

## CRETACEOUS FORAMINIFERA OF ARGENTINA: BIOGEOGRAPHIC TENDENCES

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**ABSTRACT** During Cretaceous time, the Gondwana supercontinent palaeogeography suffered progressive changes which mainly controlled the benthonic Foraminifera distribution. In Argentina, the principal Cretaceous sedimentary basins are: Neuquén and Mendoza (plus Colorado in Maastrichtian time) and Magallanes. **Neuquén and Mendoza basins.** deposits are of Neocomian and Maastrichtian age. *Neocomian.* The assemblage shows biogeographic fluctuations; particularly in Berriasian, the low diversity is the reflect of the lack of stability of the western Argentina margin; from late Valanginian to Barremian the association is composed of wide distributed and/or cosmopolitan taxa. *Maastrichtian.* At the end of the Cretaceous in the Neuquén and Mendoza (plus Colorado) basins endemic taxa increase accompanied by Northern hemisphere, bipolar distributed, species evolving into the Neuquén, Mendoza and Colorado Subprovince. **Magallanes Basin.** It is located at the southwestern extreme of South America. The provincial features changed in response to Cretaceous geologic, ecologic, and oceanographic history. *Oxfordian-Barremian.* Assemblages are composed of wide distributed and/or cosmopolitan, malagachian, and endemic taxa; gradually decreased endemism provides the basis for the inference of the Magallanes Subprovince in the Oxfordian-Hauterivian which evolved into a lower rank unit – Endemic Center – in the Barremian. *Aptian-Albian.* Specific diversity is low; a Province rank is attributed to the interval. *Albian-Late Turonian.* The income of australian taxa and the presence of endemics provide the basis for the Magallanes Province recognition. *Coniacian-Campanian.* Australian taxa increase whereas endemics decline; the Magallanes Province persisted until this time. *Maastrichtian.* Widespread species of almost bipolar distribution characterizes the interval, accompanied by Austral Realm taxa; the provincial rank which persisted since Aptian times turned to the Magallanes Subprovince. Biogeographic comparison made between the Neuquén and Mendoza (plus Colorado in Maastrichtian time) and the Magallanes Basin benthonic Foraminifera shows sharp differences and strong provincial features; this fact is probably related to physical barriers (such as ridges and highs), ecological factors and plate tectonics.

**RESUMO** FORAMINÍFEROS CRETÁCEOS DA ARGENTINA: TENDÊNCIAS BIOGEOGRÁFICAS. Durante o Cretáceo, o supercontinente Gondwana experimentou sucessivas mudanças que controlaram a distribuição dos foraminíferos bentônicos. As principais bacias sedimentares cretácicas argentinas são as de Neuquén e Mendoza (incluindo a de Colorado no Maastrichtiano) e de Magallanes. **Bacias de Neuquén e Mendoza:** Os depósitos marinhos são de idade neocomiana e maastrichtiana. *Neocomiano:* A associação evidencia flutuações biogeográficas; particularmente durante o Berriasiano a baixa diversidade reflete a instabilidade da margem ocidental argentina; a partir do Valanginiano até o Barremiano os conjuntos microfaunísticos estão compostos por taxa de ampla distribuição e/ou cosmopolitas. *Maastrichtiano:* Ao final do Cretáceo, a bacia de Neuquén e Mendoza (incluindo a de Colorado) evidencia um aumento de espécies endêmicas acompanhadas por outras do hemisfério norte de distribuição bipolar, evoluindo na Subprovíncia de Neuquén, Mendoza e Colorado. **Bacia de Magallanes:** Localizada no extremo sudoeste da América do Sul. As características provinciais se modificaram em resposta à história geológica, ecológica e oceanográfica. *Oxfordiano-Barremiano:* As associações estão integradas por espécies de ampla distribuição geográfica e/ou cosmopolitas, da República Malgash (ex-Madagáscar) e endêmicas; uma diminuição gradual do endemismo fornece a base para a inferência da existência da Subprovíncia de Magallanes em tempos oxfordianos-hauterivianos que evoluíram até uma entidade de amplitude menor – Centro Endêmico – durante o Barremiano. *Aptiano-Albiano:* A diversidade é baixa; a amplitude da província é atribuída ao referido intervalo. *Albiano-Neo-Turoniano:* A presença de taxa australianos e endêmicos dá suporte para o reconhecimento da Província de Magallanes. *Coniaciano-Campaniano:* Os taxa australianos aumentam enquanto os endêmicos diminuem; a Província de Magallanes persistiu até este intervalo de tempo. *Maastrichtiano:* Espécies de ampla distribuição, quase bipolar, caracterizam o intervalo acompanhadas por taxa de domínio austral; a amplitude provincial que persistiu desde o Albiano se transformou na Subprovíncia de Magallanes. A comparação biogeográfica entre os foraminíferos bentônicos das bacias de Neuquén e Mendoza (incluindo a de Colorado durante o Maastrichtiano) e a de Magallanes mostra grandes diferenças e marcantes características provinciais; este fato está provavelmente relacionado a barreiras físicas (tais como dorsais e altos), fatores ecológicos e tectônica de placas.

