

**LATE QUATERNARY BENTHIC FORAMINIFERA
OF THE PATTON-MURRAY SEAMOUNT GROUP,
GULF OF ALASKA**

by

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A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfillment of
the requirements for the degree of
Master of Science

Department of Earth Sciences

Carleton University

and the

Ottawa-Carleton Geoscience Centre

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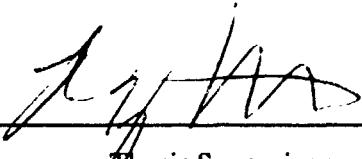
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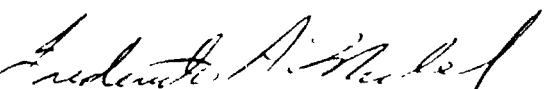
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ABSTRACT

Late Quaternary benthic foraminifera in sediment-water interface and core samples from the Patton-Murray Seamount Group in the Gulf of Alaska have provided information on the paleoceanographic history of the northeast Pacific. Q-mode cluster analysis of the surface samples distinguished two benthic foraminiferal assemblages: the Pullenia salisburyi Sediment-water Interface Assemblage and the Epistominella exigua Sediment-water Interface Assemblage. These two assemblages are differentiated by selective dissolution related to the depth of the benthic foraminiferal lysocline, the former characterizing water above the benthic foraminiferal lysocline and the latter characterizing water below it.

Cluster analysis of the foraminifera-bearing core samples together with the sediment-water interface samples, differentiated two foraminiferal biofacies: the Epistominella vitrea Biofacies and the Pullenia salisburyi-Epistominella exigua Biofacies. These two biofacies represent deposition during glacial and postglacial times, respectively. The glacial period was characterized by a shift of shallower water fauna to bathyal depths in response to the descent of the benthic foraminiferal lysocline.

A third phase of deposition, characterized by an assemblage of diatoms, radiolaria and ice-raftered debris and lacking carbonate content was recognized down-core. This siliceous phase corresponds to deposition during an interglacial when upwelling, related to intensified bottom-water circulation, caused the ascension of the lysocline.

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CHAPTER 1. INTRODUCTION

PURPOSE OF STUDY

There have been numerous studies of Foraminifera of the Pacific Ocean. Some of the major works include Brady (1881, 1884), Cushman (1910, 1911, 1913, 1914, 1915, 1932, 1933b), Barker (1960), McCulloch (1977), Saidova (1981) and others. Most of these studies have concentrated on the tropical, southern or northwestern Pacific while the northeastern Pacific has been largely ignored. The few foraminiferal-based studies published on the Northeast Pacific Ocean have focused on the shallow shelf (e.g. Cushman and McCulloch, 1939, 1940; Todd and Low, 1967; and Patterson, in press).

The paleoceanographic history of the North Pacific is crucial to our understanding of the evolution of mid-latitude and sub-arctic climates in response to polar cooling. However, as a result of the paucity of studies of the northeastern Pacific the paleoceanography of this region is poorly understood. The lack of investigation in the northeastern Pacific is partially due to the fact that much of the region lies below the carbonate compensation depth (CCD) (Berger and others, 1976) and therefore the foraminiferal fauna is not preserved. Also much of the area is covered by turbidites (Menard, 1964; Hamilton, 1967). The natural distribution of microfossils is disrupted by hydraulic sorting and the mixing of shallow-water faunas with bathyal and abyssal assemblages during turbidity current transport (Brunner and Normark, 1985). This reorganization of microfauna affects biostratigraphic and paleoceanographic interpretations.

Recent surveys on a research cruise, in August of 1987, aboard the CSS PARIZEAU documented the existence of 'pelagic windows' through the turbidite sections. These windows are presently found on seamount platforms in the Gulf of Alaska where carbonate and diatom rich sediments have been accumulating throughout the Neogene (Duncan and Clague, 1985).

This project was a reconnaissance of the benthic foraminiferal fauna of the Patton-Murray Seamount Group for an upcoming Ocean Drilling Program (ODP) site. As such it had three main objectives. The first was to produce a systematic catalogue of Late Quaternary, deep-sea, benthic foraminiferal species for the northeastern Pacific. The second aim was to determine the characteristics of the foraminiferal assemblages occupying the "carbonate window". These assemblages were then related to the water masses of Northeast Pacific Ocean. The final objective of this study was to relate changes in the benthic foraminiferal assemblages down core to changes in the associated water masses due to fluctuations of climatic conditions during the late Quaternary.

REGIONAL SETTING

The Gulf of Alaska is part of the Northeast Pacific Basin, the largest of four basins dividing the North Pacific seafloor. Large-scale tectonic features, such as the Aleutian Trench, bound the basin and strongly influence the sedimentary processes going on within it (McCoy and Sancetta, 1985). The major physiographic features of the Gulf of Alaska are the central hills and seamounts which are surrounded by the Aleutian, Tufts, and Alaska Abyssal Plains (Hamilton, 1967). The abyssal plains are areas of extensive turbidite and hemipelagic/pelagic sedimentation. Two major linear chains of seamounts and guyots, the Cobb-Eickelberg chain to the south and the Kodiak-Bowie (or Pratt-Welker) chain to the north, cut across the region from northwest to the southeast (Figure 1). These seamounts may be traces of hotspot vulcanism, but as of yet the details of their history are not well constrained (Duncan and Clague, 1986). Generally, however, the oldest seamounts are in the northwest and they get progressively younger towards the southeast.

The Patton-Murray Seamount Group shown in Figure 2 is a seamount plateau composed of several seamounts surrounding a central depression. This plateau stands several hundred metres above the surrounding abyssal plain. With an area of more than

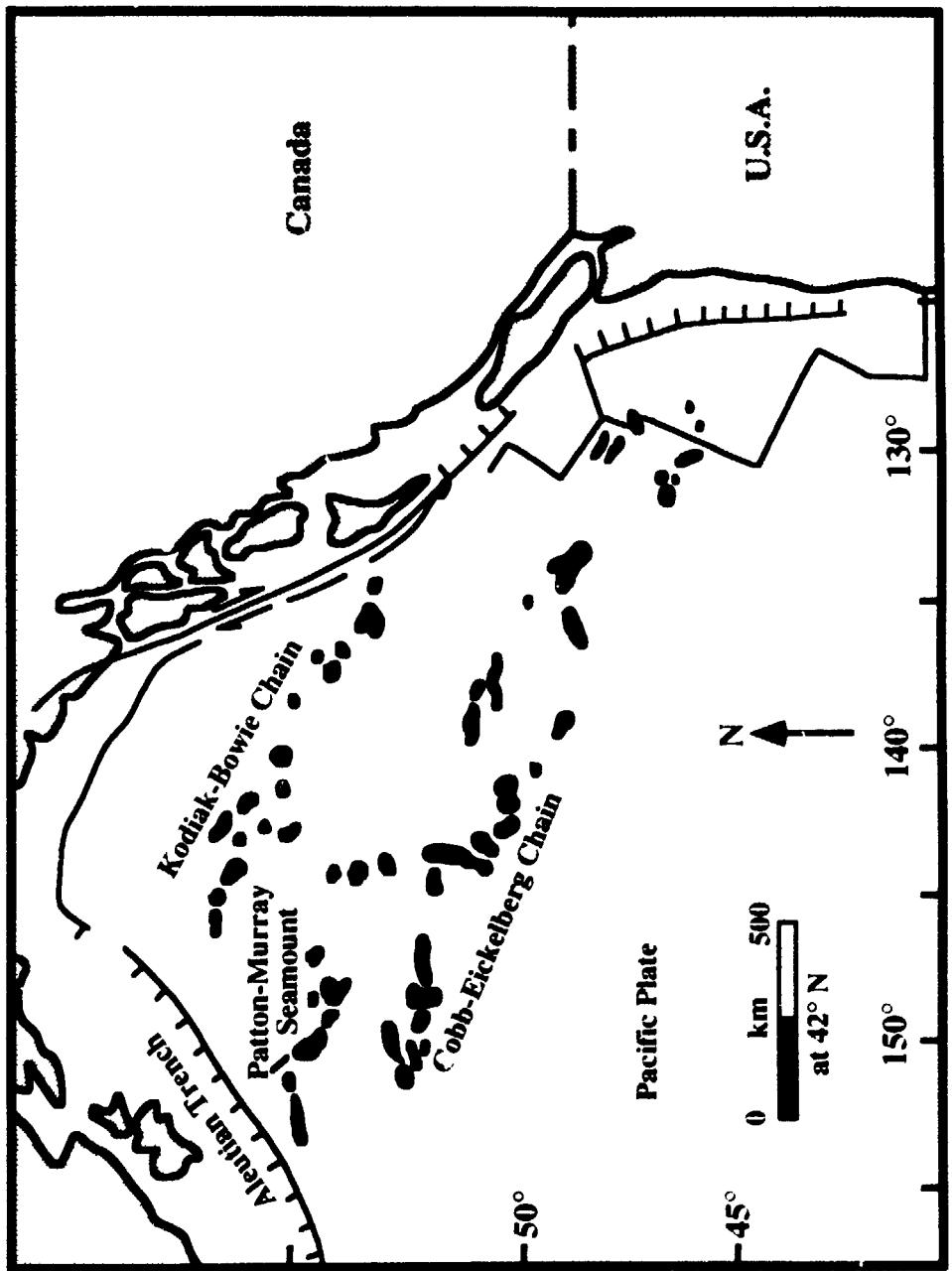


Figure 1. Major seamount chains and tectonic features of the Northeast Pacific Basin.
(After Riddiforth, 1985.)

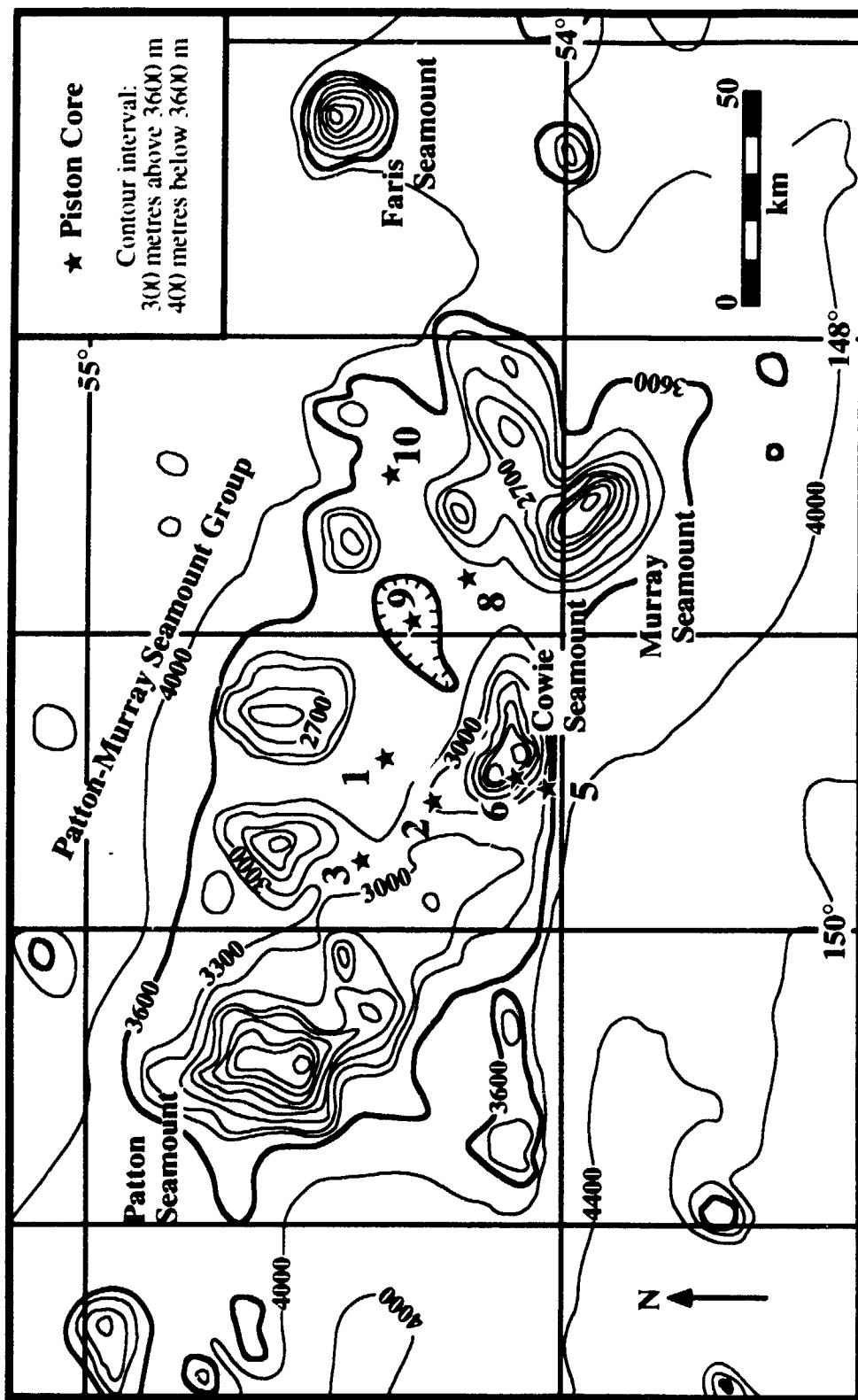


Figure 2. Bathymetric map of the Patton-Murray Seamount Group showing locations of piston cores.
Location 1: PAR87a-01; 2: PAR87a-02; 3: PAR87a-03; 5: PAR87a-05; 6: PAR87a-06; 8: PAR87a-08; 9: PAR87a-09; 10: PAR87a-10 (not part of this study).

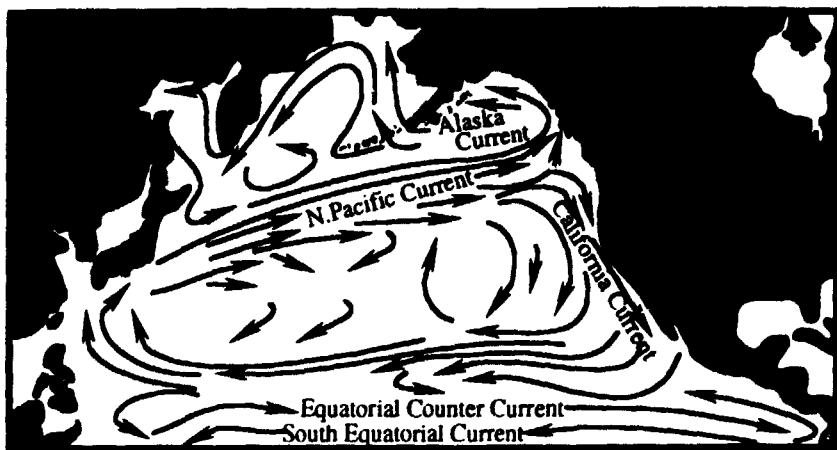
17,000 km² above 3700 m water depth, it is the largest of the seamount plateaus in the northeastern Pacific (Zahn and others, 1991). Preliminary seismic surveys revealed a thick sequence (up to 370 m) of hemipelagic sediments which can be mapped over the seamount group by its distinctive acoustic character (Hamilton, 1967). These hemipelagic sediments contain biogenic carbonate and biosiliceous sediment and abundant ice-rafted debris. Basalts dredged from the Murray Seamount were dated at 25.7 Ma (Duncan and Clague, 1985). Northward motion of the Pacific plate would have resulted in a translation of this segment of crust by about 1000 km in the last 25 ma (Rea and Duncan, 1986).

OCEANOGRAPHY

The circulation of the surface waters of the ocean depends chiefly on the prevailing winds. As a result the surface circulation of the northern Pacific is dominated by the east-northeastward flowing North Pacific Current which crosses the Pacific at approximately 40° N (Figure 3a) (Muromtsev, 1963; McCoy and Sancetta, 1985). This current separates the two major gyres of the North Pacific. The anticyclonic subtropical gyre is characterized by high surface salinity (34.00-35.00‰) and a permanent thermocline, with surface temperatures of 20°-25°C. The cyclonic subarctic gyre is characterized by low water temperatures (<12°C) and low surface salinity (33.00-32.00‰) with a permanent halocline caused by an excess of precipitation over evaporation (McCoy and Sancetta, 1985). East of approximately 150°W the North Pacific Current becomes less distinct due to waters streaming in from the subtropical gyre (Muromtsev, 1963). The circulation becomes complex with the eastward flowing water turning north into the Alaska Gyre and south into the California Current. The transition zone is characterized by steep latitudinal temperature and salinity gradients (McCoy and Sancetta, 1985).

The interaction of these water masses and their boundary currents influences the distribution of nutrients and particulate matter from air-fall or pelagic sources and thus

(a)



(b)



Figure 3. (a) Major surface currents in the North Pacific Ocean.
(b) Bottom-water circulation pattern in the North Pacific Ocean
with stippled area outlining the approximate extent of bottom-
water distribution. (From McCoy and Sancetta, 1985).

determines rates of planktic productivity. The northern boundary of the North Pacific Current defines the southernmost limit of ice-rafted debris because icebergs reaching this current are carried northeastward into the Alaska Current of the subarctic gyre.

The buoyant, low salinity surface waters of the high latitudes of the North Pacific impede deep convection. As a result there is no source of deep or bottom waters in the North Pacific (Warren, 1983). The lack of a local source means that the deep waters must be derived from other ocean basins. The deep and bottom waters of North Pacific are composed of two main components: North Atlantic Deep Water (NADW) entering the southern Pacific by the Drake Passage and Antarctic Bottom Water (AABW) formed through mixing of Circumpolar Water (CPW) with bottom waters of the Antarctic basins (McLellan, 1975; Mantyla and Reid, 1983). These waters enter the equatorial region of North Pacific basin at 170°-175°W and move sluggishly northward (Figure 3b) (Jacobs and others, 1979; McCoy and Sancetta, 1985). Deep circulation extends from approximately 1,500 m depth down to 4,000-4,500 m.

By the time these deep waters reach the North Pacific they are very depleted in oxygen and ^{13}C due to oxidation of organic carbon. Conversely, they are rich in dissolved CO₂ and nutrients. These characteristics of the North Pacific deep water have earned it the title of the "oldest" water in the World Ocean (Kroopnick, 1985). They are the result of a long residence time, isolated from the atmosphere. The high levels of dissolved CO₂ make the North Pacific deep water very corrosive to calcium carbonate, leading to a shoaling of the CCD to 3,300-3,800 m (Berger, 1979; Chen and others, 1986).

CHAPTER 2. MATERIALS AND METHODS

SOURCE AND PROCESSING OF SAMPLES

Materials examined in this study were sampled from the core collection of Pacific Geoscience Centre (PGC), Geological Society of Canada, Sidney, British Columbia. A set of 7 core-top samples, ranging from 2847 to 3738 m water depth, were selected from locations within the Patton Murray Seamount Group in the Northeast Pacific Ocean. The cores were collected during a PGC research cruise, (cruise number PGC-PAR-87-09) in August of 1987. The locations and depths of the cores used in the present study are listed in Table 1.

Core PAR87a-01 was chosen because of its central location and good recovery. It was sampled down core at an interval of approximately 20 cm. Sampling was done by Trudie Forbes of PGC under the direction of B.D. Bornhold. Forty-two samples were collected down core. Figure 4 is a simplified core log, supplied by PGC, showing the basic lithologies and the sampling levels.

The core-top samples were processed in the following manner. Each sample was boiled in water with soda ash for approximately 10 minutes. The resultant slurry was washed through a 75 μm (No. 200 mesh) sieve. This boiling process was repeated until all the clay and silt was removed. Because the samples were not cemented or consolidated, they disaggregated readily.

The down-core samples were processed by a slightly different process. The sample was shaken with water and soda ash for a period of 10 minutes with a Burrell Wrist Action Shaker (Model 75). The slurry was then washed through a 75 μm sieve. The shaking process was repeated until the samples were completely disaggregated and all clay and silt had been washed away.

The $>75 \mu\text{m}$ residue was split using a random micro-splitter. One half of the sample was qualitatively examined to determine the species of benthic foraminifera present.

Core Designation	Latitude	Location	Depth (m)	Core Length (cm)
PAR87a-01	54 24.90	149 25.84	3480	852
PAR87a-02	54 17.40	149 36.32	2920	610
PAR87a-03	54 26.49	149 47.29	3060	638
PAR87a-05	54 03.41	149 31.87	3347	92
PAR87a-06	54 05.02	149 29.08	2847	32
PAR87a-08	54 12.84	148 49.32	3446	116
PAR87a-09	54 20.27	148 56.99	3738	425

Table 1. Core information for sediment-water interface samples used in the present study.

PAR87a-01

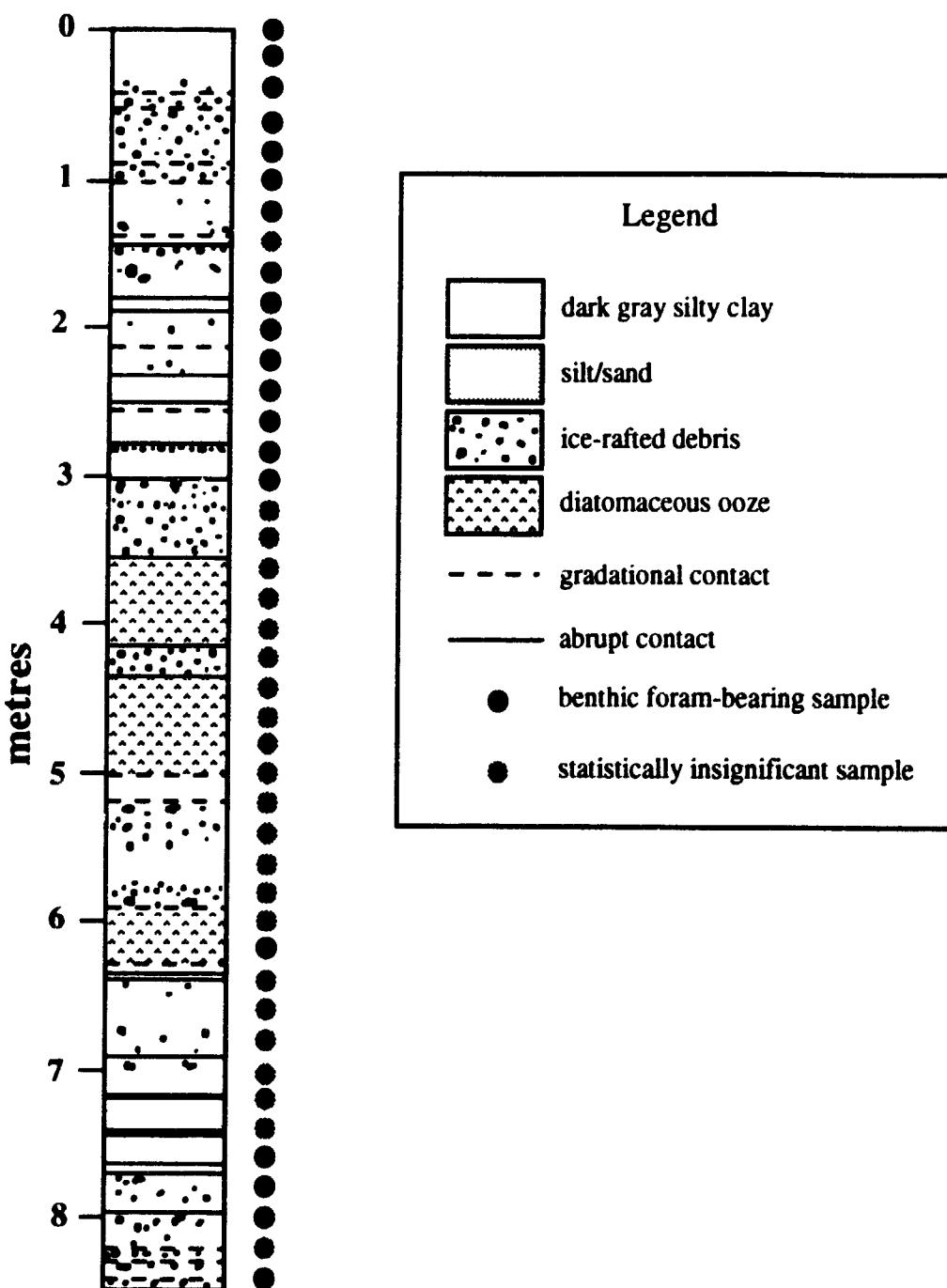


Figure 4. Stratigraphic section of core PAR87a-01 showing lithology and sampling locations (Lithologic information from an unpublished core log supplied by Pacific Geoscience Centre).

The second half was quantitatively analyzed to determine the percent abundance of each species. The quantitative half was split twice more into smaller portions (eighths of the original sample). The sample was then analyzed by one-eighth splits until at least 300 specimens had been counted or the entire quantitative half had been examined.

STATISTICAL TECHNIQUES AND CLUSTER ANALYSIS

The analyzed core and sediment-water interface samples were found to contain planktic and benthic foraminifera, diatoms and radiolaria; however, this study is concerned only with the benthic foraminifera. One hundred and forty species of benthic foraminifera have been identified during the examination of the 49 sediment-water interface and core samples. Many of the specimens examined during the course of this study showed evidence of dissolution such as reduced transparency of hyaline species, broken or damaged specimens and fragmented foraminifera. Fragments of planktic foraminifera were especially common in some samples. The systematic paleontology of the identifiable species of benthic foraminifera is presented in Chapter 3.

Although all the samples contain a biogenic component, benthic foraminifera were not always present. Eight of the 49 samples are completely devoid of benthic foraminifera while an additional 16 samples were found to contain fewer than 70 specimens. These 24 depauperate samples, including the core-top sample PAR87a-09, are not included in the matrix used for the cluster analysis.

The error associated with the fractional abundance of each species was determined using the standard error equation described by Patterson and Fishbein (1989) :

$$s_{x_i} = 1.96 \sqrt{\frac{X_i(1-X_i)}{N}}$$

where (N) is the total number of counts, and (X) is the fractional abundance of a species.

In a sample of 300 specimens, a species must be present at an abundance of at least 1.3 percent (4 specimens) before it even exceeds the associated error. Thus rare species are disregarded as random occurrences which cannot be used to reliably characterize the sample. As such, the rare species were discounted from the matrix used for cluster analysis.

Examination of the fractional abundances of each species with their associated error shows that only 20 of the total 140 species recognized were present in sufficient populations to be considered statistically significant. The fractional abundances of the reduced data set used for cluster analysis are presented in Table 2. The complete census of all samples and species is given in Appendix 1.

The reduced data set was subjected to Q-mode cluster analysis using the Stats and Cluster modules of the statistics software package SYSTAT 5 (Macintosh version 5.1, 1989). The clustering procedure was done according to the recommendations made by Fishbein and Patterson (in press). Thus, the samples were clustered in a hierarchical algorithm using the fractional abundances of the statistically significant species (the 20 species in Table 2). The SYSTAT 5 Cluster Module used a Euclidean distance and Ward's Minimum Variance linkage.

A dendrogram produced by the clustering algorithm is shown in Figure 5 (page 43). At zero Euclidean distance there are 25 clusters, each containing one sample; at the greatest Euclidean distance all the samples are grouped within a single cluster. Presumably, at some Euclidean distance between these two extremes the data set will be divided into a viable set of clusters. The appropriate Euclidean distance is somewhat arbitrary but is often indicated by a pronounced increase in the Euclidean distance between clustering levels.

Species	Sediment-water Interface Samples						Core Samples														
	PAR87-a-	08	06	05	03	02	01	18-	20	38-	40	59-	61	78-	80	98-	100	120-	122	162-	164
<i>Uvigerina senicosa</i>	0.009	0.003	0.060	0.025	0.003	0.081	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<i>Bolivinella pacifica</i>	0.015	0.011	0.000	0.043	0.011	0.006	0.042	0.000	0.002	0.007	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	
<i>Hererolepa duemplei</i>	0.003	0.043	0.026	0.058	0.031	0.048	0.038	0.007	0.037	0.039	0.049	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.090	
<i>Osyngularia parki</i>	0.001	0.109	0.058	0.001	0.062	0.009	0.000	0.000	0.000	0.000	0.003	0.013	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.000	
<i>Epistominella virrea</i>	0.141	0.077	0.041	0.165	0.174	0.030	0.094	0.316	0.310	0.411	0.215	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.387	
<i>Astrononion echolsis</i>	0.000	0.000	0.000	0.018	0.014	0.060	0.023	0.007	0.007	0.006	0.013	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.116
<i>Stainforthia exilis</i>	0.045	0.002	0.010	0.049	0.006	0.003	0.029	0.037	0.045	0.016	0.073	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.026	
<i>Melonis barbeeum</i>	0.022	0.018	0.012	0.019	0.008	0.030	0.036	0.118	0.030	0.003	0.047	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	
<i>Pullenia salisburyi</i>	0.253	0.055	0.217	0.31	0.062	0.105	0.056	0.044	0.049	0.033	0.116	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.049
<i>Gyroidina altiformis</i>	0.000	0.000	0.000	0.000	0.020	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<i>Pullenia bulboides</i>	0.013	0.005	0.011	0.009	0.006	0.012	0.012	0.000	0.032	0.023	0.011	0.012	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	
<i>Epistominella exigua</i>	0.047	0.113	0.078	0.107	0.258	0.102	0.062	0.022	0.091	0.066	0.017	0.100	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	
<i>Globocassidulina rariocula</i>	0.234	0.178	0.131	0.282	0.070	0.006	0.234	0.118	0.276	0.191	0.165	0.148	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	
<i>Melonis pomphiloides</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	
<i>Neodiscorbimella operosa</i>	0.001	0.013	0.005	0.001	0.008	0.051	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<i>Anomalinella sp.A</i>	0.000	0.002	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<i>Rosalina sp.A</i>	0.000	0.004	0.012	0.003	0.000	0.000	0.017	0.007	0.007	0.007	0.010	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.000	
<i>Cassidulina californica</i>	0.000	0.130	0.029	0.066	0.003	0.000	0.021	0.000	0.007	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
<i>Gyroidina neosoldanii</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.022	0.002	0.059	0.071	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.009	
<i>Oridorsalis tenera</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Table 2. Fractional abundance data for the species used for cluster analysis. Sediment-water interface samples are labeled as PAR87-a-08, 06, etc.; core samples are labeled by their core depth in cm. Missing samples such as PAR87-a-09 were not included in the cluster analysis because of low total counts. Total counts, fractional abundances and associated errors for all samples and species are presented in Appendix 1.

