,83	5,56	9,65	6,57	6,15	6,57	11,35	4,73	7,38
Cibicidoides sp.	Cisp	2,67	-	-	-	-	1,13	-	-	-	-	-	0,62
Cornuspira involvens	Coin	-	-	-	-	-	-	-	-	0,73	-	0,68	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	0,38
Cyambaloporretta squamosa	Cyasq	-	-	-	-	-	-	-	-	-	-	-	-
Cyclammina cancellata	Cyca	1,33	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	2,67	0,78	0,86	0,55	0,56	-	-	0,77	0,73	-	-	-
Dentalina inornata	Dein	-	0,78	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	2,67	-	-	0,55	0,56	-	1,46	-	-	1,62	0,68	0,38
Eggerella bradyi	Egbr	-	-	-	2,19	0,56	1,13	2,92	-	-	-	0,68	-
Ehrenbergina trigona	Ehtr	1,33	0,78	3,45	1,93	-	-	-	-	0,73	-	-	0,38
Epistominella exigua	Epex	-	0,78	0,86	-	-	-	-	-	-	0,55	-	1,54
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	-	-	-	-
Eponides regularis	Epre	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina spp.	Fispp	5,33	5,43	6,90	4,37	5,62	6,78	6,57	4,62	5,19	3,24	2,73	5,85
Fursenkoina bradyi	Furbr	-	-	-	0,55	-	-	0,73	-	-	-	-	-
Fursenkoina fusiformis	Furfs	-	-	0,86	0,55	-	-	-	-	1,46	0,55	-	0,38
Fursenkoina sp.	Fursp	-	-	-	0,55	-	-	-	-	0,73	-	-	-
Gavelinopsis lobatulus	Galo	1,33	0,78	0,86	-	-	-	0,73	-	0,73	1,82	2,27	2,15
Globobulimina affinis	Glaf	1,33	-	-	-	-	0,56	-	1,54	-	-	-	-
Globobulimina pacifica	Glpa	-	-	-	-	0,56	0,56	0,73	0,77	0,73	0,55	-	-
Globocassidulina elegans	Glcel	1,33	0,78	3,45	1,93	-	-	1,46	1,54	2,19	0,55	-	0,62
Globocassidulina subglobosa	Glcsb	4,00	7,75	6,34	7,14	9,56	6,21	5,84	6,92	8,76	7,27	4,55	4,62
Guttulina pacifica	Gupa	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	56-57 cm	58-59 cm	62-63 cm	66-67 cm	72-73 cm	76-77 cm	82-83 cm	86-87 cm	92-93 cm	96-97 cm	102-103 cm	106-107 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna sp.	Amphsp	-	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	2,34	1,38	0,31	0,99	0,95	-	1,00	-	0,34	-	-	-
Astrononion echolsi	Astrech	2,73	3,67	3,74	2,63	2,85	3,33	4,55	4,49	-	3,28	1,71	0,84
Bolivina albatrossi	Bolalb	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	0,31	-	0,32	0,67	-	0,45	0,34	-	-	-
Bolivina seminuda	Bolsem	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	-	0,92	0,31	0,66	-	-	0,45	-	-	0,33	0,34	-
Bolivinita quadrilatera	Blql	-	0,46	0,62	-	0,32	-	1,35	-	-	-	0,68	-
Brizalina dilatata	Brdi	-	-	-	-	-	-	0,45	-	-	-	-	-
Brizalina semilineata	Brsem	0,40	-	-	0,66	0,32	-	-	0,45	0,34	1,31	-	-
Brizalina sp.	Brsp	-	-	0,31	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	12,90	18,87	2,57	22,70	26,58	15,67	15,77	11,75	1,58	16,66	23,97	38,24
Bulimina alazanensis	Bualz	-	0,46	-	-	-	-	-	0,45	-	0,33	-	-
Bulimina costata	Buco	-	-	2,19	0,66	2,53	1,33	1,00	0,90	2,48	0,98	1,37	0,42
Buliminella elegantissima	Bumel	0,78	-	-	0,33	-	-	-	-	0,34	-	-	-
Cassidulina crassa	Cascr	-	0,46	-	-	0,32	0,33	1,00	0,45	-	0,33	-	-
Cassidulina laevigata	Caslae	2,73	5,55	5,92	3,95	2,53	2,67	2,25	0,90	1,76	2,30	0,68	1,27
Cassidulina reflexa	Cassre	-	-	-	-	0,32	-	-	-	-	-	-	-
Ceratobulimina pacifica	Cerpa	0,78	0,46	-	0,33	0,32	0,33	-	-	-	-	0,34	0,42
Chilostomella oolina	Chol	-	0,46	-	0,66	0,95	0,67	1,35	0,90	1,37	0,33	0,68	1,69
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	1,95	3,21	0,62	1,97	2,53	2,33	4,55	1,21	4,96	3,28	5,14	5,46
Cibicidoides kullenbergi	Ciku	0,78	-	0,31	-	-	-	-	-	-	-	-	-
Cibicidoides pseudoungerianus	Cipse	-	-	-	0,33	-	-	1,00	0,45	2,39	-	1,27	-
Cibicidoides robertsonianus	Cirob	-	-	-	0,33	-	0,33	-	0,90	0,68	-	0,34	-
Cibicidoides wuellerstorfi	Ciwul	8,59	5,46	7,48	6,58	5,70	8,33	9,46	7,29	8,87	5,92	4,79	3,78
Cibicidoides sp.	Cisp	0,40	-	0,31	0,99	0,32	0,33	-	0,45	0,34	-	-	0,42
Cornuspira involvens	Coin	-	0,46	-	-	-	-	-	-	-	-	-	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	0,46	-	-	-	-	-	-	-	-	-	-
Cyclammina cancellata	Cyca	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	0,40	-	-	-	-	0,33	0,45	-	-	0,66	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	-	0,46	0,31	-	0,95	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	0,40	-	-	-	0,63	0,67	0,45	0,90	0,34	0,98	0,34	0,42
Ehrenbergina trigona	Ehtr	0,40	0,46	2,49	-	2,22	1,33	1,35	1,21	0,34	0,98	0,34	0,84
Epistominella exigua	Epex	3,52	2,75	3,43	4,28	6,65	6,00	3,15	2,24	2,48	1,64	2,40	5,42
Epistominella umbonifera	Exum	0,40	-	0,31	0,33	-	0,33	-	-	-	-	-	-
Eponides regularis	Epre	-	-	-	-	-	-	-	0,45	-	-	-	-
Fissurina spp.	Fispp	5,86	2,75	3,43	5,92	3,48	8,67	4,55	8,14	6,83	5,57	8,22	5,46
Fursenkoina bradyi	Furbr	0,78	-	-	0,33	-	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	0,78	-	-	0,33	-	-	1,00	0,45	0,34	-	-	-
Fursenkoina sp.	Fursp	-	-	-	-	-	-	-	-	-	-	-	-
Gavelinopsis lobatulus	Galo	0,78	2,29	2,19	-	0,32	1,00	0,45	1,21	2,39	0,33	1.71	0,84
Globobulimina affinis	Glaf	0,40	-	-	-	-	-	-	-	-	-	-	-
Globobulimina pacifica	Glpa	0,40	0,46	-	-	-	-	0,45	0,45	-	-	-	0,42
Globocassidulina elegans	Glcel	-	-	-	0,33	-	-	-	-	-	-	-	-
Globocassidulina subglobosa	Glcsb	6,25	5,96	4,67	5,59	1,90	2,33	4,55	2,43	5,82	3,67	3,82	3,36
Guttulina pacifica	Gupa	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	112-113 cm	116-117 cm	122-123 cm	126-127 cm	132-133 cm	136-137 cm	142-143 cm	146-147 cm	152-153 cm	156-157 cm	162-163 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	-	-
Amphicoryna sp.	Amphsp	0,32	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	0,65	-	-	-	-	-	-	-	1,00	1,18	-
Astrononion echolsi	Astrech	4,54	3,49	4,73	6,43	4,19	3,13	1,37	3,24	1,33	2,75	3,33
Bolivina albatrossi	Bolalb	0,32	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	0,32	-	0,32	0,31	1,37	-	-	-	0,67
Bolivina seminuda	Bolsem	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	0,33	-	-	-	0,33
Bolivinita quadrilatera	Blql	0,32	-	-	-	0,32	0,31	-	-	-	-	0,33
Brizalina dilatata	Brdi	0,65	-	0,32	-	0,32	-	-	-	-	-	-
Brizalina semilineata	Brsem	1,29	-	-	0,34	0,97	-	0,65	-	-	0,39	1,00
Brizalina sp.	Brsp	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	11,32	32,62	26,81	21,15	18,80	31,97	33,66	21,62	16,67	18,82	21,12
Bulimina alazanensis	Bualz	-	-	-	-	-	-	-	-	-	-	-
Bulimina costata	Buco	0,65	-	0,32	-	0,65	-	0,33	-	1,00	1,18	1,32
Buliminella elegantissima	Bumel	0,32	-	-	-	0,65	-	-	-	0,33	-	0,33
Cassidulina crassa	Cascr	0,98	-	-	0,67	-	0,31	-	-	-	-	-
Cassidulina laevigata	Caslae	0,32	2,74	1,26	2,68	1,94	1,57	2,29	1,62	6,00	3,53	3,33
Cassidulina reflexa	Cassre	-	-	-	-	-	-	-	-	-	-	-
Ceratobulimina pacifica	Cerpa	-	0,35	-	-	0,32	1,57	-	1,82	0,67	-	0,67
Chilostomella oolina	Chol	-	1,83	0,32	2,13	0,97	0,63	1,63	2,73	1,33	0,78	0,67
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	0,33
Cibicidoides bradyi	Cibr	1,32	4,57	5,68	5,34	6,45	5,96	4,25	5,95	7,33	5,98	10,00
Cibicidoides kullenbergi	Ciku	-	-	-	-	0,32	-	0,33	-	0,33	0,39	0,33
Cibicidoides pseudoungerianus	Cipse	1,94	-	0,95	-	0,32	0,94	-	-	2,33	1,57	0,67
Cibicidoides robertsonianus	Cirob	-	0,35	0,32	0,34	0,32	-	0,33	-	0,67	0,39	0,67
Cibicidoides wuellerstorfi	Ciwul	2,91	1,83	2,52	2,13	5,48	4,75	5,23	3,78	3,67	2,35	3,33
Cibicidoides sp.	Cisp	-	-	-	0,67	0,32	-	0,65	-	1,33	1,18	0,33
Cornuspira involvens	Coin	-	-	-	-	-	-	-	-	-	-	-
Cornuspira sp.	Cosp	-	-	-	-	-	-	-	-	-	-	-
Cyambaloporretta squamosa	Cyasq	-	-	-	-	-	-	-	-	-	-	-
Cyclammina cancellata	Cyca	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	0,35	-	-	0,32	-	-	-	-	-	-
Dentalina inornata	Dein	-	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	-	0,35	0,64	-	-	-	0,65	1,82	-	1,18	0,33
Eggerella bradyi	Egbr	0,32	0,35	0,95	-	-	-	-	0,55	0,33	0,39	0,67
Ehrenbergina trigona	Ehtr	1,29	-	1,26	1,68	1,29	0,94	1,37	2,16	0,33	-	0,67
Epistominella exigua	Epex	2,91	3,35	4,73	2,13	1,29	1,57	1,97	1,62	2,33	3,14	4,29
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	-	-	-
Eponides regularis	Epre	-	-	-	-	-	-	-	-	-	-	-
Fissurina spp.	Fispp	8,96	3,96	6,39	4,27	4,84	3,45	7,19	11,89	5,67	3,53	4,62
Fursenkoina bradyi	Furbr	-	-	-	-	-	-	-	-	0,33	0,39	0,33
Fursenkoina fusiformis	Furfs	-	-	0,32	-	-	-	-	-	-	-	-
Fursenkoina sp.	Fursp	-	-	-	-	-	-	-	-	-	-	-
Gavelinopsis lobatulus	Galo	2,27	0,35	0,32	1,34	0,32	0,31	-	1,62	1,00	-	0,67
Globobulimina affinis	Glaf	-	-	-	-	-	-	-	-	-	-	0,33
Globobulimina pacifica	Glpa	-	-	-	-	-	-	0,33	-	-	-	0,33
Globocassidulina elegans	Glcel	-	-	-	-	-	-	-	-	-	-	-
Globocassidulina subglobosa	Glcsb	5,83	3,96	4,42	4,36	2,26	0,63	1,63	-	2,33	7,59	3,63
Guttulina pacifica	Gupa	-	0,35	-	-	-	-	-	-	-	-	-

