

Planktonic foraminifera collected by the R/V *Hero*, cruise 71-4

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During cruise 71-4 (8 April to 30 August 1971) of the R/V *Hero* (Punta Arenas, Chile-Buenos Aires, Argentina) 560 samples of surface plankton were collected for use in various planktologic studies (Lena and Souto 1972). Of these samples, 302 were used in the work reported here in order to (1) study qualitatively and quantitatively the distribution of the collected planktonic foraminiferal fauna and (2) attempt to separate different water masses by the distribution of foraminifera.

The samples were collected as follows: Throughout the whole cruise, seawater was pumped and filtered for 30 minutes at 1-hour intervals. The net used to filter the seawater had openings of approximately 64-99 microns. The foraminifera were later separated in the laboratory from the plankton samples using the filter method (Boltovskoy 1966).

Planktonic foraminifera were found in only 94 of the 302 samples because most of the samples were collected near the coast of Argentina—not a favorable area for the development of planktonic foraminifera (Boltovskoy 1970).

Approximately 200 specimens were taken from each sample, except that all the specimens were separated when the sample contained less than 200 specimens. The specimens of each sample were counted to determine:

1. The total number of foraminifera.
2. The frequency of each species.
3. The percentages of the coiling morphotypes of *Globoquadrina pachyderma*. Mixed waters of the subtropical/subantarctic convergence zone are characterized predominantly by dextral forms (dextral:sinistral ratio of approximately 95:5), and pure subantarctic waters by sinistral forms (dextral:sinistral ratio of approximately 45:55) (Boltovskoy and Watanabe 1979).
4. The specific diversity index based on the Shannon-Wiener formula.

The quality of the planktonic foraminiferal fauna was poor because the samples were collected in cold-temperate waters (subantarctic waters) which are characterized by few planktonic species. Almost all foraminiferal fauna were

very small. The abundance of small specimens may be the result of juvenile foraminifera ascending to the surface in search of more favorable food conditions, then descending when they are somewhat larger.

Of the eight species found (see figure 1), six were typical of cold and cold-temperate waters (*Globoquadrina pachyderma*, *Globigerina bulloides*, *G. quinqueloba*, *Globigerinita uvula*, *Globorotalia inflata*, and *G. truncatulinoides*), one was cosmopolitan (*Globigerina glutinata*), and one was typical of warm and warm-temperate waters (*Globigerinoides ruber*) (Boltovskoy 1969).

On the basis of the faunistic content of the studied area, it was determined that the area is dominated by subantarctic waters. Only one species common to subtropical waters (*Globigerinoides ruber*) was found, in stations 273 (37°22'S 56°47'W) and 275 (37°02'S 56°31'W), and this species was represented by a few specimens.

Four hydrologic zones were established in the studied area on the basis of frequency of each species, the coiling ratio of *Globoquadrina pachyderma*, and the index of specific diversity (see figure 2):

1. *Coastal zone waters* (subantarctic waters slightly diluted by the influence of continental waters). The majority of the samples collected in this zone did not contain planktonic foraminifera. In those that did, the number of specimens was small (1 to 4) and generally belonged to *Globoquadrina*

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- Globigerina bulloides* Orbigny, 1826, Annales des Sciences Naturelles, Paris, v. 7, p. 277, no. 1, Mod. 17 & 76 = Banner and Blow, 1960, The Cushman Foundation for Foraminiferal Research Contributions, v. 11, no. 1, p. 3, pl. 1, figs. 1, 4 (lectotype).
- Globigerina quinqueloba* Natland, 1938, Scripps Institute of Oceanography Bulletin, Technical Series, v. 4, p. 149, pl. 6, figs. 18-21.
- Globigerinita glutinata* (Egger) = *Globigerina glutinata* Egger, 1893, Abhandlungen der Bayerischen Akademie der Wissenschaften, Mathematisch-Physikalische Klasse, München, Cl. II, v. 18, p. 371, pl. 13, figs. 19-21.
- Globigerinita uvula* (Ehrenberg) = *Pylodexia uvula* Ehrenberg, 1861, Monatsberichte der königlich Preussischen Akademie der Wissenschaften zu Berlin, p. 276, 277, 308; 1873, Abhandlungen der königlichen Akademie der Wissenschaften zu Berlin, Jahrgang 1872, pl. 2, figs. 24-25.
- Globigerinoides ruber* (Orbigny) = *Globigerina ruber* Orbigny, 1839, in: Ramon de la Sagra, Histoire physique, politique et naturelle de l'Ile de Cuba, "Foraminiferes," Paris, p. 82, pl. 4, figs. 12-14.
- Globoquadrina pachyderma* (Ehrenberg) = *Aristerospira pachyderma* Ehrenberg, 1861, Monatsberichte der königlich Preussischen Akademie der Wissenschaften zu Berlin, p. 276, 277, 303, 1873, Abhandlungen der königlichen Akademie der Wissenschaften zu Berlin, Jahrgang 1872, p. 396, pl. 1, fig. 4.
- Globoquadrina pachyderma* (Ehrenberg), *forma typica* Ehrenberg, *ut supra*.
- Globoquadrina pachyderma* (Ehrenberg), *forma superficialis* Boltovskoy, 1971, in: B. M. Funnell and W. R. Riedel, Eds., *The micropaleontology of oceans*, Cambridge University Press, p. 281.
- Globorotalia inflata* (Orbigny) = *Globigerina inflata* Orbigny, 1839, in: P. Barker-Webb et S. Berthelot, *Histoire naturelle des Iles Canaries, Foraminiferes*, Paris, v. 2, pt. 2, Zool., p. 134, pl. 2, figs. 7-9.
- Globorotalia truncatulinoides* (Orbigny) = *Rotalina truncatulinoides*, 1839, *Ibidem*, v. 2, pt. 2, p. 132, pl. 2, figs. 25-27.