Species	Core Samples (cont.)											
	183- 185	196- 198	219- 221	239- 241	260- 262	280- 282	300- 302	620- 622	761- 763	781- 783	800- 802	840- 842
<i>Uvigerina senicosa</i>	0.001	0.000	0.000	0.000	0.005	0.000	0.006	0.000	0.019	0.012	0.000	0.000
<i>Bolivinella pacifica</i>	0.009	0.014	0.025	0.010	0.023	0.049	0.004	0.248	0.040	0.008	0.000	0.000
<i>Heterolepa duemplei</i>	0.065	0.089	0.029	0.029	0.019	0.011	0.043	0.000	0.000	0.034	0.004	0.019
<i>Osanglaria parki</i>	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
<i>Epistominella vitrea</i>	0.336	0.370	0.379	0.309	0.335	0.294	0.391	0.193	0.360	0.321	0.224	0.638
<i>Astronion echolsis</i>	0.092	0.048	0.031	0.002	0.045	0.017	0.048	0.009	0.003	0.023	0.063	0.026
<i>Straightforchia exilis</i>	0.040	0.021	0.053	0.012	0.076	0.015	0.004	0.000	0.003	0.018	0.000	0.022
<i>Melonis barleeanum</i>	0.006	0.034	0.015	0.017	0.017	0.032	0.009	0.000	0.003	0.001	0.004	0.000
<i>Pullenia salisburyi</i>	0.043	0.082	0.033	0.037	0.021	0.021	0.019	0.037	0.050	0.008	0.093	0.004
<i>Gyroidea altiformis</i>	0.000	0.000	0.008	0.000	0.005	0.000	0.000	0.001	0.073	0.003	0.010	0.000
<i>Pullenia bulloides</i>	0.033	0.014	0.056	0.037	0.026	0.017	0.017	0.083	0.016	0.011	0.000	0.000
<i>Epistominella exigua</i>	0.064	0.000	0.043	0.088	0.057	0.083	0.063	0.037	0.078	0.267	0.316	0.127
<i>Globocassidulina rarilocula</i>	0.165	0.192	0.174	0.275	0.178	0.102	0.121	0.018	0.161	0.038	0.181	0.056
<i>Melonis pomphiloides</i>	0.018	0.048	0.012	0.042	0.016	0.009	0.023	0.266	0.000	0.004	0.000	0.004
<i>Nediscorbinella operosa</i>	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.075	0.051	0.052
<i>Anomalinella sp.A</i>	0.000	0.000	0.046	0.037	0.026	0.196	0.035	0.000	0.003	0.019	0.000	0.000
<i>Rosalina sp.A</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.059	0.004	0.000	0.000
<i>Cassidulina californica</i>	0.008	0.000	0.001	0.007	0.000	0.000	0.001	0.000	0.006	0.000	0.000	0.000
<i>Gyroidina neosoldanii</i>	0.036	0.007	0.000	0.004	0.000	0.012	0.000	0.022	0.020	0.030	0.004	0.000
<i>Oridorsalis ?terera</i>	0.003	0.007	0.000	0.002	0.012	0.006	0.000	0.000	0.000	0.000	0.000	0.000

Table 2 (cont.). Fractional abundance data for the species used for cluster analysis.

CHAPTER 3. SYSTEMATICS

INTRODUCTION

Below is the classification of the 140 taxa of benthic foraminifera identified during the course of this study. The supraspecific classification used in this paper follows Loeblich and Tappan (1987). All specimens are identified to the generic level; however, many of the specimens are poorly preserved and/or damaged and thus identification below the generic level is not possible. In this case the specimens are designated by a letter (e.g. Uvigerina sp. A). In most cases the letter designated taxa represent only one or two specimens and therefore are insignificant. Systematic entries for the specimens identified to the species level include a partial synonymy. This synonymy is by no means complete and includes only the most important references. All identified species are described in one or more of these references so no additional description is included in this paper. Some of the more important and abundant species are illustrated in plates 1-4.

SYSTEMATIC PALEONTOLOGY

Suborder TEXTULARIINA Delage and Hérouard, 1896

Superfamily ASTRORHIZACEA Brady, 1881

Family BATHYSIPHONIDAE Avnimelech, 1952

Genus Bathysiphon M.Sars in G.O. Sars, 1872

Bathysiphon rufus de Folin, 1886

Bathysiphon rufum de Folin, 1886, p.283, pl.6, fig.8(a-c).

Superfamily HIPPOCREPINACEA Rhumbler, 1895

Family HIPPOCREPINIDAE Rhumbler, 1895

Subfamily HYPERAMMININAE Eimer and Fickert, 1899

Genus Hyperammina Brady, 1878

Hyperammina elongata Brady, 1878

Hyperammina elongata BRADY, 1878, p.433, pl.20, fig.2(a-b).

Bactrammina elongata EIMER and FICKERT, 1899, p.673.

Hyperammina sp.A

Genus Saccorhiza Eimer and Fickert, 1899

Saccorhiza ramosa (Brady, 1879)

Hyperammina ramosa BRADY, 1879, p.33, pl.3, fig.14-15.

Saccorhiza ramosa (Brady) EIMER and FICKERT, 1899, p.670.

Superfamily AMMODISCACEA Reuss, 1862

Family AMMODISCIDAE Reuss, 1862

Subfamily AMMOVERTELLININAE Saidova, 1981

Genus Glomospira Rzehak, 1885

Glomospira gordialis (Jones and Parker, 1860)

Trochammina squamata var. gordialis JONES and PARKER, 1860, p.304.

Trochammina gordialis (Jones and Parker) CARPENTER, PARKER and JONES, 1862, p.141, pl.11, fig.4.

Ammodiscus gordialis (Jones and Parker) SIDDALL, 1879, p.5.

Trochammina (Ammodiscus) gordialis (Jones and Parker) HAEUSLER, 1883, p.59, pl.4, fig.2-3.

Ammodiscus (Glomospira) gordialis (Jones and Parker) RZEHAK, 1888, p.191.

Gordiammina gordialis (Jones and Parker) RHUMBLER, 1895, p.84.

Glomospira gordialis (Jones and Parker) CUSHMAN, 1918, p.99, pl.36, fig.7-9.

Superfamily HORMOSINACEA Haeckel, 1894

Family HORMOSINIDAE Haeckel, 1894

Subfamily REOPHACINAE Cushman, 1910

Genus Reophax de Montfort, 1808

Reophax nodulosus Brady, 1879

Reophax nodulosus BRADY, 1879, p.52, pl.4, fig.7-8.

Reophax sp.A

Superfamily LITUOLACEA de Blainville, 1827

Family HAPLOPHRAGMOIDIDAE Maync, 1952

Genus Haplophragmoides Cushman, 1910

Haplophragmoides scitulum (Brady, 1881)

Haplophragmium scitulum BRADY, 1881, p.50.

Haplophragmoides scitulum (Brady) CUSHMAN, 1910, p.103, fig.153-155.

Family LITUOLIDAE de Blainville, 1827

Subfamily AMMOMARGINULININAE Podobina, 1978

Genus Ammobaculites Cushman, 1910

Ammobaculites sp. A

Ammobaculites sp. B

Superfamily LOFTUSIACEA Brady, 1884

Family CYCLAMMINIDAE Marie, 1941

Subfamily CYCLAMMININAE Marie, 1941

Genus Cyclammina Brady, 1879

Cyclammina cancellata Brady, 1879

Cyclammina cancellata Brady in NORMAN in JEFFREYS, 1876, p.214 (nom. nud.).

Cyclammina cancellata BRADY, 1879, p.62.

Superfamily TROCHAMMINACEA Schwager, 1877

Family TROCHAMMINIDAE Schwager, 1877

Subfamily TROCHAMMININAE Schwager, 1877

Genus Trochammina Parker and Jones, 1859

Trochammina simplex Cushman and McCulloch, 1939

Trochammina pacifica Cushman, var. simplex Cushman and McCulloch, 1939, p.104,
pl.11, fig.4.

Subfamily TROCHAMMINELLINAE Brönnimann, Zaninetti, and Whittaker, 1983

Genus Pseudotrochammina Frerichs, 1969

Pseudotrochammina dehiscens Frerichs, 1969

Ammoglobigerinoides dehiscens FRERICHS, 1969, p.1, pl.1, fig.1; pl.2, fig.1.

Superfamily VERNEUILINACEA Cushman, 1911

Family VERNEUILINIDAE Cushman, 1911

Subfamily VERNEUILININAE Cushman, 1911

Genus Gaudryina d'Orbigny, 1839a

Gaudryina sp.A.

Superfamily TEXTULARIACEA Ehrenberg, 1838

Family EGGERELLIDAE Cushman, 1937

Subfamily EGGERELLINAE Cushman, 1937

Genus Eggerella Cushman, 1933a

Eggerella bradyi (Cushman, 1911)

Verneuilina bradyi CUSHMAN, 1911, p.54, text-fig.87(a-b).

Eggerella bradyi (Cushman) PHLEGER and PARKER, 1951, p.6, pl.3, fig.1-2.

Genus Karreriella Cushman, 1933a

Karreriella bradyi, (Cushman, 1911)

Gaudryina bradyi CUSHMAN, 1911, p.67, text-fig.107(a-c).

Karreriella bradyi (Cushman) PHLEGER and PARKER, 1951, p.6, pl.3, fig.4.

Karreriella parkerae Uchio, 1960

Karreriella parkerae UCHIO, 1960, pl.2, fig.21-23.

Family VALVULINIDAE Berthelin, 1880

Subfamily VALVULININAE Berthelin, 1880

Genus Cribrogoesella Cushman, 1935

Cribrogoesella pacifica Cushman and McCulloch, 1939

Cribrogoesella pacifica CUSHMAN and McCULLOCH, 1939, p.99, pl.10, fig.10-12.

Suborder MILIOLINA Delage and Hérouard, 1896

Superfamily MILIOLACEA Ehrenberg, 1839

Family HAUERINIDAE Schwager, 1876

Subfamily MILIOLINELLINAE Vella, 1957

Genus Pyrgo Defrance, 1824

Pyrgo depressa (d'Orbigny, 1826)

Biloculina depressa d'ORBIGNY, 1826, p.298, no.7.

Pyrgo depressa (d'Orbigny) BARKER, 1960, p.4, pl.2, fig.12,16-17; pl.3, fig.1-2.

Pyrgo murrhina (Schwager, 1866)

Biloculina murrhina SCHWAGER, 1866, p.203, pl.4, fig.15(a-c).

Pyrgo murrhina (Schwager) CUSHMAN, 1932, p.64, pl.15, fig.1-3.

Genus Triloculina d'Orbigny 1826

Triloculina trihedra Loeblich and Tappan, 1953

Triloculina trihedra Loeblich and Tappan, 1953, p.45, pl.4, fig.10.

Triloculina sp.A

Subfamily SIGMOILINITINAE Luczkowska, 1974

Genus Sigmoilinita Seiglie, 1965

Sigmoilinita tenuis (Czjzek, 1848)

Quinqueloculina tenuis CZJZEK, 1848, p.149, pl.13, fig.31-34.

Sigmoilina tenuis (Czjzek) PHLEGER, PARKER and PIERSON, 1953, p.28, pl.5, fig.18.

Sigmoilinita tenuis (Czjzek) LOEBLICH and TAPPAN, 1987, p.348.

Sigmoilinita sp.A

Suborder LAGENINA Delage and Hérouard, 1896

Superfamily NODOSARIACEA Ehrenberg, 1838

Family NODOSARIIDAE Ehrenberg, 1838

Subfamily NODOSARIINAE Ehrenberg, 1838

Genus Botuloides S.Y.Zheng, 1979

Botuloides sp.A.

Genus Laevidentalina Loeblich and Tappan, 1986

Laevidentalina frobisherensis (Loeblich and Tappan, 1953)

Dentalina frobisherensis LOEBLICH and TAPPAN, 1953, p.55, pl.10, fig.1-9.

Genus Nodosaria Lamarck, 1812

Nodosaria cf. N. subsoluta Cushman, 1923

Nodosaria subsoluta CUSHMAN, 1923, p.74, pl.13, fig.1.

Nodosaria sp.A.

Genus Pyramidulina Fornasini, 1894

Pyramidulina dolioris (Parr, 1950)

Nodosaria dolioris PARR, 1950, p.330, pl.12, fig.2.

Nodosaria cf. N. dolioris Parr. LAGOÉ, 1977, p.121, pl.2, fig.5.

Family VAGINULINIDAE Reuss, 1860

Subfamily LENTICULININAE Chapman, Parr, and Collins, 1934

Genus Lenticulina Lamarck, 1804

Lenticulina sp.A.

Genus Saracenaria Defrance, 1824

Saracenaria italicica Defrance, 1824

Saracenaria italicica DEFRENCE in de Blainville, 1824, p.176, pl.13, fig.6.

Family LAGENIDAE Reuss, 1862

Genus Hyalinonetrion Patterson and Richardson, 1988

Hyalinonetrion dentaliforme (Bagg, 1912)

Lagena dentaliforme BAGG, 1912, p.45, pl.13, fig.1-2.

Hyalinonetrion sahulense Patterson and Richardson 1988

Hyalinonetrion sahulense PATTERSON and RICHARDSON, 1988, p.243, fig.5-6.

Genus Lagena Walker and Jacob in Kanmacher, 1798

Lagena sp.A.

Genus Procerolagena Puri, 1954

Procerolagena complurecosta (Patterson, 1990)

Lagena complurecosta PATTERSON, 1990, p.681, fig.3.1-3.3.

Procerolagena purii Andersen, 1961

Procerolagena purii ANDERSEN, 1961, p.79, pl.16, fig.6.

Procerolagena wiesneri (Parr, 1950)

Lagena striata (d'Orbigny) var. interrupta WIESNER, 1931, p.119, pl.18, fig.213.

Lagena striata (Montagu) var. wiesneri PARR, 1950, p.301 new name for Lagena striata (Montagu) var. interrupta Wiesner [not L. striata (Walker and Jacob) var. interrupta Williamson 1848].

Procerolagena sp.A.

Genus Pygmaeoseistron Patterson and Richardson, 1988

Pygmaeostripon laevis (Montagu, 1803)

Vermiculum laeve MONTAGU, 1803, p.524.

Lagena vulgaris WILLIAMSON, 1858, p.3, pl.1, fig.5.

Lagena sulcata Walker and Jacob var. laevis (Montagu) PARKER and JONES, 1865,
p.349, pl.13, fig.22.

Lagena laevis (Montagu) CUSHMAN and GRAY, 1946, p.18, pl.3, fig.21-23.

Pygmaeostripon hispidulum (Cushman, 1913)

Lagena hispidula CUSHMAN, 1913, p.14, pl.5, fig.2-3.

Pygmaeostripon hispidulum (Cushman) PATTERSON and RICHARDSON, 1988,
p.243, pl.7-10.

Pygmaeostripon sp.A.

Family ELLIPSOLAGENIDAE Silvestri, 1923

Subfamily OOLININAE Loeblich and Tappan, 1961

Genus Exsculptina Patterson and Richardson, 1988

Exsculptina sidebottomi (Earland, 1934)

Lagena sidebottomi EARLAND, 1934, p.161, pl.7, fig.23.

Exsculptina sidebottomi (Earland) PATTERSON and RICHARDSON, 1988, p.247,
fig.14-21.

Exsculptina sp.A

Genus Heteromorphina R.W. Jones, 1984

Heteromorphina dubiosa (McCulloch, 1977)

Lagenosolenia dubiosa McCULLOCH, 1977, p.57, pl.56, fig.18-19,26; pl.57, fig.8.

Genus Favulina Patterson and Richardson, 1988

Favulina hexagona (Williamson, 1848)

Entosolenia squamosa (Montagu) var. hexagona WILLIAMSON, 1848, p.20, pl.2, fig.23.

Lagena hexagona (Williamson) BRADY, 1884, p.472, pl.58, fig.32-33.

Oolina hexagona (Williamson) LOEBLICH and TAPPAN, 1953, p.69, pl.14, fig.1-2.

Favulina melo (d'Orbigny, 1839)

Oolina melo d'ORBIGNY, 1839b, p.20, pl.5, fig.9.

Entosolenia squamosa (Montagu) var. scalariformis WILLIAMSON, 1848, p.20, pl.1, fig.21-22.

Oolina melo d'Orbigny LOEBLICH and TAPPAN, 1953, p.71, pl.12, fig.8-15.

Favulina melo d'Orbigny PATTERSON and RICHARDSON, 1988, p.249.

Genus Homalohedra Patterson and Richardson, 1988

Homalohedra apiopleura (Loeblich and Tappan, 1953)

Lagena apiopleura LOEBLICH and TAPPAN, 1953, p.59, pl.10, fig.14-15.

Homalohedra pertusa (McCulloch, 1977)

Lagena pertusa McCULLOCH, 1977, p.43, pl.53, fig.29(a-b,d).

Homalohedra subacuticosta (Parr, 1950)

Lagena subacuticosta PARR, 1950, p.302, pl.8, fig.3.

Homalohedra williamsoni (Alcock, 1865)

Entosolenia williamsoni ALCOCK, 1865, p.193.

Lagena williamsoni (Alcock) WRIGHT, 1876-77, p.104, pl.4, fig.14.

Homalohedra sp.A.**Homalohedra** sp.B.Genus **Lagnea** Popescu, 1983**Lagnea tenuistriatiformis** (McCulloch, 1977)**Lagenosolenia** (?) **tenuistriatiformis**. McCULLOCH, 1977, p.74, pl.51, fig.7.**Solenina** **tenuistriatiformis** (McCulloch) R.W. JONES, 1984, p.121.Genus **Oolina** d'Orbigny 1839b**Oolina globosa** (Montagu, 1803)**Vermiculum globosum** MONTAGU, 1803, p.523.**Lagena globosa** (Montagu) BROWN, 1827, pl.1, fig.37.**Entosolenia globosa** (Montagu) WILLIAMSON, 1848, p.16, pl.2, fig.13-14.**Lagena sulcata** (Walker and Jacob) var. (**Entosolenia**) **globosa** (Montagu) PARKER and JONES, 1865, p.348, pl.13, fig.37(a-b); pl.16, fig.10(a-b).**Oolina** sp.AGenus **Vasicostella** Patterson and Richardson, 1987**Vasicostella** sp.A.

Subfamily ELLIPSOLAGENINAE Silvestri, 1923

Genus **Fissurina** Reuss 1850**Fissurina agassizi** Todd and Brönnimann, 1957

Fissurina agassizi TODD and BRÖNNIMANN, 1957, p.36, pl.9, fig.14.

Fissurina balteata McCulloch, 1977

Fissurina balteata McCulloch, 1977, p.91, pl.57, fig.15.

Fissurina cucurbitasema Loeblich and Tappan, 1953

Fissurina cucurbitasema Loeblich and Tappan, 1953, p.76, pl.14, fig.10-11.

Fissurina lucida (Williamson, 1848)

Entosolenia marginata (Montagu) var. lucida WILLIAMSON, 1848, p.17, pl.2, fig.17.

Fissurina spiniformis McCulloch, 1977

Fissurina spiniformis McCulloch, 1977, p.131, pl.59, fig.8.

Fissurina subrevertens Parr, 1950

Fissurina subrevertens PARR, 1950, p.308, pl.8, fig.10(a-b).

Fissurina sp.A.

Fissurina sp.B.

Fissurina sp.C.

Fissurina sp.D.

Genus Lagenosolenia McCulloch, 1977

Lagenosolenia sp.A

Lagenosolenia sp.B

Genus Pseudoolina R.W.Jones

Pseudoolina sp.A.

Subfamily PARAFISSURININAE R.W. Jones, 1984

Genus Parafissurina Parr, 1947

Parafissurina felsinea (Fornasini, 1894)

Lagena felsinea FORNASINI, 1894.

Lagena emaciata Reuss var. felsinea FORNASINI, 1901, p.47, text-fig.1.

Parafissurina lata (Wiesner, 1931)

Ellipsolagena lata WIESNER, 1931, p.121, pl.24, stereo-fig.K-1.

Parafissurina lata (Wiesner) BOLTOVSKOY and WATANABE, 1977, p.60, pl.5, fig.21-23.

Parafissurina sp.A.

Genus Wiesnerina R.W. Jones, 1984

Wiesnerina carinata Taylor, 1987

Wiesnerina carinata TAYLOR in Patterson and Richardson, 1987, p.224, pl.4, fig.9-11; pl.5, fig.13.

Family GLANDULINIDAE Reuss, 1860

Subfamily GLANDULINIAE Reuss, 1860

Genus Laryngosigma Loeblich and Tappan, 1953

Laryngosigma invecta McCulloch, 1977

Laryngosigma invecta McCULLOCH, 1977, p.193, pl.87, fig.10.

Suborder ROBERTININA Loeblich and Tappan, 1984

Superfamily CERATOBULIMINACEA Cushman, 1927a

Family EPISTOMINIDAE Wedekind, 1937

Subfamily EPISTOMININAE Wedekind, 1937

Genus Hoeglundina Brotzen, 1948

Hoeglundina elegans (d'Orbigny, 1826)

Rotalia (Turbinulina) elegans d'ORBIGNY, 1826, p.276, no.54 (not Rotalia elegans d'Orbigny, 1826, p.272, no.6).

Pulvinulina elegans (d'Orbigny) CUSHMAN, 1915, p.63, pl.26, fig.3.

Hoglundina elegans (d'Orbigny) BARKER, 1960, p.216, pl.105, fig.3-6.

Hoeglundina elegans (d'Orbigny) Loeblich and Tappan, 1964, p.775, fig.636:3-5.

Superfamily ROBERTOMACEA Reuss, 1850

Family ROBERTINIDAE Reuss, 1850

Subfamily ROBERTININAE Reuss, 1850

Genus Robertinoides Höglund, 1947

Robertinoides charlottensis (Cushman, 1925)

Cassidulina charlottensis CUSHMAN, 1925, p.41, pl.6, fig.6-7.

Robertina charlottensis (Cushman) CUSHMAN and PARKER, 1936, p.97, pl.16, fig.12(a-b).

Robertina californica CUSHMAN and PARKER, 1936, p.97, pl.16, fig.14(a-b).

Robertinoides (?) charlottensis (Cushman) LOEBLICH and TAPPAN, 1953, p.108, pl.20, fig.6-7.

Suborder ROTALIINA Delage and Hérouard, 1896

Superfamily BOLIVINACEA Glaessner, 1937

Family BOLIVINIDAE Glaessner, 1937

Genus Bolivina d'Orbigny, 1839b

Bolivina minuta Natland, 1938

Bolivina minuta NATLAND, 1938, p.146, pl.5, fig.10.

Bolivina sp.A.

Genus Bolivinellina Saidova, 1975

Bolivinellina pacifica (Cushman and McCulloch, 1942)
(Plate 2, Figures 1,2)

Bolivina acerosa Cushman var. pacifica CUSHMAN and McCULLOCH, 1942, p.185,
pl.21, fig.2-3.

Bolivinellina pescicula Saidova, 1975

Bolivinellina pescicula SAIDOVA, 1975, p.301.

Genus Brizalina Costa, 1856

Brizalina fragilis (Phleger and Parker, 1951)

Bolivina fragilis PHLEGER and PARKER, 1951, p.13, pl.6, fig.14,23-24(a-b).

Superfamily BOLIVINITACEA Cushman, 1927a

Family BOLIVINITIDAE Cushman, 1927a

Genus Abditodentrix Patterson, 1985

Abditodentrix pseudothalmanni (Boltovskoy, 1981)

Bolivinita pseudothalmanni BOLTOVSKOY, 1981, p.44-46, pl.1, figs.1-5.

Abditodentrix asketocomptella PATTERSON, 1985, p.140, pl.1, figs.1-9.

Superfamily CASSIDULINACEA d'Orbigny, 1839a

Family CASSIDULINIDAE d'Orbigny, 1839a

Genus Cassidulina d'Orbigny, 1826

Cassidulina californica Cushman and Hughes, 1925

Cassidulina californica CUSHMAN and HUGHES, 1925, p.12, pl.2, fig.1.

Cassidulina delicata Cushman, 1927b

Cassidulina delicata CUSHMAN, 1927b, p.168, pl.6,fig.5.

Cassidulina translucens Cushman and Hughes, 1925

Cassidulina translucens CUSHMAN and HUGHES, 1925, p.15, pl.2, fig.5.

Genus Globocassidulina Voloshinova, 1960

Globocassidulina rarilocula (Cushman, 1933b)
(Plate 2, Figure 3)

Cassidulina rarilocula CUSHMAN, 1933b, p.93, pl.10, fig.4.

Globocassidulina sp.A

Subfamily EHRENBERGININAE Cushman, 1927a

Ehrenbergina Reuss, 1850

Ehrenbergina pacifica Cushman, 1927c

Ehrenbergina pacifica Cushman, 1927c, p.5, pl.2, fig.2(a-b).

Superfamily TURRILINACEA Cushman, 1927a

Famiiy TOSAIIDAE Saidova, 1981

Genus Tosaia Takayanagi, 1953

Tosaia symmetrica McCulloch, 1977

Tosaia symmetrica McCULLOCH, 1977, p.243, pl.104, fig.12.

Family STAINFORTHIIDAE Reiss, 1963

Genus Stainforthia Hofker, 1956

Stainforthia exilis (Brady, 1884)
(Plate 2, Figure 4,5)

Bulimina elegans d'Orbigny var. exilis BRADY, 1884, p.339, pl.50, fig.5-6.

Bulimina exilis Brady LOEBLICH and TAPPAN, 1953, p.110, pl.20, fig.4-5.

Superfamily BULIMINACEA Jones, 1875

Family SIPHOGENERINOIDIDAE Saidova, 1981

Subfamily SIPHOGENERINOIDINAE Saidova, 1981

Genus Euloxostomum McCulloch, 1977

Euloxostomum alatum (Seguenza, 1862)

Vulvulina alata SEGUENZA, 1862, p. 115, pl.2, fig.5.

Bolivina pseudobeyrichi CUSHMAN, 1926a, p.35, text fig. 57a,b.

Bolivina alata (Seguenza) TODD and LOW, 1967, p.A26, pl.4, fig. 6,7.

Family BULIMINIDAE d'Orbigny, 1826

Genus Bulimina d'Orbigny, 1826

Bulimina rostrata Brady, 1884

Bulimina rostrata BRADY, 1884, p.408, pl.51, fig.14-15.

Bulimina buchiana d'Orbigny CUSHMAN, 1922a, p.95, pl.20, fig.4 (not Bulimina buchiana d'Orbigny, 1846).

Bulimina rostriformis McCulloch, 1977

Bulimina buchiana d'Orbigny BRADY 1884, p.407, pl.51, fig.18-19, (not Bulimina buchiana d'Orbigny, 1846).

Bulimina sp.nov. BARKER, 1960, pl.51, fig.18-19.

Bulimina rostriformis McCulloch, 1977, p.245, pl.104, fig.8.

Bulimina striata d'Orbigny, 1843

Bulimina striata d'ORBIGNY in Guerin-Meneville, 1843, p.8, pl.2, fig.16,16a.

Genus Globobulimina Cushman, 1927a

Globobulimina affinis (d'Orbigny, 1839a)

Bulimina affinis d'ORBIGNY, 1839a, p.105, pl.2, fig.25-26.

Globobulimina sp.A.

Genus Protoglobobulimina Hofker, 1951

Protoglobobulimina pupoides (d'Orbigny, 1846)

Bulimina pupoides d'ORBIGNY, 1846, p.185, pl.11, fig.11-12.

Protoglobobulimina sp.A

Family BULIMINELLIDAE Hofker, 1951

Genus Buliminella Cushman, 1911

Buliminella sp. A.

Buliminella sp.B.

Buliminella sp.C.

Family UVIGERINIDAE Haeckel, 1894

Subfamily UVIGERININAE Haeckel, 1894

Genus Euuvigerina Thalmann, 1952

Euuvigerina juncea (Cushman and Todd, 1941)

Uvigerina juncea CUSHMAN and TODD, 1941, p.78. pl.20, fig. 4-11.

Euuvigerina peregrina (Cushman, 1923)

Uvigerina peregrina CUSHMAN , 1923, p.166, pl.42, fig.7-10.