**INTRODUCTION** The existence on the earth surface of biogeographic units based on several living organic groups is a fact clearly recognized in present times; the biotic differentiation is observed on terrestrial environments as well as in the marine ones. The causes which originate the faunal segregation are multiple and their interrelations complex, being the most important: a. ecological factors, such as temperature, salinity, pH, oxygen, substrate, food disponibility, nutrients, calcium carbonate, and microelements; b. physical, in particular land barriers and ocean deeps which impede the free dispersion of organisms and cause their isolation; c. geodinamical, such as sea floor spreading and continental drift, and d. oceanographic, in particular deep water masses and surficial currents. They are responsible – in a large extend – for the outling of bioentities and their fluctuations.

The purpose of this paper is to determine the Argentina Cretaceous marine patterns of biogeographic units based on benthonic Foraminifera species.

Most authors (Kauffman 1973) use the generic or subgeneric taxonomic level for paleobiogeographic inferences. Analysing Foraminifera, species are more reliable for the obtention of objective quantitative results in the definition of biogeographic units and their evolution, since genera and subgenera are mostly wide distributed geographically and tend to show a great tendency toward cosmopolitanism.

In Argentina, such its occurs in other areas, biogeographic tendencies show a changing picture along the Cretaceous, as a result of the natural history of the region.

In early Cretaceous (Berriasian-Albian) times, the distribution of marine and continental areas was markedly

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different than in the Recent (Fig. 1). In the southern hemisphere, South America, Africa, Antarctica, Australia, Madagascar and India stand physically united or more proximal forming the Gondwana supercontinent which occupied latitudinal positions different than those of today.

The Tethys sea covered geographic areas approximately equivalent to the present Mediterranean and Caribbean united, although of larger dimensions; to the west and east it was communicated with the remainder marine water masses. Southernwards a southern proto Atlantic ocean and an incipient southwestern Indic Ocean invaded freely African and South American meridional areas; in the Southern hemisphere these incipient oceans constituted the geographic dispersal way of several biologic groups, among others, the benthonic Foraminifera.

In late Cretaceous (Cenomanian-Maastrichtian) time (Fig. 2), beside other significant palaeogeographic modifications, the interval is essentially characterized by continuous Atlantic spreading, segregation of the Gondwana supercontinent and the consequent free communication between the North and South Atlantic oceans, changes in paleocirculation pattern and new migratory ways, among other important effects.

**METHODS** In order to analyze Argentina foraminiferal assemblages, their palaeobiogeographic features and the evolution during the Cretaceous, the available taxonomic information is listed and the assemblages compared with those of other regions.