Species	Code	0-1 cm	4-5 cm	8-9 cm	12-13 cm	16-17 cm	22-23 cm	26-27 cm	32-33 cm	36-37 cm	42-43 cm	46-47 cm	52-53 cm
Gyroidinoides altiformis	Gyral	-	2,33	-	-	0,56	1,13	1,46	0,77	-	0,55	-	0,38
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	-	-	-	0,73	-	1,46	-	0,68	-
Gyroidinoides orbicularis	Gyror	-	3,88	0,86	2,73	2,89	3,95	4,38	1,54	0,73	3,24	2,27	0,92
Gyroidinoides polius	Gyrpo	-	-	-	0,55	0,56	-	-	-	-	-	0,68	-
Gyroidinoides soldanii	Gyrso	-	1,55	2,59	-	1,12	0,56	-	0,77	-	-	-	0,62
Gyroidinoides sp.	Gyrsp	-	-	0,86	-	-	-	0,73	-	-	1,82	-	-
Hanzawaia nipponica	Hnwni	-	-	0,86	-	-	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	-	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	-	3,18	-	3,28	3,38	1,13	2,19	3,85	4,38	7,27	2,27	5,54
Karreriella bradyi	Karbr	-	-	-	-	-	-	2,19	-	-	-	0,68	0,38
Lagena spp.	Laspp	-	-	3,45	1,93	3,93	1,69	0,73	1,54	1,46	0,55	1,35	1,54
Laticarinina pauperata	Ltpa	-	1,55	0,86	1,93	-	1,13	0,73	0,77	0,73	0,55	1,35	1,24
Lenticulina sp.	Lesp	1,33	-	0,86	1,93	-	1,69	1,46	0,77	2,19	0,55	1,35	0,62
Marginulina obesa	Maob	-	-	-	-	-	-	0,73	0,77	-	-	1,35	0,38
Marginulina sp.	Masp	-	-	-	0,55	0,56	0,56	0,73	-	-	-	-	-
Marsipella cylindrica	Mrcy	1,33	-	-	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	1,33	-	-	0,55	1,12	-	0,73	-	2,19	0,55	1,35	-
Martinottiella perparva	Mtpr	-	-	-	-	-	-	-	-	-	-	-	-
Melonis barleeanum	Meba	1,33	3,18	1,72	0,55	1,12	1,13	0,73	2,38	0,73	1,82	-	0,92
Melonis pompilioides	Mepo	-	-	0,86	1,64	-	-	-	-	-	-	-	-
Miliolinella oblonga	Miob	-	-	0,86	0,55	0,56	1,13	-	-	-	0,55	0,68	0,38
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	1,46	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella bradyi	Nnbr	-	0,78	-	-	-	-	-	-	-	-	-	-
Nonionella iridea	Nnir	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella turgida	Nntu	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	-	-	0,56	2,82	-	2,38	0,73	-	2,73	1,54
Oolina sp.	Oosp	-	0,78	0,86	0,55	1,12	0,56	2,19	-	-	-	1,35	-
Oridorsalis tener umbonatus	Ortu	5,33	6,22	1,72	3,83	7,33	2,82	2,92	5,38	5,19	1,82	2,73	1,54
Osangularia cultur	Oscu	-	0,78	-	-	-	-	-	-	0,73	1,82	1,35	1,24
Parafissurina sp.	Pasp	1,33	4,66	3,45	0,55	1,12	1,69	-	2,38	-	1,82	1,35	0,92
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	-	-	-
Planulina ariminensis	Plar	-	-	-	-	-	-	-	-	-	-	-	-
Pleurostomella alternans	Psal	-	-	-	-	-	-	-	-	-	-	-	0,38
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	-	1,46	0,55	-	1,24
Pullenia bulloides	Pubu	6,67	6,98	6,90	11,48	8,43	5,65	6,57	3,85	2,92	3,78	5,45	4,62
Pullenia quinqueloba	Pu5	1,33	3,18	2,59	3,83	2,89	2,26	2,19	0,77	0,73	1,62	0,68	2,15
Pullenia sp.	Pusp	-	-	-	-	-	0,56	-	-	-	-	-	-
Pyrgo depressa	Pyde	5,33	1,55	0,86	2,73	1,12	1,13	0,73	2,38	-	0,55	0,68	3,38
Pyrgo lucernula	Pylu	-	-	-	-	-	-	-	1,54	-	-	-	-
Pyrgo murrhina	Pyu	2,67	1,55	1,72	-	1,12	0,56	0,73	0,77	2,19	1,82	1,35	3,69
Pyrgo vespertilio	Pyve	-	-	-	-	-	-	-	-	-	0,55	-	-
Pyrgo sp.	Pysp	1,33	1,55	-	-	-	1,69	-	-	-	-	0,68	-
Pyrulina angusta	Pyra	-	-	-	-	-	-	-	0,77	0,73	-	-	-
Pyrulina cylindroides	Pycl	-	-	-	-	-	-	-	-	0,73	-	-	-
Pyrulina extensa	Pyrex	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	-	0,56	-	-	-	-	-	0,68	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	2,26	-	-	0,73	-	-	0,62

Species	Code	56-57 cm	58-59 cm	62-63 cm	66-67 cm	72-73 cm	76-77 cm	82-83 cm	86-87 cm	92-93 cm	96-97 cm	102-103 cm	106-107 cm
Gyroidinoides altiformis	Gyral	-	0,46	0,93	0,66	-	0,33	0,45	1,21	0,68	0,33	-	0,42
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	-	-	-	0,45	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	2,34	1,38	0,62	1,97	2,22	0,67	2,25	0,45	1,37	1,31	1,71	1,69
Gyroidinoides polius	Gyrpo	-	-	-	0,33	-	-	-	-	0,34	-	-	-
Gyroidinoides soldanii	Gyrso	0,78	0,92	-	1,32	-	0,67	-	0,90	0,68	0,98	-	-
Gyroidinoides sp.	Gyrsp	-	-	-	0,99	-	-	-	0,45	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	0,32	-	-	0,45	-	-	0,34	-
Hauerinella incostans	Hurin	-	-	-	-	-	0,33	-	-	-	-	-	-
Hoeglundina elegans	Hoel	3,52	1,83	1,25	2,33	2,53	3,33	0,45	0,90	0,68	0,99	-	0,42
Karreriella bradyi	Karbr	-	-	-	-	-	-	0,45	-	0,34	0,98	-	0,42
Lagena spp.	Laspp	1,56	0,92	0,93	0,99	1,58	2,67	3,15	1,62	2,48	0,66	2,55	2,18
Laticarinina pauperata	Ltpa	1,17	-	0,31	0,33	-	0,33	0,45	2,24	-	0,33	-	-
Lenticulina sp.	Lesp	-	-	-	0,33	-	0,33	0,45	0,45	0,34	0,33	0,34	-
Marginulina obesa	Maob	0,40	-	0,31	0,33	0,32	-	-	0,90	-	-	-	0,42
Marginulina sp.	Masp	-	-	-	-	-	0,33	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	-	-	0,93	0,33	-	1,00	0,45	1,62	0,34	0,33	0,68	0,42
Martinottiella perparva	Mtpr	-	-	-	-	0,32	-	-	0,45	-	-	-	-
Melonis barleeanum	Meba	2,34	5,46	2,19	2,33	1,58	2,67	2,25	4,45	1,24	4,26	7,53	4,22
Melonis pompilioides	Mepo	-	-	-	0,33	-	-	1,00	2,24	0,68	-	-	-
Miliolinella oblonga	Miob	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	0,33	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	0,99	0,32	0,33	-	-	0,68	-	0,34	-
Nonionella bradyi	Nnbr	-	-	-	-	0,32	-	0,45	-	-	0,98	0,34	-
Nonionella iridea	Nnir	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella turgida	Nntu	-	0,46	-	-	-	-	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-	0,42
Nummoloculina contraria	Numco	-	-	-	-	-	0,33	-	-	0,34	-	0,34	-
Nummoloculina irregularis	Numir	1,56	0,46	0,62	1,97	-	-	-	0,90	-	-	-	-
Oolina sp.	Oosp	-	0,46	-	0,99	1,27	-	-	0,45	-	-	-	-
Oridorsalis tener umbonatus	Ortu	3,13	0,92	2,19	2,97	2,85	4,00	4,55	6,88	2,39	6,23	6,57	1,27
Osangularia cultur	Oscu	0,78	1,38	-	0,33	0,32	-	-	-	0,34	-	-	-
Parafissurina sp.	Pasp	-	-	1,87	0,33	1,90	1,67	0,45	0,90	2,48	3,28	0,34	1,27
Patellina jugosa	Ptju	-	0,46	-	0,99	-	-	-	-	0,34	-	-	-
Planulina ariminensis	Plar	-	-	-	-	-	-	-	-	-	0,33	-	-
Pleurostomella alternans	Psal	-	-	-	-	-	0,33	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	1,95	0,92	-	-	-	-	-	-	-	-	0,34	-
Pullenia bulloides	Pubu	7,31	2,29	1,25	1,64	2,53	4,33	4,95	6,48	7,85	1,82	0,68	2,18
Pullenia quinqueloba	Pu5	0,78	1,83	2,49	0,99	1,27	2,00	1,82	2,83	1,76	3,28	3,77	1,69
Pullenia sp.	Pusp	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	1,17	2,29	1,56	0,99	0,95	0,67	1,35	2,24	1,24	0,66	0,68	0,42
Pyrgo lucernula	Pylu	-	-	0,31	-	0,63	0,33	-	-	-	-	-	-
Pyrgo murrhina	Pyu	2,34	2,29	4,36	1,32	1,58	0,67	1,35	0,90	3,41	0,66	3,42	0,42
Pyrgo vespertilio	Pyve	-	0,46	0,31	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	-	-	0,31	0,33	-	-	-	-	0,34	0,33	0,34	-
Pyrulina angusta	Pyra	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina cylindroides	Pycl	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	0,40	-	-	-	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	-	-	-	-	-
Pyrulina gutta	Pyrgu	0,40	-	-	-	-	-	-	-	-	-	-	-

Species	Code	112-113 cm	116-117 cm	122-123 cm	126-127 cm	132-133 cm	136-137 cm	142-143 cm	146-147 cm	152-153 cm	156-157 cm	162-163 cm
Gyroidinoides altiformis	Gyral	-	0,70	-	0,34	0,65	0,31	-	-	0,33	-	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	1,94	0,70	1,26	1,34	0,97	0,63	0,65	3,78	1,67	1,18	1,98
Gyroidinoides polius	Gyrpo	-	-	-	-	-	-	-	-	0,67	-	-
Gyroidinoides soldanii	Gyrso	0,65	1,83	0,32	0,34	0,32	0,31	-	0,55	0,33	-	-
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	0,32	-	-	0,34	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	-	-	-	-	-	-	-	-	-	-	0,33
Hoeglundina elegans	Hoel	0,32	0,35	-	1,67	0,65	0,94	0,33	0,55	2,00	1,97	1,65
Karreriella bradyi	Karbr	0,32	-	-	0,34	0,65	-	0,65	-	-	0,39	0,67
Lagena spp.	Laspp	0,98	2,44	2,52	1,68	1,61	2,58	2,29	1,62	2,00	1,57	1,65
Laticarinina pauperata	Ltpa	-	-	0,64	0,34	0,65	0,31	-	0,55	0,67	-	-
Lenticulina sp.	Lesp	-	-	0,64	0,67	0,65	0,63	-	0,55	0,67	0,39	0,33
Marginulina obesa	Maob	0,32	-	0,32	-	0,65	0,31	0,33	-	0,33	0,39	0,33
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	-
Marsipella cylindrica	Mrcy	-	-	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	0,32	0,70	-	0,34	0,32	0,31	0,65	-	-	-	-
Martinottiella perparva	Mtpr	-	-	-	-	-	-	-	1,62	-	-	1,32
Melonis barleeanum	Meba	4,27	6,98	3,47	4,70	2,93	2,19	4,92	3,78	3,00	2,35	2,64
Melonis pompilioides	Mepo	-	-	-	-	-	6,90	0,98	-	3,00	1,57	-
Miliolinella oblonga	Miob	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	0,33	0,39	-
Nodosaria sp.	Ndsp	0,65	-	-	-	0,32	0,63	-	-	-	-	0,33
Nonionella bradyi	Nnbr	-	-	-	-	-	-	-	-	-	-	-
Nonionella iridea	Nnir	0,65	-	-	-	-	-	-	-	-	-	-
Nonionella turgida	Nntu	-	-	-	-	0,32	-	-	-	-	-	-
Nonionella sp.	Nnsp	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	-	-	-	-	-	-	-	-	-	0,39	-
Nummoloculina irregularis	Numir	-	-	-	0,34	-	0,63	-	-	0,67	-	-
Oolina sp.	Oosp	0,32	0,35	0,64	0,34	-	0,31	-	-	-	-	0,33
Oridorsalis tener umbonatus	Ortu	3,56	4,27	4,73	5,37	8,65	5,64	5,56	3,78	6,00	3,92	5,62
Osangularia cultur	Oscu	-	-	-	-	0,32	-	-	-	0,33	-	-
Parafissurina sp.	Pasp	1,29	1,22	-	0,34	0,32	0,31	0,65	1,82	1,33	1,18	0,67
Patellina jugosa	Ptju	-	-	-	-	-	-	-	-	-	1,97	-
Planulina ariminensis	Plar	-	-	-	-	0,32	-	-	-	-	-	-
Pleurostomella alternans	Psal	0,98	0,35	-	0,34	0,32	0,31	-	-	-	-	0,67
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	3,24	3,96	2,52	6,71	8,80	4,72	2,61	4,32	4,00	3,92	0,33
Pullenia quinqueloba	Pu5	2,27	0,70	3,15	2,68	2,26	1,25	1,97	1,82	3,00	3,92	1,00
Pullenia sp.	Pusp	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	1,62	0,91	0,32	1,68	0,65	1,89	-	0,55	2,33	1,18	2,64
Pyrgo lucernula	Pylu	-	-	0,32	-	-	-	-	-	-	-	0,33
Pyrgo murrhina	Pyu	1,62	1,83	0,32	1,67	2,59	1,25	0,65	1,62	0,33	1,18	0,33
Pyrgo vespertilio	Pyve	-	-	-	-	-	-	-	0,55	-	-	-
Pyrgo sp.	Pysp	0,65	-	-	-	0,32	-	-	-	0.33	-	-
Pyrulina angusta	Pyra	-	-	-	-	-	-	-	-	-	-	-
Pyrulina cylindroides	Pycl	-	-	-	-	-	-	-	-	-	-	-
Pyrulina extensa	Pyrex	-	-	-	-	-	-	-	-	-	-	-
Pyrulina fusiformis	Pyrf	-	-	-	-	-	-	-	-	-	-	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	-	-	-	-	-	-