Genus Uvigerina d'Orbigny, 1826

Uvigerina senticosa Cushman, 1927
(Plate 2, Figure 6)

Uvigerina senticosa CUSHMAN, 1927b, p.159, pl.3, fig.14.

Uvigerina sp. A.

Uvigerina sp. B.

Uvigerina sp. C.

Subfamily ANGULOGERININAE Galloway, 1933

Genus Angulogerina Cushman, 1927a

Angulogerina galapagoensis McCulloch, 1977

Angulogerina galapagoensis McCulloch, 1977, p.263, pl.107, fig.8-10.

Superfamily DELOSINACEA Parr, 1950

Family CAUCASINIDAE N.K. Bykova, 1959

Subfamily CAUCASININAE N.K. Bykova, 1959

Genus Francesita Loeblich and Tappan, 1963

Francesita advena (Cushman, 1922a)

Virgulina(?) advena CUSHMAN, 1922a, p.120, pl.25, fig.1-3.

Eggerella advena (Cushman) CUSHMAN, 1937, p.51, pl.5, fig.12-15.

Francesita advena (Cushman) LOEBLICH and TAPPAN, 1963, p.215, fig.3-6.

Superfamily DISCORBACEA Ehrenberg, 1838

Family DISCORBIDAE Ehrenberg, 1838

Genus Neodiscorbinella McCulloch, 1977

Neodiscorbinella operosa (McCulloch, 1977)

Discorbinita operosa McCULLOCH, 1977, p.299, pl.127, fig.7,9-11,13.

Neodiscorbinella operosa (McCulloch) LOEBLICH and TAPPAN, 1987, p.557.

Family ROSALINIDAE Reiss, 1963

Genus Rosalina d'Orbigny, 1826

Rosalina columbiensis (Cushman, 1925)

Discorbis columbiensis CUSHMAN, 1925, p.43, pl.6, fig.13(a-c).

Rosalina columbiensis (Cushman) LANKFORD and PHLEGER, 1973, p.127, pl.5,
fig.10-12.

Rosalina sp.A.

Family SPHAEROIDINIDAE Cushman, 1927a

Genus Sphaeroidina d'Orbigny, 1826

Sphaeroidina bulloides d'Orbigny, 1826

Sphaeroidina bulloides d'ORBIGNY, 1826, p.267.

Superfamily DISCORBINELLACEA Sigal in Piveteau, 1952

Family PSEUDOPARRELLIDAE Voloshinova in Voloshinova and Dain, 1952

Subfamily PSEUDOPRSELLINAE Voloshinova in Voloshinova and Dain, 1952

Genus Epistominella Husezima and Maruhasi, 1944

Epistominella exigua (Brady, 1884)
(Plate 1, Figures 1,2)

Pulvinulina exigua BRADY, 1884, p.696, pl.103, fig.13-14.

Epistominella exigua (Brady) F.L. PARKER, 1954, p.533, pl.10, fig.22-23.

Epistominella vitrea Parker, 1953
(Plate 1, Figures 3,4,5)

Epistominella vitrea PARKER in PARKER, PHLEGER, and PEIRSON, 1953, p.9, pl.4,
fig.34-36, 40-41.

Superfamily PLANORBULINACEA Schwager, 1877

Family CIBICIDIIDAE Cushman, 1927a

Subfamily CIBICIDINAE Cushman, 1927a

Genus Fontbotia González-Donoso and Linares, 1970

Fontbotia wuellerstorfi (Schwager, 1866)

Anomalina wuellerstorfi SCHWAGER, 1866, p.258, pl.7, fig.105 (not fig.107).

Truncatulina wuellerstorfi BRADY, 1884, p.662, pl.93, fig.8-9.

Fontbotia wuellerstorfi (Schwager) GONZÁLEZ-DONOSO and LINARES, 1970, pl.2, fig.2-4.

Cibicides wuellerstorfi (Schwager) SRINIVASAN and SHARMA, 1980, pl.8, fig.11-13.

Genus Lobatula Fleming, 1828

Lobatula fletcheri (Galloway and Wissler, 1927)

Cibicides fletcheri GALLOWAY and WISSLER, 1927, p.64, pl.10, fig.8-9.

Genus Montfortella Loeblich and Tappan, 1963

Montfortella disjuncta (McCulloch, 1977)

Hetercibicides disjuncta McCULLOCH, 1977, p.449, pl.188, fig.5-7.

Montfortella disjuncta (McCulloch) LOEBLICH and TAPPAN, 1987, p.583, pl.637, fig.4-6.

Superfamily NONIONACEA Schultze, 1854

Family NONIONIDAE Schultze, 1854

Subfamily NONIONINAE, Schultze, 1854

Genus Nonionella Cushman, 1926b

Nonionella pulchella Hada, 1931

Nonionella pulchella HADA, 1931, p.120, text-fig.79.

Nonionella stella Cushman and Moyer, 1930

Nonionella miocenica Cushman var. stella CUSHMAN and MOYER, 1930, p.56, pl.7, fig.17.

Subfamily ASTRONONIONINAE Saidova, 1981

Genus Astrononion Cushman and Edwards, 1937

Astrononion echolsis Kennett, 1967
 (Plate 2, Figure 7,8)

Astrononion echolsis KENNELL, 1967, p.134, pl.11, fig. 7(a-b),8.

Subfamily PULLENIINAE Schwager, 1877

Genus Melonis Montfort, 1808

Melonis barleeanum (Williamson, 1858)
 (Plate 3, Figures 1,2)

Nonionina barleeanata WILLIAMSON, 1858, p.32, pl.3, figs.68,69.

Gavelinonion barleeanum (Williamson) BARKER, 1960, p.224, pl.109, fig.8-9.

Melonis pompilioides (Fichtel and Moll) MURRAY, 1971, p.199, pl.84, fig.1-7.

Melonis barleeanus (Williamson) PFLUM AND FRERECHS, 1976, pl.7, fig.5,6.

Melonis barleeanum (Williamson) CORLISS, 1979, p.10, pl.5, fig.7-8.

Melonis pompilioides (Fichtel and Moll, 1798)
 (Plate 3, Figures 3)

Nautilus pompilioides FICHTEL and MOLL, 1798, p.39, pl.2, fig.(a-c).

Melonis etruscus MONTFORT, 1808, p.67, text fig.on p.66.

Melonis pompilioides (Fichtel and Moll) RÖGL and HANSEN, 1984, p.30, pl.2, fig.1-2;
 pl.3, fig.1.

Genus Pullenia Parker and Jones in Carpenter, Parker and Jones, 1862

Pullenia bulloides (d'Orbigny, 1846)
 (Plate 3, Figures 4,5)

Nonionina bulloides d'ORBIGNY, 1826, p.127 (nom. nud.).

Nonionina bulloides d'ORBIGNY, 1846, p.107, pl.5, fig.9-10.

Pullenia sphaeroides (d'Orbigny) CUSHMAN, 1914, p.20, pl.11, fig.2.

Pullenia bulloides (d'Orbigny) BARKER, 1960, p.174, pl.84, fig.12-13.

Pullenia salisburyi R.E.Stewart and K.C. Stewart, 1930
 (Plate 1, Figures 6,7)

Pullenia salisburyi STEWART and STEWART, 1930, p.72, pl.8, fig.2.

Pullenia sp.A

Superfamily CHILOSTOMELLACEA Brady, 1881

Family CHILOSTOMELLIDAE Brady, 1881

Subfamily CHILOSTOMELLINAE Brady, 1881

Genus Chilostomella Reuss in Czyzak, 1849

Chilostomella oolina Schwager, 1878

Chilostomella oolina SCHWAGER, 1878, p.513, pl.1, fig.16.

Chilostomella oolina Schwager BARKER, 1960, p.112, pl.55, fig.12-14, 17-18.

Family OSANGULARIIDAE Loblich and Tappan, 1964

Genus Osangularia Brotzen, 1940

Osangularia parki (Finlay, 1939)
 (Plate 3, Figures 6,7)

Cibicides parki FINLAY, 1939, p. 528, p.69, fig.1(a-b).

Nuttallides umboniferus (Cushman) R. WRIGHT, 1978, p.716, pl.6, fig.13-14, (not

Pulvinulinella umbonifera Cushman 1933b).

Cibicidoides parki (Finlay) BOERSMA, 1986, p.988, pl.7, fig.1-5; pl.8, fig.1-5.

Family ORIDORSALIDAE Loeblich and Tappan, 1984

Genus Oridorsalis Anderson, 1961

Oridorsalis tenera (Brady, 1884)

Truncatulina tenera BRADY, 1884, p.665, pl.95, fig.11(a-c).

Eponides (?) tenera (Brady) BARKER, 1960, p.196, pl.95, fig.11(a-c).

Eponides tenera (Brady) BERGGREN, 1972, p.986, pl.6, fig.10-11.

Oridorsalis umbonatus (Reuss) R.WRIGHT, 1978, p.716, pl.6, fig.15-19 (not Rotalina umbonata Reuss, 1851).

Oridorsalis umbonatus (Reuss) SCHNITKER, 1979, p.404, pl.8, fig.4-6 (not Rotalina umbonata Reuss, 1851).

Oridorsalis sp.A.

Family HETEROLEPIDAE González-Donoso, 1969

Genus Anomalinoides Brotzen 1942

Anornalinoides spissiformis (Cushman and Stainforth, 1945)

Anomalina alazanensis Nuttall var. spissiformis CUSHMAN and STAINFORTH, 1945, p.71, pl.14, fig.5(1-c).

Genus Heterolepa Franzenau, 1884

Heterolepa dutemplei (d'Orbigny, 1846)

Rotalina dutemplei d'ORBIGNY, 1846, p.157, pl.8, fig. 19-21.

Heterolepa simplex FRANZENAU, 1884, p.214.

Heterolepa dutemplei (d'Orbigny) PAPP and SCHMID, 1985, p.61, pl.52, fig.1-6.

Family GAVELINELLIDAE Hofker, 1956

Subfamily GAVELINELLINAE Hofker, 1956

Genus Anomalinulla Saidova, 1975

Anomalinulla sp.A.

Genus Gyroidina d'Orbigny, 1826

Gyroidina altiformis Stewart and Stewart, 1930
(Plate 4, Figures 1-4)

Gyroidina soldanii d'Orbigny var. altiformis STEWART and STEWART, 1930, p.67,
pl.9, fig.2(a-c).

Gyroidina neosoldanii Brotzen, 1936
(Plate 4, Figures 5-7)

Rotalia soldanii (d'Orbigny) BRADY, 1884, p.706, pl.107, fig.6 (a-c), 7(a-c) (not
Rotalina soldanii D'ORBIGNY, 1826).

Gyroidina neosoldanii BROTZEN, 1936, p.158.

Gyroidina sp.A

Genus Linaresia González-Donoso, 1968

Linaresia semicibrata (Beckmann, 1954)

Anomalina ponipiliooides Galloway and Heminway var. semicibrata BECKMANN, 1954,
p.400, text-fig.24-25; pl.27, fig.3.

Anomalina valvulariformis KHALILOV, 1967, .159, pl.34, fig.3(a-c).

Anomalinooides semicibrata (Beckman) BOERSMA, 1986, p.988, pl.1, fig.1-6.

Linaresia semicibrata (Beckman) LOEBLICH and TAPPAN, 1987, p.640, pl.722, fig.1-
7.

Family TRICHOHYALIDAE Saidova, 1981

Genus Buccella Andersen, 1952

Buccella frigida (Cushman, 1922b)

Pulvinulina frigida CUSHMAN, 1922b., p.12.

Eponides frigida (Cushman) CUSHMAN, 1931, p.45.

Eponides frigidus (Cushman) CUSHMAN, 1948, p.71, pl.8, fig.7.

Buccella frigida (Cushman) ANDERSEN, 1952, p.144, text-fig.4-6.

Buccella sp.A.

Superfamily ROTALIACEA Ehrenberg, 1839

Family ELPHIDIIDAE Galloway, 1933

Subfamily ELPHIDIINAE Galloway, 1933

Genus Cribroelphidium Cushman and Brönnimann, 1948

Cribrelphidium foraminosum (Cushman, 1939)

Elphidium hughesi var. CUSHMAN and GRANT, 1927, p.75, pl.7, fig.5.

Elphidium hughesi var. foraminosum CUSHMAN, 1939, p.49, pl.13, fig.8(a-b).

Elphidium hughesi Cushman and Grant BERGEN and O'NEIL, 1979, p.1290, pl.1, fig.1-2.

CHAPTER 4. DISCUSSION

INTERPRETATION OF CLUSTER ANALYSIS

For this study, two dendograms were produced. The first, shown in Figure 5, is the Q-mode analysis of both the core and sediment-water interface samples. It is immediately obvious from Figure 5 that the foraminifera-bearing samples have been subdivided into two clusters. The mean fractional abundances and ranges of the characteristic species, presented in Table 3, indicate very little variation between the two assemblages. This is not unexpected considering that all the samples cluster together within a Euclidean distance of less than 0.300 (Figure 5). The smaller the Euclidean distance the greater the similarity between clusters (Fishbein and Patterson, in press).

The first cluster (Figure 5), which comprises all the sediment-water interface samples and a few samples near the base of the core, is the Pullenia salisburyi-Epistominella exigua Biofacies. It is a variable assemblage and is loosely constrained by a fractional abundance of >0.10 of Pullenia salisburyi and/or Epistominella exigua and <0.20 Epistominella vitrea (Table 3; Figure 6). A scatter plot of the occurrence of Pullenia salisburyi versus Epistominella spp. in the sediment-water interface samples (Figure 7) indicates that although the data is scattered the abundance of Epistominella spp. declines as the abundance of Pullenia salisburyi increases.

The second biofacies is a tight cluster of samples characterized by relatively high fractional abundance (>0.20) of Epistominella vitrea (Table 3; Figure 6). This assemblage, termed the Epistominella vitrea Biofacies, encompasses all the samples from near the core-top down to the level of disappearance of the benthic foraminifera and a few samples at the base of the core.

Although all the sediment-water interface samples clustered together in the previous Q-mode analysis and the samples appeared to be very similar (based on the low Euclidean distance), a second Q-mode cluster analysis was performed on the core-top samples alone.

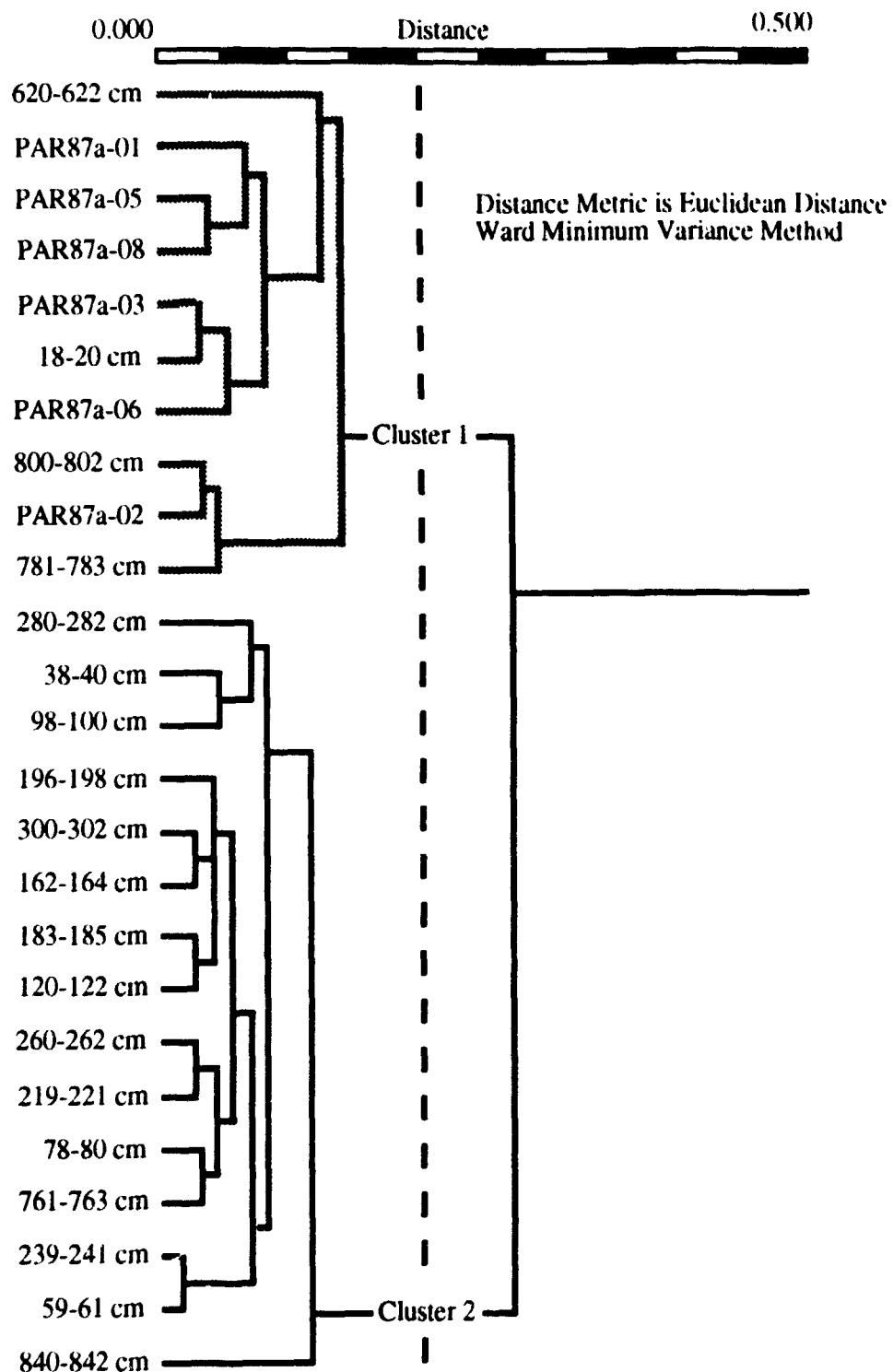


Figure 5. Q-mode dendrogram of statistically significant sediment-water interface and core samples divided into 2 distinct clusters.

Species	Mean	Cluster 1		Cluster 2		
		low	high	Mean	low	high
<i>Uvigerina senticosa</i>	0.026	0	0.081	0.002	0	0.019
<i>Bolivinella pacifica</i>	0.038	0	0.248	0.013	0	0.049
<i>Heterolepa dueemplei</i>	0.029	0	0.058	0.039	0	0.089
<i>Osanglaria parki</i>	0.024	0	0.109	0.001	0	0.013
<i>Epistominella vitrea</i>	0.146	0.030	0.321	0.356	0.215	0.638
<i>Astrononion echolsis</i>	0.021	0	0.063	0.040	0.002	0.116
<i>Stainforthia exilis</i>	0.016	0	0.049	0.032	0.003	0.076
<i>Melonis barleeanum</i>	0.015	0	0.036	0.023	0	0.118
<i>Pullenia salisburyi</i>	0.092	0.008	0.253	0.046	0.004	0.116
<i>Gyroidina neosoldanii</i>	0.010	0	0.047	0.019	0	0.071
<i>Gyroidina altiformis</i>	0.013	0	0.073	0.002	0	0.013
<i>Pullenia bulloides</i>	0.016	0	0.083	0.020	0	0.056
<i>Epistorinella exigua</i>	0.139	0.037	0.316	0.064	0	0.127
<i>Globocassidulina rariocula</i>	0.137	0.006	0.234	0.162	0.056	0.276
<i>Melonis pompilioides</i>	0.027	0	0.266	0.014	0	0.048
<i>Neodiscorbinella operosa</i>	0.021	0	0.075	0.004	0	0.052
<i>Anomalinulla sp.A</i>	0.003	0	0.019	0.023	0	0.196
<i>Rosalina sp.A</i>	0.004	0	0.017	0.005	0	0.059
<i>Cassidulina californica</i>	0.025	0	0.130	0.003	0	0.010
<i>Oridorsalis ?tenua</i>	0.001	0	0.012	0.010	0	0.125

Table 3. Mean fractional abundances and ranges of the species of the clusters shown in Figure 5. The most important species in each cluster are in bold type.

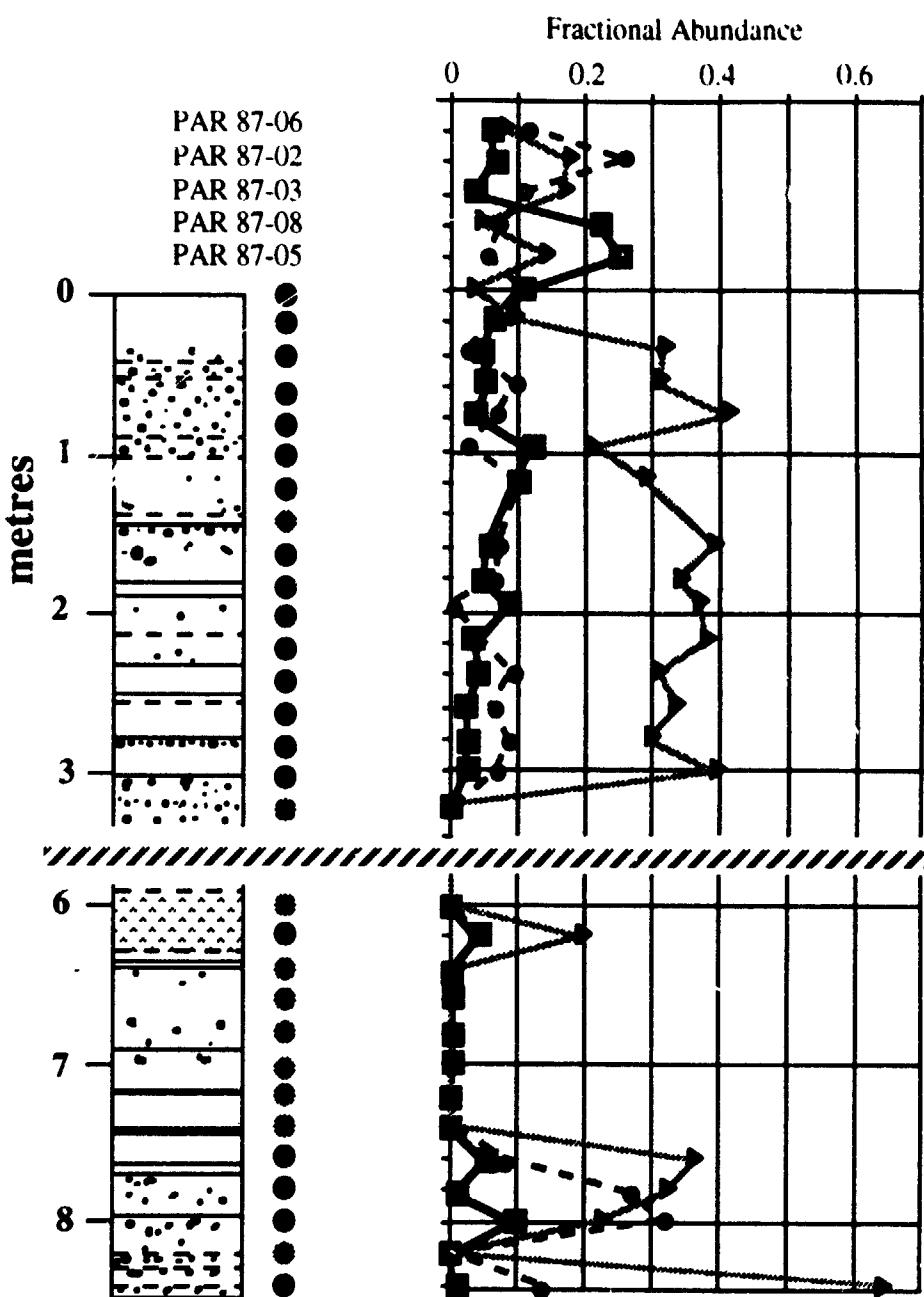


Figure 6. Graphical representation of the fractional abundances of key indicator species in sediment-water interface and core samples. PAR87a-01 is represented by the sample at the top of the core marked by a star.
 (\blacksquare) represents *Pullenia salisburyi*; (\bullet) represents *Epistominella exigua*; and (\blacktriangle) represents *Epistominella vitrea*. The key to lithologic symbols is given in Figure 4 (page 11). The gray hatched bar across the core and graph represents 2.6 m of core void of benthic foraminifera.

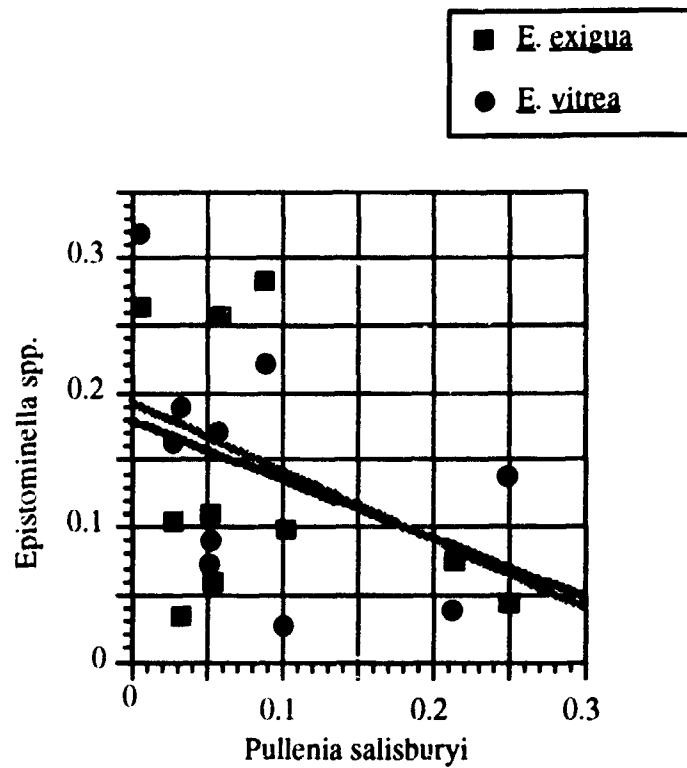


Figure 7. Scatter plot of the fractional abundances of *Pullenia salisburyi* versus *Epistominella exigua* and *Epistominella vitrea* for the samples of the *Pullenia salisburyi*-*Epistominella exigua* Biofacies (cluster 1 of Figure 5). The black line represents the trend of *Epistominella exigua* and gray line represents the trend of *Epistominella vitrea*.

This was done in the hope of recognizing trends in the distribution of the sediment-water interface samples previously obscured by down-core noise. The dendrogram, presented in Figure 8, produced by the second Q-mode analysis recognizes two clusters. The first cluster, termed the Epistominella exigua Sediment-water Interface Assemblage, is characterized by relatively high abundance of Epistominella exigua and low abundance of Pullenia salisburyi (Table 4; Figure 9). The second biofacies is the Pullenia salisburyi Sediment-water Interface Assemblage. Table 4 and Figure 9 show that it is characterized by an increased abundance of Pullenia salisburyi and a slight increase in the fractional abundance of Pullenia bulloides.

BENTHIC FORAMINIFERAL ASSEMBLAGES

The sediment-water interface assemblages recognized by the second Q-mode analysis show a striking correlation to water depth (Figure 9). The Epistominella exigua Sediment-water Interface Assemblage comprises the samples which are from water depths down to approximately 3100 m while the Pullenia salisburyi Sediment-water Interface Assemblage encompasses the samples from greater depths (3300-3500 m).

It is worthwhile noting here that sample PAR87a-09, not included in the cluster analysis because of its very low total count, contained mostly unidentifiable fragments of foraminifera, many of them are from non-calcareous agglutinate species. This sample was collected from a depth of 3738 m.

The strong correlation between the sediment-water interface assemblages and depth and the occurrence of a poorly-preserved calcareous/agglutinated fauna found below 3700 m suggests that the assemblages are related to selective dissolution of the calcareous fauna and are therefore strongly controlled by the level of the lysocline. The lysocline is the level or depth at which there is a marked increase in the dissolution of calcium carbonate (Berger, 1975). Dissolution of calcium carbonate fauna is selective. The selectiveness is

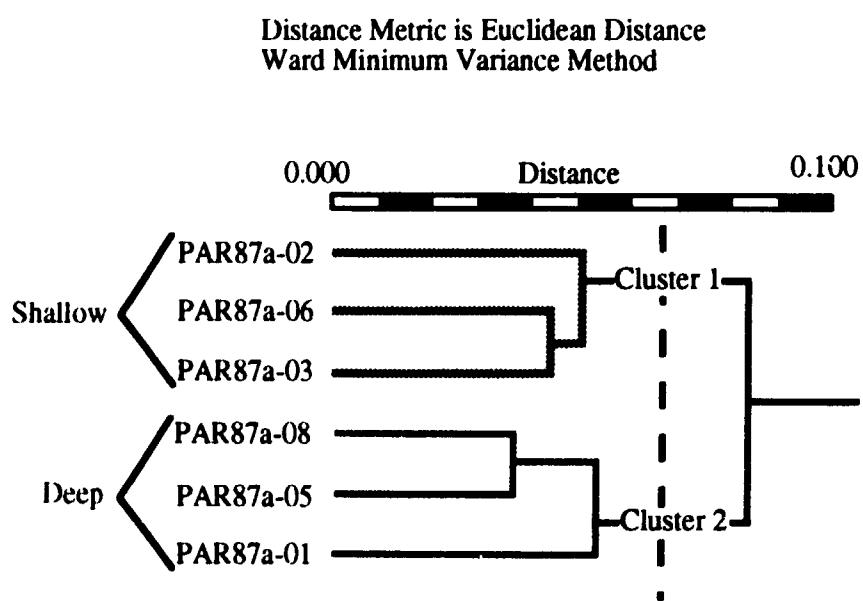


Figure 8. Q-mode dendrogram of sediment-water interface samples showing 2 distinct clusters.