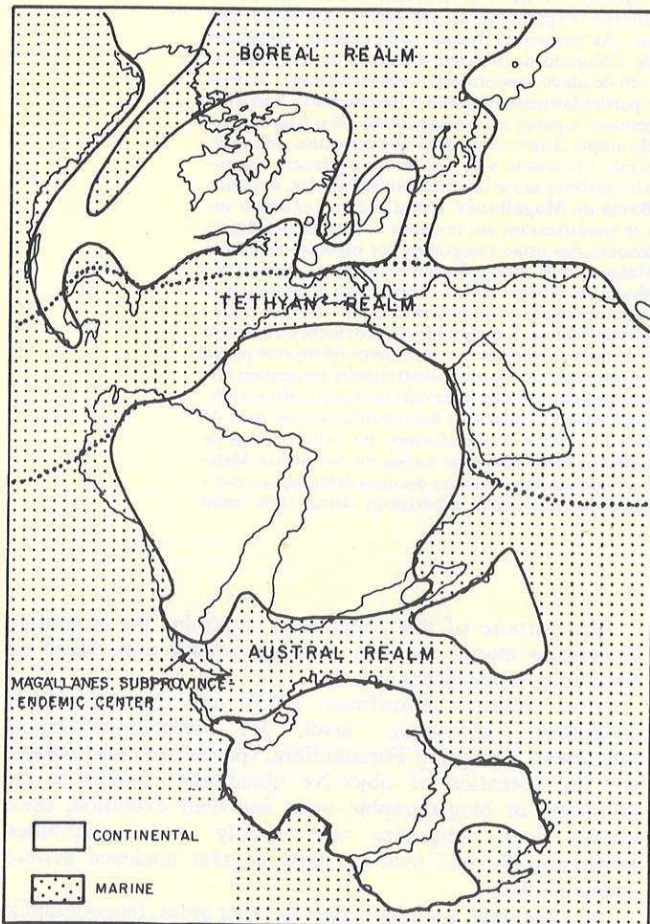


Figure 1 - Distribution of land and sea areas in the Early Cretaceous (Berriasian-Barremian) (in part after Tedford, 1974). In Argentina the Neuquén and Mendoza basin benthonic foraminiferal assemblage is of wide geographic distribution; the Magallanes assemblage is representative of a Subprovince (Oxfordian-Hauterivian) and an Endemic Center (Barremian).

Taxonomic determinations made by several authors are used in their original sense; no attempt is made for taxonomic modifications. With the finality to incorporate the largest number of species as possible, the following criteria have been adopted: a. species which are classified only at the generic level are ignored; b. those taxa introduced in the literature as *cf.* or *aff.* are interpreted to belong to the taxonomic unit with which they are compared or show affinities; c. species classified with a question mark (?) are assigned to the taxon; d. subspecies are considered as species.

For the obtention of quantitative results, the criteria proposed by Simpson (1943), Johnson (1971) and Kauffman (1973) are used.

Simpson Coefficient is given by the formula (Simpson 1943):

$$SC = \frac{C}{N_1} \cdot 100 \quad (1)$$

Johnson (1972) Provincial Index equation is:

$$PI = \frac{C}{2E_1} \quad (2)$$

where:

SC = Simpson Coefficient

PI = Provincial Index

C = Number of common species to both compared areas

$N_1$  = Total number of species of the smaller population

$E_1$  = Number of endemic taxa in the area under consideration

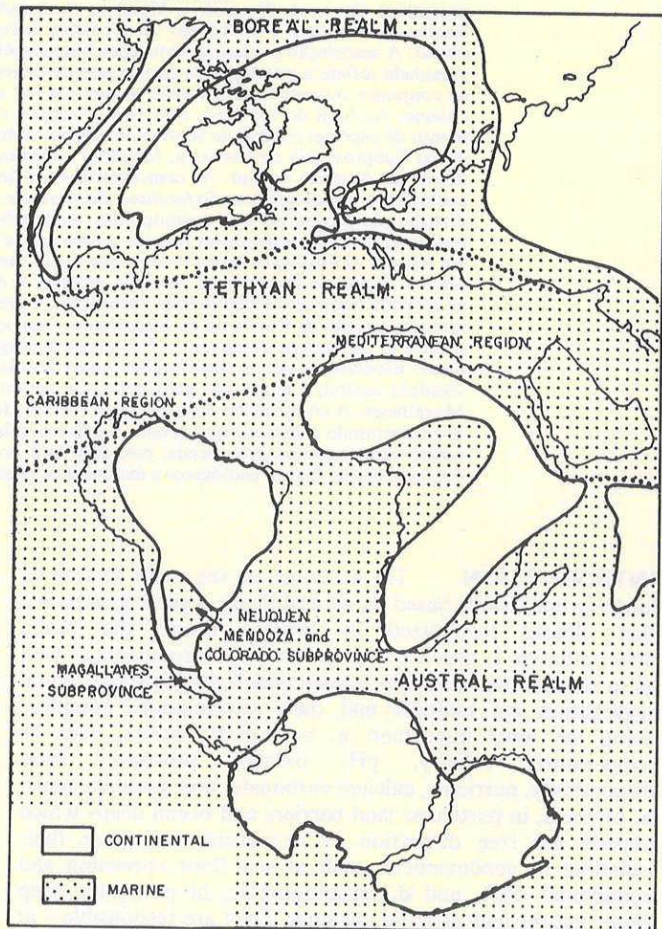


Figure 2 - Distribution of land and sea in the Late Cretaceous (Maastrichtian) (in part after Tedford, 1974). In Argentina the Neuquén and Mendoza (+ Colorado) basins assemblage, of bipolar distribution and endemics, denote a Subprovince; in the Magallanes basin the homonymous Subprovince is recognized.

Kauffman (*op. cit.*) proposed the differentiation of Cretaceous biogeographic units having into account the degree of endemism in a given area; these are: **a.** Endemic Center, with 5-10% of endemic genera; **b.** Subprovince 10-15%; **c.** Province 25-50%; **d.** Region 50-75% and Realm > 75% of endemic genera.

Using Simpson Coefficient, values higher than 60 indicate cosmopolitanism and minor endemism. Applying Johnson Provincial Index values minor than 1 satisfy provincial conditions; higher values coincide with cosmopolitan situations.

In several figures, the Argentina recorded taxa are listed according to their stratigraphic range and basin occurrence; in these lists, asterisk (\*) indicate the geographic occurrence of the species as follows:

- \* Afromalgachian species
- \*\* Australian species
- \*\*\* Endemic species

Taxa classified at the specific level with no asterisk are of wide geographic distribution.

The outlining of paleobiogeographic units are calculated quantitatively having into account the total endemic taxa in regional space and time.

**CRETACEOUS MARINE SEDIMENTARY BASINS OF ARGENTINA** Late Malm or Araucanian tectonic movements modified substantially the distribution of erosive areas and depositional centers; the previous behaviour of the southernmost extreme of South America had a cratonic or quasi cratonic character (Urien *et al.* 1981).

The basins in which early Cretaceous marine sedimentation is registered are: **a.** Neuquén and Mendoza, and **b.** Magallanes.

During late Cretaceous time, sea level changes allowed the

ingressions in the areas: **a.** Sierras Subandinas-Cordillera Oriental; **b.** Neuquén and Mendoza and Colorado basins, which were united at the end of the Cretaceous; and **c.** Magallanes basin.

**Sierras Subandinas - Cordillera Oriental** Late Cretaceous deposits are of marginal nature; foraminiferal microfaunas are extremely poor.

The only Foraminifera cited belong to the genera *Discorbis*, *Valvulineria*, *Lingulogavelinella*, *Oritostella*, and *Bilingulogavelinella* of Senonian age (Méndez & Viviers 1973) and *Miliolinella* of Maastrichtian age (Kielbowicz & Angelozzi 1984).

Due to the scarce micropaleontological material it is not possible to realize an quantitative faunal analysis.

**Neuquén and Mendoza Basins** (Figs. 3a-c, 4a-b) Marine sedimentation is registered since the Jurassic. During early Cretaceous (Berriasian-Barremian), a succession of lithostratigraphic units were deposited; the nature of this deposits is preponderantly marine and probably - in a large part - of restricted environment.

During the ?Albian-?Campanian interval marine sedimentation was interrupted; only in the Maastrichtian a new high sea level stand is registered.

The late Cretaceous Interseonion tectonic movements produced a change in the regional slope; with this event the first neatly atlantic ingression took place in the basin. During Maastrichtian time, the Neuquén and Mendoza and Colorado basins stand united. Marine and in some cases polihaline deposits were preceded by a marked subsidence, particularly in areas of the present day Colorado and Negro rivers courses, accompanied by a sedimentation of continental aquatic environment, probably lagoons, marhes etc.