SHI9016 Species %

Species	Code	0-1 cm	4-5 cm	8-9 cm	12-13 cm	16-17 cm	22-23 cm	26-27 cm	32-33 cm	36-37 cm	42-43 cm	46-47 cm	52-53 cm
Quinqueloculina lamarckiana	Qulk	-	-	-	-	-	-	-	0,77	2,19	0,55	2,73	1,85
Quinqueloculina seminulum	Qusem	-	3,88	2,59	1,64	1,69	0,56	2,19	3,77	-	1,82	4,55	1,85
Quinqueloculina venusta	Quve	2,67	-	-	-	-	-	-	-	-	-	-	0,38
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina columellaris	Reco	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	0,56	-	-	-	-	-	-
Reophax distans	Reostn	2,67	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	5,33	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	1,33	-	-	-	-	-	-	-	-	-	-	-
Reophax spiculifer	Reoplf	1,33	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	-	-	-	-	-	1,46	-	2,27	0,62
Robertinoides brady	Robbr	-	-	-	-	-	-	-	0,77	-	2,16	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	0,38
Sigmoilopsis schlumbergeri	Sgmsch	-	0,78	-	0,55	-	2,26	1,46	3,77	0,73	2,73	0,68	1,54
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-
Siphoeggerella siphonella	Sphsph	1,33	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	1,55	1,72	1,64	-	-	-	0,77	-	1,92	-	0,38
Siphotextularia curta	Stxcu	-	-	-	-	-	-	-	-	-	-	-	0,38
Siphotextularia sp.	Stxsp	4,00	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	-	-	0,86	1,64	1,69	0,56	3,65	-	2,19	3,24	0,68	1,54
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	-	-	-	-	0,56	-	-	0,73	-	1,35	0,38
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-	-
Technitella legumen	Tchle	1,33	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	0,77	-	-	-	-
Textularia lateralis	Txlat	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	0,38
Textularia pseudogramen	Txpgr	-	-	-	0,55	-	-	0,73	0,77	-	-	-	-
Textularia sp.	Txsp	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina cuneata	Trcu	-	-	-	0,55	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	1,33	-	-	-	-	-	-	0,77	-	-	-	1,24
Triloculina tricarinata	Trtr	-	-	2,59	1,93	2,25	-	0,73	2,38	-	1,82	0,68	1,24
Triloculina sp.	Trsp	-	-	-	-	0,56	-	-	-	-	0,55	-	0,38
Uvigerina peregrina	Uvpe	1,33	-	1,72	-	-	-	-	-	-	-	-	0,62
Uvigerina porrecta	Uvpr	1,33	-	-	1,93	0,56	1,69	-	-	0,73	-	-	-
Uvigerina proboscidea	Uvprob	4,00	5,43	2,59	8,20	5,62	6,21	4,38	8,46	9,49	6,49	15,55	6,15
Valvulineria sp.	Vlsp	-	-	-	-	0,56	-	-	-	-	-	-	-

Species	Code	56-57 cm	58-59 cm	62-63 cm	66-67 cm	72-73 cm	76-77 cm	82-83 cm	86-87 cm	92-93 cm	96-97 cm	102-103 cm	106-107 cm
Quinqueloculina lamarckiana	Qulk	-	0,46	-	0,99	-	-	-	-	0,34	-	-	0,42
Quinqueloculina seminulum	Qusem	0,78	0,46	0,93	1,32	0,63	0,33	0,45	0,45	1,24	0,66	0,34	0,84
Quinqueloculina venusta	Quve	0,78	0,46	-	-	1,27	-	0,45	-	1,76	-	-	0,84
Quinqueloculina sp.	Qusp	-	-	0,62	-	-	-	-	-	-	-	-	-
Rectobolivina columellaris	Reco	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	0,33	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	0,45	-	-	-	-
Reophax distans	Reostn	-	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	-	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	-	-	-	-	-	-	-	-	-	-	-	-
Reophax spiculifer	Reoplf	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	0,33	-	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	0,46	-	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	1,17	1,83	1,25	0,99	-	-	-	0,90	1,24	0,33	2,74	-
Siphogenerina raphanus	Sphrah	-	-	-	-	-	0,33	-	-	-	-	-	-
Siphoeggerella siphonella	Sphsph	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	0,78	-	0,31	0,33	-	0,33	0,45	0,45	0,68	0,33	-	-
Siphotextularia curta	Stxcu	-	1,83	-	-	0,32	0,33	-	-	-	0,66	0,68	-
Siphotextularia sp.	Stxsp	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	0,40	-	-	0,99	0,32	1,00	1,35	-	0,68	0,33	-	0,42
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	0,42
Spiroloculina depressa	Srdep	0,40	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	0,33	-	-	-	-	-	-	-	-
Technitella legumen	Tchle	-	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lateralis	Txlat	-	-	0,93	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	-	0,46	-	0,33	-	-	-	0,45	0,34	0,33	-	-
Textularia sp.	Txsp	-	0,46	-	-	0,32	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	0,33	-	-	-	0,33	-	-
Triloculina cuneata	Trcu	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	0,40	0,46	-	-	-	-	-	-	-	-	-	-
Triloculina tricarinata	Trtr	0,78	0,46	0,62	0,33	0,63	0,67	1,82	2,24	1,24	0,33	0,34	1,69
Triloculina sp.	Trsp	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	-	0,46	0,93	0,33	1,90	1,00	-	-	-	0,33	0,34	-
Uvigerina porrecta	Uvpr	-	0,46	-	0,33	0,32	1,00	-	0,45	-	-	-	0,42
Uvigerina proboscidea	Uvprob	7,42	9,63	1,59	5,92	7,59	8,33	1,82	8,97	12,63	9,18	7,53	6,72
Valvulineria sp.	Vlsp	0,40	0,46	0,31	-	0,95	0,67	-	-	-	0,66	0,68	1,27

SHI9016 Species %

Species	Code	112-113 cm	116-117 cm	122-123 cm	126-127 cm	132-133 cm	136-137 cm	142-143 cm	146-147 cm	152-153 cm	156-157 cm	162-163 cm
Quinqueloculina lamarckiana	Qulk	-	-	-	-	0,32	-	-	-	-	0,39	-
Quinqueloculina seminulum	Qusem	1,29	0,35	2,52	1,34	2,93	-	0,98	1,62	1,00	1,18	-
Quinqueloculina venusta	Quve	0,32	1,52	-	0,67	0,65	-	0,65	-	-	-	0,33
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina columellaris	Reco	-	-	-	-	0,32	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	-	-	-	-
Reophax distans	Reostn	-	-	-	-	-	-	-	-	-	-	-
Reophax nodulosus	Reono	-	-	-	-	-	-	-	-	-	-	-
Reophax pilulifer	Reopi	-	-	-	-	-	-	-	-	-	-	-
Reophax spiculifer	Reoplf	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	-	-	0,31	-	-	-	-	-
Robertinoides brady	Robbr	-	-	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	1,29	0,35	-	0,34	0,65	-	0,65	2,73	0,33	1,57	1,98
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-
Siphoeggerella siphonella	Sphsph	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	0,32	-	1,26	1,34	-	-	-	-	-	-	-
Siphotextularia curta	Stxcu	-	-	0,32	0,67	-	0,31	-	-	-	-	-
Siphotextularia sp.	Stxsp	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	0,65	0,35	0,32	-	0,32	0,31	-	-	0,33	0,39	0,67
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina depressa	Srdep	-	-	-	0,34	-	-	0,33	0,55	-	-	-
Spiroloculina rotunda	Srrot	0,32	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	-	-	-	-	-	0,31	-	-	0,33	-	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-
Technitella legumen	Tchle	-	-	-	-	-	-	-	-	-	-	-
Textularia goesii	Txoes	-	-	-	-	-	-	-	-	-	-	-
Textularia lateralis	Txlat	-	-	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	0,32	-	0,32	0,34	-	-	0,33	-	-	-	-
Textularia sp.	Txsp	-	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	0,39	0,33
Triloculina cuneata	Trcu	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	-	0,34	0,32	-	-	-	0,33	-	-
Triloculina tricarinata	Trtr	0,98	1,22	1,58	0,34	0,65	0,31	0,98	2,16	0,33	0,78	0,33
Triloculina sp.	Trsp	-	-	-	0,34	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	-	1,63	-	0,67	-	0,94	-	0,55	-	-	0,33
Uvigerina porrecta	Uvpr	-	-	-	-	0,65	-	-	-	-	0,39	0,33
Uvigerina proboscidea	Uvprob	11,32	6,42	7,89	7,38	4,52	6,90	6,86	5,95	7,33	1,98	6,94
Valvulineria sp.	Vlsp	0,32	1,22	2,28	1,67	1,29	0,31	1,37	0,55	0,33	0,39	1,00

APPENDIX A5

Counts data of benthic foraminifera from *BAR9403* samples. Numbers are given as percentage of the total number of specimens in each sample.

Species	Code	0-1 cm	5-6 cm	10-11 cm	15-16 cm	20-21 cm	25-26 cm	30-31cm	35-36 cm	39.5-40.5 cm	45-46 cm	50-51 cm	55-56 cm	60-61 cm	65-66 cm	70-71 cm	75-76 cm	80-81 cm	85-86 cm	90-91 cm	95-96 cm	100-101 cm
Allomorphina pacifica	Allpa	-	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-	-	[illegible]
Ammobaculites americanus	Abam	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	[illegible]	[illegible]	-
Astrononion echolsi	Astrech	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Bolivina albatrossi	Bolalb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	[illegible]	-
Bolivina seminuda	Bolsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivinita quadrilatera	Blql	-	-	[illegible]	-	-	-	[illegible]	-	[illegible]	-	-	[illegible]	-	-	-	-	-	-	-	[illegible]	-
Brizalina dilatata	Brdi	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Brizalina semilineata	Brsem	-	-	-	-	-	[illegible]	-	-	-	-	[illegible]	-	-	[illegible]	-	-	[illegible]	-	-	-	-
Buliuina aculeata	Buac	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-
Bulimina alazanensis	Bualz	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina costata	Buco	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-
Bulimina exilis	Buexs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-
Bulimina gibba	Bugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]	-	-
Bulimina marginata	Buma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Cassidulina crassa	Cascr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Cassidulina laevigata	Caslae	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]
Ceratobulimina pacifica	Cerpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chilostomella oolina	Chol	-	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cibicidoides pseudoungerianus	Cipse	-	-	[illegible]	[illegible]	-	-	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Cibicidoides robertsonianus	Cirob	-	[illegible]	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Cibicidoides wuellerstorfi	Civul	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cibicidoides sp.	Cisp	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspira involvens	Coin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Deasub	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Eggerella bradyi	Egbr	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	-	-	[illegible]	-	-
Ehrenbergina trigona	Ehtr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella exigua	Epex	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Fissurina spp.	Fispp	-	-	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-
Fursenkoina bradyi	Furbr	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Fursenkoina earlandi	Furea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]	-
Fursenkoina fusiformis	Furfs	-	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fursenkoina sp.	Fursp	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-
Gavelinopsis lobatulus	Galo	-	-	-	-	-	[illegible]	-	[illegible]	-	-	-	-	-	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	-
Globobulimina affinis	Glaf	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-
Globobulimina pacifica	Glpa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-
Globocassidulina subglobosa	Glcsb	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Gyroidinoides altiformis	Gyral	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	[illegible]	-	-	-
Gyroidinoides lamarckianus	Gyrlmk	-	-	-	-	-	-	-	[illegible]	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	-
Gyroidinoides polius	Gyrpo	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	-
Gyroidinoides soldanii	Gyrso	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	-	[illegible]	-	-	-	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-
Hyalinea balthica	Hyba	-	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	-	-
Karrerulina apicularis	Karap	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karreriella novangliae	Karno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karreriella bradyi	Karbr	[illegible]	-	-	-	-	-	[illegible]	[illegible]	-	-	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-
Lagena spp.	Laspp	-	[illegible]	-	[illegible]	-	-	[illegible]	-	[illegible]	-	-	-	[illegible]	-	-	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Laticarinina pauperata	Ltpa	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	[illegible]	[illegible]	-
Lenticulina spp.	Lespp	-	-	-	-	-	-	[illegible]	-	-	[illegible]	-	[illegible]	-	[illegible]	-	-	-	-	-	[illegible]	-
Loxostomum karrerianum	Lxka	-	-	[illegible]	-	-	-	-	-	[illegible]	-	-	[illegible]	-	[illegible]	[illegible]	-	-	-	-	-	-