Figure 1. List of species determined.

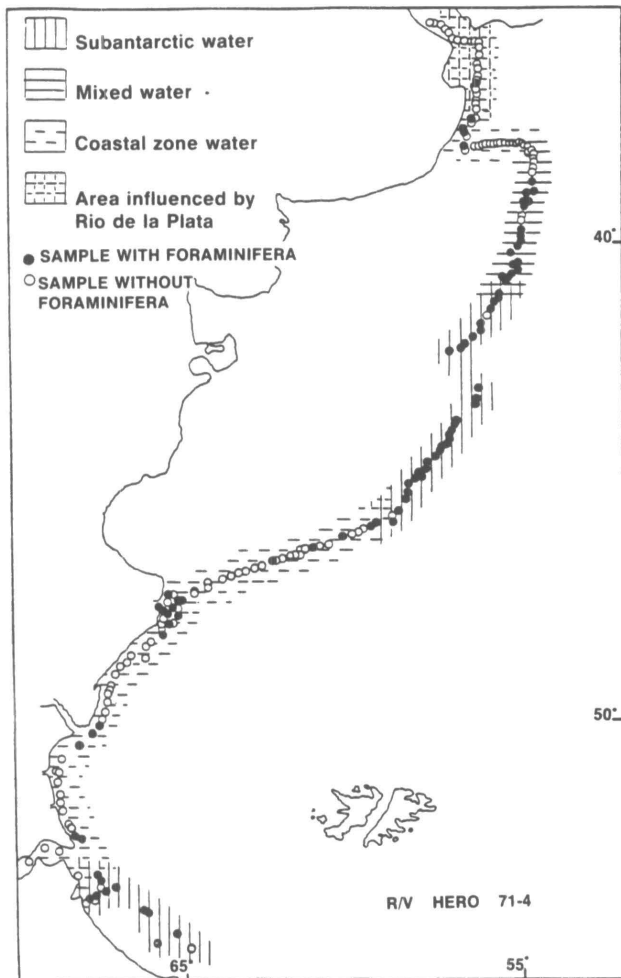


Figure 2. R/V *Hero*, Cruise 71-4. Sample locations and distributions of different water masses found during the cruise.

pachyderma (forma *superficiaria*) or *G. bulloides*. The exceptions were station 66 (47°27'S 65°31'W), where 94 specimens were collected and 7 species were determined, and station 103 (47°40'S 65°31'W), with 4 specimens and 2 species.

The index of specific diversity was zero except for stations 66 and 103, which had indexes of 2.49 and 1.00, respectively. The differences in values of diversity index and frequency of species and specimens between station 66 and the other stations suggest that station 66 was collected in an upwelling of subantarctic waters.

2. *Zone influenced by the Malvinas Current* (subantarctic waters). The number of species and specimens per sample in this zone was higher than in the others. Generally, the number of specimens ranged between 100 and 250, but in stations 161 (44°09'S 57°08'W), 164 (43°53'S 56°59'W), and 165 (43°30'S 56°22'W) the numbers of specimens were 1,500, 2,100, and 900, respectively.

The more abundant species were *Globoquadrina pachyderma* (f. *typica*), *G. pachyderma* (f. *superficiaria*), *G. bulloides*, and *Globorotalia inflata*.

The average percentage of sinistral specimens of *G. pachyderma* was 63.8 percent to the south of the Strait of Magellan and 34 percent to the north of 46°S. This last value, consid-

ered low for subantarctic waters, can be explained by the samples being collected near the western limit of the convergence zone. Near this limit there may be an increase in surface temperature that favors the development of dextral forms of *G. pachyderma* (Boltovskoy 1970; Ericson 1959).

The index of specific diversity ranged between 1.00 and 2.52, with an average index of 1.95. The lower index values were observed near the western and eastern limits of this zone.

3. *Subantarctic/subtropical convergence zone*. Only a few samples were collected in the western limit of this zone. The most abundant species were *Globoquadrina pachyderma* (f. *superficiaria*), indicating a dominance of subantarctic waters. The percentage of sinistral specimens of *G. pachyderma* ranged between 0 and 100 percent (average 43 percent), and the index of specific diversity ranged between 0 and 2.00 (average 1.23).

The variability is great because the convergence zone is made up of stripes and spots of different mixes of subtropical and subantarctic waters.

4. *Zone influenced by the Rio de la Plata*. This zone is characterized by the lack of planktonic foraminifera, since shallow depths and low salinity (less than 30 percent) prevent their development.

The presence of planktonic foraminifera (*Globigerina pachyderma*, f. *superficiaria*) in station 282 (36°16'S 56°26'W) is an exception and probably can be attributed to their being carried there by a storm.

The limits between these zones are plotted in figure 2. These limits coincide with those previously reported (Boltovskoy 1970, 1978; Lena 1976).

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