Species	Mean	Cluster 1		Cluster 2		
		Low	High	Mean	Low	High
<i>Uvigerina senticosa</i>	0.010	0.003	0.025	0.026	0.003	0.048
<i>Bolivinella pacifica</i>	0.022	0.011	0.043	0.007	0	0.015
<i>Heterolepa dutemplei</i>	0.044	0.043	0.058	0.026	0.003	0.048
<i>Osanglaria parki</i>	0.057	0.062	0.109	0.023	0.001	0.058
<i>Epistominella vitrea</i>	0.139	0.077	0.174	0.071	0.141	0.030
<i>Astrononion echolsis</i>	0.011	0	0.018	0.020	0	0.060
<i>Stainforthia exilis</i>	0.019	0.002	0.049	0.019	0.003	0.045
<i>Melonis barleeanum</i>	0.015	0.008	0.019	0.021	0.012	0.030
<i>Pullenia salisburyi</i>	0.049	0.031	0.062	0.192	0.105	0.253
<i>Gyroidina neosoldanii</i>	0	0	0	0	0	0
<i>Gyroidina altiformis</i>	0	0	0	0.007	0	0.020
<i>Pullenia bulloides</i>	0.007	0.005	0.009	0.012	0.011	0.013
<i>Epistominella exigua</i>	0.160	0.107	0.258	0.076	0.047	0.102
<i>Globocassidulina rarilocula</i>	0.177	0.070	0.282	0.124	0.006	0.234
<i>Melonis pompilioides</i>	0	0	0	0	0	0
<i>Neodiscorbinella operosa</i>	0.008	0.001	0.013	0.019	0.001	0.051
<i>Anomalinulla sp.A</i>	0.001	0	0.002	0	0	0
<i>Rosalina sp.A</i>	0.002	0	0.004	0.004	0	0.012
<i>Cassidulina californica</i>	0.066	0.003	0.130	0.010	0	0.029
<i>Oridorsalis ?tenera</i>	0	0	0	0	0	0

Table 4. Mean fractional abundances and ranges of the species of the clusters shown in Figure 8. The key indicator species in each cluster is in bold type.

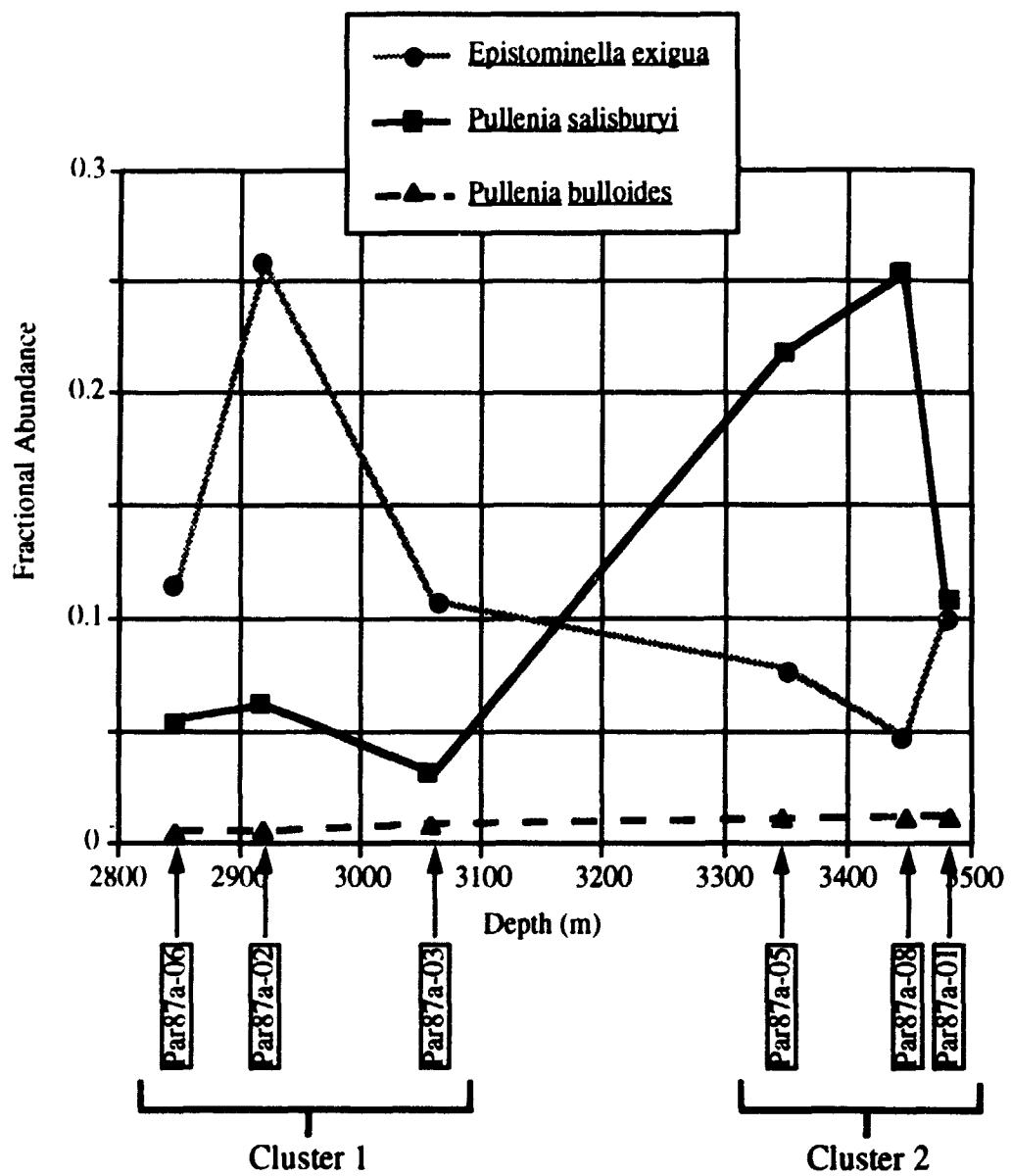


Figure 9. Graphical representation of the occurrence of key indicator species in the sediment-water interface assemblages.

controlled largely by morphology and mineralogy of the fauna; aragonitic fauna (e.g. pteropods) are more susceptible to dissolution than calcitic fauna. Many of the morphological adaptations used by planktic foraminifera to provide buoyancy (e.g. thin tests with abundant pores, spines, etc.) also make them prone to dissolution after death (Berger, 1970). As a result the lysocline varies according to the indicator. The benthic foraminiferal lysocline is the level at which there is a marked decrease in the preservation of benthic foraminifera. This level is deeper than the planktic foraminiferal lysocline. The lysocline differs from the Carbonate Compensation Depth (CCD) which is the depth at which the rate of dissolution exceeds rate of supply of calcium carbonate (Berger, 1979). While the CCD always occurs at greater depth than the lysocline the distance between them varies.

Berger (1979) indicated that the CCD rises from approximately 3500 to 3000 m across the Gulf of Alaska thus the position of the benthic foraminiferal lysocline is above 3500 m over the Patton-Murray Seamount Group. This suggests that the sediment-water interface assemblages may be distinguished by preservation due to the position of the benthic foraminiferal lysocline; the shallower Epistominella exigua Sediment-water Interface Assemblage characterizes water above the benthic foraminiferal lysocline while the deeper Pullenia salisburyi Sediment-water Interface Assemblage occupies the waters below it. This positions the benthic foraminiferal lysocline at a depth of between 3100 and 3300 m.

The importance of selective dissolution is indicated by loss of transparency and damaged chambers of many specimens due to etching and fragmentation of planktic foraminifera. This is especially evident in the deeper samples and is extreme in sample PAR87a-09 where even the benthic foraminifera are fragmented. The poor preservation of PAR87a-09 suggests that this sample was well below the benthic foraminiferal lysocline, close to the CCD.

Interpretation of the core clusters is not as straightforward. The core (Figure 10) can be divided into 3 units, 2 foraminifera-bearing zones at the top and bottom of the core and a long barren section composed largely of diatomaceous ooze and ice rafted debris, referred to in the following discussion as the null assemblage. The foraminifera-bearing section at the base of the core suggests conditions similar to those at present but it is difficult to make valid conclusions on so few samples. Therefore interpretation of the core assemblages will concentrate on the upper foraminifera-bearing unit.

The foraminiferal assemblages, the Pullenia salisburyi-Epistominella exigua Biofacies and Epistominella vitrea Biofacies divide the upper unit into two subunits. The Pullenia salisburyi-Epistominella exigua, as discussed above, represents present conditions and is interpreted to represent deposition very close to the benthic foraminiferal lysocline.

The Epistominella vitrea Biofacies represents a move towards increased calcium carbonate preservation at depth. It also appears to represent a shift of the fauna from shallower water to bathyal depths. Epistominella vitrea, the dominant taxon of this assemblage, has previously been reported from the shelf in the Gulf of Alaska (Bergen and O'Neil, 1979) and is also relatively common in Holocene sediments of Dixon Entrance and Hecate Strait, British Columbia (Patterson, in press).

Faunal shifts have been documented for both the Atlantic and Pacific Oceans (eg. Saidova, 1967; Streeter, 1973; Heath and others, 1976). Schnitker (1974) described the transition of a Epistominella exigua assemblage in the Northern Atlantic from its present-day continental slope depths into the basin. These faunal variations coincide with the last glacial maximum (18 ka). Streeter (1973) relates these shifts to changes in the bottom-water masses as a result of reduction or cessation of NADW production during periods of glaciation.

Although the faunal shifts in the Pacific coincide with those in the Atlantic their relationship to bottom-water circulation is less clearly understood. One likely cause for the

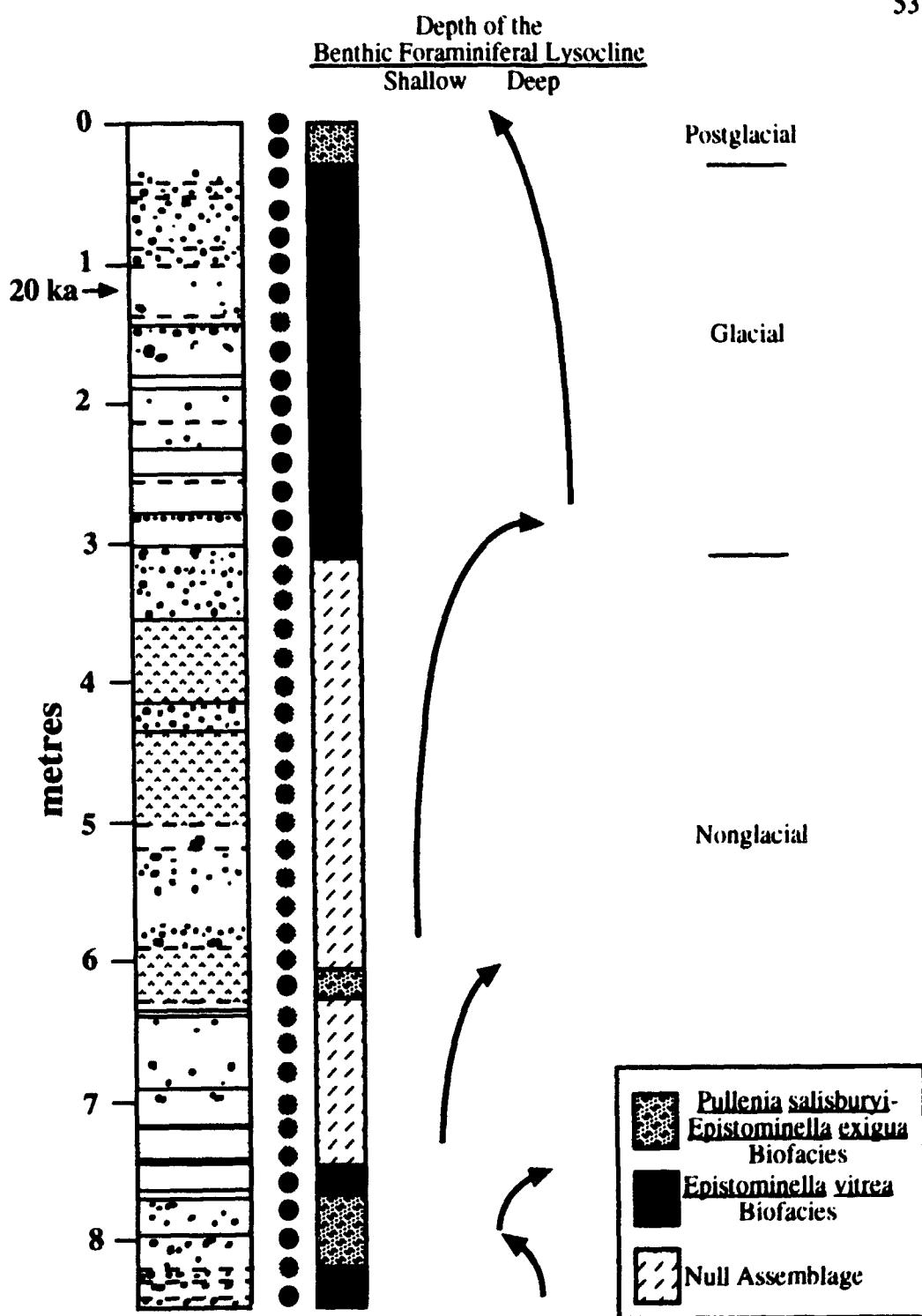


Figure 10. Stratigraphic section of core PAR87a-01 showing foraminiferal biofacies, trends in the relative depth of the benthic foraminiferal lysocline and suggested climatic conditions. The date (20 ka) comes from Zahn and others (1991). Key to lithologic symbols is given in Figure 4 (page 10).

changes in foraminiferal distribution is the production of intermediate and deep waters in the North Pacific during glacial times. These North Pacific Deep Waters (NPDW) would be young and as a result not enough time would have passed to allow enrichment in CO₂ and depletion of oxygen through the oxidation of organic carbon. Thus NPDW would have a higher O₂ content and lower CO₂ content than the present deep waters. The lower CO₂ content means that the NPDW would be less corrosive to calcium carbonate, thus pushing down the lysocline and CCD. Formation of NPDW has been implied by anomalously high ¹³C values in benthic foraminifera during the last glacial maximum (18 ka); (Shackleton and Duplessy, 1985). The high ¹³C values are also the result of a lack of oxidation of organic carbon.

The null assemblage is the result of upwelling. "Old" bottom-waters with their high CO₂ content and low oxygen content are very corrosive. Upwelling of these old waters results in a shoaling or shallowing of the lysocline and CCD. The oxygen depletion of these deep waters means they are nutrient-rich. Increased nutrient fluxes to the ocean surface result in an increase in planktic productivity. The combination of high productivity and water corrosive to calcium carbonate leads to the deposition of sediments which are silica-rich and carbonate-deplete. Barron and Keller (1982) have documented hiatuses in the carbonate record throughout the Miocene.

Upwelling is believed to be initiated by intensified bottom-water circulation brought on by increased Antarctic Bottom Water (AABW) production. Duplessy and others (1984) found that the "interglacial" ocean had lower ¹³C values. This they interpreted as being due to an increase in AABW formation resulting in intensified deep circulation and upwelling.

LATE PLEISTOCENE CLIMATIC FLUCTUATIONS

The Late Pleistocene was a time of changing climatic conditions. These changes are

recorded by the three biofacies shown in Figure 10. The changing climate of the Late Pleistocene influenced the circulation in the deep Pacific which, in turn, influenced the level of the CCD and lysocline. The earliest interval in the core is characterized by the same two benthic foraminiferal biofacies as the top of the core. This suggests that deep circulation was similar to present circulation. Thus, it is possible that the very base of the core represents a glacial-nonglacial transition.

The transition period was followed by a warmer nonglacial phase of increased AABW production. This increased production led to upwelling through enhanced bottom water circulation. During this period the CCD and lysocline were elevated leading to very poor preservation of carbonate sediment. The null assemblage composed largely of diatomaceous ooze and ice rafted debris resulted from deposited during the non-glacial period.

The next phase, marked by the return of the foraminiferal biofacies, is believed to represent the last glacial period. During this period the CCD and lysocline were depressed by the production of NPDW and increased carbonate saturation of the deep waters of the Pacific (Berger, 1979). The production of deep water was made possible because of the colder drier climate in the North Pacific (Douglas and Woodruff, 1981).

The final phase recorded in the core is the most recent deglaciation. During this postglacial period the CCD and lysocline have once again been elevated. This is indicated by the present foraminiferal biofacies.

This brief history fits the chronology of the Late Quaternary of British Columbia presented by Clague (1981). The siliceous phase is equivalent to the Olympia nonglacial (59 - 29 ka), the Epistominella vitrea Biofacies is equivalent to the Fraser Glacial (25 - 13 ka) and the Pullenia salisburyi-Epistominella exigua Biofacies represents the current postglacial phase. The single date (i.e. 20 ka BP) assigned to the core (Figure 10) was obtained from Zahn and others (1991). These authors determined it indirectly by visual

correlation of the oxygen isotope record of PAR87a-01 with that of core PAR87a-10 dated by ^{14}C .

CHAPTER 5. CONCLUSIONS

This study showed that benthic foraminifera are good indicators of paleoceanographic circulation in the Late Quaternary of the northeastern Pacific deep-sea.

Two sediment-water interface assemblages, produced by Q-mode cluster analysis of the 6 statistically significant core-top samples, indicate deposition near the benthic foraminiferal lysocline. The Epistominella exigua Sediment-water Interface Assemblage is indicative of the water mass above the benthic foraminiferal lysocline while the Pullenia salisburyi Sediment-water Interface Assemblage characterizes the water mass below the benthic foraminiferal lysocline. The seventh core-top sample, contained only poorly preserved fragments of calcareous and agglutinated taxa and probably represents deposition well below the benthic foraminiferal lysocline. Thus at the present time over the Patton-Murray Seamount Group the benthic foraminiferal lysocline is located at a depth of between 3100 and 3300 m.

Three assemblages were recognized down-core: the Pullenia salisburyi-Epistominella exigua Biofacies, the Epistominella vitrea Biofacies and the null assemblage. The null assemblage comprises all the silica-rich and carbonate-depleted samples. This assemblage represents upwelling of corrosive, nutrient-rich bottom water due to intensified bottom circulation initiated by increased AABW production during a nonglacial period equivalent to the Olympia nonglacial of British Columbia. The Epistominella vitrea Biofacies represents increased carbonate preservation due to depression of the lysocline during the glacial phase equivalent to the Fraser glacial. The Pullenia salisburyi-Epistominella exigua Biofacies indicates a shoaling of the lysocline during the present postglacial period.

The main controlling factor in distribution benthic foraminifera in the northeastern Pacific appears to be selective dissolution. The importance of selective dissolution is illustrated by the poor preservation solution-susceptible planktics and the high abundance

of etched benthics. The extent of dissolution is controlled by the depth of the (foraminiferal) lysocline which is in turn regulated by water chemistry (i.e. O₂ and CO₂ content) related to deep ocean circulation.

REFERENCES

- Alcock, T., 1865. Notes on natural history specimens lately received from Connemara. Lit. Philos. Society Proceedings, Manchester, England, v.4, p.195.
- Andersen, H.V., 1952. *Buccella*, a new genus of the rotaliid foraminifera. Journal of the Washington Academy of Sciences, v. 42, p. 143-151.
- _____, 1961. Genesis and paleontology of the Mississippi River mudlumps, Part II: Foraminifera of the mudlumps, lower Mississippi River delta. Louisiana Department of Conservation, Geological Bulletin, v. 35, p. 1-208.
- Avnimelech, M., 1952. Revision of the tubular Monothalamia. Contributions from the Cushman Foundation for Foraminiferal Research, v. 3, p. 60-68.
- Bagg, R.M. Jr., 1912. Pliocene and Pleistocene foraminifera from southern California. U.S. Geological Survey Bulletin 513, 153 p.
- Barker, R.W., 1960. Taxonomic notes on the species figured by H.B. Brady in his report on the Foraminifera dredged by H.M.S. Challenger during the years 1873-1876. Society of Economic Paleontologists and Mineralogists Special Publication No. 9, 238 p.
- Barron, J.A. and Keller, G., 1982. Widespread Miocene deep-sea hiatuses: coincidence with periods of global cooling. Geology, v. 10, p. 577-581.
- Beckmann, J.P., 1954. Die Foraminiferen der Oceanic Formation (Eocaen-Oligocaen) von Barbados, Kl. Antillen. Eclogae Geologicae Helvetiae, v. 46, p. 301-412.
- Bergen, F.W. and O'Neil, P., 1979. Distribution of Holocene foraminifera in the Gulf of Alaska. Journal of Paleontology, v. 53, p. 1267-1292.
- Berger, W.H., 1970. Planktonic Foraminifera: selective solution and the lysocline. Marine Geology, v. 8, p. 111-138.
- _____, 1975. Dissolution of deep-sea carbonates: an introduction in Sliter, W.V., Bé, A.W.H. and Berger, W.H., (eds.). Dissolution of deep-sea carbonates. Special Publication, Cushman Foundation for Foraminiferal Research, No. 13, 159 p.
- _____, 1979. Preservation of Foraminifera in Foraminiferal Ecology and Paleoecology. SEPM Short Course No. 6, Houston, Texas, p. 105-155.
- Berger, W.H., Adelseck, C.G., Jr., and Mayer, L.A., 1976. Distribution of carbonate in surface sediments of the Pacific Ocean. Journal of Geophysical Research, v. 81(15), p. 2617-2627.
- Berggren, W.A., 1972. Cenozoic biostratigraphy and paleobiogeography of the north Atlantic. Initial Reports of the Deep Sea Drilling Project, v. 12, p. 965-1002.
- Berthelin, G., 1880. Mémoire sur les Foraminifères fossiles de l'Etage Albien de Moncley

- (Doubs). Mémoires de la Société Géologique de France, ser. 3, v. 1(5), p. 1-84.
- Blainville, H.M. Ducrotay de, 1824. Dictionnaire des Sciences Naturelles, mollus-morf, v. 32. Paris: R.G. Levrault.
- _____, 1827. Manuel de Malacologie et de Conchyliologie (1825). Paris: F.G. Levrault.
- Boersma, A., 1986. Biostratigraphy and biogeography of Tertiary bathyal benthic foraminifers: Tasman Sea, Coral Sea, and on the Chatham Rise. Initial Reports of the Deep Sea Drilling Project, v. 90, p. 961-1035.
- Boltovskoy, E., 1981. Foraminiferos bentonicos del sitio 360 del "Deep Sea Drilling Project (Eoceno medio - Plioceno inferior). Asociacion Geologica Argentina, Revista, v. 36, p. 389-423.
- Boltovskoy, E., and Watanabe, S., 1977. Foraminiferos calcareos uniloculares de profundidades grandes del Atlantic sur y del Indico (Neogeno-Reciente). Revista del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" e Instituto Nacional de Investigación de las Ciencias Naturales, Hydrobiologia, v. 5, p. 41-64.
- Brady, H.B., 1878. On the Reticularian and Radiolarian Rhizopoda (Foraminifera and Polycystina) of the North Polar Expedition of 1875-76. Annals and Magazine of Natural History, ser. 5, v. 1, p. 425-440.
- _____, 1879. Notes on some of the Reticularian Rhizopoda of the "Challenger" Expedition. Part 1. On new or little known arenaceous types. Quarterly Journal of Microscopical Science, new ser., v. 19, p. 20-63.
- _____, 1881. Notes on some of the reticularian Rhizopoda of the Challenger Expedition. Part III. 1. Classification. 2. Further notes on new species. 3. Note on Biloculina mud. Quarterly Journal of Microscopical Science, new ser., v. 21, p. 31-71.
- _____, 1884. Report on the foraminifera dredged by H. M. S. Challenger, during the years 1873-1876 in Report on the Scientific Results of the Voyage of the H. M. S. Challenger during the years 1873-1876. Zoology, v. 9.
- Brönnimann, P., Zaninetti, L., and Whittaker, J.E., 1983. On the classification of the Trochamminacea (Foraminiferida). Journal of Foraminiferal Research, v. 13, p. 202-218.
- Brotzen, F., 1936. Foraminiferen aus dem schwedischen untersten Senon von Eriksdal in Schonen. Årsbok Sveriges Geologiska Undersökning, v. 30(3), p. 1-206.
- _____, 1940. Flintrännans och trindelrännans Geologi. Årsbok Sveriges Geologiska Undersökning, v. 34(5), p. 1-33.
- _____, 1942. Die Foraminiferengattung Gavelinella nov. gen. und die Systematik der Rotaliiformes. Årsbok Sveriges Geologiska Undersökning, v. 36(8), p. 1-60.

- _____, 1948. The Swedish Paleocene and its foraminiferal fauna. *Årsbok Sveriges Geologiska Undersökning*, v. 42(2), p. 1-140.
- Brown, T., 1827. *Illustrations of the Conchology of Great Britain and Ireland*. Edinburgh: W.H. and D. Lizar.
- Brunner, C.A. and Normark, W.R., 1985. Biostratigraphic implications for turbidite depositional processes on the Monterey deep-sea fan, central California. *Journal of Sedimentary Petrology*, v. 55(4), p. 495-505.
- Bykova, N.K., 1959 in Rauzer-Chernoussova, D.M., and Fursenko, A.V., (ed.) *Osnovy Paleontologii, Obshchaya chast'*, Prosteyshie [Principles of Paleontology, part 1. Protozoa]. Moscow: Akademiya Nauk SSSR.
- Carpenter, W.B., Parker, W.K., and Jones, T.R., 1862. *Introduction to the study of the Foraminifera*. London: Ray Society, 319 p.
- Chapman, F., Parr, W.J., and Collins, A.C., 1934. Tertiary foraminifera of Victoria, Australia - The Balcombeian deposits of Port Phillip, Part III. *Journal of the Linnaean Society of London, Zoology*, v. 38, p. 553-577.
- Chen, C.A., Rodman, M.R., Wei, C., Olson, E.J., Feely, R.A., and Gendron, J.F., 1986. Carbonate Chemistry of the North Pacific Ocean. U.S. Department of Energy Research and Development Report, DOE/NBB 79, 176 p.
- Clague, J.J., 1981. Late Quaternary Geology and Geochronology of British Columbia. Part 2: Summary and Discussion of Radiocarbon-Dated Quaternary History. Geological Survey of Canada, paper 80-35, 41 p.
- Corliss, B.H., 1979. Taxonomy of Recent deep-sea benthonic foraminifera from the southeast Indian Ocean. *Micropaleontology*, v. 25(1), p. 1-19.
- Costa, O.G., 1856. *Paleontologia del regno di Napoli*, Part II. *Atti dell'Accademia Pontaniana*, Napoli, v. 7(2), p. 113-378.
- Cushman, J.A., 1910. A monograph of the foraminifera of the North Pacific Ocean. Part 1: Astrorhizidae and Lituolidae. *Bulletin of the United States National Museum*, v. 71(1), p. 1-134.
- _____, 1911. A monograph of the foraminifera of the North Pacific Ocean. Part 2: Textulariidae. *Bulletin of the United States National Museum*, v. 71(2), p. 1-108.
- _____, 1913. A monograph of the foraminifera of the North Pacific Ocean. Part 3: Lagenidae. *Bulletin of the United States National Museum*, v. 71(3), p. 1-125.
- _____, 1914. A monograph of the foraminifera of the North Pacific Ocean. Part 4: Chilostomellidae, Globigerinidae, Nummulitidae. *Bulletin of the United States National Museum*, v. 71(4), p. 1-46.
- _____, 1915. A monograph of the foraminifera of the North Pacific Ocean. Part 5:

- Rotaliidae. Bulletin of the United States National Museum, v. 71(5), p. 1-81.
- _____, 1918. The foraminifera of the Atlantic Ocean, Part 1: Astrorhizidae. Bulletin of the United States National Museum, v. 104(1), p. 1-111.
- _____, 1922a. The foraminifera of the Atlantic Ocean, Part 3: Textulariidae. Bulletin of the United States National Museum, v. 104(3), p. 1-143.
- _____, 1922b. Results of the Hudson Bay expedition, 1920; I-The foraminifera, Canada. Biological Board of Canada, Contributions of Canadian Biology (1921), No. 9, p. 135-147.
- _____, 1923. The foraminifera of the Atlantic Ocean, Part 4: Lagenidae. Bulletin of the United States National Museums, v. 104 (4), p. 1-228.
- _____, 1925. Recent foraminifera from British Columbia. Contributions from the Cushman Laboratory for Foraminiferal Research, v.1, p. 51-60.
- _____, 1926a. Some new foraminifera from the Upper Eocene of the southeastern Coastal Plain of the United States. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 2(2), p. 29-38.
- _____, 1926b. Foraminifera of the typical Monterey of California. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 2(3), p. 53-69.
- _____, 1927a. An outline of a re-classification of the foraminifera. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 3, p. 1-105
- _____, 1927b. Recent foraminifera from off the West coast of America. Bulletin of the Scripps Institution of Oceanograph, Technical series, v. 1(10), p. 119-188.
- _____, 1927c. Foraminifera of the genus Ehrenbergina and its species. Proceedings of the United States National Museum, Washington, D.C., v. 70, p. 1-8.
- _____, 1931. The foraminifera of the Atlantic Ocean, Part 8: Rotaliidae, Amphisteginidae, Calcarinidae, Cymbaloporettidae, Globorotaliidae, Anomaliniidae, Planorbulinidae, Rupertiidae and Homotremidae. Bulletin of the United States National Museums, v. 104 (8), p. 1-179.
- _____, 1932. The foraminifera of the Tropical Pacific collections of the "Albatross", 1899-1900. Part 1: Astrorhizidae to Trochamminidae. Bulletin of the United States National Museums, v. 161(1), p. 1-88.
- _____, 1933a. Some new foraminiferal genera. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 9, p. 32-38.
- _____, 1933b. Some new Recent foraminifera from the tropical Pacific. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 9, p. 77-95.
- _____, 1935. Fourteen new species of Foraminifera. Smithsonian Miscellaneous collections, v. 91(21), p. 1-9.