Species	Code	105-106 cm	110-111 cm	115-116 cm	120-121 cm	125-126 cm	130-131 cm	135-136 cm	140-141 cm	145-146 cm	150-151 cm	155-156 cm	160-161 cm	165-166 cm	170-171 cm	175-176 cm	180-181 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-
Ammobaculites americanus	Abam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	-	-	-	[illegible]
Astrononion echolsi	Astrech	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-
Bolivina albatrossi	Bolalb	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Bolivina robusta	Bolro	-	-	-	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	-	-	-	-	-	-
Bolivina seminuda	Bolsem	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	-	-	-	-	-	-	[illegible]	-
Bolivina sp.	Bolsp	-	-	[illegible]	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]
Bolivinita quadrilatera	Blql	-	-	-	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
Brizalina dilatata	Brdi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina semilineata	Brsem	-	-	-	-	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	-
Bulimina aculeata	Buac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bulimina alazanensis	Bualz	-	[illegible]	[illegible]	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Bulimina costata	Buco	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bulimina exilis	Buexs	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Bulimina gibba	Bugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina marginata	Buma	-	-	-	-	-	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-
Cassidulina crassa	Cascr	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]
Cassidulina laevigata	Caslae	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
Ceratobulimina pacifica	Cerpa	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	-	-	[illegible]	-	-	-	-	-	-
Chilostomella oolina	Chol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cibicidoides pseudoungerianus	Cipse	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	-	-	-
Cibicidoides robertsonianus	Cirob	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	[illegible]
Cibicidoides wuellerstorfi	Ciwul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cibicidoides sp.	Cisp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cornuspira involvens	Coin	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Dentalina subsoluta	Desub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	[illegible]	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]
Eggerella bradyi	Egbr	[illegible]	-	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	-	[illegible]	[illegible]	-	-	-	-
Ehrenbergina trigona	Ehtr	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Epistominella exigua	Epex	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina spp.	Fispp	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fursenkoina bradyi	Furbr	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]
Fursenkoina earlandi	Furea	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-
Fursenkoina fusiformis	Furfs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]
Fursenkoina sp.	Fursp	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Gavelinopsis lobatulus	Galo	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	[illegible]
Globobulimina affinis	Glaf	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Globobulimina pacifica	Glpa	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	-	[illegible]	-	-	[illegible]	[illegible]	[illegible]
Globocassidulina subglobosa	Glosb	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gyroidinoides altiformis	Gyral	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	[illegible]	-	-	[illegible]	[illegible]	-	-
Gyroidinoides lamarckianus	Gyrlmk	[illegible]	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Gyroidinoides orbicularis	Gyror	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	[illegible]	-	-	-	[illegible]
Gyroidinoides polius	Gyrpo	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	[illegible]	-
Gyroidinoides soldanii	Gyrso	[illegible]	[illegible]	-	-	-	-	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	-	-	-
Gyroidinoides sp.	Gyrsp	-	[illegible]	[illegible]	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-
Hoeglundina elegans	Hoel	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Hyalinea balthica	Hyba	-	[illegible]	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	-	[illegible]	-
Karreriulina apicularis	Karap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karreriella novangliae	Karno	-	-	-	-	-	-	[illegible]	-	-	-	[illegible]	-	-	-	-	-
Karreriella bradyi	Karbr	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Lagena spp.	Laspp	-	-	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-	[illegible]	-	-
Laticarinina pauperata	Ltpa	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-
Lenticulina spp.	Lespp	-	-	-	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Loxostomum karrerianum	Lxka	-	-	-	-	-	[illegible]	-	-	-	[illegible]	[illegible]	-	-	-	-	-

Species	Code	185-186 cm	190-191 cm	195-196 cm	200-201 cm	205-206 cm	210-211 cm	215-216 cm	230-231 cm	235-236 cm	240-241 cm	245-246 cm	255-256 cm	260-261 cm	265-266 cm	270-271 cm	275-276 cm
Allomorphina pacifica	Allpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammobaculites americanus	Abam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomalina globulosa	Aaglob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Astrononion echolsi	Astrech	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Bolivina albatrossi	Bolalb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina robusta	Bolro	-	-	-	-	-	-	-	[illegible]	-	-	-	[illegible]	-	[illegible]	-	-
Bolivina seminuda	Bolsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bolivina sp.	Bolsp	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	-	-	-	-
Bolivinita quadrilatera	Blql	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	-	[illegible]	[illegible]
Brizalina dilatata	Brdi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brizalina semilineata	Brsem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina aculeata	Buac	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bulimina alazanensis	Bualz	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Bulimina costata	Buco	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bulimina exilis	Buexs	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bulimina gibba	Bugi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulimina marginata	Buma	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina crassa	Cascr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cassidulina laevigata	Caslae	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ceratobulimina pacifica	Cerpa	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Chilostomella oolina	Chol	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cibicides lobatulus	Clob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides bradyi	Cibr	[illegible]	[illegible]	-	-	-	[illegible]	-	-	-	[illegible]	-	[illegible]	-	[illegible]	[illegible]	-
Cibicidoides pseudoungerianus	Cipse	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides robertsonianus	Cirob	-	[illegible]	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-
Cibicidoides wuellerstorfi	Ciwul	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cibicidoides sp.	Cisp	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-
Cornuspira involvens	Coin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina communis	Deco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina subsoluta	Desub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dentalina sp.	Desp	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dorothia bradyana	Dobr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]
Eggerella bradyi	Egbr	-	-	-	[illegible]	-	-	[illegible]	[illegible]	-	-	[illegible]	-	-	-	-	-
Ehrenbergina trigona	Ehtr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epistominella exigua	Epex	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Epistominella umbonifera	Exum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fissurina spp.	Fispp	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Fursenkoina bradyi	Furbr	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-
Fursenkoina earlandi	Furea	-	-	-	-	[illegible]	[illegible]	-	-	[illegible]	-	-	-	-	-	-	-
Fursenkoina fusiformis	Furfs	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
Fursenkoina sp.	Fursp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gavelinopsis lobatulus	Galo	-	[illegible]	-	[illegible]	-	-	-	-	[illegible]	[illegible]	-	-	-	[illegible]	-	-
Globobulimina affinis	Glaf	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]
Globobulimina pacifica	Glpa	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	-	-	[illegible]	-
Globocassidulina subglobosa	Glcsb	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	-
Gyroidinoides altiformis	Gyral	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Gyroidinoides lamarckianus	Gyrlmk	[illegible]	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	[illegible]	-
Gyroidinoides orbicularis	Gyror	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Gyroidinoides polius	Gyrpo	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Gyroidinoides soldanii	Gyrso	-	[illegible]	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	-	-	[illegible]
Gyroidinoides sp.	Gyrsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hanzawaia nipponica	Hnwni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hauerinella incostans	Hurin	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoeglundina elegans	Hoel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Hyalinea balthica	Hyba	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	-
Karrerulina apicularis	Karap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karreriella novangliae	Karno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karreriella bradyi	Karbr	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-
Lagena spp.	Laspp	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-
Laticarinina pauperata	Ltpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenticulina spp.	Lespp	-	-	[illegible]	-	-	-	-	-	-	[illegible]	-	-	-	-	-	[illegible]
Loxostomum karrerianum	Lxka	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Code	0-1 cm	5-6 cm	10-11 cm	15-16 cm	20-21 cm	25-26 cm	30-31cm	35-36 cm	39.5-40.5 cm	45-46 cm	50-51 cm	55-56 cm	60-61 cm	65-66 cm	70-71 cm	75-76 cm	80-81 cm	85-86 cm	90-91 cm	95-96 cm	100-101 cm
Marginulina obesa	Maob	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	[illegible]	[illegible]	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-
Martinottiella perparva	Mtpr	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Melonis barleeanum	Meba	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]
Melonis pompilioides	Mepo	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella subrotunda	Misb	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	[illegible]	-	-
Neoconorbina terquemi	Nete	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	[illegible]	-
Nonionella bradyi	Nnbr	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]
Nonionella iridea	Nnir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	-	-	-	-
Nummoloculina contraria	Numco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	-	-	-	-	[illegible]	-	[illegible]	[illegible]	-	-	-	[illegible]	-	-	-	-	[illegible]	-	-
Oolina spp.	Oospp	-	-	-	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	[illegible]	-	-	-	[illegible]	-	-
Oridorsalis tener umbonatus	Ortu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Osangularia cultur	Oscu	-	-	-	-	-	[illegible]	-	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	-
Parafissurina spp.	Paspp	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]	-
Praemassilina arenaria	Paear	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Pullenia bulloides	Pubu	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Pullenia quinqueloba	Pu5	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	-	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	-	[illegible]	-
Pullenia sp.	Pusp	-	-	[illegible]	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	-	-	-
Pyrgo elongata	Pyel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Pyrgo lucernula	Pylu	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Pyrgo murrhina	Pyu	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
Pyrgo serrata	Pyse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo sp.	Pysp	-	-	[illegible]	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]	-	-	-	-	-	-	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	-	[illegible]	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum	Qusem	-	-	-	-	-	-	-	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	-
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	-	-	-	[illegible]	-	-	[illegible]	-	-	-	[illegible]	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-
Rectobolivina columellaris	Reco	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina torrida	Rgto	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rlsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-
Sigmoilopsis schlumbergeri	Sgmsch	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	-	-	-	-	-	-
Siphotextularia curta	Stxcu	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Sphaeroidina bulloides	Sbull	-	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Spiroloculina tenuis	Srten	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Textularia pseudogramen	Txpgr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina tricarinata	Trtr	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	[illegible]
Uvigerina peregrina	Uvpe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Uvigerina proboscidea	Uvprob	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-
Valvulineria sp.	Vlsp	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-

Species	Code	105-106 cm	110-111 cm	115-116 cm	120-121 cm	125-126 cm	130-131 cm	135-136 cm	140-141 cm	145-146 cm	150-151 cm	155-156 cm	160-161 cm	165-166 cm	170-171 cm	175-176 cm	180-181 cm
Marginulina obesa	Maob	-	[illegible]	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Marginulina subullata	Masub	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Martinottiella communis	Mtcom	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	[illegible]	-	-	[illegible]	[illegible]
Martinottiella perparva	Mtpr	[illegible]	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	-	[illegible]
Melonis barleeanum	Meba	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	-	[illegible]	-	[illegible]
Melonis pompilioides	Mepo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella subrotunda	Misb	-	-	-	-	-	-	-	[illegible]	-	-	[illegible]	-	-	-	-	-
Neoconorbina terquemi	Nete	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella bradyi	Nnbr	-	-	-	[illegible]	-	-	-	-	[illegible]	-	-	[illegible]	-	-	[illegible]	-
Nonionella iridea	Nnir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-	-
Oolina spp.	Oospp	-	-	[illegible]	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Oridorsalis tener umbonatus	Ortu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Osangularia cultur	Oscu	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-
Parafissurina spp.	Paspp	-	[illegible]	-	-	[illegible]	-	[illegible]	-	-	[illegible]	-	-	-	-	[illegible]	[illegible]
Praemassillina arenaria	Paear	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	[illegible]	-	-	-	[illegible]	-	[illegible]	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	-	-	[illegible]	-
Pullenia quinqueloba	Pu5	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	-	-	[illegible]	-
Pullenia sp.	Pusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
Pyrgo elongata	Pyel	-	-	-	-	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	[illegible]	-
Pyrgo lucernula	Pylu	-	-	[illegible]	[illegible]	-	-	[illegible]	-	-	[illegible]	-	-	-	-	-	-
Pyrgo murrhina	Pyu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pyrgo serrata	Pyse	-	-	-	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
Pyrgo sp.	Pysp	-	-	-	-	-	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	-	-	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum	Qusem	[illegible]	-	-	-	-	[illegible]	[illegible]	-	-	-	[illegible]	-	-	-	-	-
Quinqueloculina sp.	Qusp	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-
Quinqueloculina venusta	Quve	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rectobolivina columellaris	Reco	-	-	-	-	-	[illegible]	-	-	-	[illegible]	-	-	-	[illegible]	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina torrida	Rgto	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	-	-	-	-	-
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	-	-	[illegible]	[illegible]
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	-	-	-	-	-	[illegible]	-	[illegible]	-	-	[illegible]	-	-	-	-
Siphotextularia curta	Stxcu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides	Sbull	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	[illegible]	-	[illegible]
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Triloculina tricarinata	Trtr	[illegible]	-	-	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Uvigerina proboscidea	Uvprob	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Valvulineria sp.	Vlsp	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BAR9403 Species %

Species	Code	185-186 cm	190-191 cm	195-196 cm	200-201 cm	205-206 cm	210-211 cm	215-216 cm	230-231 cm	235-236 cm	240-241 cm	245-246 cm	255-256 cm	260-261 cm	265-266 cm	270-271 cm	275-276 cm
Marginulina obesa	Maob	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina subullata	Masub	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marginulina sp.	Masp	-	-	-	-	-	-	[illegible]	-	[illegible]	-	-	[illegible]	-	-	-	[illegible]
Martinottiella communis	Mtcom	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]
Martinottiella perparva	Mtpr	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-
Melonis barleeanum	Meba	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
Melonis pompilioides	Mepo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miliolinella subrotunda	Misb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]
Neoconorbina terquemi	Nete	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria radicula	Ndrd	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nodosaria sp.	Ndsp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella bradyi	Nnbr	[illegible]	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-
Nonionella iridea	Nnir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina contraria	Numco	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	-
Nummoloculina irregularis	Numir	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	[illegible]	[illegible]
Oolina spp.	Oospp	[illegible]	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Oridorsalis tener umbonatus	Ortu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Osangularia cultur	Oscu	-	-	-	-	-	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-
Parafissurina spp.	Paspp	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]	-	[illegible]	-	-	-	-	-	-
Praemassillina arenaria	Pasar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psammosphaera parva	Pmpa	-	-	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-
Pseudoguadryna atlantica	Psoat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pullenia bulloides	Pubu	[illegible]	-	[illegible]	[illegible]	-	-	-	[illegible]	[illegible]	-	[illegible]	-	-	-	[illegible]	[illegible]
Pullenia quinqueloba	Pu5	-	[illegible]	-	-	-	[illegible]	-	-	[illegible]	-	[illegible]	-	-	[illegible]	[illegible]	-
Pullenia sp.	Pusp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo depressa	Pyde	-	[illegible]	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pyrgo elongata	Pyel	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo lucernula	Pylu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrgo murrhina	Pyu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pyrgo serrata	Pyse	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	[illegible]
Pyrgo sp.	Pysp	-	-	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-
Pyrulina gutta	Pyrgu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina lamarckiana	Qulk	-	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum	Qusem	[illegible]	-	-	-	-	-	[illegible]	-	[illegible]	[illegible]	-	[illegible]	-	[illegible]	-	-
Quinqueloculina sp.	Qusp	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina venusta	Quve	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rectobolivina columellaris	Reco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectobolivina dimorpha	Redi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina comatula	Rgco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rectoglandulina torrida	Rgto	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reussella simplex	Rllsi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robertina tasmanica	Rbta	-	[illegible]	-	-	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Robertinoides brady	Robbr	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]
Saracenaria italica	Sarit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sigmoilopsis schlumbergeri	Sgmsch	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	-	-	[illegible]	-	[illegible]	-	-	[illegible]	-
Siphogenerina raphanus	Sphrah	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siphotextularia catenata	Stxca	-	[illegible]	-	-	-	-	[illegible]	-	[illegible]	-	-	-	-	-	-	-
Siphotextularia curta	Stxcu	-	[illegible]	-	[illegible]	-	-	-	-	-	-	-	[illegible]	-	-	-	-
Sphaeroidina bulloides	Sbull	-	-	-	[illegible]	-	-	-	-	-	-	-	-	-	-	-	[illegible]
Spiroloculina communis	Srcom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina rotunda	Srrot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spiroloculina tenuis	Srten	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stainforthia complanata	Stfco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia lythostrota	Txlyt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Textularia pseudogramen	Txpgr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifarina bradyi	Tfbr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina subvalvularis	Trsu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triloculina tricarinata	Trtr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uvigerina peregrina	Uvpe	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-
Uvigerina proboscidea	Uvprob	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]
Valvulineria sp.	Vlsp	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