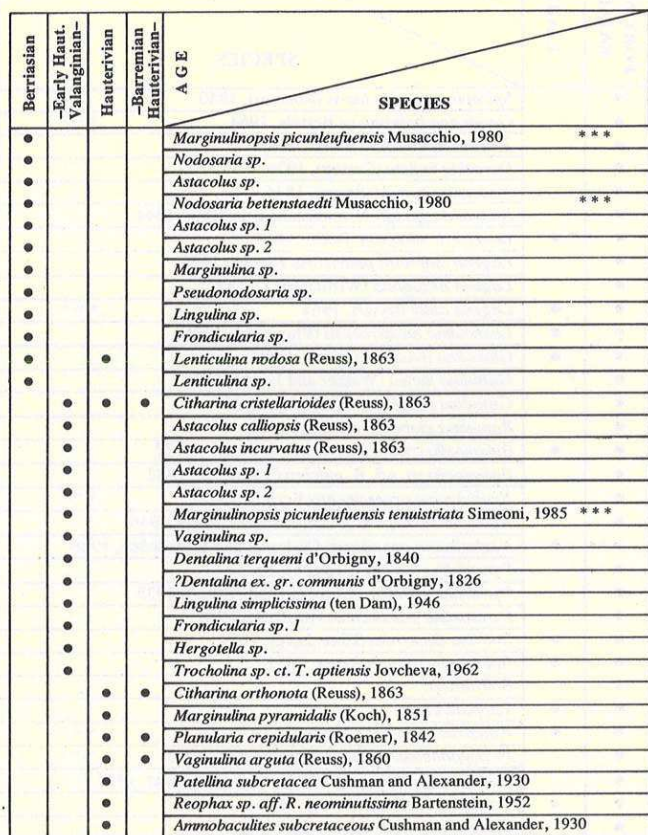


Figure 3a - Stratigraphic distribution of Early Cretaceous (Berriasian-Barremian) benthonic Foraminifera in the Neuquén and Mendoza basin

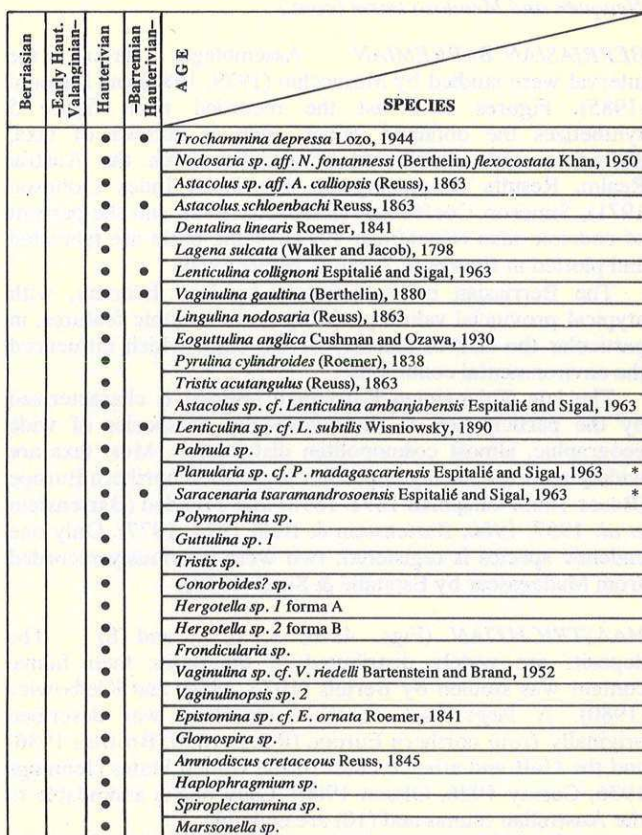


Figure 3b - Stratigraphic distribution of Early Cretaceous (Berriasian-Barremian) benthonic Foraminifera in the Neuquén and Mendoza basin (cont.)