- _____, 1937. A monograph of the foraminiferal family Valvulinidae. Special Publications Cushman Laboratory for Foraminiferal Research, No. 8, 210 p.
- _____, 1939. A monograph of the foraminiferal family Nonionidae. Professional Papers United States Geological Survey, v. 191, p. 1-100.
- _____, 1948. Foraminifera, Their Classification and Economic Use. 4th edition, Cambridge, Mass.:Harvard University Press.
- Cushman, J.A. and Brönnimann, P., 1948. Some new genera and species of foraminifera from brackish water of Trinidad. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 24, p. 15-21.
- Cushman, J.A. and Edwards, P.G., 1937. Astrononion a new genus of the foraminifera, and its species. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 13, p. 29-36.
- Cushman, J.A. and Grant, U.S., 1927. Late Tertiary and Quaternary Elphidiums of the west coast of North America. San Diego Society of Natural History Transactions, v. 5, p. 69-82.
- Cushman, J.A. and Gray, H.B., 1946. A foraminiferal fauna from the Pliocene of Timms Point, California. Special Publications Cushman Laboratory for Foraminiferal Research, No. 19, 46 p.
- Cushman, J.A. and Hughes, D.D., 1925. Some later Tertiary Cassidulinas of California. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 1, p. 11-17.
- Cushman, J.A. and McCulloch, I., 1939. A report on some arenaceous Foraminifera. Allan Hancock Pacific Expeditions, v. 6(1), p. 1-113.
- _____, and _____, 1940. Some Nonionidae in the collections of the Allan Hancock Foundation. Allan Hancock Pacific Expeditions, v. 6(3), p. 145-178.
- _____, and _____, 1942. Some Virgulininae in the collections of the Allan Hancock Foundation. Allan Hancock Pacific Expeditions, v. 6(4), p. 179-230.
- Cushman, J.A. and Moyer, D.A., 1930. Some Recent foraminifera from off San Pedro, California. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 6, p. 49-62.
- Cushman, J.A. and Parker, F.L., 1936. Some species of Robertina. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 12(4), p. 92-100.
- Cushman, J.A. and Stainforth, R.M. 1945. The foraminifera of the Cipero Marl Formation of Trinidad, British West Indies. Special Publications Cushman Laboratory for Foraminiferal Research, No. 14, 74 p.
- Cushman, J.A. and Todd, R. 1941. Notes on the species of Uvigerina and Angulogerina

- described from the Pliocene and Pleistocene. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 17, p. 70-78.
- Czjzek, J., 1848. Beitrag zur Kenntnis der fossilen Foraminiferen des Wiener Beckens. Naturwissenschaftliche Abhandlungen, Wien, v. 2(1), p. 137-150.
- _____, 1849. Über zwei neue Arten von Foraminiferen aus dem Tegel von Baden und Möllersdorf. Bericht über die Mittheilungen Freuden der Naturwissenschaften in Wien, v. 5, p. 50-56.
- Defrance, J.L.M., 1824. Dictionnaire des Sciences Naturelles, v. 32, moll-morf. Strasbourg: F.G. Levrault.
- Delage, Y. and Hérouard, E., 1896. Traité de Zoologie Concète, v. 1, La Cellule et les Protozoaires. Paris: Schleicher Frères.
- Douglas, R. and Woodruff, F., 1981. Deep Sea Benthic Foraminifera in Emiliani, C. (ed.) The Oceanic Lithosphere: The Sea, v. 7, p. 1233-1327.
- Duncan, R.A., and Clague, D.A., 1985. Pacific Plate Motion Recorded by Linear Volcanic Chains in Nairn, A.E.M., Stehli, F.G., and Uyeda, S. (eds.). The Ocean Basins and Margins, Vol. 7A: The Pacific Ocean. New York: Plenum Press, 733 p.
- Duplessy, J.-C., and Shackleton, N.J., Matthews, R.K., Prell, W., Ruddiman, W.F., Caralp, M., and Hendy, C.H., 1984. ¹³C Record of Benthic Foraminifera in the Last Interglacial Ocean: Implications for the Carbon Cycle and the Global Deep Water Circulation. Quaternary Research, v. 21(2), p. 225-243.
- Earland, A., 1934. Foraminifera. Part III. The Falklands sector of the Antarctic (excluding South Georgia). Discovery Reports, v. 10 p. 1-208.
- Ehrenberg, C.G., 1838. Über dem blossen Auge unsichtbare Kalkthierchen und Kieselthierchen als Hauptbestandtheile der Kreidegebirge. Bericht über die zu Bekanntmachung geeigneten Verhandlungen der Königlichen Preussischen Akademie der Wissenschaften zu Berlin, v. 1838, p. 192-200.
- _____, 1839. Über die Bildung der Kreidefelsen und Kreidemergels durch unsichtbare Organismen. Physikalische Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1838 [v. 1840: separate 1839], p. 59-147.
- Eimer, G.H.T., and Fickert, C., 1899. Die Artbildung und Verwandtschaft bei den Foraminiferen. Entwurf einer natürlichen Eintheilung derselben. Zeitschrift für Wissenschaftliche Zoologie, v. 65, p.599-708.
- Fichtel, L. von and Moll, J.P.C. von, 1798. Testacea microscopica, aliaque minuta ex generibus Argonauta et Nautilus, ad naturam picta et descripta (Microscopische und andere klein Schalthiere aus den geschlechtern Argonaute und Schiffer). Vienna: Camesina.
- Finlay, H.J., 1939. New Zealand foraminifera: Key species in stratigraphy- No. 1.

- Transactions of the Royal Society of New Zealand, v. 68, p. 504-543.
- Fishbein, E. and Patterson, R.T., (in press). Error Weighted Maximum Likelihood (EWML): a new statistically-based method to cluster quantitative micropaleontological data. *Journal of Paleontology*.
- Fleming, J., 1828. A History of British Animals, Exhibiting the Descriptive Characters and Systematic Arrangement of the Genera and Species of Quadrupeds, Birds, Fishes, Mollusca and Radiata of the United Kingdom. Edinburgh: Bell and Bradfute.
- Flint, J.M., 1897 (1899). Recent Foraminifera. A descriptive catalogue of specimens dredged by the U.S. Fish Commission Steamer Albatross, Report of the United States National Museum for 1897, p. 249-349.
- Folin, L. de, 1886. Les Bathysiphons; premières pages d'une monographie du genre. Soc. Linn. Bordeaux, Actes, Bordeaux, France, v.40 (series 4, tome 10).
- Fornasini, C., 1894. Quinto contributo alla conoscenza della microfauna Terziaria Italiana. Memorie della R. Accademie delle Scienze dell'Istituto di Bologna, Scienze Naturali, ser. 5, v. 4, p. 201-230.
- _____, 1901. Intorno a la nomenclatura di alcuni Nodosaridi neogenici italiani. Memorie della R. Accademie delle Scienze dell'Istituto di Bologna, Scienze Naturali, ser. 5, v. 9, p.46-76.
- Franzenau, A., 1884. Heterolepa egy új genus a Foraminiferák Rendjében. Természettudományi Füzetek, Budapest, v. 8, p.181-184, 214-217.
- Frerichs, W.E., 1969. Recent arenaceous foraminifers from Gulf of Mexico. Paleontological Contributions, University of Kansas, Paper, v. 46, p. 1-2.
- Galloway, J.J., 1933. A Manual of Foraminifera. Bloomington: Principia Press.
- Galloway J.J., and Wissler, S.G., 1927. Pleistocene foraminifera from the Lomita Quarry, Palos Verdes Hills, California. *Journal of Paleontology*, v. 1, p. 35-87.
- Glaessner, M.F., 1937. Die Entfaltung der Foraminiferenfamilie Buliminidae. Problemy Paleontologii, Paleontologicheskaya Laboratoriya Moskovskogo Gosudarstvennogo Universiteta, 2-3:411-422.
- González-Donoso, J.M., 1968. Algunos géneros y especies nuevas de foraminíferos de la Depresión de Granada. *Acta Geológica Hispánica*, v. 3, p. 73-77.
- _____, 1969. Données nouvelles sur la texture et la structure du test de quelques foraminifères du Bassin de Grenade (Espagne). *Revue de Micropaléontologie*, v. 12, p. 3-8.
- González-Donoso, J.M. and Linares, D., 1970. Datos sobre los foraminíferos del Tortonense de Alcalá la Real (Jaén). *Revista Española de Micropaleontología*, v. 2, p. 235-242.

- Guérin-Méneville, F.E., 1843. *Iconographie du Règne Animal de G. Cuvier; Mollusques.* Paris: J.B. Baillière.
- Hada, Y., 1931. Report of the biological Survey of Mutsu Bay. 19, Notes on the Recent foraminifera from Mutsu Bay. *Science Reports of the Tōhoku University, ser. 4, Biology* v. 6(1), p.45-148.
- Haeckel, E., 1894. *Systematische Phylogenie. Entwurf eines Natürlichen Systems der Organismen auf Grund ihrer Stammesgeschichte. Theil 1, Systematische Phylogenie der Protisten und Pflanzen.* Berlin: Georg Reiner.
- Haeusler, R., 1883. Ueber die neue Foraminiferengattung *Thuramminopsis*. *Neues Jahrbuch für Mineralogie*, v. 2, p. 68-72.
- Hamilton, E.L., 1967. Marine Geology of Abyssal Plains in the Gulf of Alaska. *Journal of Geophysical Research*, v. 72(16), p. 4189-4213.
- Heath, G.R., Moore, T.C., Jr., and Dauphin, J., 1976. Late Quaternary rates of opal, quartz, organic carbon and calcium carbonate in Cascadia Basin, NE Pacific in Cline, R., and Hays, J., (eds.) *Investigations of Late Quaternary Paleoceanography and Paleoclimatology*, Geological Society of America Memoir, no.145, p. 393-410.
- Hofker, J., 1951. The foraminifera of the Siboga expedition. Part III. *Siboga-Expeditie, Monographie IVa.* Leiden: E.J.Brill, 513 p.
- _____, 1954. Über die Familie Epistomariidae (Foram.). *Palaeontographica*, v. 105A, p. 166-206.
- _____, 1956. Tertiary foraminifera of coastal Ecuador: Part II, Additional notes on the Eocene species. *Journal of Paleontology*, v. 30, p.891-958.
- Höglund, H., 1947. Foraminifera in the Gullmar Fjord and Skagerak. *Zoologiska Bidrag Från Uppsala*, v. 26, p.1-328.
- Husezima R., and Maruhasi, M., 1944. A new genus and thirteen new species of foraminifera from the core-sample of Kasiwazaki oil field, Niigata-ken. *Journal Sigenkagadu Kenkyusyo*, v. 1(3), p. 391-400.
- Jacobs, S.S., Gordon, A.L. and Arda, J.L., Jr., 1979. Circulation and melting beneath the Ross Ice Shelf. *Science*, v. 203, p. 439-442.
- Jeffreys, J.G., 1876. On the Crustacea, Tunicate Polyzoa, Echinodermata, Actinozoa, Foraminifera, Polycystina, and Spongida, in Preliminary reports of the biological results of a cruise in H.M.S."Valorous" to Davis Straits in 1875. *Proceedings of the Royal Society of London*, v. 25, p. 212-215.
- Jones, F.W., 1875. in Griffith, J.W., and Henfrey, A. *The Micrographic Dictionary*, vol.1, 3rd ed. London:van Voorst.

- Jones, R.W., 1984. A revised classification of the unilocular Nodosariida and Buliminida (Foraminifera). *Revista Española de Micropaleontología*, v. 16, p. 91-160.
- Jones, T.R., and Parker, W.K., 1860. On the Rhizopodal fauna of the Mediterranean, compared with that of the Italian and some other Tertiary deposits. *Quarterly Journal of the Geological Society of London*, v. 16, p. 452-458.
- Kanmacher, F., 1798. Adam's Essays on the Microscope; the Second Edition, with Considerable Additions and Improvements. London: Dillon & Keating, 712 p.
- Kennett, J.P., 1967. New foraminifera from the Ross Sea, Antarctica. Contributions from the Cushman Foundation for Foraminiferal Research, v. 18, p. 133-135.
- Khalilov, D.M., 1967. Mikrofauna i stratigrafiya Paleogenovykh otlozheniy Azerbaydzhana, Chast' 2 [Microfauna and stratigraphy of Paleogene strata of Azerbaijan, Part 2]. Baku: Instituta Geologii im Akademika I.M. Gubkina, Akademiya Nauk Azerbaydzhanskoy SSR.
- Kroopnick, P.M., 1985. The distribution of ^{13}C of CO_2 in the world oceans. *Deep-Sea Research*, v. 32, p. 57-84.
- Lagoe, M.B., 1977. Recent benthic foraminifera from the central Arctic Ocean. *Journal of Foraminiferal Research*, v. 7(2), p. 106-129.
- Lamarck, J.B., 1804. Suites des mémoires sur les fossiles des environs de Paris. *Annales Muséum National d'Histoire Naturelle*, v.5, p. 179-188.
- _____, 1812. Extrait du cours de Zoologie du Muséum d'Histoire Naturelle sur les animaux invertébrés, v. 2. Paris: d'Hautel, 127 p.
- Lankford, R.R., and Phleger, F.B., 1973. Foraminifera from the nearshore turbulent zone, western North America. *Journal of Foraminiferal Research*, v. 3, p. 101-132.
- Loeblich, A.R., Jr., and Tappan, H., 1953. Studies of Arctic Foraminifera. *Smithsonian Miscellaneous Collections*, v. 121(7), p. 1-150.
- _____, and _____, 1961. Suprageneric classification of the Rhizopoda. *Journal of Paleontology*, v. 35, p. 245-330.
- _____, and _____, 1963. Four new Recent genera of Foraminiferida. *Journal of Protozoology*, v. 10, p. 212-215.
- _____, Jr., and _____, 1964. Sarcodina chiefly "Thecamoebians" and Foraminiferida, in R.C. Moore, ed., *Treatise on Invertebrate Paleontology*, Part C, Protista 2. Lawrence: Geological Society of America and University of Kansas Press.
- _____, and _____, 1984. Suprageneric classification of the Foraminiferida (Protozoa). *Micropaleontology*, v. 30, p. 1-70.

- _____, and _____. 1986. Some new revised genera and families of hyaline calcareous Foraminiferida (Protozoa). *Transactions of the American Microscopical Society*, v. 105, p. 239-265.
- _____, and _____. 1987. Foraminiferal genera and their classification, (2 vol.), New York : Van Nostrand, Reinhold Co., 2047 p.
- Luczkowska, E., 1974. Miliolidae (Foraminiferida) from Miocene of Poland Part I. Revision of the classification. *Acta Palaeontologica Polonica*, v. 17, p. 341-377.
- Mantyla, A.W. and Reid, J.L., 1983. Abyssal characteristics of the World Ocean waters. *Deep-Sea Research*, v. 30(8A), p. 805-833.
- Marie, P., 1941. Les foraminifères de la Craie à *Belmnitella mucronata* du Bassin de Paris. *Mémoires du Museum Nationale d'Histoire Naturelle*, n. sér., v. 12(1), p. 1-296.
- Maync, W., 1952. Critical taxonomic study and nomenclatural revision of the Lituolidae based upon the prototype of the family, *Lituola nautiloidea* Lamarck, 1804. Contributions from the Cushman Laboratory for Foraminiferal Research, v.3, p.35-56.
- McCoy, F.W., and Sancetta, C., 1985. North Pacific Sediments in Nairn, A.E.M., Stehli, F.G., and Uyeda, S. (eds.). *The Ocean Basins and Margins*, Vol. 7A: The Pacific Ocean. New York: Plenum Press, 733 p.
- McCulloch, I., 1977. Qualitative observations on Recent foraminiferal tests with emphasis on the Eastern Pacific (4 Vol.). Los Angeles, California: University of Southern California Press, 1079 p.
- McLellan, H.J., 1965. Elements of Physical Oceanography. Toronto: Pergamon of Canada Ltd., 151 p.
- Menard, H.W., 1964. Marine Geology of the Pacific. New York: McGraw-Hill, 271 p.
- Montagu, G., 1803. *Testacea Britannica, or Natural History of British Shells Marine, Land and Fresh Water, including the Most Minute*. Romsey, England: J.S. Hollis, 606 p.
- Montfort, P. Denys de, 1808. *Conchyliologie Systématique et Classification Méthodique des Coquilles*, vol.1, Paris: F.Schoell, 410 p.
- Muromtsev, A.M., 1963. The Principal Hydrological Features of the Pacific Ocean. Jerusalem: Israel Program for Scientific Translations, 417 p.
- Murray, J.W., 1971. An atlas of British Recent foraminiferids. London: Heinemann Educational Books, London, 244 p.
- Natland, M.L., 1938. New species of foraminifera off the west coast of North America and from the Later Tertiary of the Los Angeles basin. *University of California, Scripps Institution of Oceanography Bulletin*, v. 4, p. 137-164.

- Orbigny, A. d', 1826. Tableau méthodique de la classe des Céphalopodes. *Annales des Sciences Naturelles*, v. 7, p. 245-314.
- _____, 1839a. Foraminifères, in Ramon de la Sagra (ed.). *Histoire physique, politique et naturelle de l'île de Cuba*. Paris: Arthus Bertrand, 224 p.
- _____, 1839b. *Voyage daons l'Amérique méridionale-Foraminifères*, Vol.5, part 5. Paris and Strasbourg: P. Bertrand, 86 p.
- _____, 1846. Foraminifères fossiles du Bassin Tertiare de Vienne (Autriche). Paris: Gide et Compe, 303 p.
- Papp, A and Schmid, M.E., 1985. Die Fossilen Foraminiferen des Tertiären Beckens von Wien revision der monographie von Alcide d'Orbigny (1846). *Abhandlungen der Geologischen Bundesanstalt*, v. 37, p. 311.
- Parker, F.L., 1954. Planktonic foraminiferal species in Pacific sediments. *Micropaleontology*, v. 8, p. 219-254.
- Parker, F.L., Phleger, F.B., and Peirson, J.F., 1953. Ecology of Foraminifera from San Antonio Bay and environs, southwest Texas. *Special Publications Cushman Foundation for Foraminiferal Research*, No. 2, 75 p.
- Parker, W.K. and Jones, T.R., 1859. On the nomenclature of the foraminifera. II. On the species enumerated by Walker and Montagu. *Annals and Magazine of Natural History*, ser. 3, v. 4, p.333-351.
- _____, and _____, 1865. On some foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay. *Philosophical Transactions of the Royal Society*, v.155, p.325-441.
- Parr, W.J., 1947. The Lagenid foraminifera and their relationships. *Proceedings of the Royal Society of Victoria*, n. ser., v. 58, p.116-130.
- _____, 1950. Foraminifera. *Reports B.A.N.Z. Antarctic Research Expedition 1929-1931, Ser. B. , (Zoology, Botany)*, v. 5(6), p. 232-392.
- Patterson, R.T., 1985. *Abdiodentrix*. A new foraminiferal genus in the family Bolivinitidae. *Journal of Foraminiferal Research*, v. 15, p. 138-140.
- _____, 1990. Eleven new and renamed species of benthic foraminifera from the Early to Middle Pleistocene Santa Barbara Formation, at Santa Barbara, California. *Journal of Paleontology*, v. 64, p. 681-691.
- _____, in press. Benthic Foraminiferal Biofacies in Queen Charlotte Sound and Southern Hecate Strait, British Columbia: Late Quaternary Distribution and Paleoecological Importance. *Journal of Foraminiferal Research*.
- Patterson, R.T., and Fishbein, E., 1989. Re-examination of the statistical methods used to determine the number of point counts needed for micropaleontological quantitative

- research. *Journal of Paleontology*, v.63, p.245-248.
- Patterson, R.T., and Richardson, R.P., 1987. A taxonomic revision of the unilocular foraminifera. *Journal of Foraminiferal Research*, v. 17, p. 212-216.
- _____, and _____, 1988. Eight new genera of unilocular Foraminiferida, family Lagenidae. *Transactions of the American Microscopical Society*, v. 107, p. 240-258.
- Pflum, C.E., and Frerichs, W.E., 1976. Gulf of Mexico deep-water foraminifers. Special Publications Cushman Foundation of Foraminiferal Research, No.14, 124 p.
- Phleger, F.B. and Parker, F.L., 1951. Ecology of foraminifera, northwest Gulf of Mexico; Part II - Foraminifera species. *Geological Society of America Memoir No.46, Pt. II*, p.1-64.
- Phleger, F.B. and Parker, F.L., and Peirson, J.F., 1953. North Atlantic foraminifera. *Swedish Deep-sea Expedition, 1947-1948 Reports*, v. 7, p. 3-122.
- Piveteau, J., 1952. *Traité de Paléontologie*, vol. 1. Paris: Masson et Cie.
- Podobina, V. M., 1978. *Sistematika i filogeniya Gaplofragmiidey* [Systematics and phylogeny of the Haplophragmiidae]. Tomsk: Tomsk Univeritet.
- Popescu, Gh., 1983. Marine Middle Miocene monothalamous foraminifera from Romania. *Memorii Institutul de Geologie si Geofizica Bucarest*, v. 31, p. 261-280.
- Puri, H.S., 1954. Contribution to the study of the Miocene of the Florida panhandle. *Bulletin Florida Satare Geological Survey*, v. 36, p. 1-345.
- Rea, D.K., and Duncan, R.A., 1986. North Pacific plate convergence: a quantitative record of the past 140 m.y. *Geology*, v. 14, p. 373-376.
- Reiss, Z., 1963. Reclassification of perforate foraminifera. *Bulletin of the Geological Survey of Israel*, v. 35, p. 1-111.
- Reuss, A.E., 1850. Neues Foraminiferen aus den Schichten des österreichischen Tertiärbeckens. *Denkschriften der Kaiserlichen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Classe*, v. 1, p. 365-390.
- _____, 1851. Ueber die fossilen Foraminiferen und Entomostraceen der Septarienthone der Umgegend von Berlin. *Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin*, v. 3, p.49-91.
- _____, 1860. Die Foraminiferen der Westphälischen Kreideformation. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Classe*, v. 40, p.147-238.
- _____, 1862. Entwurf einer systematischen Zusammenstellung der Foraminiferen. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Classe* (1861), v. 44(1), p.355-396.

- Rhumbler, L., 1895. Entwurf eines natürlichen Systems der Thalamophoren. Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen, Math.-Physik. Klasse, v. 1985(1), p.51-98.
- Riddihough, R., 1985. The Northeast Pacific Ocean and Margin. in Nairn, A.E.M., Stehli, F.G., and Uyeda, S. (eds.). The Ocean Basins and Margins, Vol. 7A: The Pacific Ocean. New York: Plenum Press, 733 p.
- Rögl, F. and Hansen, H.J., 1984. Foraminifera described by Fichtel and Moll in 1798, a revision of Testacea Microscopica. Verlag Ferdinand Berger and Söhne, Wien, 143 p.
- Rzehak, A., 1885. Bemerkungen über einige Foraminiferen der Oligocän Formation. Verhandlungen des Naturforschenden Vereins in Brünn (1884), v. 23, p. 123-129.
- _____, 1888. Die Foraminiferen der Nummuliten-schichten des Waschberges und Michelsberges bei Stockerau in Nieder-Oesterreich. Verhandlungen der Geologischen Bundesanstalt, v. 1888, kp. 226-229.
- Saidova, Kh.M., 1967. Sediment stratigraphy and the paleogeography of the Pacific Ocean by benthonic Foraminifera during the Quaternary. Progress in Oceanography, v. 4, p.143-151.
- _____, 1975. Bentosny Foraminifery Tikhogo Okeana [Benthonic foraminifera of the Pacific Ocean], vol.3. Moscow: Institut Okeanologii P.P. Shirshova, Akademiya Nauk SSSR.
- _____, 1981. O sovremennom sostoyanii sistemy nadvidovykh taksonov Kaynozoyskikh bentosnykh foraminifer [On an up-to-date system of supraspecific taxonomy of Cenozoic benthonic foraminifera]. Moscow: Institut Okeanologii P.P. Shirshova, Akademiya Nauk SSSR.
- Sar, G.O., 1872. Undersøgelser over Hardenagerfjordens Fauna. Forhandlinger i Videnskasselskabet i Kristiania, v. 1871, p. 246-255
- Schnitker, D., 1974. West Atlantic abyssal circulation during the past 120,000 years. Nature, v. 248, p.385-387.
- _____, 1979. Cenozoic deep water benthic foraminifers, Bay of Biscay: Initial Reports of the Deep Sea Drilling Project, v. 48, p. 377-414.
- Schultze, M.S., 1854. Über den Organismus der Polythalamien (Foraminiferen), nebst Bemerkungen über die Rhizopoden im Allgemeinen. Leipzig: Wilhelm Englemann.
- Schwager, C., 1866. Fossile Foraminiferen von Kar Nikovar, Reise der Österreichischen Fregatte Novara um Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. Von Wüllerstorff-Urbair, Geologischer Theil, vol. 2, no. 1, Geologische Beobachtungen, no. 2. Paläontologisch Mittheilungen p. 187-268.

- _____, 1876. Saggio di una classificazione dei foraminiferi avuto riguardo alle loro famiglie naturali. *Bulletino R. Comitato Geologico d'Italia*, v. 7, p. 475-485.
- _____, 1877. Quadro del proposto sistema di classificazione dei foraminiferi con guscio. *Bulletino R. Comitato Geologico d'Italia*, v. 8, p. 18-27.
- _____, 1878. Nota su alcuni foraminiferi nuovi del tufo di stretto presso girenti: *Bulletino R. Comitato Geologico d'Italia*, v. 9, p. 511-514, 519-529.
- Seguenza, G., 1862. Dei terreni Terziarii del distretto di Messina; Parte II-Descrizione dei foraminiferi monotalamici delle marne Mioceniche del distretto di Messina. Messina: T. Capra.
- Seiglie, G.A., 1965. Some observations on Recent foraminifers from Venezuela, Part I. Contributions from the Cushman Laboratory for Foraminiferal Research, v. 16, p. 70-73.
- Shackleton, N.J. and Duplessy, J.-C., 1985. Carbon Isotope Evidence for formation of North Pacific Deep Water at 18 ka BP glacial maximum. *EOS*, v. 66(18), p. 292.
- Silvestri, A., 1923. Lo stipite della Elissoforme e le sue affinità. *Memorie della Pontificia Accademia della Scienze, Nuovi Lincei*, ser. 2, v. 6, p. 231-270.
- Srinivasan, M.S., and Sharma, V., 1980. Schwager's Car Nicobar Foraminifera in the Reports of the Novar Expedition- a revision. Nw Delhi: Today & Tomorrow's Printers and Publishers.
- Stewart, R.E. and Stewart, K.C., 1930. Post-Miocene foraminifera from the Ventura Quadrangle, Ventura County, California. *Journal of Paleontology*, v. 4, p. 60-72.
- Streeter, S.S., 1973. Bottom water and benthonic Foraminifera in the North Atlantic . Glacial-Interglacial Contrasts. *Quaternary Research*, v. 3(1), p. 131-141.
- SYSTAT 5 for the Macintosh, Version 5.1, 1989. Evanston, Illinois: SYSTAT, Inc.
- Takayanagi, Y., 1953. New genus and species of foraminifera found in the Tonohama Group, Kochi Prefecture, Shikoku, Japan, Short Papers from the Institute of Geology and Paleontology, Tohoku University, v. 5, p. 25-36.
- Thalmann, H.E., 1952. Bibliography and index to new genera, species and varieties of foraminifera for the year 1951. *Journal of Paleontology*, v. 26, p. 953-992.
- Todd, R., and Brönnimann, P., 1957. Recent foraminifera and thecamoebina from the eastern Gulf of Paria. Special Publications Cushman Laboratory for Foraminiferal Research, no. 3, p. 1-43.
- Todd, R., and Low, D., 1967. Recent Foraminifera from the Gulf of Alaska and southeastern Alaska. *Geological Survey Professional Paper*, no. 573-A, 46 p.
- Uchio, T., 1960. Ecology of living benthonic foraminifera from the San Diego, California, area. Special Publications Cushman Laboratory for Foraminiferal

- Research, no. 5, p. 1-72.
- Vella, P., 1957. Studies in New Zealand foraminifera. Paleontological Bulletin, Wellington, v. 28, p. 1-64.
- Voloshinova, N.A., 1960. Uspekhi mikropaleontologii v dele izucheniya vnutrennego stroeniya foraminifer [Progress in micropaleontology in the work of studying the inner structure of Foraminifera] in Trudy Pervogo Seminara po Mikrofaune. Leningrad: Vsesoyuznyy Neftyanoy Nauchno-issledovatel'skii Geologorazvedochnyy Intitut (VNIGRI), p. 48-87.
- Voloshinova, N.A., and Dain, L.G., 1952. Iskopаемые Foraminifery SSSR. Nonionidy, Cassidulinidy i Khilostomellidy [Fossil Foraminifera of the USSR, Nonionidae, Cassidulinidae and Chilostomellidae]. Trudy Vsesoyuznogo Neftyanogo Nauchno-issledovatel'skogo Geologo-razvedochnogo Intituta (VNIGRI), n. ser., v. 63, p. 1-151.
- Warren, B.A., 1983. Why is there no deep water formed in the North Pacific? Journal of Marine Research, v. 41, p. 327-347.
- Wedekind, P.R., 1937. Einführung in die Grundlagen der historischen Geologie. Band II. Mikrobiostratigraphie die Korallen- und Foraminiferenzeit. Stuttgart: Ferdinand Enke.
- Wiesner, H., 1931. Die Foraminiferen der deutschen Südpolar Expedition 1901-1903, Deutsche Südpolar-Expedition, vol. 20. Zoologie, v. 12, p. 53-165.
- Williamson, W.C., 1848. On the Recent British species of the genus Lagena. Annals and Magazine of Natural History, ser. 2, v. 1, p. 1-20.
- _____, 1858 On the Recent foraminifera of Great Britain. London: Ray Society, 107 p.
- Wright, R., 1978. Neogene benthic foraminifers from DSDP Leg 42A, Mediterranean Sea. Initial Reports of the Deep Sea Drilling Project, v. 42, p. 709-726.
- Wright, J., 1877. Proceedings Belfast Naturalists' Field Club (1873-1880), n. ser. 1 (Appendix 4), p. 100-148.
- Zahn, R., Pedersen, T.F., Bornhold, B.D., and Mix, A.C., 1991. Water Mass Conversion in the Glacial Subarctic Pacific (54°N , 148°W): Physical Constraints and the Benthic-Planktonic Stable Isotope Record. Paleoceanography.
- Zheng, S.Y., 1979. The Recent foraminifera of the Xisha Islands, Guangdong Province, China. II. Studia Marina Sinica, v. 16, p. 143-182.