APPENDIX B

List of the calcareous infaunal species

Species	References	Dataset
Amphicoryna proxima	2	CT,a
Amphicoryna scalris	2	CT,a
Amphicoryna sp.	2	CT,a,c
Astacolus crepidulus	2	CT,a,b
Astacolus insolitus	2	CT,a
Astrononion echolsi	17*	CT,a,b,c,d
Astrononion stelligerum	17*	CT,a,b
Bolivina albatrossi	20	CT,a,c,d
Bolivina decussata	20	CT,a,c,d
Bolivina pseudoplicata	20	CT,a,b,c,d
Bolivina robusta	1	CT
Bolivina seminuda	20	CT
Bolivina spissa	20	CT
Bolivina sp.	20	CT,b,c,d
Bolivinita quadrilatera	21	CT,a,c,d
Brizalina dilatata	4,14,15	CT,a,c,d
Brizalina semilineata	3	CT,a,b,c,d
Brizalina sp.	3	CT,a,b,c
Bulimina aculeata	3,8,16,19	CT,a,b,c,d
Bulimina alazanensis	3,8,16	CT,a,c,d
Bulimina costata	3,8,16	CT,a,b,c,d
Bulimina exilis	3,8,16	d
Bulimina gibba	3,8,16	CT,d
Bulimina marginata	3,8,16	CT,a,b
Bulimina striata	3,8,16	CT
Buliminella elegantissima	20	CT,a,c
Buliminella sp.	20	CT,a,b
Cassidulina crassa	21*	CT,a,b,c,d
Cassidulina laevigata	21	CT,a,b,c,d
Cassidulina reflexa	21*	CT,c
Ceratobulimina pacifica	2	CT,a,b,c,d
Chilostomella oolina	3,5,11,16,21	CT,a,b,c,d
Dentalina advena	2	CT
Dentalina communis	2	CT,a,b,c,d
Dentalina filiformis	2	CT,a
Dentalina guttifera	2	CT
Dentalina inornata	2	CT,a,c
Dentalina intorta	2	CT
Dentalina neugeboreni	2	CT
Dentalina subsoluta	2	CT,a,d
Dentalina sp.	2	CT,a,b,c,d
Eherenbergina trigona	2	CT,a,b,c,d
Fissurina spp.	2	CT,a,b,c,d
Fursenkoina bradyi	3,7	CT,b,c,d
Fursenkoina davisii	3,7	CT,a

Species	References	Dataset
Fursenkoina earlandi	3,7	CT,a,d
Fursenkoina fusiformis	3,7	CT,a,b,c,d
Fursenkoina punctata	3,7	CT
Fursenkoina sp.	3,7	CT,a,c,d
Globobulimina affinis	3,5,7,12,15,18,21	CT,a,b,c,d
Globobulimina notovata	3*,5,7*,12*,15*,18*,21*	a
Globobulimina pacifica	3*,5,7*,12*,15*,16,18*,21*	CT,a,b,c,d
Globobulimina pupoides	3*,5,7*,12*,15*,18*,21*	CT
Gyroidinoides altiformis	21	CT,a,b,c,d
Gyroidinoides lamarckianus	21*	CT,a,b,c,d
Gyroidinoides orbicularis	21	CT,a,b,c,d
Gyroidinoides polius	21*	CT,a,b,c,d
Gyroidinoides soldanii	21*	CT,a,b,c,d
Gyroidinoides sp.	21*	CT,a,b,c,d
Lagena spp.	2	CT,a,b,c,d
Lenticulina spp.	3,11	CT,a,b,c,d
Marginulina glabara	2	CT
Marginulina obesa	2	CT,a,b,c,d
Marginulina subullata	2	CT,a,b,d
Marginulina sp.	2	CT,a,b,c,d
Melonis barleeanum	3,7,9,21	CT,a,b,c,d
Melonis pompilioides	17	CT,a,b,c,d
Nodosaria calomorpha	2	CT
Nodosaria inflexa	2	CT,a
Nodosaria radicula	2	CT,b,d
Nodosaria simplex	2	CT,a
Nodosaria sp.	2	CT,a,c,d
Nonion germanicum	3*,18*	CT
Nonion sp.	18	CT,c
Nonionella bradyi	6*	CT,a,c,d
Nonionella iridea	6*	CT,a,c,d
Nonionella turgida	3,6,20	CT,a,c
Nonionella sp.	6*	CT,a,c
Oolina spp.	2	CT,a,b,c,d
Parafissurina spp.	2	CT,a,b,c,d
Pleurostomella alternans	13	CT
Pleurostomella sp.	13*	CT
Pullenia bulloides	3	CT,a,b,c,d
Pullenia quinqueloba	3*	CT,a,b,c,d
Pullenia sp.	3*	CT,a,b,c,d
Rectobolivina columellaris	2	CT,c,d
Rectobolivina dimorpha	2	CT,a,b,c,d
Rectoglandulina comatula	2	c,d
Rectoglandulina torrida	2	d
Saracenaria italica	2	CT,a,b,c,d
Trifarina bradyi	3*	CT,a,c,d
Uvigerina peregrina	10,21	CT,a,b,c,d
Uvigerina porrecta	10*,21*	CT,a,b,c
Uvigerina proboscidea	10*,21*	CT,a,b,c,d

Species	References	Dataset
Uvigerina **sp.**	10*,21*	CT,a,b
Vaginulinopsis sublegumen	2	CT,a
Vaginulinopsis tasmanica	2	CT,a
Vaginulinopsis **sp.**	2	CT

References	No.	Dataset
Corliss (1985)	1	CT = Core tops
Corliss and Chen (1988)	2	a = *Fr10/95 GC17*
Corliss (1991)	3	b = *Fr10/95 GC5*
Barmawidjaia et al. (1992)	4	c = *SHI9016*
Bernhard (1992)	5	d = *BAR9403*
Jorissen et al. (1992)	6	
Buzas et al. (1993)	7	
Miao and Thunnel (1993)	8	
Gooday (1994)	9	
Jorissen et al. (1994)	10	
Rathburn and Corliss (1994)	11	
Faridduddin and Loubere (1997)	12	
McCorkle et al. (1997)	13	
De Stigter et al. (1998)	14	
Jannik (1998)	15	
Jorissen et al. (1998)	16	
Benhard and Sen Gupta (1999)	17	
Gooday and Rathburn (1999)	18	
Schmiedl et al. (2000)	19	
Ernst et al. (2002)	20	
Fontanier et al. (2002)	21	

Note: Corliss and Chen (1985) classification was applied only for those species for which a direct observation on living (Rose-Bengal stained) specimens was not available. Taxa classified as infaunal following this method are characterised by small percentages and do not exert a big influence on the general trend of Infaunal Species group.

* = references classifying comparable species, or species differently named.

APPENDIX C

Q – mode Factor Analysis (Principal components) of the species-abundance (n/g) data sets.

1) *Fr10/95 GC17*: factor scores for the three *Q* – mode varimax-factors.

Species	F1	F2	F3	Species	F1	F2	F3
Allomorphina pacifica	-0.20	-0.29	-0.19	*Dentalina subsoluta*	-0.19	-0.27	-0.38
Alveolophragmium ringens	-0.15	-0.28	-0.32	*Dentalina* sp.	-0.20	-0.29	-0.16
Alveolophragmium subglobosum	-0.08	-0.29	-0.34	*Discopulvinulina araucana*	-0.18	-0.28	-0.47
Ammobaculites sp.	-0.23	-0.29	-0.09	*Discopulvinulina subbertheloti*	-0.24	-0.12	-0.32
Ammodiscus pacificus	-0.10	-0.29	-0.33	*Dorothia bradyana*	-0.32	0.86	-0.31
Ammonia beccarii	-0.15	-0.36	-0.04	*Dorothia exilis*	-0.15	-0.28	-0.14
Amphicoryna scalris	-0.16	-0.24	-0.33	*Eggerella bradyi*	-0.05	-0.18	-0.06
Amphicoryna sp.	-0.17	-0.22	-0.30	*Eggerella scabra*	-0.18	-0.27	-0.32
Anomalina globulosa	-0.07	-0.38	0.34	*Eggerella* sp.	-0.16	-0.29	-0.28
Astacolus crepidulus	-0.18	-0.26	-0.32	*Ehrenbergina trigona*	0.05	6.50	-1.69
Astrononion echolsi	-0.39	-0.20	2.05	*Elphidium crispum*	-0.15	-0.28	-0.32
Astrononion stelligerum	-0.18	-0.26	-0.31	*Elphidium incertum*	-0.16	-0.28	-0.31
Bigenerina nodosaria	-0.15	-0.28	-0.32	*Epistominella umbonifera*	0.08	-0.41	0.36
Bolivina midwayensis	-0.21	-0.02	-0.35	*Eponides regularis*	-0.09	-0.31	-0.28
Bolivina robusta	6.70	-1.09	0.57	*Eponides tumiduls*	0.01	-0.30	-0.36
Bolivina seminuda	-0.20	-0.20	-0.09	*Eponides* sp.	-0.18	-0.31	-0.22
Bolivinita quadrilatera	-0.50	-0.08	1.00	*Fissurina alveolata*	-0.18	-0.28	-0.28
Brizalina dilatata	2.25	-1.44	1.35	*Fissurina crebra*	-0.18	-0.28	-0.29
Brizalina semilineata	-0.18	-0.25	-0.32	*Fissurina kerguelensis*	-0.19	-0.29	-0.29
Brizalina sp.	-0.16	-0.29	-0.32	*Fissurina marginata*	-0.17	-0.28	-0.14
Bulimina aculeata	-0.43	2.08	-0.91	*Fissurina orbignyana*	-0.20	-0.38	-0.07
Bulimina alazanensis	-0.33	-0.40	0.07	*Fissurina semimarginata*	-0.17	-0.29	-0.29
Bulimina costata	0.20	0.20	0.03	*Fissurina submarginata*	-0.12	-0.27	-0.25
Bulimina marginata	-0.21	-0.29	-0.19	*Fissurina wiesneri*	-0.18	-0.27	-0.21
Buliminella elegantissima	-0.30	0.09	-0.32	*Fissurina* sp.	0.03	1.42	-0.59
Buliminella sp.	-0.18	-0.26	-0.32	*Fursenkoina davisii*	-0.33	-0.31	0.04
Cassidulina carinata	0.30	-0.37	-0.28	*Fursenkoina earlandi*	-0.18	-0.28	-0.31
Cassidulina crassa	-0.29	0.23	-0.37	*Fursenkoina fusiformis*	-0.21	-0.13	-0.30
Ceratobulimina pacifica	0.84	-0.19	2.77	*Fursenkoina* sp.	-0.17	-0.25	-0.27
Chilostomella oolina	0.24	0.10	-0.07	*Gavelinopsis lobatulus*	0.32	0.41	1.19
Cibicides lobatulus	-0.24	0.26	-0.42	*Globobulimina affinis*	-0.17	-0.19	-0.21
Cibicidoides bradyi	1.11	0.09	4.50	*Globobulimina notovata*	-0.19	-0.23	-0.30
Cibicidoides kullenbergi	-0.24	0.92	1.10	*Globobulimina pacifica*	-0.04	-0.14	-0.31
Cibicidoides pseudoungerianus	1.07	1.93	2.20	*Globocassidulina subglobosa*	-0.67	-2.08	9.57
Cibicidoides robertsonianus	-0.23	0.00	0.37	*Glomospira charoides*	-0.15	-0.28	-0.32
Cibicidoides wuellerstorfi	-0.24	8.44	0.04	*Gyroidinoides altiformis*	-0.15	-0.25	-0.32
Cibicidoides sp.	-0.33	0.14	0.12	*Gyroidinoides lamarckianus*	-0.25	-0.18	-0.19
Cornuspira carinata	-0.15	-0.24	-0.31	*Gyroidinoides orbicularis*	0.37	-0.64	1.75
Cornuspira involvens	-0.05	-0.34	-0.20	*Gyroidinoides polius*	-0.08	0.03	-0.42
Cornuspira sp.	-0.18	-0.28	-0.29	*Gyroidinoides soldanii*	0.41	0.00	0.88
Cornuspiroides primitivus	-0.19	-0.27	-0.27	*Gyroidinoides* sp.	-0.10	-0.28	-0.32
Cyambaloporretta squamosa	-0.25	-0.21	0.00	*Hanzawaia nipponica*	-0.23	-0.07	-0.31
Cyclammina cancellata	-0.15	-0.28	-0.32	*Hauerinella incostans*	-0.44	1.29	-0.27
Dentalina communis	-0.24	-0.28	-0.28	*Hoeglundina elegans*	0.09	3.58	-0.22
Dentalina filiformis	-0.15	-0.28	-0.15	*Karreriella apicularis*	-0.08	-0.29	-0.34
Dentalina inornata	0.01	-0.29	-0.32	*Karreriella bradyi*	0.04	0.81	-0.47