APPENDIX 1

Fractional Abundance Data and associated error for all species.

Species used for cluster analysis are in bold type.

SAMPLE	SPECIES	87a-9 %	Error	87a-8 %	Error	87a-6 %	Error	87a-5 %	Error	87a-3 %	Error	87a-2 %	Error
	<i>Laevidentalina fimbriata</i>	X	X	0.003	0.002	X	X	X	X	X	X	X	X
	<i>Nodosaria subsolana</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Nodosaria sp.A.</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Pyramidulina dolioraris</i>	X	X	0.001	0.001	X	X	X	X	X	X	X	X
	<i>Leniculina sp.A.</i>	X	X	X	X	0	0	X	X	0.001	0.001	X	X
	<i>Saracenaria italicica</i>	X	X	X	X	X	X	X	X	0.001	0.001	X	X
	<i>Hyalinonetron dentaliforme</i>	X	X	0.005	0.003	0.001	0.001	0.001	0.001	0.007	0.003	X	X
	<i>Hyalinonetron sahulense</i>	X	X	0.001	0.001	0	0	0.001	0.001	0.001	0.001	X	X
	<i>Lagena sp. A</i>	X	X	0.001	0.002	0.001	X	X	X	X	X	X	X
	<i>Procerolagena complurecosta</i>	X	X	X	X	0.001	0.001	0.001	0.001	0.001	0.001	X	X
	<i>Procerolagena purii</i>	X	X	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	X	X
	<i>Procerolagena niesmeri</i>	X	X	X	X	0.001	0.001	X	X	0.001	0.001	X	X
	<i>Procerolagena sp. A</i>	X	X	X	X	0.002	0.001	0.017	0.004	X	X	0.008	0.005
	<i>Pygmaeostrion hispidulum</i>	X	X	0.004	0.002	0.001	0.001	0.004	0.002	0.001	0.001	0.003	0.003
	<i>Pygmaeostrion cf. hispidulum</i>	X	X	0.001	0.001	0	0	0.002	0.002	X	X	0.003	0.003
	<i>Pygmaeostrion laevis</i>	X	X	0.001	0.001	0.001	0.001	0.003	0.002	0.001	0.001	0.001	0.006
	<i>Pygmaeostrion sp. A</i>	X	X	0.001	0.001	0	0	X	X	X	X	X	X
	<i>Exsculptina siuebonomi</i>	X	X	0.003	0.002	0	0	0.002	0.002	0.001	0.001	X	X
	<i>Exsculptina sp. A</i>	X	X	X	X	0.001	0.001	0.003	0.002	0.001	0.001	X	X
	<i>Heteromorphina cf. dubiosa</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Favulina hexagona</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Favulina melo</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Homalohedra apiopleura</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Homalohedra pertusa</i>	X	X	X	X	0	0	0.001	0.001	X	X	X	X
	<i>Homalohedra subacuticosta</i>	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Homalohedra williamsoni</i>	X	X	X	X	0	0	0	0	X	X	X	X

SAMPLE	SPECIES	87a-9 %	Error	87a-8 %	Error	87a-6 %	Error	87a-5 %	Error	87a-3 %	Error	87a-2 %	Error
	<i>Bolivina minuta</i>	X	X	0.001	0.001	X	X	X	X	X	X	X	X
	<i>Bolivina sp.A.</i>	X	X	0.015	0.004	0.011	0.002	X	X	0.043	0.005	0.011	0.006
	<i>Bolivinellina pacifica</i>	X	X	0.01	0.004	0.005	0.001	X	X	0.004	0.001	0.014	0.006
	<i>Bolivinellina pescicula</i>	X	X	X	X	0.001	0.001	X	X	X	X	X	X
	<i>Brazalina fragilis</i>	X	X	X	X	0.028	0.003	0.012	0.004	0.004	0.001	0.017	0.007
	<i>Abdiodentrix asketocompella</i>	X	X	X	X	0.007	0.029	0.006	0.066	0.006	0.003	0.003	0.003
	<i>Cassidulina californica</i>	X	X	X	X	0.13	0.007	0.029	0.006	0.066	0.006	0.017	0.007
	<i>Cassidulina delicata</i>	X	X	X	X	0.005	0.001	X	X	0.013	0.003	0.013	0.003
	<i>Cassidulina translucens</i>	X	X	X	X	0.004	0.001	X	X	0.001	0.001	X	X
	<i>Globocassidulina rarioculina</i>	X	X	0.234	0.015	0.178	0.008	0.131	0.011	0.282	0.011	0.07	0.014
	<i>Globocassidulina sp.A.</i>	X	X	X	X	0.002	0.001	X	X	X	X	X	X
	<i>Ehrenbergina pacifica</i>	0.033	0.033	X	X	0.002	0.001	0.005	0.002	X	X	X	X
	<i>Tosaya symmetrica</i>	0.033	0.033	X	X	0	0	X	X	X	X	X	X
	<i>Stainforthia exilis</i>	X	X	0.045	0.007	0.002	0.001	0.01	0.003	0.049	0.005	0.006	0.004
	<i>Euloxostomum alatum</i>	X	X	0.001	0.001	0	0	X	X	X	X	X	X
	<i>Buliminina rostrata</i>	X	X	0.009	0.003	X	X	0.016	0.004	X	X	0.011	0.006
	<i>Buliminina rostriformis</i>	X	X	X	X	0.037	0.004	0.012	0.004	X	X	0.028	0.009
	<i>Buliminina striata</i>	X	X	0.001	0.001	0	0	X	X	X	X	X	X
	<i>Globobuliminina affinis</i>	X	X	X	X	X	X	X	X	0.005	0.002	X	X
	<i>Globobuliminina sp.A.</i>	X	X	X	X	X	X	X	X	0.001	0.001	0.003	0.003
	<i>Protoglobobuliminina pupoides</i>	X	X	0.001	0.001	X	X	X	X	0.001	0.001	X	X
	<i>Buliminella sp.A.</i>	X	X	0.009	0.003	0.01	0.002	0.027	0.005	X	X	0.017	0.007
	<i>Buliminella sp.B.</i>	X	X	X	X	0	0	X	X	X	X	X	X
	<i>Buliminella sp.C.</i>	X	X	X	X	0.001	0.001	X	X	X	X	0.003	0.003
	<i>Euvigerina juncea</i>	X	X	X	X	0.003	0.001	X	X	X	X	0.004	0.001

SAMPLE	87a-9	87a-8	87a-6	87a-5	87a-3	87a-2
SPECIES	%	Error %	Error %	Error %	Error %	Error %
<i>Oridorsalis ?tenua</i>	X	X	X	X	X	X
<i>Oridorsalis sp.A.</i>	X	X	0.026	0.006	0.036	0.004
<i>Heterolepa dutemplei</i>	0.133	0.062	0.003	0.002	0.043	0.004
<i>Anomalinella sp.A.</i>	X	X	X	X	X	X
<i>Gyroidina altiformis</i>	X	X	X	X	X	X
<i>Gyroidina neosoldanii</i>	X	X	X	X	X	X
<i>Gyroidina sp.A.</i>	X	X	X	X	X	X
<i>Linaresia semicirrata</i>	X	X	0.001	0.001	0.001	X
<i>Buccella frigida</i>	X	X	0.006	0.003	0.009	0.002
<i>Buccella sp.A.</i>	X	X	X	0.001	0.001	X
<i>Cribroelphidium foraminosum</i>	X	X	X	X	X	X

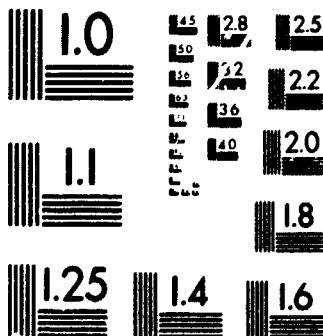
SAMPLE TOTAL COUNT	0-2 cm 334	18-20 cm 1030	38-40 cm 136	59-61 cm 536	98-100 cm 304	466	78-80 cm 304	98-100 cm 466	120-122 cm 431
SPECIES	%	Error %	Error %	Error %	Error %	Error %	Error %	Error %	Error %
<i>B. rufus</i>	X	X	X	X	X	X	X	X	X
<i>H. elongata</i>	0.012	0.006	X	X	X	X	X	X	X
<i>Hyperammina sp.A</i>	0.039	0.011	X	X	X	X	X	X	X
<i>S. ramosa</i>	0.018	0.007	0.001	0.001	X	X	X	X	X
<i>G. gordialis</i>	0.003	0.003	X	X	X	X	X	X	X
<i>R. nodulosa</i>	0.021	0.008	X	X	X	X	X	X	X
<i>Reophax sp.A</i>	X	X	X	X	X	X	X	X	X
<i>H. scitulum</i>	0.048	0.012	X	X	X	X	X	X	X
<i>Ammobaculites sp.A</i>	X	X	X	X	X	X	X	X	X
<i>Ammobaculites sp.B</i>	X	X	X	X	X	X	X	X	X
<i>C. cancellata</i>	X	X	X	X	X	X	X	X	X
<i>T. simplex</i>	X	X	X	X	X	X	X	X	X
<i>P. dentiscens</i>	0.003	0.003	X	X	X	X	X	X	X
<i>Gaudryina sp.A</i>	X	X	X	X	X	X	X	X	X
<i>E. bradyi</i>	X	X	0.002	0.001	0.015	0.01	0.002	0.003	0.003
<i>K. bradyi</i>	X	X	X	X	X	X	X	X	0.005
<i>K. parkerae</i>	X	X	X	X	X	X	X	X	X
<i>C. pacifica</i>	0.006	0.004	X	X	X	X	X	X	X
<i>P. depressa</i>	X	X	X	X	X	0.004	0.003	0.003	X
<i>P. murrhina</i>	X	X	0.027	0.005	X	X	0.003	0.003	X
<i>T. trihedra</i>	0.006	0.004	0.007	0.003	0.007	0.007	X	0.013	0.007
<i>Triloculina sp.A</i>	0.036	0.01	0.019	0.004	X	X	0.013	0.005	0.003
<i>S. tenuis</i>	0.003	0.003	X	X	X	X	X	0.003	0.004
<i>Sigmoilinella sp.A</i>	X	X	X	X	X	X	X	X	X
<i>Bouloides sp.A</i>	0.015	0.007	X	X	X	X	X	X	X

SAMPLE	0-2 cm	18-20 cm	38-40 cm	59-61 cm	78-80 cm	98-100 cm	120-122 cm
SPECIES	%	Error	%	Error	%	Error	%
<i>L. fimbriata</i>	X	X	X	X	X	X	X
<i>N. subsolua</i>	0.003	0.003	X	X	X	X	X
<i>Nodosaria sp.A</i>	X	X	X	X	X	X	X
<i>P. dolioris</i>	X	X	X	X	X	X	X
<i>Lenticulina sp.A</i>	0.003	0.003	X	X	X	X	X
<i>S. italica</i>	X	X	0.004	0.002	0.022	0.013	0.002
<i>H. dentiforme</i>	X	X	X	X	X	X	X
<i>H. sahlense</i>	0.006	0.004	0.001	0.001	X	X	X
<i>Lagena sp.A</i>	X	X	X	X	X	X	X
<i>P. complurecosa</i>	X	X	X	X	X	X	X
<i>P. purii</i>	X	X	X	X	X	X	X
<i>P. wiesneri</i>	X	X	X	X	0.007	0.007	X
<i>Procerolagena sp.A</i>	0.006	0.004	X	X	X	X	X
<i>P. hispidum</i>	0.006	0.004	0.001	0.001	0.037	0.016	0.082
<i>P. cf. hispidulum</i>	0.003	0.003	0.001	0.001	X	X	X
<i>P. laevis</i>	0.015	0.007	X	X	X	X	X
<i>Pygmaeostritron sp.A</i>	X	X	X	X	X	X	X
<i>E. sidebonomi</i>	X	X	X	X	X	X	X
<i>Exsculptina sp.A</i>	X	X	X	X	X	X	X
<i>H. cf. dubiosa</i>	X	X	X	X	X	X	X
<i>F. hexagona</i>	0.003	0.003	0.001	0.001	X	X	X
<i>F. melo</i>	0.006	0.004	X	X	X	X	X
<i>H. apiopleura</i>	X	X	X	X	X	X	X
<i>H. pertusa</i>	X	X	X	X	X	X	X
<i>H. subacuticostia</i>	X	X	0.001	0.001	X	X	X
<i>H. williamsoni</i>	X	X	X	X	0.002	0.002	X

SAMPLE SPECIES	0-2 cm %	Error %	18-20 cm %	Error %	38-40 cm %	Error %	59-61 cm %	Error %	78-80 cm %	Error %	98-100 cm %	Error %	120-122 cm %	Error %
<i>E. peregrina</i>	0.006	0.004	0.002	0.001	X	X	X	X	X	X	X	X	X	X
<i>U. senilisosa</i>	0.081	0.015	0.065	0.008	X	X	X	X	X	X	X	X	X	X
<i>Uvigerina sp.A</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	0.012	0.006	X	X	X	X	X	X	X	X	X	X	X	X
<i>A. galapagoensis</i>	0.012	0.006	0.001	0.001	X	X	X	X	X	X	X	X	X	X
<i>F. advena</i>	X	X	0.001	0.001	X	X	X	X	X	X	X	X	X	X
<i>N. operosa</i>	0.051	0.012	0.002	0.001	X	X	X	X	X	X	X	X	X	X
<i>R. columbiensis</i>	X	X	0.015	0.004	X	X	0.007	0.004	0.013	0.007	0.015	0.006	0.005	0.003
<i>Rosalia</i> sp.A	X	X	0.017	0.004	0.007	0.007	0.002	0.002	0.01	0.006	0.004	0.003	X	X
<i>S. bulboides</i>	X	X	X	X	X	X	X	X	X	X	X	0.004	0.003	X
<i>E. exigua</i>	0.102	0.017	0.062	0.008	0.022	0.013	0.091	0.012	0.066	0.014	0.017	0.006	0.1	0.014
<i>E. vitrea</i>	0.03	0.009	0.094	0.009	0.316	0.04	0.31	0.02	0.411	0.028	0.215	0.019	0.29	0.022
<i>F. wuelstorffii</i>	0.003	0.003	X	X	X	X	0.013	0.005	X	X	0.002	0.002	X	X
<i>L. fleischeri</i>	X	X	0.015	0.004	0.007	0.007	0.004	0.003	X	X	0.009	0.004	0.007	0.004
<i>M. disjuncta</i>	X	X	X	X	X	X	0.002	0.002	0.016	0.007	0.006	0.004	X	X
<i>N. pulchella</i>	X	X	0.001	0.015	0.01	0.009	0.004	0.007	0.005	X	X	X	X	X
<i>N. stella</i>	X	X	0.001	0.001	X	X	X	X	X	X	X	X	X	X
<i>A. echolsis</i>	0.06	0.013	0.023	0.005	0.007	0.007	0.006	0.003	0.013	0.007	0.034	0.008	0.109	0.015
<i>M. barleeanum</i>	0.03	0.009	0.036	0.006	0.118	0.028	0.03	0.007	0.003	0.003	0.047	0.01	0.002	0.002
<i>M. pomilioides</i>	X	X	X	X	X	X	X	X	0.003	0.003	0.021	0.007	0.005	0.003
<i>P. bulboides</i>	0.012	0.006	0.012	0.003	X	X	0.032	0.008	0.023	0.009	0.011	0.005	0.012	0.005
<i>P. salisburyi</i>	0.105	0.017	0.056	0.007	0.044	0.018	0.049	0.009	0.033	0.01	0.116	0.015	0.093	0.014
<i>Pullenia</i> sp.A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>C. collina</i>	X	X	X	X	X	X	X	X	0.003	0.003	0.002	0.002	X	X
<i>O. parki</i>	0.009	0.005	X	X	X	X	X	X	0.013	0.005	0.005	0.003		

2 | of/de | 2

PM-1 3½" x 4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT



PRECISIONSM RESOLUTION TARGETS

MONITORS IN METHYLENE BLUE TESTING SINCE 1974
Micro
COPIERS / SCANNERS / PRINTERS

SAMPLE	SPECIES	0-142 cm	162-164 cm	183-185 cm	196-198 cm	219-221 cm	239-241 cm
		% Error	% Error	% Error	% Error	% Error	% Error
	<i>L. fribisherenesis</i>	X	0.003	0.003	X	X	X
	<i>N. subsoluta</i>	X	X	X	X	X	X
	<i>Nodovaria sp.A</i>	X	X	0.003	0.003	X	X
	<i>P. dolioris</i>	X	X	X	X	X	X
	<i>Lenticulina sp.A</i>	X	X	X	0.001	0.001	X
	<i>S. italicica</i>	X	X	X	0.001	0.001	X
	<i>H. dentataiforme</i>	X	X	X	0.001	0.001	X
	<i>H. sahlense</i>	X	X	X	0.001	0.001	X
	<i>Lagenia sp.A</i>	X	X	X	X	X	X
	<i>P. complurecosta</i>	X	0.003	0.003	X	X	X
	<i>P. purii</i>	X	X	X	X	X	X
	<i>P. wiesneri</i>	X	X	0.001	0.001	0.007	0.007
	<i>Procerolagena sp.A</i>	X	X	X	X	X	X
	<i>P. hispidulum</i>	X	0.003	0.003	0.002	0.001	0.002
	<i>P. cf. hispidulum</i>	X	0.003	0.003	0.001	0.001	0.001
	<i>P. laevis</i>	X	0.003	0.003	X	X	X
	<i>Pygmaeoseistron sp.A</i>	X	X	X	X	X	X
	<i>E. sidebottomi</i>	X	X	0.002	0.001	X	X
	<i>Exsculptina sp.A</i>	X	X	0.001	0.001	X	X
	<i>H. cf. dubiosa</i>	X	X	X	X	X	X
	<i>F. hexagona</i>	X	X	X	X	X	X
	<i>F. melo</i>	X	X	0.001	0.001	X	X
	<i>H. apiopleura</i>	X	X	X	X	X	X
	<i>H. pertusa</i>	X	X	X	X	X	X
	<i>H. subacuticostata</i>	X	0.003	0.003	X	X	X
	<i>H. williamsoni</i>	X	X	X	X	X	X

SAMPLE SPECIES	-0.142 cm	0.142 cm	162-164 cm	183-185 cm	196-198 cm	219-221 cm	239-241 cm
	%	Error	%	Error	%	Error	%
<i>B. minuta</i>	X	X	X	X	X	X	X
<i>Bolivina sp.A</i>	X	X	0.003	0.003	X	0.001	0.001
<i>B. pacifica</i>	X	X	0.006	0.004	0.009	0.003	0.014
<i>B. pescicula</i>	X	X	X	0.003	0.001	X	X
<i>B. fragilis</i>	X	X	X	X	X	X	X
<i>A. askevocomptaella</i>	X	X	0.006	0.004	X	X	X
<i>C. californica</i>	X	X	0.008	0.003	X	X	X
<i>C. delicata</i>	X	X	0.003	0.003	0.002	0.001	0.001
<i>C. translucens</i>	X	X	X	X	X	X	X
<i>G. rariloculina</i>	X	X	0.017	0.165	0.611	0.192	0.033
<i>Globocassidulina sp.A</i>	X	X	0.001	0.001	X	X	X
<i>E. pacifica</i>	X	X	0.003	0.003	0.001	0.001	0.001
<i>T. symmetrica</i>	X	X	0.026	0.009	0.04	0.006	0.021
<i>S. exilis</i>	X	X	X	X	X	X	X
<i>E. alatum</i>	X	X	X	X	X	X	X
<i>B. rostrata</i>	X	X	X	X	X	X	X
<i>B. rostriformis</i>	X	X	X	X	X	X	X
<i>B. striata</i>	X	X	X	X	X	X	X
<i>G. affinis</i>	X	X	X	X	X	X	X
<i>Globobulimina sp.A</i>	X	X	X	X	X	X	X
<i>P. pupoides</i>	X	X	0.006	0.004	X	X	0.001
<i>Protoglobobulim. sp.A</i>	X	X	X	X	X	X	X
<i>Buliminella sp.A</i>	X	X	0.003	0.003	0.002	0.001	0.001
<i>Buliminella sp.B</i>	X	X	X	X	X	X	X
<i>Buliminella sp.C</i>	X	X	X	X	X	X	X
<i>E. juncea</i>	X	X	X	X	X	X	X

SAMPLE SPECIES	0-142 cm %	162-164 cm %	183-185 cm %	196-198 cm %	219-221 cm %	239-241 cm %
	Error	Error	Error	Error	Error	Error
<i>E. peregrina</i>	X	X	0.001	0.001	X	X
<i>U. senticosa</i>	X	X	0.001	0.001	X	X
<i>Uvigerina sp.A</i>	X	X	X	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	X	X	X	X	X	X
<i>A. galapagoensis</i>	X	X	X	X	X	X
<i>F. avena</i>	X	X	X	X	X	X
<i>N. operosa</i>	X	X	0.003	0.002	X	X
<i>R. columbiensis</i>	X	X	0.004	0.003	0.002	X
<i>Rosalina sp.A</i>	X	X	X	X	X	0.003
<i>S. bulboides</i>	X	X	X	X	X	X
<i>E. exigua</i>	X	X	0.026	0.036	0.014	0.37
<i>E. vitrea</i>	X	X	0.006	0.004	X	0.043
<i>F. wuellestorfi</i>	X	X	0.002	0.001	X	0.007
<i>L. flecheri</i>	X	X	0.002	0.001	0.007	0.04
<i>M. disjuncta</i>	X	X	0.004	X	X	0.379
<i>N. pulchella</i>	X	X	X	X	X	0.016
<i>N. stella</i>	X	X	X	X	X	0.309
<i>A. echolysis</i>	X	X	0.017	0.092	0.009	0.023
<i>M. barleeanum</i>	X	X	0.006	0.004	0.006	0.002
<i>M. pomilioides</i>	X	X	0.012	0.006	0.018	0.034
<i>P. bulboides</i>	X	X	0.009	0.005	0.033	0.015
<i>P. salisburyi</i>	X	X	0.049	0.012	0.043	0.004
<i>Pullenia sp.A</i>	X	X	0.003	0.003	X	0.012
<i>C. oolina</i>	X	X	0.001	0.001	X	0.042
<i>O. parki</i>	X	X	0.001	0.001	X	0.001

SAMPLE SPECIES	G-142 cm	162-164 cm	183-185 cm	196-198 cm	219-221 cm	239-241 cm
	%	Error %	%	Error %	%	Error %
<i>O. ?tenera</i>	X	X	X	0.003	0.001	0.007
<i>Oridorsalis sp.A</i>	X	X	X	X	X	X
<i>H. du templei</i>	X	X	0.09	0.015	0.065	0.007
<i>Anomalinulla sp.A</i>	X	X	X	X	X	X
<i>G. atliformis</i>	X	X	X	X	X	X
<i>G. neosoldanii</i>	X	X	0.009	0.005	0.036	0.005
<i>Gyroidina sp.A</i>	X	X	X	X	X	X
<i>L. semicibrain</i>	X	X	X	X	X	X
<i>B. frigida</i>	X	X	0.006	0.004	0.004	0.002
<i>Buccella sp.A</i>	X	X	X	X	X	X
<i>C. foraminosum</i>	X	X	X	X	X	X

SAMPLE	TOTAL COUNT	SPECIES	260-262 cm	280-282 cm	300-302 cm	320-322 cm	340-342 cm	360-362 cm
			%	%	%	%	%	%
			Error	Error	Error	Error	Error	Error
		<i>B. rufus</i>	0.001	0.001	X	X	X	X
		<i>H. elongata</i>	X	X	X	X	X	X
		<i>Hyperummina</i> sp.A	X	X	X	X	X	X
		<i>S. rimosa</i>	X	X	X	X	X	X
		<i>G. gordialis</i>	X	X	X	X	X	X
		<i>R. nodulosa</i>	X	X	X	X	X	X
		<i>Reophax</i> sp.A	X	X	X	X	X	X
		<i>H. scitulum</i>	X	X	X	X	X	X
		<i>Ammobaculites</i> sp.A	X	X	X	X	X	X
		<i>Ammobaculites</i> sp.B	X	X	X	X	X	X
		<i>C. cancellata</i>	X	X	X	X	X	X
		<i>T. simplex</i>	X	X	X	X	X	X
		<i>P. dehuscens</i>	X	X	X	X	X	X
		<i>Gaudryina</i> sp.A	X	X	X	X	X	X
		<i>E. bradyi</i>	0.005	0.002	0.008	0.004	0.024	0.004
		<i>K. bradyi</i>	0.001	0.001	X	X	X	X
		<i>K. parkerae</i>	X	X	X	X	X	X
		<i>C. pacifica</i>	X	X	X	X	X	X
		<i>P. depressa</i>	0.002	0.001	0.002	0.002	0.001	0.001
		<i>P. murrhina</i>	0.001	0.001	X	X	0.002	0.001
		<i>T. trihedra</i>	0.022	0.004	0.011	0.005	0.017	0.003
		<i>Triloculina</i> sp.A	0.041	0.006	0.043	0.009	0.015	0.003
		<i>S. tenuis</i>	X	X	X	X	X	X
		<i>Sigmaillinita</i> sp.A	X	X	X	X	X	X
		<i>Bouloides</i> sp.A	X	X	X	X	X	X

SAMPLE	SPECIES	0-262 cm	280-282 cm	300-302 cm	320-322 cm	340-342 cm	360-362 cm
		%	Error	%	Error	%	Error
	<i>L. fimbriata</i>	X	X	X	X	X	X
	<i>N. subsolana</i>	X	X	0.002	0.002	X	X
	<i>Nodosaria sp.A</i>	X	X	X	X	X	X
	<i>P. dolliolaris</i>	X	X	X	X	X	X
	<i>Lenitulina sp.A</i>	X	X	X	X	X	X
	<i>S. italicica</i>	0.002	0.001	X	X	0.001	0.001
	<i>H. denitaliforme</i>	X	X	0.004	0.003	0.001	0.001
	<i>H. sahulense</i>	X	X	0.002	0.002	X	X
	<i>Lagena sp.A</i>	X	X	X	X	0.001	0.001
	<i>P. complurecosta</i>	0.001	0.001	X	X	0.001	0.001
	<i>P. purii</i>	X	X	X	X	0.001	0.001
	<i>P. wiesneri</i>	X	X	X	X	X	X
	<i>Procerolagena sp.A</i>	0.001	0.001	X	X	X	X
	<i>P. hispidulum</i>	0.002	0.001	X	X	0.001	0.001
	<i>P. cf. hispidulum</i>	0.001	0.001	X	X	0.001	0.001
	<i>P. laevis</i>	0.001	0.001	X	X	X	X
	<i>Pygmaeostriator sp.A</i>	X	X	X	X	X	X
	<i>E. sidebonomi</i>	X	X	X	X	X	X
	<i>Exsculpiina sp.A</i>	0.002	0.001	X	X	X	X
	<i>H. cf. dubiosa</i>	X	X	X	X	X	X
	<i>F. hexagona</i>	X	X	X	X	0.001	0.001
	<i>F. melo</i>	0.001	0.001	X	X	X	X
	<i>H. apiopleura</i>	0.001	0.001	X	X	X	X
	<i>H. pernusa</i>	X	X	X	X	X	X
	<i>H. subacuticosta</i>	X	X	X	X	X	X
	<i>H. williamsoni</i>	X	X	X	X	X	X