Species	F1	F2	F3	Species	F1	F2	F3
Karreriella novangliae	-0.20	-0.21	-0.31	*Pyrgo* sp.	-0.18	-0.28	-0.29
Lagena formosa	-0.18	-0.28	-0.25	*Pyrgoella sphera*	-0.19	-0.13	-0.35
Lagena gracilis	-0.13	-0.28	-0.33	*Pyrulina cylindroides*	-0.11	-0.26	-0.27
Lagena hispidula	-0.10	-0.28	-0.33	*Pyrulina extensa*	0.22	0.46	1.03
Lagena laevis	0.01	-0.46	0.11	*Pyrulina fusiformis*	-0.21	-0.15	-0.28
Lagena plumigera	-0.22	-0.30	-0.12	*Quinqueloculina lamarckiana*	-0.19	-0.01	-0.29
Lagena striata	-0.23	0.49	-0.51	*Quinqueloculina seminulum*	0.77	1.69	0.86
Lagena sulcata	-0.11	-0.29	-0.35	*Quinqueloculina venusta*	-0.20	-0.10	-0.34
Lagena sp.	-0.17	-0.26	-0.27	*Quinqueloculina* sp.	-0.19	-0.17	-0.31
Laticarinina pauperata	-0.15	-0.27	-0.32	*Rectobolivina dimorpha*	-0.14	0.07	0.64
Lenticulina calcar	-0.09	-0.32	-0.25	*Reophax guttifer*	-0.23	-0.19	-0.22
Lenticulina crassa	-0.16	-0.27	-0.08	*Reophax nodulosus*	-0.15	-0.28	-0.32
Lenticulina cultur	0.07	-0.39	-0.08	*Reophax pilulifer*	-0.15	-0.28	-0.32
Lenticulina gibba	-0.15	-0.28	-0.32	*Reussella simplex*	-0.15	-0.28	-0.32
Lenticulina orbicularis	-0.17	-0.27	-0.28	*Rhabdammina abyssorum*	-0.09	-0.28	-0.34
Lenticulina peregrina	-0.11	-0.33	-0.20	*Rhizammina algaeformis*	-0.18	-0.26	-0.32
Lenticulina rotulata	-0.11	-0.17	-0.34	*Robertina tasmanica*	-0.14	-0.28	-0.31
Lenticulina sp.	-0.20	0.22	-0.11	*Robertinoides brady*	-0.15	-0.28	-0.32
Marginulina obesa	-0.04	-0.19	-0.17	*Saccorhiza ramosa*	-0.14	-0.23	-0.29
Marginulina subullata	-0.18	-0.25	-0.32	*Sagrinella* sp.	2.30	0.90	1.13
Marginulina sp.	-0.19	-0.31	-0.25	*Saracenaria italica*	-0.15	-0.28	-0.32
Marsipella cylindrica	0.37	-0.16	0.55	*Sigmoilopsis schlumbergeri*	-0.22	0.02	0.89
Martinottiella comminis	-0.54	-0.33	0.63	*Siphogenerina raphanus*	-0.19	-0.27	-0.28
Melonis barleeanum	-0.16	0.28	0.48	*Siphotextularia catenata*	-0.18	-0.25	-0.32
Melonis pompilioides	-0.02	-0.15	-0.33	*Siphotextularia curta*	-0.18	-0.25	-0.32
Miliolinella oblonga	-0.18	-0.25	-0.31	*Sphaeroidina bulloides*	-0.24	-0.22	-0.19
Miliolinella subrotunda	-0.07	-0.21	0.01	*Spiroloculina communis*	-0.19	-0.25	-0.31
Nodosaria inflexa	-0.15	-0.28	-0.32	*Spiroloculina depressa*	-0.19	-0.16	-0.23
Nodosaria radicula	-0.11	-0.21	-0.33	*Spiroloculina elevata*	-0.22	-0.27	-0.19
Nodosaria sp.	-0.21	-0.32	-0.20	*Spiroloculina rotunda*	-0.15	-0.28	-0.32
Nonionella bradyi	-0.21	-0.21	-0.09	*Spiroloculina tenuiseptata*	-0.12	-0.18	-0.36
Nonionella iridea	-0.12	-0.29	-0.28	*Stainforthia complanata*	-0.18	-0.28	-0.29
Nonionella turgida	-0.18	-0.28	-0.28	*Technitella bradyi*	-0.10	-0.28	-0.33
Nonionella sp.	-0.23	0.00	-0.39	*Textularia agglutinans*	-0.18	-0.28	-0.31
Nummoloculina contraria	-0.53	0.08	0.77	*Textularia goesii*	-0.14	-0.28	-0.29
Nummoloculina irregularis	1.02	2.57	5.65	*Textularia lateralis*	-0.18	-0.24	-0.28
Oolina exagona	-0.16	-0.28	-0.31	*Textularia lythostrota*	-0.13	-0.28	-0.32
Oolina globosa	-0.11	-0.25	-0.24	*Textularia porrecta*	0.01	-0.24	-0.33
Oolina sp.	-0.11	-0.29	-0.33	*Textularia pseudogramen*	-0.19	-0.26	-0.28
Oridorsalis tener stellatus	-0.13	-0.28	-0.32	*Textularia* sp.	-0.04	0.43	0.26
Oridorsalis tener umbonatus	0.63	0.03	1.16	*Trifarina bradyi*	0.18	0.41	0.67
Osangularia cultur	0.82	-0.21	2.12	*Triloculina cuneata*	-0.18	-0.25	-0.31
Parafissurina lateralis	-0.19	-0.27	-0.27	*Triloculina insignis*	-0.28	0.15	-0.31
Parafissurina sp.	-0.16	-0.28	-0.31	*Triloculina subvalvularis*	-0.26	0.45	-0.46
Patellina jugosa	-0.21	-0.30	0.05	*Triloculina tricarinata*	-0.19	0.00	-0.34
Praeglobobulimina subspinescens	-0.09	-0.19	-0.33	*Triloculina trigonula*	-0.20	0.68	0.06
Praemassillina arenaria	-0.13	-0.28	-0.32	*Triloculina* sp.	-0.23	-0.32	-0.09
Psammosphaera parva	-0.15	-0.28	-0.32	*Trochammina globigeriniformis*	-0.26	-0.20	-0.15
Pullenia bulloides	-0.18	-0.25	-0.32	*Uvigerina hispida*	-0.15	-0.29	-0.26
Pullenia quadrilobata	-0.19	-0.28	-0.28	*Uvigerina peregrina*	-0.80	5.99	1.20
Pullenia quinqueloba	0.20	-0.11	0.48	*Uvigerina porrecta*	-0.18	-0.25	-0.31
Pyrgo comata	0.22	0.59	0.49	*Uvigerina proboscidea*	11.76	0.32	-2.32
Pyrgo depressa	-0.19	-0.27	-0.28	*Uvigerina* sp.	-0.18	-0.25	-0.28
Pyrgo elongata	-0.19	-0.26	-0.30	*Vaginulina spinigera*	-0.16	-0.28	-0.32

Species	F1	F2	F3	Species	F1	F2	F3
Pyrgo lucernula	0.14	0.19	0.26	*Vaginulina subelegans*	-0.16	-0.28	-0.31
Pyrgo murrhina	-0.07	0.23	0.60	*Valulineria* sp.	-0.01	-0.01	0.15
Pyrgo serrata	-0.22	0.03	-0.29	*Virgulina rotundata*	-0.24	-0.01	-0.21
Pyrgo vespertilio	-0.16	-0.28	-0.31				

2) *Fr10/95 GC17*: factor loadings for the three Q – mode varimax-factors.

Sample	F1	F2	F3	Sample	F1	F2	F3
0-1 cm	0.87	0.12	0.28	**93-94 cm**	0.20	0.23	0.85
3-4 cm	0.89	0.16	0.34	**97-98 cm**	0.48	0.45	0.60
5-6 cm	0.94	0.14	0.19	**101-102 cm**	0.12	0.34	0.84
9-10 cm	0.90	0.17	0.32	**105-106 cm**	0.33	0.29	0.83
13-14 cm	0.94	0.12	0.16	**109-110 cm**	0.28	0.41	0.66
17-18 cm	0.92	0.13	0.18	**113-114 cm**	0.23	0.24	0.82
21-22 cm	0.92	0.11	0.25	**117-118 cm**	0.34	0.31	0.79
25-26 cm	0.87	0.16	0.32	**121-122 cm**	0.22	0.44	0.65
29-30 cm	0.90	0.19	0.22	**125-126 cm**	0.16	0.58	0.55
33-34 cm	0.78	0.27	0.39	**127-128 cm**	0.08	0.34	0.33
37-38 cm	0.74	0.38	0.38	**133-134 cm**	0.15	0.88	0.20
41-42 cm	0.62	0.37	0.49	**137-138 cm**	0.14	0.83	0.19
45-46 cm	0.42	0.16	0.69	**141-142 cm**	0.16	0.78	0.16
49-50 cm	0.39	0.31	0.67	**145-146 cm**	0.16	0.87	0.28
53-54 cm	0.37	0.32	0.73	**149-150 cm**	0.19	0.89	0.26
57-58 cm	0.27	0.20	0.84	**153-154 cm**	0.18	0.79	0.44
61-62 cm	0.29	0.12	0.86	**157-158 cm**	0.15	0.92	0.27
65-66 cm	0.26	0.14	0.90	**161-162 cm**	0.17	0.90	0.22
69-70 cm	0.35	0.19	0.85	**165-166 cm**	0.05	0.94	0.20
73-74 cm	0.31	0.24	0.85	**169-170 cm**	0.25	0.87	0.28
77-78 cm	0.30	0.28	0.80	**173-174 cm**	0.19	0.86	0.17
81-82 cm	0.27	0.42	0.75	**177-178 cm**	0.26	0.86	0.26
85-86 cm	0.29	0.29	0.83				
89-90 cm	0.29	0.31	0.82				

3) *Fr10/95GC5*: factor scores for the two Q – mode varimax-factors.

Species	F1	F2	F3	Species	F1	F2	F3
Allomorphina pacifica	-0.28	-0.15	-0.28	*Cibicides lobatulus*	-0.31	-0.17	-0.23
Anomalina globulosa	-0.30	-0.17	-0.15	*Cibicidoides bradyi*	-0.43	-0.06	2.82
Astacolus crepidulus	-0.23	-0.16	-0.40	*Cibicidoides kullengbergi*	-0.39	-0.19	0.34
Astrononion echolsi	2.41	0.25	2.23	*Cibicidoides pseudoungerianus*	-0.45	-0.24	0.84
Bolivina seminuda	-0.29	-0.09	-0.40	*Cibicidoides robertsonianus*	-0.34	-0.18	-0.07
Bolivina sp.	-0.27	-0.13	-0.41	*Cibicidoides wullerstorfi*	5.25	-0.02	2.93
Brizalina semilineata	-0.37	-0.14	0.05	*Cibicidoides* sp.	-0.34	-0.18	-0.08
*Brizalina*sp.	-0.26	-0.15	-0.43	*Cyclammina cancellata*	-0.39	-0.22	0.25
Bulimina aculeata	-1.72	9.94	0.36	*Dentalina communis*	-0.22	-0.13	-0.40
Bulimina costata	0.49	0.02	-0.72	*Dentalina* sp.	-0.27	-0.16	-0.26
Bulimina marginata	-0.26	-0.15	-0.43	*Dorothia bradyana*	-0.27	-0.15	-0.39
Buliminella sp.	-0.31	-0.17	-0.23	*Eggerella bradyi*	-0.27	-0.17	0.06
Cassidulina crassa	-0.34	-0.15	-0.07	*Ehrenbergina trigona*	-0.32	-0.18	-0.09
Cassidulina laevigata	0.68	0.02	-0.99	*Epistominella exigua*	4.54	1.49	-0.60
Ceratobulimina pacifica	-0.87	-0.28	4.13	*Epistominella umbonifera*	-0.29	-0.14	-0.40
Chilostomella oolina	2.81	1.12	-3.66	*Fissurina* sp.	1.28	-0.09	0.95

Species	F1	F2	F3	Species	F1	F2	F3
Fursenkoina bradyi	-0.23	-0.15	-0.45	*Parafrondicularia* sp.	-0.29	-0.14	-0.40
Fursenkoina fusiformis	-0.25	-0.14	-0.41	*Pullenia bulloides*	-0.28	-0.19	1.50
Globobulimina affinis	0.00	-0.09	-0.62	*Pullenia quinqueloba*	-0.16	0.07	-0.29
Globobulimina pacifica	-0.24	-0.09	-0.43	*Pullenia* sp.	-0.22	-0.18	-0.11
Globocassidulina elegans	-0.31	-0.17	-0.23	*Pyrgo depressa*	-0.27	-0.12	0.30
Globocassidulina subglobosa	-0.51	-0.11	4.20	*Pyrgo lucernula*	-0.36	-0.16	0.07
Globulina minuta	-0.27	-0.15	-0.41	*Pyrgo murrhina*	3.33	0.08	-1.86
Glomospira charoides	-0.27	-0.15	-0.41	*Pyrgo vespertilio*	-0.34	-0.18	-0.07
Gyroidinoides altiformis	-0.30	-0.20	0.07	*Pyrgo* sp.	0.14	-0.18	-0.54
Gyroidinoides lamarckianus	-0.24	-0.16	-0.31	*Pyrulina fusiformis*	-0.30	-0.14	-0.32
Gyroidinoides orbicularis	0.02	-0.08	0.25	*Quinqueloculina inmata*	-0.31	-0.17	-0.23
Gyroidinoides polius	-0.27	-0.16	-0.17	*Quinqueloculina lamarckiana*	-0.31	-0.17	-0.23
Gyroidinoides soldanii	-0.23	-0.13	-0.15	*Quinqueloculina seminulum*	0.04	-0.12	0.39
Gyroidinoides sp.	-0.25	-0.15	-0.44	*Quinquqloculina stelligera*	-0.37	-0.20	0.09
Hanzawaia nipponica	-0.31	-0.17	-0.23	*Quinqueloculina venusta*	-0.28	-0.05	0.56
Hoeglundina elegans	0.37	-0.21	1.33	*Quinqueloculina* sp.	-0.29	-0.14	-0.37
Karreriella bradyi	-0.31	-0.16	-0.24	*Rectobolivina dimorpha*	-0.27	-0.15	-0.41
Lagena sp.	-0.16	-0.12	0.50	*Reussella simplex*	-0.31	-0.17	-0.23
Laticarinina pauperata	-0.21	-0.13	0.29	*Robertina tasmanica*	-0.29	-0.14	-0.39
Lenticulina sp.	-0.17	-0.16	-0.44	*Robertinoides brady*	-0.32	-0.13	0.31
Marginulina obesa	-0.27	-0.13	-0.29	*Saracenaria italica*	-0.31	-0.17	-0.23
Marginulina subullata	-0.29	-0.13	-0.40	*Sigmoilopsis schlumbergeri*	-0.03	-0.12	-0.53
Marginulina sp.	-0.29	-0.14	-0.40	*Siphoeggerella siphonella*	-0.31	-0.17	-0.23
Martinottiella communis	-0.23	-0.15	-0.40	*Siphotextularia catenata*	-0.35	-0.11	-0.06
Martinottiella perparva	-0.29	-0.14	-0.37	*Siphotextularia curta*	-0.27	-0.15	-0.41
Melonis barleeanum	-0.23	-0.13	-0.13	*Sphaeroidina bulloides*	-0.27	0.00	2.55
Melonis pompilioides	0.32	-0.07	-0.58	*Stilostomella abyssorum*	-0.31	-0.17	-0.23
Miliolinella oblonga	-0.31	-0.15	-0.23	*Stilostomella inflexa*	-0.31	-0.17	-0.23
Miliolinella subrotunda	-0.34	-0.17	-0.07	*Stilostomella* sp.	-0.29	-0.14	-0.39
Nodosaria radicula	-0.29	-0.14	-0.40	*Textularia lateralis*	-0.31	-0.17	-0.23
Nonion sp.	-0.31	-0.17	-0.23	*Triloculina subvalvularis*	-0.21	-0.14	-0.41
Nummoloculina irregularis	-0.30	-0.06	-0.05	*Triloculina tricarinata*	-0.30	-0.15	0.20
Oolina sp.	-0.19	-0.06	-0.04	*Uvigerina peregrina*	1.97	-0.01	-1.90
Oridorsalis tener umbonatus	3.76	0.71	1.86	*Uvigerina porrecta*	-0.42	-0.23	0.41
Oridorsalis sp.	-0.29	-0.14	-0.39	*Uvigerina proboscidea*	0.03	0.10	1.06
Osangularia cultur	-0.42	-0.23	0.41	*Uvigerina* sp.	-0.29	-0.14	-0.39
Parafissurina sp.	0.26	-0.02	-0.52	*Valvulineria* sp.	-0.29	-0.13	-0.40

4) *Fr10/95 GC5*: factor loadings for the two *Q* – mode varimax-factors.

Sample	F1	F2	Sample	F1	F2	Sample	F1	F2
0-1 cm	0.35	-0.02	45-46 cm	0.10	0.99	85-86 cm	0.93	0.11
5-6 cm	0.49	0.38	49-50 cm	0.07	0.99	89-90 cm	0.93	0.11
9-10 cm	0.48	0.40	53-54 cm	0.43	0.87	93-94 cm	0.93	0.19
13-14 cm	0.59	0.34	57-58 cm	0.39	0.86	97-98 cm	0.93	0.14
17-18 cm	0.16	0.92	61-62 cm	0.86	0.26	101-102 cm	0.90	0.22
21-22 cm	0.08	0.97	65-66 cm	0.84	0.17	105-106 cm	0.82	0.25
25-26 cm	0.13	0.98	69-70 cm	0.73	0.56	109-110 cm	0.86	0.11
29-30 cm	0.09	0.98	73-74 cm	0.88	0.23	113-114 cm	0.85	0.19
33-34 cm	0.20	0.94	77-78 cm	0.92	0.21	117-118 cm	0.78	0.07
37-38 cm	0.29	0.95	81-82 cm	0.90	0.19	121-122 cm	0.92	0.13
41-45 cm	0.06	0.98						

5) *SHI9016*: factor scores for the two Q – mode varimax-factors.

Species	F1	F2	Species	F1	F2
Allomorphina pacifica	-0.21	-0.43	*Gyroidinoides orbicularis*	0.06	1.20
Amphicoryna sp.	-0.21	-0.42	*Gyroidinoides polius*	-0.20	-0.35
Anomalina globulosa	-0.10	0.04	*Gyroidinoides soldanii*	-0.10	0.00
Astrononion echolsi	0.86	1.38	*Gyroidinoides* sp.	-0.22	-0.30
Bolivina albatrossi	-0.10	-0.46	*Hanzawaia nipponica*	-0.18	-0.41
Bolivina robusta	-0.21	-0.42	*Hauerinella incostans*	-0.19	1.80
Bolivina seminuda	-0.26	0.10	*Hoeglundina elegans*	-0.19	-0.47
Bolivina sp.	-0.21	-0.44	*Karreriella bradyi*	-0.15	-0.27
Bolivinita quadrilatera	-0.12	-0.44	*Lagena truncata*	0.43	0.45
Brizalina dilatata	-0.17	-0.46	*Lagena* sp.	-0.22	-0.39
Brizalina semilineata	-0.08	-0.27	*Laticarinina pauperata*	-0.22	-0.39
Brizalina sp.	-0.19	-0.47	*Lenticulina crassa*	-0.21	-0.42
Bulimina aculeata	11.13	-3.17	*Lenticulina peregrina*	-0.22	0.14
Bulimina alazanensis	-0.18	-0.46	*Lenticulina* sp.	-0.20	0.20
Bulimina costata	-0.19	0.93	*Marginulina obesa*	-0.13	-0.29
Buliminella elegantissima	-0.20	-0.19	*Marginulina* sp.	-0.24	-0.31
Cassidulina crassa	-0.16	-0.24	*Marsipella cylindrica*	1.36	0.18
Cassidulina laevigata	0.72	1.06	*Martinottiella comminis*	0.12	-0.37
Cassidulina reflexa	-0.19	-0.47	*Martinottiella perparva*	-0.29	-0.17
Ceratobulimina pacifica	-0.49	1.12	*Melonis barleeanum*	-0.22	-0.39
Chilostomella oolina	-0.59	2.42	*Melonis pompilioides*	-0.15	0.01
Cibicides lobatulus	1.51	1.65	*Miliolinella oblonga*	-0.11	-0.49
Cibicidoides bradyi	-0.41	0.50	*Nodosaria radicula*	-0.20	-0.37
Cibicidoides kullenbergi	-0.43	1.34	*Nodosaria* sp.	-0.10	-0.47
Cibicidoides pseudoungerianus	-0.17	-0.15	*Nonionella bradyi*	-0.17	-0.41
Cibicidoides robertsonianus	-0.09	-0.22	*Nonionella iridea*	-0.19	-0.46
Cibicidoides wuellerstorfi	0.90	4.75	*Nonionella turgida*	-0.19	-0.47
Cibicidoides sp.	-0.19	-0.47	*Nonionella* sp.	-0.18	-0.47
Cornuspira involvens	-0.21	-0.39	*Nummoloculina contraria*	-0.17	-0.46
Cornuspira sp.	-0.21	-0.44	*Nummoloculina irregularis*	-0.22	0.21
Cyambaloporretta squamosa	-0.19	-0.47	*Oolina globosa*	-0.21	-0.43
Cyclammina cancellata	-0.22	-0.39	*Oolina* sp.	-0.19	-0.08
Dentalina communis	-0.27	-0.03	*Oridorsalis tener umbonatus*	1.23	2.21
Dentalina inornata	-0.22	-0.41	*Osangularia cultur*	-0.20	-0.15
Dentalina sp.	-0.16	-0.20	*Parafissurina lateralis*	-0.27	-0.24
Eggerella bradyi	-0.16	0.01	*Parafissurina* sp.	0.00	0.49
Ehrenbergina trigona	0.18	-0.06	*Patellina jugosa*	-0.19	-0.46
Epistominella exigua	1.40	-0.50	*Planulina ariminensis*	-0.13	-0.45
Epistominella umbonifera	-0.20	-0.46	*Pleurostomella alternans*	-0.19	-0.24
Eponides regularis	-0.17	-0.46	*Pseudoguadryna atlantica*	-0.11	-0.47
Fissurina bradyi	-0.20	-0.46	*Pullenia bulloides*	0.43	0.99
Fissurina sp.	1.57	3.34	*Pullenia quinqueloba*	0.52	4.34
Fursenkoina bradyi	-0.18	-0.38	*Pullenia* sp.	-0.21	-0.43
Fursenkoina fusiformis	-0.22	-0.20	*Pyrgo depressa*	-0.21	-0.42
Fursenkoina sp.	-0.22	-0.38	*Pyrgo lucernula*	0.08	0.77
Gavelinopsis lobatulus	0.10	0.15	*Pyrgo murrhina*	-0.18	-0.38
Globobulimina affinis	-0.25	-0.24	*Pyrgo vespertilio*	-0.23	-0.37
Globobulimina pacifica	-0.43	0.35	*Pyrgo* sp.	-0.20	-0.46
Globocassidulina elegans	0.25	4.47	*Pyrulina angusta*	-0.22	-0.39
Globocassidulina subglobosa	-0.22	-0.21	*Pyrulina cylindroides*	-0.26	-0.22
Guttulina pacifica	-0.19	-0.47	*Pyrulina extensa*	-0.24	-0.13
Gyroidinoides altiformis	-0.17	0.01	*Pyrulina fusiformis*	0.29	0.59
Gyroidinoides lamarckianus	-0.24	-0.29	*Pyrulina gutta*	-0.18	-0.44

Species	F1	F2	Species	F1	F2
Quinqueloculina lamarckiana	-0.25	0.01	*Spiroloculina depressa*	-0.19	-0.47
Quinqueloculina seminulum	-0.11	0.90	*Spiroloculina rotunda*	-0.22	-0.39
Quinqueloculina venusta	-0.19	-0.47	*Spiroloculina tenuis*	-0.21	-0.39
Quinqueloculina sp.	-0.05	-0.31	*Stainforthia complanata*	-0.20	0.01
Rectobolivina columellaris	-0.24	-0.24	*Stilostomella lepidula*	-0.08	-0.47
Rectobolivina dimorpha	-0.19	-0.46	*Stilostomella* sp.	-0.27	-0.24
Rectoglandulina comatula	-0.19	-0.47	*Technitella legumen*	-0.22	-0.39
Reophax distans	-0.29	-0.17	*Textularia goesii*	-0.17	-0.46
Reophax nodulosus	-0.22	-0.39	*Textularia lateralis*	-0.21	-0.43
Reophax pilulifer	-0.22	-0.39	*Textularia lythostrota*	-0.22	-0.38
Reophax spiculifer	-0.25	-0.32	*Textularia pseudogramen*	-0.21	-0.26
Robertina tasmanica	-0.21	-0.42	*Textularia* sp.	0.02	0.28
Robertinoides brady	-0.25	-0.28	*Trifarina bradyi*	-0.18	-0.47
Saracenaria italica	-0.21	-0.44	*Triloculina cuneata*	-0.21	-0.44
Sigmoilopsis schlumbergeri	-0.31	0.56	*Triloculina subvalvularis*	-0.22	-0.41
Siphogenerina raphanus	0.00	0.40	*Triloculina tricarinata*	-0.18	-0.32
Siphoeggerella siphonella	-0.20	-0.46	*Triloculina* sp.	-0.18	-0.47
Siphotextularia catenata	-0.22	-0.39	*Uvigerina peregrina*	-0.02	-0.34
Siphotextularia curta	-0.19	-0.47	*Uvigerina porrecta*	-0.20	-0.13
Siphotextularia sp.	-0.21	-0.29	*Uvigerina proboscidea*	2.47	4.55
Sphaeroidina bulloides	-0.20	-0.46	*Valvulineria* sp.	-0.19	-0.46
Spiroloculina communis	-0.19	-0.47	*Virgulina rotundata*	0.15	-0.55

6) *SHI9016*: factor loadings for the two Q – mode varimax-factors.