SAMPLE SPECIES	0-262 cm %	280-282 cm %	300-302 cm %	320-322 cm %	340-342 cm %	360-362 cm %
	Error	Error	Error	Error	Error	Error
<i>Homalohedra sp.A</i>	X	X	X	X	X	X
<i>Homalohedra sp.B</i>	X	X	X	X	X	X
<i>L. tenuisstriiformis</i>	X	X	X	X	X	X
<i>O. globosa</i>	0.002	0.001	X	X	X	X
<i>Oolina sp.A</i>	0.004	0.002	0.002	0.004	0.002	X
<i>Vasicostella sp.A</i>	X	X	X	0.001	0.001	X
<i>F. agassizi</i>	0.002	0.001	X	0.002	0.001	X
<i>F. baileyata</i>	X	X	X	X	X	X
<i>F. cucurbitasema</i>	X	X	X	X	X	X
<i>F. lucida</i>	0.001	0.001	X	0.001	0.001	X
<i>F. spinosiformis</i>	0.002	0.001	X	0.005	0.002	X
<i>F. subrevertens</i>	X	X	X	X	X	X
<i>Fissurina sp.A</i>	X	X	X	X	X	X
<i>Fissurina sp.B</i>	X	X	X	X	X	X
<i>Fissurina sp.C</i>	X	X	X	X	X	X
<i>Fissurina sp.D</i>	X	X	X	X	X	X
<i>Lagenosolenia sp.A</i>	0.002	0.001	X	0.001	0.001	X
<i>Lagenosolenia sp.B</i>	0.001	0.001	X	0.001	0.001	X
<i>Pseudoclinia sp.A</i>	0.002	0.001	X	0.004	0.002	X
<i>P. felsinea</i>	X	X	X	X	X	X
<i>P. lata</i>	X	X	X	X	X	X
<i>P. primita longa</i>	0.002	0.001	0.004	0.003	X	X
<i>W. carinata</i>	X	X	X	X	X	X
<i>L. invicta</i>	X	X	X	X	X	X
<i>H. elegans</i>	0.001	0.001	X	X	X	X
<i>R. charlottensis</i>	X	X	0.002	0.002	X	X

SAMPLE SPECIES	0-262 cm %	280-282 cm %	300-302 cm %	320-322 cm %	340-342 cm %	360-362 cm %
	Error	Error	Error	Error	Error	Error
<i>B. minuta</i>	X	X	X	X	X	X
<i>Bolivina sp.A</i>	X	X	X	X	X	X
<i>B. pacifica</i>	0.023	0.004	0.049	0.009	0.004	0.002
<i>B. pescicula</i>	0.001	0.001	0.004	0.003	X	X
<i>B. fragilis</i>	X	X	X	X	X	X
<i>A. asketocompella</i>	X	X	X	X	X	X
<i>C. californica</i>	X	X	X	X	X	X
<i>C. delicata</i>	X	X	X	X	X	X
<i>C. translucens</i>	X	X	X	X	X	X
<i>G. rarioculina</i>	0.178	0.011	0.102	0.013	0.121	0.008
<i>Globocassidulina sp.A</i>	X	X	X	X	X	X
<i>E. pacifica</i>	0.001	0.001	X	X	0.003	0.001
<i>T. symmetrica</i>	X	X	X	X	0.001	0.001
<i>S. exilis</i>	0.076	0.007	0.015	0.005	0.004	0.002
<i>E. alatum</i>	X	X	X	X	X	X
<i>B. rostrata</i>	X	X	X	X	X	X
<i>B. rostriformis</i>	X	X	X	X	X	X
<i>B. striata</i>	X	X	X	X	X	X
<i>G. affinis</i>	X	X	X	X	X	X
<i>Globobulimina sp.A</i>	X	X	X	X	X	X
<i>P. pupoides</i>	0.001	0.001	X	X	0.001	0.001
<i>Protoglobobulim. sp.A</i>	0.003	0.002	0.004	0.004	0.003	0.008
<i>Buliminella sp.A</i>	0.006	0.002	0.023	0.006	0.001	0.001
<i>Buliminella sp.B</i>	X	X	X	X	0.001	0.001
<i>Buliminella sp.C</i>	X	X	X	X	X	X
<i>E. juncea</i>	X	X	X	X	X	X

SAMPLE SPECIES	0-262 cm %	0-262 cm %	280-282 cm %	300-302 cm %	300-302 cm %	320-322 cm %	320-322 cm %	340-342 cm %	340-342 cm %	360-362 cm %	360-362 cm %
<i>E. peregrina</i>	0.001	0.001	X	X	0.006	0.002	X	X	X	X	X
<i>U. senilisosa</i>	0.005	0.002	X	X	0.006	0.002	X	X	X	X	X
<i>Uvigerina sp.A</i>	X	X	X	X	X	X	X	X	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	X	X	X	X	X	X	X	X	X	X	X
<i>A. galapagoensis</i>	X	X	X	X	X	X	X	X	X	X	X
<i>F. advena</i>	0.001	0.001	X	X	X	X	X	X	X	X	X
<i>N. operosa</i>	X	X	X	X	X	X	X	X	X	X	X
<i>R. columbiensis</i>	X	X	X	X	0.01	0.003	X	X	X	X	X
<i>Rosalina sp.A</i>	X	X	X	X	X	X	X	X	X	X	X
<i>S. bulloides</i>	X	X	X	X	0.001	0.001	X	X	X	X	X
<i>E. exigua</i>	0.057	0.007	0.083	0.012	0.063	0.006	0.048	0.046	X	X	0.056
<i>E. vitrea</i>	0.335	0.013	0.294	0.02	0.391	0.012	0.381	0.106	X	X	0.556
<i>F. wuellestorfi</i>	0.001	0.001	0.002	0.002	0.001	0.001	X	X	X	X	X
<i>L. flecheri</i>	0.003	0.002	X	X	0.005	0.002	X	X	X	X	X
<i>M. disjuncta</i>	0.001	0.001	X	X	0.002	0.001	X	X	X	X	X
<i>N. pulchella</i>	X	X	0.002	0.002	0.001	0.001	X	X	X	X	X
<i>N. stella</i>	X	X	0.004	0.003	0.001	0.001	X	X	X	X	X
<i>A. echiosis</i>	0.045	0.006	0.017	0.006	0.048	0.005	0.095	0.064	X	X	0.111
<i>M. barleeanum</i>	0.023	0.004	0.038	0.008	0.038	0.005	0.005	0.005	X	X	0.056
<i>M. pomilioides</i>	0.016	0.004	0.009	0.004	0.023	0.004	0.004	0.004	X	X	0.054
<i>P. bulloides</i>	0.026	0.005	0.017	0.006	0.017	0.003	0.286	0.099	X	X	0.056
<i>P. salisburyi</i>	0.021	0.004	0.021	0.006	0.019	0.003	0.003	0.003	X	X	0.054
<i>Pullenia sp.A</i>	X	X	X	X	X	X	X	X	X	X	X
<i>C. oolina</i>	X	X	X	X	0.001	0.001	X	X	X	X	X
<i>O. parki</i>	X	X	X	X	0.001	0.001	X	X	X	X	X

SAMPLE TOTAL COUNT	380-382 cm	400-402 cm	418-420 cm	437-439 cm	460-462 cm	479-481 cm
SPECIES	%	%	%	%	%	%
<i>B. rufus</i>	X	X	X	X	X	X
<i>H. elongata</i>	X	X	X	X	X	X
<i>Hyperammina</i> sp.A	X	X	X	X	X	X
<i>S. ramosa</i>	X	X	X	X	X	X
<i>G. gordialis</i>	X	X	X	X	X	X
<i>R. nodulosa</i>	X	X	X	X	X	X
<i>Reophax</i> sp.A	X	X	X	X	X	X
<i>H. sciuulum</i>	X	X	X	X	X	X
<i>Ammobaculites</i> sp.A	X	X	X	X	X	X
<i>Ammobaculites</i> sp.B	X	X	X	X	X	X
<i>C. cancellata</i>	X	X	X	X	X	X
<i>T. simplex</i>	X	X	X	X	X	X
<i>P. dehiscens</i>	X	X	X	X	X	X
<i>Gaudryina</i> sp.A	X	X	X	X	X	X
<i>E. bradyi</i>	X	X	X	X	X	X
<i>K. bradyi</i>	X	X	X	X	X	X
<i>K. parkerae</i>	X	X	X	X	X	X
<i>C. pacifica</i>	X	X	X	X	X	X
<i>P. depressa</i>	X	X	X	X	X	X
<i>P. murkhina</i>	X	X	X	X	X	X
<i>T. trihedra</i>	0.042	0.041	X	X	X	X
<i>Triloculina</i> sp.A	X	X	0.025	0.025	X	X
<i>S. tenuis</i>	X	X	X	X	X	X
<i>Sigmoilinata</i> sp.A	X	X	X	X	X	X
<i>Bonuloides</i> sp.A	X	X	X	X	X	X

SAMPLE SPECIES	:0-382 cm	400-402 cm	418-420 cm	437-439 cm	460-462 cm	479-481 cm
	%	Error	%	Error	%	Error
<i>Homalohedra sp.A</i>	X	X	X	X	X	X
<i>Homalohedra sp.B</i>	X	X	X	X	X	X
<i>L. tenuistriatiformis</i>	X	X	X	X	X	X
<i>O. globosa</i>	X	X	X	X	X	X
<i>Oolina sp.A</i>	0.042	0.041	X	X	X	X
<i>Vasicostella sp.A</i>	X	X	X	X	X	X
<i>F. agassizi</i>	X	X	X	X	X	X
<i>F. balteata</i>	X	X	X	X	X	X
<i>F. cucurbitasema</i>	X	X	X	X	X	X
<i>F. lucida</i>	X	X	X	X	X	X
<i>F. spinosiformis</i>	X	X	X	X	X	X
<i>F. subrevertens</i>	X	X	X	X	X	X
<i>Fissurina sp.A</i>	X	X	X	X	X	X
<i>Fissurina sp.B</i>	X	X	X	X	X	X
<i>Fissurina sp.C</i>	X	X	X	X	X	X
<i>Fissurina sp.D</i>	X	X	X	X	X	X
<i>Lagenosolenia sp.A</i>	X	X	X	X	X	X
<i>Lagenosolenia sp.B</i>	X	X	X	X	X	X
<i>Pseudoolina sp.A</i>	0.042	0.041	X	X	X	X
<i>P. felsinea</i>	X	X	X	X	X	X
<i>P. lata</i>	X	X	X	X	X	X
<i>P. prolatoelongata</i>	X	X	X	X	X	X
<i>W. carinata</i>	X	X	X	X	X	X
<i>L. invecta</i>	X	X	X	X	X	X
<i>H. elegans</i>	X	X	X	X	X	X
<i>R. charlouensis</i>	X	X	X	X	X	X

SAMPLE SPECIES	:0-382 cm %	400-402 cm %	418-420 cm %	437-439 cm %	460-462 cm %	479-481 cm %
	Error	Error	Error	Error	Error	Error
<i>B. minuta</i>	X	X	X	X	X	X
<i>Bolivina sp.A</i>	X	X	X	X	X	X
<i>B. pacifica</i>	0.125	0.068	X	X	X	X
<i>B. pescicula</i>	X	X	X	X	X	0.5
<i>B. fragilis</i>	X	X	X	X	X	X
<i>A. asketocompella</i>	X	X	X	X	X	X
<i>C. californica</i>	X	X	X	X	X	X
<i>C. delicata</i>	X	X	X	X	X	X
<i>C. translucens</i>	X	X	X	X	X	X
<i>G. rariloculina</i>	X	X	X	X	X	X
<i>Globocassidulina sp.A</i>	X	X	X	X	X	X
<i>E. pacifica</i>	0.042	0.041	X	X	X	X
<i>T. symmetrica</i>	X	X	X	X	X	X
<i>S. exilis</i>	X	X	X	X	X	X
<i>E. alatum</i>	X	X	X	X	X	X
<i>B. rostrata</i>	X	X	X	X	X	X
<i>B. rostriformis</i>	X	X	X	X	X	X
<i>B. striata</i>	X	X	X	X	X	X
<i>G. affinis</i>	X	X	X	X	X	X
<i>Globobulimina sp.A</i>	X	X	X	X	X	X
<i>P. pupoides</i>	X	X	X	X	X	X
<i>Orotoglobobulim. sp.A</i>	X	X	X	X	X	X
<i>Buliminella sp.B</i>	X	X	X	X	X	X
<i>Buliminella sp.C</i>	X	X	X	X	X	X
<i>E. juncea</i>	X	X	X	X	X	X

SAMPLE SPECIES	:0-382 cm	400-402 cm	418-420 cm	437-439 cm	460-462 cm	479-481 cm
	%	Error %	%	Error %	%	Error %
<i>E. peregrina</i>	X	X	X	X	X	X
<i>U. senticosa</i>	X	X	0.025	0.025	X	X
<i>Uvigerina sp.A</i>	X	X	X	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	X	X	X	X	X	X
<i>A. galapagoensis</i>	X	X	X	X	X	X
<i>F. advena</i>	X	X	X	X	X	X
<i>N. operosa</i>	X	X	X	X	X	X
<i>R. columbiensis</i>	X	X	X	X	X	X
<i>Rosalina sp.A</i>	X	X	X	X	X	X
<i>S. bulloides</i>	X	X	X	X	X	X
<i>E. exigua</i>	0.042	0.041	X	X	X	X
<i>E. virea</i>	0.167	0.076	0.75	0.668	X	0.25
<i>F. wuellerstorfi</i>	X	X	X	X	X	0.217
<i>L. fletcheri</i>	X	X	X	X	X	X
<i>M. disjuncta</i>	X	X	X	X	X	X
<i>N. pulchella</i>	X	X	X	X	X	X
<i>N. stella</i>	X	X	X	X	X	X
<i>A. echolsis</i>	X	X	X	X	X	X
<i>M. barleeanum</i>	0.042	0.041	X	X	X	X
<i>M. pomilioides</i>	0.042	0.041	0.05	0.034	X	X
<i>P. bulloides</i>	0.125	0.068	0.125	0.052	X	X
<i>P. salisburyi</i>	X	X	X	X	X	X
<i>Pullenia sp.A</i>	X	X	X	X	X	X
<i>C. oolina</i>	X	X	X	X	X	X
<i>O. parki</i>	X	X	X	X	X	X

SAMPLE SPECIES	:0-382 cm	400-402 cm	418-420 cm	437-439 cm	460-462 cm	479-481 cm
	%	Error	%	Error	%	Error
<i>O. ?lenera</i>	0.042	0.041	0.025	0.025	X	X
<i>Oridorsalis sp.A</i>	X	X	X	X	X	X
<i>H. duemplei</i>	0.042	0.041	X	X	X	X
<i>Anomalinulla sp.A</i>	X	X	X	X	X	X
<i>G. altiformis</i>	X	X	X	X	X	X
<i>G. neosoldanii</i>	0.042	0.041	X	X	X	X
<i>Gyroidina sp.A</i>	0.042	0.041	X	X	X	X
<i>L. semicirrata</i>	X	X	X	X	X	X
<i>B. frigida</i>	0.125	0.068	X	X	X	X
<i>Buccella sp.A</i>	X	X	X	X	X	X
<i>C. foraminosum</i>	X	X	X	X	X	X

SAMPLE	TOTAL COUNT	SPECIES	500-502 cm	517-519 cm	540-542 cm	560-562 cm	577-579 cm	600-602 cm
			%	%	%	%	%	VOID
		<i>B. rufus</i>	X	X	X	X	X	X
		<i>H. elongata</i>	X	X	X	X	X	X
		<i>Hyperammina</i> sp.A	X	X	X	X	X	X
		<i>S. ramosa</i>	X	X	X	X	X	X
		<i>G. gordialis</i>	X	X	X	X	X	X
		<i>R. nodulosa</i>	X	X	X	X	X	X
		<i>Reophax</i> sp.A	X	X	X	X	X	X
		<i>H. scitulum</i>	X	X	X	X	X	X
		<i>Ammobaculites</i> sp.A	X	X	X	X	X	X
		<i>Ammobaculites</i> sp.B	X	X	X	X	X	X
		<i>C. cancellata</i>	X	X	X	X	X	X
		<i>T. simplex</i>	X	X	X	X	X	X
		<i>P. dehisces</i>	X	X	X	X	X	X
		<i>Gaudryina</i> sp.A	X	X	X	X	X	X
		<i>E. bradyi</i>	X	X	X	X	X	X
		<i>K. bradyi</i>	X	X	X	X	X	X
		<i>K. parkerae</i>	X	X	X	X	X	X
		<i>C. pacifica</i>	X	X	X	X	X	X
		<i>P. depressa</i>	X	X	X	X	X	X
		<i>P. murrhina</i>	X	X	X	X	X	X
		<i>T. trihedra</i>	0.067	0.064	0.015	0.015	0.029	0.02
		<i>Triloculina</i> sp.A	X	X	X	X	X	X
		<i>S. tenuis</i>	X	X	X	X	X	X
		<i>Sigmoilinella</i> sp.A	X	X	X	X	X	X
		<i>Bouloides</i> sp.A	X	X	X	X	X	X

SAMPLE SPECIES	10-502 cm %	517-519 cm %	540-542 cm %	560-562 cm %	577-579 cm %	600-602 cm %
	Error	Error	Error	Error	Error	Error
<i>L. frobisherensis</i>	X	X	X	X	X	X
<i>N. subsoluta</i>	X	X	X	X	X	X
<i>Nodovaria</i> sp.A	X	X	X	X	X	X
<i>P. dolioris</i>	X	X	X	X	X	X
<i>Lenticulina</i> sp.A	X	X	X	X	X	X
<i>S. italica</i>	X	X	X	X	X	X
<i>H. dentiforme</i>	X	X	X	X	X	X
<i>H. sahulense</i>	X	X	X	X	X	X
<i>Lagena</i> sp.A	X	X	X	X	X	X
<i>P. comphurecosta</i>	X	X	X	X	X	X
<i>P. purii</i>	X	X	X	X	X	X
<i>P. wiesneri</i>	X	X	X	X	X	X
<i>Procerolagena</i> sp.A	X	X	X	X	X	X
<i>P. hispidulum</i>	X	X	X	X	X	X
<i>P. cf. hispidulum</i>	X	X	X	X	X	X
<i>P. laevis</i>	X	X	X	X	X	X
<i>Pygmaenseistron</i> sp.A	X	X	X	X	X	X
<i>E. sidebottomi</i>	X	X	X	X	X	X
<i>Exsculptina</i> sp.A	X	X	X	X	X	X
<i>H. cf. dubiosa</i>	X	X	X	X	X	X
<i>F. hexagona</i>	X	X	X	X	X	X
<i>F. melo</i>	X	X	X	X	X	X
<i>H. apiopleura</i>	X	X	X	X	X	X
<i>H. perusa</i>	X	X	X	X	X	X
<i>H. subacuticostata</i>	X	X	X	X	X	X
<i>H. williamsoni</i>	X	X	X	X	X	X

SAMPLE	10-502 cm	517-519 cm	540-542 cm	560-562 cm	577-579 cm	600-602 cm	Error
SPECIES	%	%	%	%	%	%	Error
<i>Homalohedra sp.A</i>	X	X	X	X	X	X	X
<i>Homalohedra sp.B</i>	X	X	X	X	X	X	X
<i>L. tenuistratiformis</i>	X	X	X	X	X	X	X
<i>O. globosa</i>	X	X	X	X	X	X	X
<i>Oolina sp.A</i>	X	X	X	X	X	X	X
<i>Vasicostella sp.A</i>	X	X	X	X	X	X	X
<i>F. agassizi</i>	X	X	X	X	X	X	X
<i>F. baliceata</i>	X	X	X	X	X	X	X
<i>F. cucurbitasema</i>	X	X	X	X	X	X	X
<i>F. lucida</i>	X	X	X	X	X	X	X
<i>F. spinosiformis</i>	X	X	X	X	X	X	X
<i>F. subrevertens</i>	X	X	X	X	X	X	X
<i>Fissurina sp.A</i>	X	X	X	X	X	X	X
<i>Fissurina sp.B</i>	X	X	X	X	X	X	X
<i>Fissurina sp.C</i>	X	X	X	X	X	X	X
<i>Fissurina sp.D</i>	X	X	X	X	X	X	X
<i>Lagenosolenia sp.A</i>	X	X	X	X	X	X	X
<i>Lagenosolenia sp.B</i>	X	X	X	X	X	X	X
<i>Pseudoolina sp.A</i>	X	X	X	X	X	X	X
<i>P. felsinea</i>	X	X	X	X	X	X	X
<i>P. lata</i>	X	X	X	X	X	X	X
<i>P. prolato longa</i>	X	X	X	X	X	X	X
<i>W. carinata</i>	X	X	X	X	X	X	X
<i>L. invecia</i>	X	X	X	X	X	X	X
<i>H. elegans</i>	X	X	X	X	X	X	X
<i>R. charliensis</i>							

SAMPLE	10-502 cm	517-519 cm	540-542 cm	560-562 cm	577-579 cm	600-602 cm
SPECIES	%	Error	%	Error	%	Error
<i>B. minuta</i>	X	X	X	X	X	X
<i>Bolivina sp.A</i>	X	X	0.088	0.034	X	X
<i>B. pacifica</i>	X	X	X	X	0.08	0.054
<i>B. pescicula</i>	X	X	X	X	X	X
<i>B. fragilis</i>	X	X	X	X	X	X
<i>A. asketocompelta</i>	X	X	X	X	X	X
<i>C. californica</i>	X	X	0.044	0.025	X	X
<i>C. delicata</i>	X	X	0.015	0.015	X	X
<i>C. translucens</i>	X	X	X	X	X	X
<i>G. rariloculina</i>	X	X	0.015	0.015	0.04	0.039
<i>Globocassidulina sp.A</i>	X	X	X	X	X	X
<i>E. pacifica</i>	X	X	X	X	X	X
<i>T. symmetrica</i>	X	X	0.015	0.015	X	X
<i>S. exilis</i>	X	X	X	X	X	X
<i>E. alatum</i>	X	X	X	X	X	X
<i>B. rostrata</i>	X	X	X	X	X	X
<i>B. rostriformis</i>	X	X	X	X	X	X
<i>B. striata</i>	X	X	X	X	X	X
<i>G. affinis</i>	X	X	X	X	X	X
<i>Globulinella sp.A</i>	X	X	X	X	X	X
<i>P. pupoidea</i>	X	X	X	X	0.16	0.073
<i>Orotoglobobulim. sp.A</i>	X	X	X	X	X	X
<i>Bulininella sp.A</i>	X	X	X	X	X	X
<i>Bulininella sp.B</i>	X	X	0.029	0.02	X	X
<i>Bulininella sp.C</i>	X	X	X	X	X	X
<i>E. juncea</i>	X	X	X	X	X	X

SAMPLE SPECIES	10-502 cm %	517-519 cm %	540-542 cm %	560-562 cm %	577-579 cm %	600-602 cm %
	Error	Error	Error	Error	Error	Error
<i>E. peregrina</i>	X	X	X	X	X	X
<i>U. senticosa</i>	X	X	X	X	X	X
<i>Uvigerina sp.A</i>	X	X	X	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	X	X	X	X	X	X
<i>A. galapagoensis</i>	X	X	X	X	X	X
<i>F. advena</i>	X	X	X	X	X	X
<i>N. operosa</i>	X	X	X	X	X	X
<i>R. columbiensis</i>	0.067	0.064	0.029	0.02		
<i>Rosalina sp.A</i>	X	X	X	X	X	X
<i>S. bulloides</i>	X	X	X	X	X	X
<i>E. exigua</i>	X	X	0.118	0.039	X	X
<i>E. viorea</i>	0.467	0.129	0.279	0.054	0.4	0.098
<i>F. wuelllerstorfi</i>	X	X	X	X	X	X
<i>L. fletcheri</i>	X	X	0.044	0.025	1	0
<i>M. disjuncta</i>	X	X	X	X	X	X
<i>N. pulchella</i>	X	X	X	X	X	X
<i>N. stella</i>	X	X	X	X	X	X
<i>A. echolsis</i>	X	X	X	X	X	X
<i>M. barleeanum</i>	X	X	X	X	X	X
<i>M. pompoloides</i>	0.067	0.064	X	X		
<i>P. bulloides</i>	0.2	0.103	0.206	0.049	X	X
<i>P. salisburyi</i>	X	X	X	X	X	X
<i>Pullenia sp.A</i>	0.133	0.088	X	X	X	X
<i>C. coolina</i>	X	X	X	X	X	X
<i>O. parkii</i>	X	X	X	X	X	X

SAMPLE	:0-622 cm	642-644 cm	657-659 cm	680.5-682.5 cm	701-703 cm	720-722 cm
SPECIES	%	Error	%	Error	%	Error
<i>L. fimbherensis</i>	X	X	X	X	X	X
<i>N. subsoluta</i>	X	X	X	X	X	X
<i>Nodosaria sp.A</i>	X	X	X	X	X	X
<i>P. dolioris</i>	X	X	X	X	X	X
<i>Lenticulina sp.A</i>	X	X	X	X	X	X
<i>S. italicica</i>	X	X	X	X	X	X
<i>H. denitaliforme</i>	X	X	X	X	X	X
<i>H. sahlense</i>	X	X	X	X	X	X
<i>Lagenia sp.A</i>	X	X	X	X	X	X
<i>P. complurecosta</i>	X	X	X	X	X	X
<i>P. purii</i>	X	X	X	X	X	X
<i>P. wiesneri</i>	X	X	X	X	X	X
<i>Procerolagena sp.A</i>	X	X	X	X	X	X
<i>P. hispidulum</i>	X	X	X	X	X	X
<i>P. cf. hispidulum</i>	X	X	X	X	X	X
<i>P. laevis</i>	X	X	X	X	X	X
<i>Pygmaeoestriorn sp.A</i>	X	X	X	X	X	X
<i>E. sidebottomi</i>	X	X	X	X	X	X
<i>Exsculptina sp.A</i>	X	X	X	X	X	X
<i>H. cf. dubiosa</i>	X	X	X	X	X	X
<i>F. hexagona</i>	X	X	X	X	X	X
<i>F. melo</i>	X	X	X	X	X	X
<i>H. apiopleura</i>	X	X	X	X	X	X
<i>H. perusa</i>	X	X	X	X	X	X
<i>H. subacuticosta</i>	X	X	X	X	X	X
<i>H. williamsoni</i>	X	X	X	X	X	X

SAMPLE	0-622 cm	642-644 cm	657-659 cm	680.5-682.5 cm	701-703 cm	720-722 cm
SPECIES	%	%	%	%	%	%
<i>Homalohedra</i> sp.A	X	X	X	X	X	X
<i>Homalohedra</i> sp.B	X	X	X	X	X	X
<i>L. tenuistratiformis</i>	X	X	X	X	X	X
<i>O. globosa</i>	X	X	X	X	X	X
<i>Oolina</i> sp.A	X	X	X	X	X	X
<i>Vasicosietta</i> sp.A	X	X	X	X	X	X
<i>F. agassizi</i>	X	X	X	X	X	X
<i>F. balteata</i>	X	X	X	X	X	X
<i>F. cucurbitasema</i>	X	X	X	X	X	X
<i>F. lucida</i>	X	X	X	X	X	X
<i>F. spinosiformis</i>	X	X	X	X	X	X
<i>F. subrevertens</i>	X	X	X	X	X	X
<i>Fissurina</i> sp.A	X	X	X	X	X	X
<i>Fissurina</i> sp.B	X	X	X	X	X	X
<i>Fissurina</i> sp.C	0.009	0.009	X	X	X	X
<i>Fissurina</i> sp.D	X	X	X	X	X	X
<i>Lagenosolenia</i> sp.A	X	X	X	X	X	X
<i>Lagenosolenia</i> sp.B	X	X	X	X	X	X
<i>Pseudoolina</i> sp.A	X	X	X	X	X	X
<i>P. felsinea</i>	X	X	X	X	X	X
<i>P. lata</i>	X	X	X	X	X	X
<i>P. prolatolonga</i>	X	X	X	X	X	X
<i>W. carinata</i>	X	X	X	X	X	X
<i>L. invecta</i>	X	X	X	X	X	X
<i>H. elegans</i>	X	X	X	X	X	X
<i>R. charlottensis</i>	X	X	X	X	X	X

SAMPLE SPECIES	:0-622 cm %	642-644 cm %	657-659 cm %	680.5-682.5 cm %	701-703 cm %	720-722 cm %
	Error	Error	Error	Error	Error	Error
<i>B. minuta</i>	X	X	X	X	X	X
<i>Bolivina sp.A</i>	X	X	X	X	X	X
<i>B. pacifica</i>	0.248	0.041	X	X	X	X
<i>B. pescicula</i>	X	X	X	X	X	X
<i>B. fragilis</i>	X	X	X	X	X	X
<i>A. asketocompella</i>	X	X	X	X	X	X
<i>C. californica</i>	X	X	X	X	X	X
<i>C. delicata</i>	X	X	X	X	X	X
<i>C. translucens</i>	X	X	X	X	X	X
<i>G. rariloculina</i>	0.018	0.013	0.097	0.053	X	X
<i>Globocassidulina sp.A</i>	X	X	X	X	X	X
<i>E. pacifica</i>	X	X	X	X	X	X
<i>T. symmetrica</i>	X	X	X	X	X	X
<i>S. exilis</i>	X	X	X	X	X	X
<i>E. alatum</i>	X	X	X	X	X	X
<i>B. rostrata</i>	X	X	X	X	X	X
<i>B. rostriformis</i>	X	X	X	X	X	X
<i>B. striata</i>	X	X	X	X	X	X
<i>G. affinis</i>	X	X	X	X	X	X
<i>Globobulimina sp.A</i>	X	X	X	X	X	X
<i>P. pupoides</i>	0.009	0.009	X	X	X	X
<i>Drotoglobobulim. sp.A</i>	X	X	0.032	0.032	X	X
<i>Buliminella sp.A</i>	X	X	X	X	X	X
<i>Buliminella sp.B</i>	X	X	X	X	X	X
<i>Buliminella sp.C</i>	X	X	X	X	X	X
<i>E. juncea</i>						

SAMPLE SPECIES	:0-622 cm %	642-644 cm %	657-659 cm %	680.5-682.5 cm %	701-703 cm %	720-722 cm %
	Error	Error	Error	Error	Error	Error
<i>E. peregrina</i>	X	X	X	X	X	X
<i>U. senticosa</i>	X	X	X	X	X	X
<i>Uvigerina sp.A</i>	X	X	X	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	X	X	X	X	X	X
<i>A. galapagoensis</i>	X	X	X	X	X	X
<i>F. advena</i>	X	X	X	X	X	X
<i>N. operosa</i>	X	X	X	X	X	X
<i>R. columbiensis</i>	X	X	X	X	X	X
<i>Rosalina sp.A</i>	X	X	X	X	X	X
<i>S. bulloides</i>	X	X	X	X	X	X
<i>E. exigua</i>	0.037	0.018	0.065	0.044		
<i>E. vitrea</i>	0.193	0.038	0.645	0.086		
<i>F. wuellestorfi</i>	X	X	X	X	X	X
<i>L. flecheri</i>	X	X	X	X	X	X
<i>M. disjuncta</i>	X	X	X	X	X	X
<i>N. pulchella</i>	X	X	X	X	X	X
<i>N. stella</i>	X	X	X	X	X	X
<i>A. echolsis</i>	0.009	0.009	X	X	X	X
<i>M. barleeanum</i>	X	X	X	X	X	X
<i>M. pomilioides</i>	0.266	0.042	0.032	0.032	X	X
<i>P. bulloides</i>	0.083	0.026	0.032	0.032	X	X
<i>P. salisburyi</i>	0.037	0.018	0.032	0.032	X	X
<i>Pullenia sp.A</i>	X	X	X	X	X	X
<i>C. oolina</i>	X	X	X	X	X	X
<i>O. parki</i>	X					

SAMPLE	:0-622 cm	642-644 cm	657-659 cm	680.5-682.5 cm	701-703 cm	720-722 cm	
SPECIES	%	Error	%	Error	%	Error	%
<i>O. ?ienera</i>	X	X	X	X	X	X	X
<i>Oridorsalis sp.A</i>	X	X	X	X	X	X	X
<i>H. dutemplei</i>	X	X	X	X	X	X	X
<i>Anomalinulla sp.A</i>	X	X	X	X	X	X	X
<i>G. altiformis</i>	0.073	0.025	X	X	X	X	X
<i>G. neosoldanii</i>	X	X	0.032	0.032	X	X	X
<i>Gyroidina sp.A</i>	X	X	X	X	X	X	X
<i>L. semicibrata</i>	X	X	X	X	X	X	X
<i>B. frigida</i>	X	X	X	X	X	X	X
<i>Buccella sp.A</i>	X	X	X	X	X	X	X
<i>C. foraminosum</i>	X	X	X	X	X	X	X

SAMPLE	0-742 cm	761-763 cm	781.5-783.5 cm	800-802 cm	820.5-822.5 cm	840-842 cm
SPECIES	%	Error	%	Error	%	Error
<i>L.frobisherensis</i>	X	X	X	X	X	X
<i>N.subsoluta</i>	X	X	X	X	X	X
<i>Nodosaria sp.A</i>	X	X	X	X	X	X
<i>P.doliolaris</i>	X	X	X	X	X	X
<i>Leniculina sp.A</i>	X	X	0.006	0.004	X	X
<i>S.italica</i>	X	X	0.006	0.004	X	X
<i>H. dentiliforme</i>	X	X	X	X	X	X
<i>H. sahulense</i>	X	X	X	X	X	X
<i>Lagenia sp.A</i>	X	X	X	X	X	X
<i>P.complurecosta</i>	X	X	X	X	X	X
<i>P.purii</i>	X	X	X	X	X	X
<i>P.wiesneri</i>	X	X	X	X	X	X
<i>Procerolagena sp.A</i>	X	X	X	X	X	X
<i>P.hispidulum</i>	X	X	X	X	X	X
<i>P.cf.hispidulum</i>	X	X	X	X	X	X
<i>P.laevis</i>	X	X	X	X	X	X
<i>Pygmaeoestiron sp.A</i>	X	X	X	X	X	X
<i>E.sidebonomi</i>	X	X	X	X	X	X
<i>Exsculptina sp.A</i>	X	X	X	X	X	X
<i>H.cf.dubiosa</i>	X	X	X	X	X	X
<i>F.hexagona</i>	X	X	X	X	X	X
<i>F.melo</i>	X	X	X	X	X	X
<i>H.apiopleura</i>	X	X	X	X	X	X
<i>H.perusa</i>	X	X	X	X	X	X
<i>H.subacuticostata</i>	X	X	X	X	X	X
<i>H.williamseni</i>	X	X	X	X	X	X

SAMPLE	0-742 cm	761-763 cm	781.5-783.5 cm	800-802 cm	820.5-822.5 cm	840-842 cm
SPECIES	%	Error	%	Error	%	Error
<i>Homalohedra sp.A</i>	X	X	X	X	X	X
<i>Homalohedra sp.B</i>	X	X	X	X	X	X
<i>L. tenuisriatiformis</i>	X	X	X	X	X	X
<i>O. globosa</i>	X	X	X	X	X	X
<i>Oolina sp.A</i>	X	X	X	X	X	X
<i>Vasicostella sp.A</i>	X	X	X	X	X	X
<i>F. agassizii</i>	X	X	X	X	X	X
<i>F. balteata</i>	X	X	X	X	X	X
<i>F. cucurbitasema</i>	X	X	X	X	X	X
<i>F. lucida</i>	X	X	X	X	X	X
<i>F. spinosiformis</i>	X	X	X	X	X	X
<i>F. subrevertens</i>	X	X	X	X	X	X
<i>Fissurina sp.A</i>	X	X	X	X	X	X
<i>Fissurina sp.B</i>	X	X	X	X	X	X
<i>Fissurina sp.C</i>	X	X	X	X	X	X
<i>Fissurina sp.D</i>	X	X	X	X	X	X
<i>Lagenosolenia sp.A</i>	X	X	X	X	X	X
<i>Lagenosolenia sp.B</i>	X	X	X	X	X	X
<i>Pseudoolina sp.A</i>	X	X	X	X	X	X
<i>P. felsinea</i>	X	X	X	X	X	X
<i>P. lata</i>	X	X	X	X	X	X
<i>P. prolato longa</i>	X	X	X	X	X	X
<i>W. carinata</i>	X	X	X	X	X	X
<i>L. invecia</i>	X	X	X	X	X	X
<i>H. elegans</i>	X	X	X	X	X	X
<i>R. charlottensis</i>	X	X	X	X	X	X

SAMPLE SPECIES	-0.742 cm	761-763 cm	781.5-783.5 cm	800-802 cm	820.5-822.5 cm	840-842 cm
	%	Error	%	Error	%	Error
<i>B. minuta</i>	X	X	X	X	X	X
<i>Bolivina sp.A</i>	X	X	X	X	X	X
<i>B. pacifica</i>	X	X	0.04	0.011	0.008	0.003
<i>B. pescicula</i>	X	X	X	X	X	X
<i>B. fragilis</i>	X	X	X	X	X	X
<i>A. askerocampella</i>	X	X	0.003	0.003	X	X
<i>C. californica</i>	X	X	0.006	0.004	X	X
<i>C. delicata</i>	X	X	X	X	X	X
<i>C. translucens</i>	X	X	X	X	X	X
<i>G. rariloculina</i>	X	X	0.161	0.021	0.038	0.007
<i>Globocassidulina sp.A</i>	X	X	X	X	X	X
<i>E. pacifica</i>	X	X	X	X	0.181	0.025
<i>T. symmetrica</i>	X	X	X	X	X	X
<i>S. exilis</i>	X	X	0.003	0.003	0.018	0.005
<i>E. alatum</i>	X	X	X	X	X	X
<i>B. rostrata</i>	X	X	X	X	X	X
<i>B. rostriformis</i>	X	X	X	X	X	X
<i>B. striata</i>	X	X	X	X	X	X
<i>G. affinis</i>	X	X	X	X	X	X
<i>Globobulimina sp.A</i>	X	X	X	X	X	X
<i>P. pupoides</i>	X	X	0.006	0.004	0.003	0.002
<i>Oriologlobulim. sp.A</i>	X	X	X	X	X	X
<i>Buliminella sp.A</i>	X	X	X	X	X	X
<i>Buliminella sp.B</i>	X	X	X	X	X	X
<i>Buliminella sp.C</i>	X	X	X	X	X	X
<i>E. juncea</i>	X	X	0.003	0.003	0.001	0.001

SAMPLE SPECIES	-0.742 cm	761.7-763 cm	781.5-783.5 cm	800-802 cm	820.5-822.5 cm	840-842 cm
	% Error	% Error	% Error	% Error	% Error	% Error
<i>E. peregrina</i>	X	0.012	0.006	0.007	0.003	X
<i>U. senticosa</i>	X	0.019	0.008	0.012	0.004	X
<i>Uvigerina sp.A</i>	X	0.012	0.006	X	X	X
<i>Uvigerina sp.B</i>	X	X	X	X	X	X
<i>Uvigerina sp.C</i>	X	X	X	X	X	X
<i>A. galapagoensis</i>	X	X	X	X	X	X
<i>F. avena</i>	X	X	X	X	X	X
<i>N. operosa</i>	X	0.006	0.004	0.075	0.01	0.051
<i>R. columbiensis</i>	X	0.009	0.005	0.016	0.005	X
<i>Rosalina sp.A</i>	X	X	0.059	0.013	0.004	0.002
<i>S. bulloides</i>	X	X	X	X	X	X
<i>E. exigua</i>	X	0.078	0.015	0.267	0.016	0.316
<i>E. virea</i>	X	0.36	0.027	0.321	0.017	0.224
<i>F. wuellestorfi</i>	X	X	X	X	X	X
<i>L. fletcheri</i>	X	0.009	0.005	0.01	0.004	0.008
<i>M. disjuncta</i>	X	X	0.006	0.004	0.002	X
<i>N. pulchella</i>	X	0.031	0.01	0.001	X	X
<i>N. stella</i>	X	X	X	X	X	X
<i>A. echolsis</i>	X	0.003	0.003	0.023	0.006	0.063
<i>M. barleeanum</i>	X	0.003	0.003	0.014	0.004	0.004
<i>M. pom-poides</i>	X	X	0.004	0.002	X	X
<i>P. bulloides</i>	X	0.016	0.007	0.011	0.004	X
<i>P. salisburyi</i>	X	0.05	0.012	0.008	0.003	0.093
<i>Pullenia sp.A</i>	X	0.009	0.005	0.014	0.004	X
<i>C. oolina</i>	X	X	X	X	X	X
<i>O. parki</i>	X	X	X	X	X	X

Plate 1

Figs. 1,2. *Epistominella exigua* (Brady); sample PAR87a-01; 1. dorsal view X370; 2. ventral view X450.

Figs. 3-5. *Epistominella vitrea* Parker; sample PAR87a-08; 3. dorsal view X500; 4. sample PAR87a-01; dorsal view X550; 5. ventral view X500.

Figs. 6,7. *Pullenia salisburyi* R.E. Stewart and K.C. Stewart; sample PAR87a-01; 6. side view X170; 7. apertural view X300.

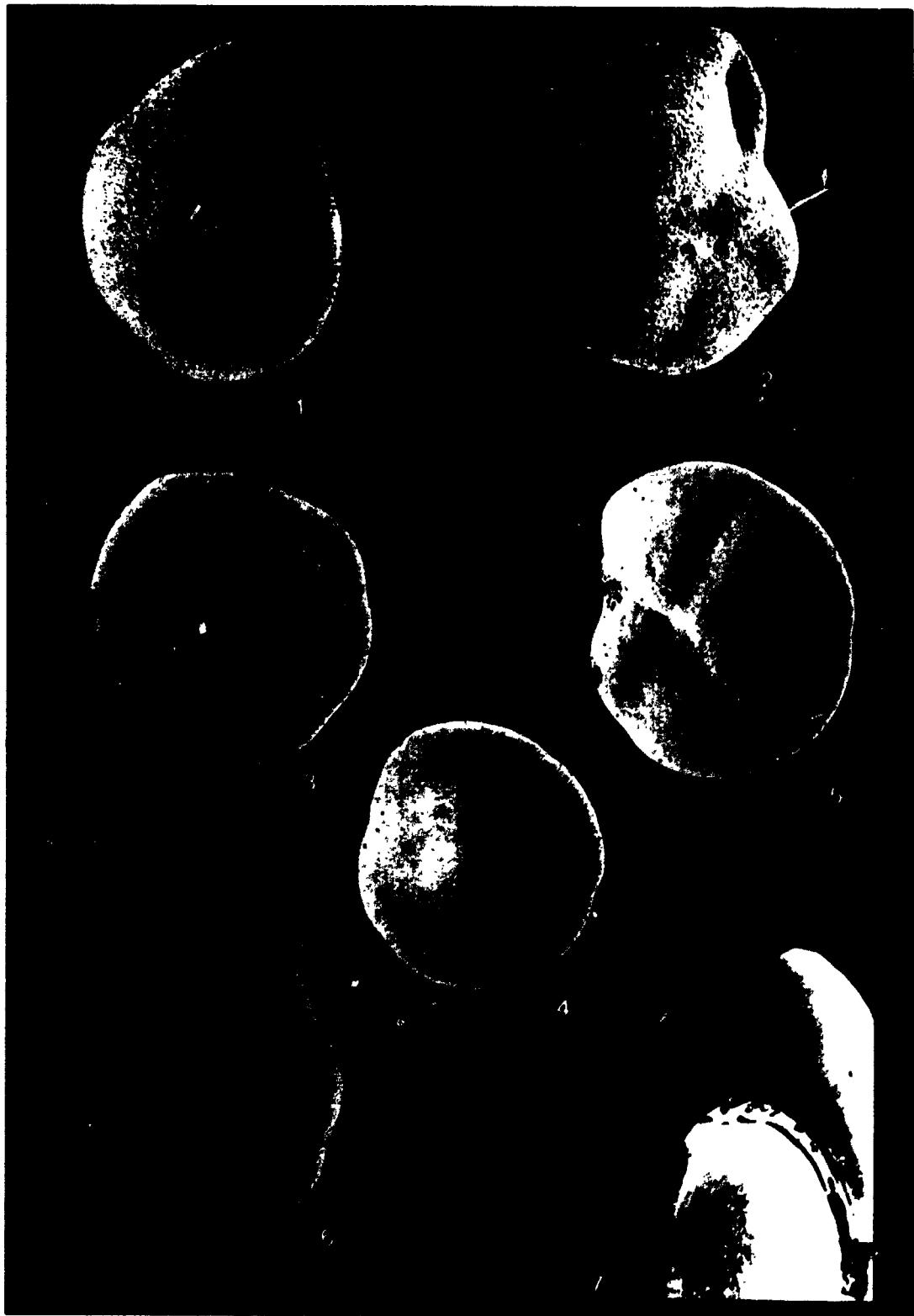


Plate 2

- Figs. 1,2. Bolivinella pacifica (Cushman and McCulloch); sample PAR87a-03; 1. apertural view X950; 2. side view X230.
- Figs. 3. Globocassidulina rarilocula (Cushman); sample PAR87a-01; 3. side view X220.
- Figs. 4-5. Strainforthia exilis (Brady); sample PAR87a-03; 4. side view X350; 5. sample PAR87a-05; side view, final chamber broken X270
- Figs. 6. Uvigerina senticosa Cushman; sample PAR87a-01; 6. side view X180.
- Figs. 7,8. Astrononion echolsis Kennett; sample PAR87a-01; 7. oblique side view showing aperture X350; 8. side view X250.

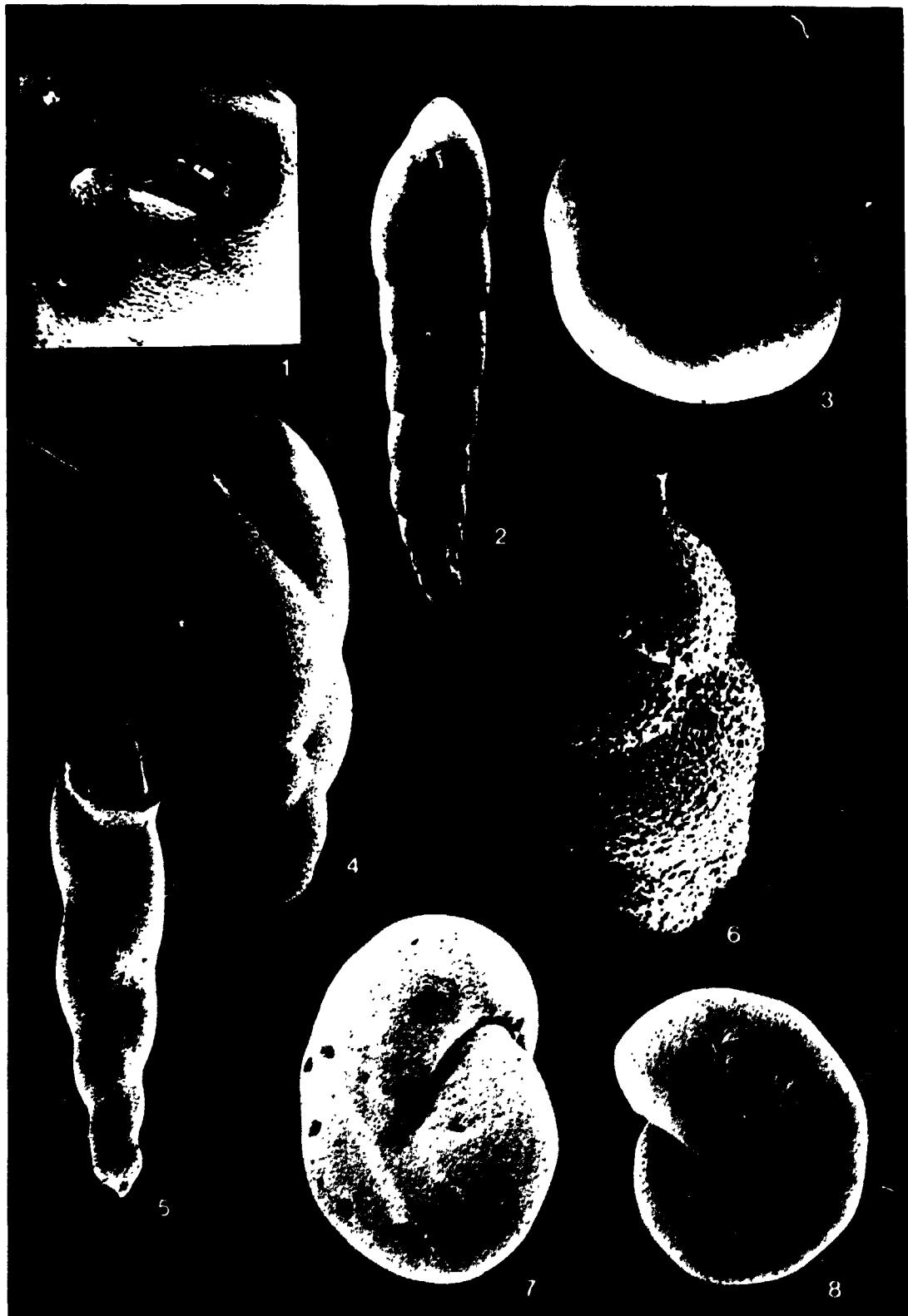


Plate 3

Figs. 1,2. Melonis barleeanum (Williamson); sample PAR87a-01; 1. apertural view X200; 2. side view X140.

Figs. 3. Melonis pompilioides (Fichtel and Moll); sample PAR87a-01; 3. side view X190.

Figs. 4,5. Pullenia bulloides (d'Orbigny); sample PAR87a-01; 4. side view X250; 5. sample PAR87a-08; apertural view X400.

Figs. 6,7. Osangularia parki (Finlay); sample PAR87a-06; 6. dorsal view X100; 7. ventral view X180.

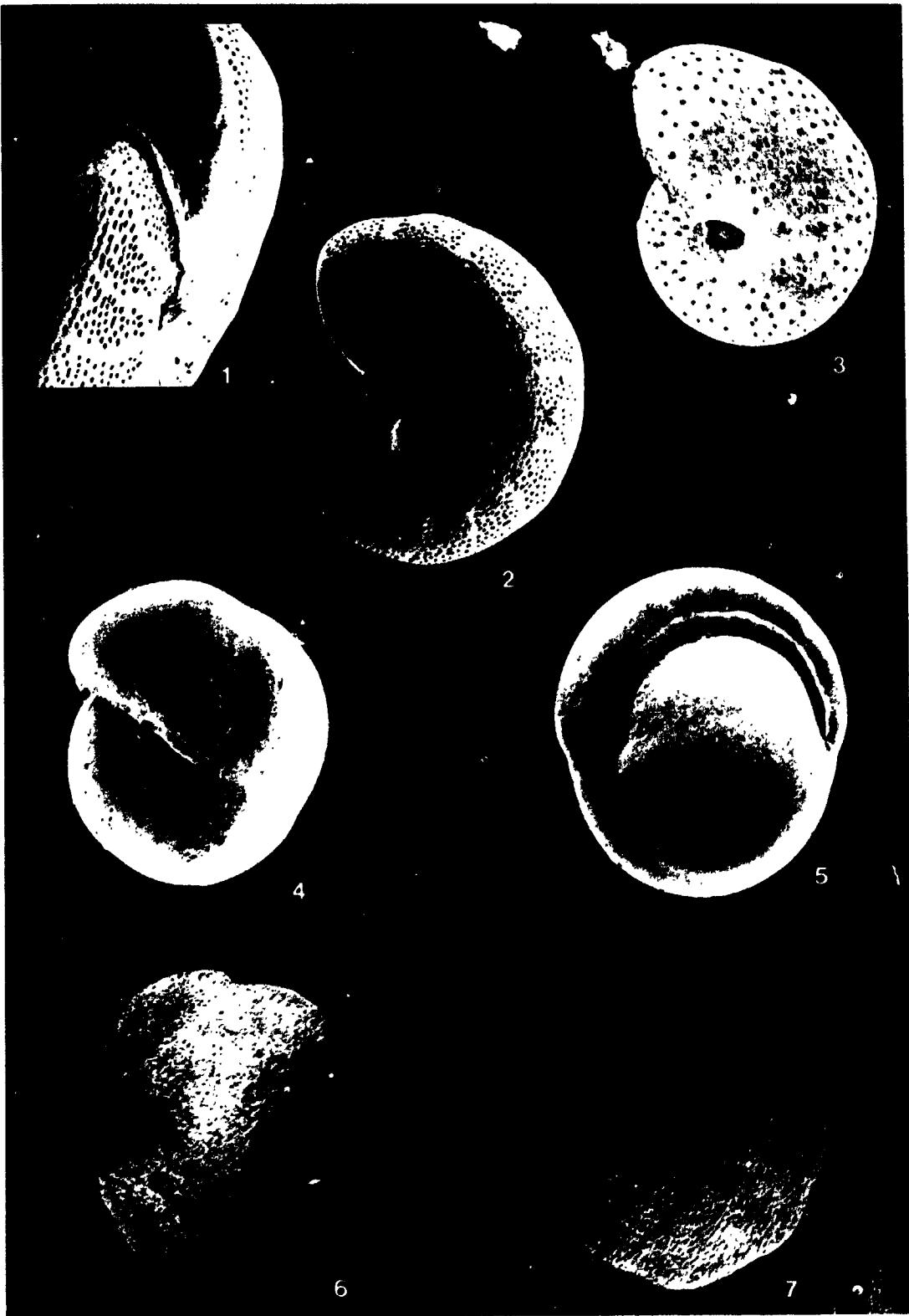
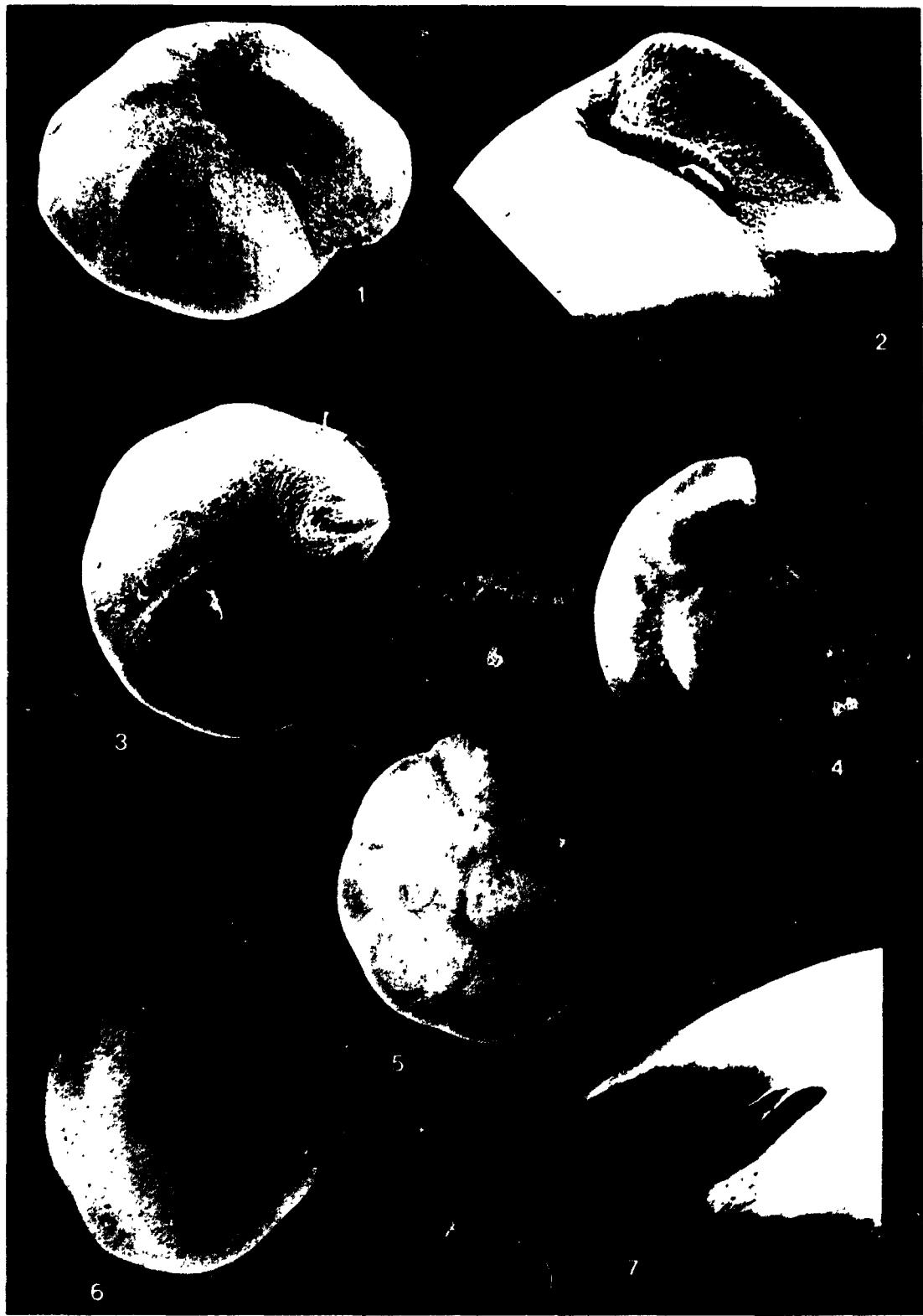


Plate 4

Figs. 1-4. Gyroidina altiformis Stewart and Stewart; sample PAR87a-01; 1. slightly oblique dorsal view X160; 2. edge view X230; 3. dorsal view X150; 4. ventral view X120.

Figs. 5-7. Gyroidina neosoldani Brotzen; sample PAR87a-01; 5. dorsal view X75; 6. slightly oblique ventral view X160; 7. edge view X400.



END

2|5|0|5|93|

FIN