Sample	F1	F2	Sample	F1	F2	Sample	F1	F2
0-1 cm	0.15	0.66	56-57 cm	0.78	0.54	112-113 cm	0.74	0.51
4-5 cm	0.21	0.84	58-59 cm	0.91	0.27	116-117 cm	0.98	0.04
8-9 cm	0.19	0.81	62-63 cm	0.90	0.26	122-123 cm	0.97	0.13
12-13 cm	0.21	0.87	66-67 cm	0.94	0.21	126-127 cm	0.93	0.26
16-17 cm	0.19	0.90	72-73 cm	0.97	0.10	132-133 cm	0.88	0.33
22-23 cm	0.19	0.89	76-77 cm	0.86	0.41	136-137 cm	0.96	0.05
26-27 cm	0.16	0.84	82-83 cm	0.85	0.46	142-143 cm	0.98	0.05
32-33 cm	0.23	0.88	86-87 cm	0.77	0.53	146-147 cm	0.91	0.23
36-37 cm	0.23	0.84	92-93 cm	0.68	0.65	152-153 cm	0.89	0.35
42-43 cm	0.13	0.85	96-97 cm	0.83	0.46	156-157 cm	0.90	0.33
46-47 cm	0.22	0.76	102-103 cm	0.95	0.18	162-163 cm	0.93	0.19
52-53 cm	0.38	0.80	106-107 cm	0.98	-0.01			

7) *BAR9403*: factor scores for the four Q – mode varimax-factors.

Species	F1	F2	F3	F4	Species	F1	F2	F3	F4
Allomorphina pacifica	-0.26	-0.09	0.03	-0.18	*Bulimina alazanensis*	-0.13	-0.14	-0.23	-0.31
Ammobaculites americanus	-0.17	-0.20	-0.09	-0.36	*Bulimina costata*	0.14	1.50	1.36	-0.50
Anomalina globulosa	0.02	-0.30	-0.48	0.25	*Bulimina exilis*	-0.08	0.76	-0.29	-0.69
Astrononion echolsi	0.06	-0.18	-0.57	0.80	*Bulimina gibba*	-0.16	-0.21	-0.22	-0.22
Bolivina albatrossi	-0.15	-0.17	-0.19	-0.37	*Bulimina marginata*	-0.13	-0.17	-0.20	-0.34
Bolivina robusta	0.00	-0.16	-0.36	-0.15	*Cassidulina crassa*	-0.14	-0.16	-0.20	-0.36
Bolivina seminuda	-0.11	-0.18	-0.23	-0.33	*Cassidulina laevigata*	0.35	1.24	-0.04	0.58
Bolivina sp.	-0.01	-0.17	-0.27	-0.28	*Ceratobulimina pacifica*	-0.05	-0.21	-0.32	-0.18
Bolivinita quadrilatera	0.11	-0.15	-0.09	-0.25	*Chilostomella oolina*	-0.13	0.15	0.92	1.92
Brizalina dilatata	-0.15	-0.15	-0.23	-0.32	*Cibicides lobatulus*	-0.15	-0.17	-0.20	-0.36
Brizalina semilineata	-0.15	-0.19	-0.23	-0.07	*Cibicidoides bradyi*	-0.02	-0.31	0.06	1.61
Bulimina aculeata	10.71	0.80	-1.55	-0.90	*Cibicidoides pseudoungerianus*	-0.09	-0.43	-0.23	0.79

Species	F1	F2	F3	F4	Species	F1	F2	F3	F4
Cibicidoides robertsonianus	-0.18	-0.24	0.09	-0.26	*Nonionella iridea*	-0.18	-0.18	-0.21	-0.21
Cibicidoides wullerstorfi	0.70	0.19	-0.07	8.11	*Nummoloculina contraria*	-0.13	-0.16	-0.21	-0.38
Cibicidoides sp.	-0.16	-0.09	-0.18	-0.43	*Nummoloculina irregularis*	-0.14	0.02	-0.22	-0.40
Cornuspira involvens	-0.14	-0.18	-0.19	-0.36	*Oolina* sp.	-0.17	-0.07	0.03	-0.46
Dentalina communis	-0.15	-0.17	-0.19	-0.37	*Oridorsalis tener umbonatus*	-0.86	10.31	0.96	-0.25
Dentalina subsoluta	-0.18	-0.16	-0.12	-0.33	*Osangularia cultur*	-0.08	0.01	-0.45	0.00
Dentalina sp.	-0.13	-0.19	-0.05	-0.40	*Parafissurina* sp.	-0.05	-0.10	-0.30	-0.23
Dorothia bradyana	-0.17	-0.09	-0.17	-0.42	*Praemassillina arenaria*	-0.14	-0.18	-0.19	-0.36
Eggerella bradyi	-0.11	-0.24	0.14	-0.12	*Psammosphaera parva*	-0.15	-0.16	-0.19	-0.37
Ehrenbergina trigona	-0.15	-0.17	-0.19	-0.36	*Pseudoguadryna atlantica*	-0.14	-0.18	-0.23	-0.29
Epistominella exigua	1.49	-1.41	9.93	-1.37	*Pullenia bulloides*	-0.19	-0.26	0.52	0.35
Epistominella umbonifera	-0.18	-0.16	-0.12	-0.33	*Pullenia quinqueloba*	-0.12	-0.27	0.22	0.11
Fissurina sp.	0.06	-0.16	0.12	0.16	*Pullenia* sp.	-0.15	-0.18	-0.22	-0.29
Fursenkoina bradyi	-0.09	-0.18	-0.08	-0.36	*Pyrgo depressa*	-0.06	0.16	-0.36	-0.20
Fursenkoina earlandi	-0.15	-0.17	-0.20	-0.25	*Pyrgo elongata*	-0.12	-0.21	-0.21	-0.26
Fursenkoina fusiformis	0.06	0.68	-0.18	0.74	*Pyrgo lucernula*	-0.17	0.21	-0.41	-0.40
Fursenkoina sp.	-0.15	-0.24	-0.06	-0.23	*Pyrgo murrhina*	0.04	1.45	2.57	0.83
Gavelinopsis lobatulus	0.08	-0.24	-0.45	0.20	*Pyrgo serrata*	0.04	0.02	-0.21	-0.44
Globobulimina affinis	-0.16	0.04	0.85	-0.08	*Pyrgo* sp.	-0.17	0.05	-0.13	-0.40
Globobulimina pacifica	-0.15	-0.29	0.74	0.39	*Pyrulina gutta*	-0.16	-0.11	-0.21	-0.35
Globocassidulina subglobosa	0.38	-0.45	0.12	1.37	*Quinqueloculina lamarckiana*	-0.17	-0.14	-0.12	-0.36
Gyroidinoides altiformis	-0.11	-0.22	-0.24	-0.04	*Quinqueloculina seminulum*	-0.19	0.00	-0.10	-0.10
Gyroidinoides lamarckianus	-0.15	-0.19	-0.14	-0.16	*Quinqueloculina venusta*	-0.08	1.24	-0.31	-0.80
Gyroidinoides orbicularis	-0.16	-0.30	-0.38	1.25	*Quinqueloculina* sp.	-0.13	-0.17	-0.19	-0.37
Gyroidinoides polius	-0.24	-0.30	0.43	0.61	*Rectobolivina columellaris*	-0.13	-0.24	-0.17	-0.25
Gyroidinoides soldanii	-0.13	-0.04	-0.43	-0.02	*Rectobolivina dimorpha*	-0.17	-0.20	-0.09	-0.36
Gyroidinoides sp.	-0.14	-0.21	-0.25	-0.17	*Rectoglandulina comatula*	-0.15	-0.15	-0.17	-0.40
Hanzawaia nipponica	-0.15	-0.17	-0.19	-0.37	*Rectoglandulina torrida*	-0.16	-0.13	-0.21	-0.37
Hauerinella incostans	-0.14	-0.18	-0.17	-0.37	*Reussella simplex*	-0.15	-0.17	-0.20	-0.36
Hoeglundina elegans	0.50	0.47	-0.36	1.31	*Robertina tasmanica*	-0.15	-0.14	-0.17	-0.36
Hyalinea balthica	-0.21	-0.10	0.16	-0.28	*Robertinoides brady*	0.01	-0.17	-0.28	-0.34
Karreriella apicularis	-0.17	-0.20	-0.09	-0.36	*Saracenaria italica*	-0.15	-0.19	-0.20	-0.31
Karreriella bradyi	-0.23	-0.20	0.08	-0.09	*Sigmoilopsis schlumbergeri*	-0.09	0.03	-0.81	1.70
Karreriella novangliae	-0.13	-0.18	-0.20	-0.36	*Siphogenerina raphanus*	-0.19	-0.06	-0.18	-0.41
Lagena sp.	-0.20	-0.31	0.26	0.06	*Siphotextularia catenata*	-0.11	0.14	-0.30	-0.40
Laticarinina pauperata	-0.12	-0.20	-0.25	-0.23	*Siphotextularia curta*	-0.14	-0.15	-0.18	-0.33
Lenticulina sp.	-0.20	-0.02	-0.06	-0.27	*Sphaeroidina bulloides*	-0.15	-0.35	0.09	0.38
Loxostomum karrerianum	-0.21	-0.20	0.12	-0.24	*Spiroloculina communis*	-0.16	-0.13	-0.21	-0.37
Marginulina obesa	-0.17	-0.24	-0.07	-0.18	*Spiroloculina rotunda*	-0.15	-0.20	-0.21	-0.27
Marginulina subullata	-0.15	-0.17	-0.20	-0.34	*Spiroloculina tenuis*	-0.21	-0.04	-0.35	-0.19
Marginulina sp.	-0.15	-0.12	-0.15	-0.34	*Stainforthia complanata*	-0.15	-0.17	-0.19	-0.37
Martinottiella communis	-0.14	0.10	-0.28	-0.30	*Textularia lythostrota*	-0.16	-0.17	-0.21	-0.31
Martinottiella perparva	-0.15	-0.12	-0.15	-0.38	*Textularia pseudogramen*	-0.14	-0.18	-0.19	-0.36
Melonis barleeanum	-0.43	0.24	0.13	2.59	*Trifarina bradyi*	-0.14	-0.18	-0.19	-0.36
Melonis pompilioides	-0.20	-0.22	0.00	-0.26	*Triloculina subvalvularis*	-0.13	-0.18	-0.20	-0.35
Miliolinella subrotunda	-0.18	-0.03	-0.18	-0.40	*Triloculina tricarinata*	-0.20	0.00	-0.36	-0.21
Neoconorbina terquemi	-0.17	-0.20	-0.08	-0.37	*Uvigerina peregrina*	0.26	-0.70	1.40	2.51
Nodosaria radicula	-0.15	-0.17	-0.19	-0.37	*Uvigerina proboscidea*	0.56	-0.33	0.89	3.45
Nodosaria sp.	-0.16	-0.17	-0.21	-0.31	*Valvulineria*sp.	0.57	-0.08	0.31	-0.21
Nonionella bradyi	-0.17	-0.07	-0.28	-0.23					

8) *BAR9403*: factor loadings for the four *Q* – mode varimax-factors.

Sample	F1	F2	F3	F4	Sample	F1	F2	F3	F4
0-1 cm	0.06	0.36	0.54	0.43	**140-141 cm**	0.96	0.15	0.11	0.05
5-6 cm	0.15	0.28	0.87	0.25	**145-146 cm**	0.98	0.11	0.05	0.02
10-11 cm	0.15	0.27	0.77	0.29	**150-151 cm**	0.92	0.20	0.00	0.21
15-16 cm	0.15	0.28	0.87	0.05	**155-156 cm**	0.93	0.17	0.12	0.20
20-21 cm	0.41	0.34	0.75	0.19	**160-161 cm**	0.94	0.15	0.27	-0.01
25-26 cm	0.69	0.53	0.41	0.05	**165-166 cm**	0.87	0.05	0.46	-0.01
30-31cm	0.55	0.31	0.62	0.19	**170-171 cm**	0.92	0.24	0.22	0.07
35-36 cm	0.54	0.43	0.36	0.43	**175-176 cm**	0.93	0.09	0.32	0.03
39.5-40.5 cm	0.73	0.56	0.07	0.16	**180-181 cm**	0.98	0.13	0.08	0.01
45-46 cm	0.29	0.66	0.11	0.28	**185-186 cm**	0.84	0.17	0.50	0.01
50-51 cm	0.30	0.49	0.14	0.70	**190-191 cm**	0.97	0.16	0.12	0.07
55-56 cm	0.11	0.16	0.39	0.71	**195-196 cm**	0.86	0.45	0.03	0.05
60-61 cm	0.18	0.52	0.51	0.43	**200-201 cm**	0.71	0.38	0.26	0.30
65-66 cm	0.01	0.84	0.31	0.27	**205-206 cm**	0.23	0.88	0.15	0.20
70-71 cm	0.04	0.76	0.25	0.52	**210-211 cm**	0.88	0.16	0.20	0.20
75-76 cm	0.11	0.41	0.21	0.76	**215-216 cm**	0.60	0.65	0.32	0.21
80-81 cm	0.12	0.32	0.14	0.82	**220-221 cm**	0.55	0.77	0.19	0.18
85-86 cm	0.11	0.33	0.43	0.69	**225-226 cm**	0.80	0.35	0.23	0.30
90-91 cm	0.06	0.16	0.01	0.83	**230-231 cm**	0.30	0.73	0.25	0.41
95-96 cm	0.22	0.52	0.14	0.64	**235-236 cm**	0.69	0.63	0.23	0.13
100-101 cm	-0.04	0.48	0.00	0.40	**240-241 cm**	0.29	0.83	0.25	0.28
105-106 cm	0.57	0.39	0.04	0.52	**245-246 cm**	0.37	0.61	0.25	0.47
110-111 cm	0.70	0.54	-0.01	0.38	**255-256 cm**	0.33	0.89	0.17	0.15
115-116 cm	0.88	0.28	-0.01	0.20	**260-261 cm**	0.06	0.87	0.15	0.14
120-121 cm	0.89	0.23	-0.04	0.21	**265-266 cm**	0.43	0.77	0.23	0.14
125-126 cm	0.98	0.09	-0.01	0.06	**270-271 cm**	0.57	0.39	0.64	0.08
130-131 cm	0.91	0.12	0.08	0.16	**275-276 cm**	0.41	0.74	0.42	0.13
135-136 cm	0.93	0.13	0.05	0.04					