Berriasian	Early Haut-Valanginian	Hauterivian	Barremian	Hauterivian	AGE	SPECIES
						<i>Cyclogyra</i> sp.
						<i>Wellmanella</i> ? sp.
						<i>Miliammina</i> sp.
						<i>Dentalina</i> sp. cf. <i>D. communis</i> d'Orbigny, 1826
						<i>Maegulinina</i> sp. 1
						<i>Marginulina</i> sp. 2
						<i>Spirofrondicularia frondicularioides</i> (Chapman), 1984
						<i>Lingulina</i> sp.
						<i>Globulina</i> sp.
						<i>Pyrollinoides</i> ? sp.
						<i>Glandulopleurostomella</i> ? sp.
						<i>Pseudopolymorphina</i> sp. cf. <i>P. roanokoensis</i> Tappan, 1943
						<i>Epistomina</i> sp.
						<i>Astaculus</i> sp. cf. <i>A. calliopsis</i> (Reuss), 1863
						<i>Planularia madagascariensis</i> Espitalié and Sigal, 1963 *
						<i>Lenticulina ambanjabensis</i> Espitalié and Sigal, 1963
						<i>Marssonella</i> sp.
						<i>Miliammina</i> sp.
						<i>Cyclogyra</i> sp.
						<i>Pseudonodosaria</i> sp.
						<i>Astaculus</i> sp.
						<i>Lenticulina</i> sp.
						<i>Trisix</i> sp.
						<i>Marginulina</i> sp.
						<i>Epistomina</i> sp.
						<i>Pyrollina</i> sp.
						<i>Eoguttulina</i> sp.
						<i>Conorboides</i> sp.

Figure 3c – Stratigraphic distribution of Early Cretaceous (Berriasian-Barremian) benthonic Foraminifera in the Neuquén and Mendoza basin (cont.)

**BERRIASIAN-BARREMIAN** Assemblages from the interval were studied by Musacchio (1979, 1980) and Simeoni (1985). Figures 3a-c list the recorded taxa; figure 5 synthesizes the obtained values, such as number of taxa, endemics, wide distributed or peculiar from the Austral Realm. Results concerning the Provincial Index (Johnson 1971), Simpson Coefficient (Simpson 1943), and the percent of endemic taxa (Kauffman 1973) of the basin are tabulated and plotted in figures 6, 7, and 8, respectively.

The Berriasian is characterized by low diversity, with atypical provincial values probably do to tectonic features, in particular the lack of stability of the basin which influenced the environmental conditions.

The late Valanginian-Barremian interval is characterized by the participation in the community of species of wide geographic, almost cosmopolitan distribution. Most taxa are widely recorded, being important to mention northern Europe (Reuss 1863, Chapman 1891-1898) and Trinidad (Bartenstein et al. 1957, 1966, Bartenstein & Bolli 1973, 1977). Only one endemic species is registered; two were previously recorded from Madagascar by Espitalié & Sigal (1963).

**MAASTRICHTIAN** (Figs. 4a-b; 5, 6, 7 and 8) The deposits are widely distributed in the basin; their faunal content was studied by Bertels (1972, 1980) and Kielbowicz (1980). A large part of the assemblage was described originally from northern Europe (Reuss 1850, Brotzen 1936) and the Gulf and atlantic coast of the United States (Jennings 1936, Carsey 1926, Olsson 1960). Only one is assimilable to the Australian faunas and (10) are endemic.

Besides the endemic taxa, the principal feature of the association is the bipolar distribution; the latitudinal dispersal lost their cosmopolitan or wide distributed character such it was evident in early Cretaceous times. The Subprovince of

Neuquén, Mendoza and Colorado is recognized. **PALAEOBIOGEOGRAPHIC TENDENCES IN THE NEUQUÉN AND MENDOZA (PLUS COLORADO IN THE MAASTRICHTIAN) BASINS** During early Cretaceous time, the South American and African continents stand united or very close; climates were more uniform and latitudinal thermal gradients lesser than today; in marine areas the paleotemperature belts were much broader and gradational than in recent times. The marine current designs probably followed and approximately circumcontinental model. This hypothesis is supported by the fact of the practically cosmopolitan or wide distributed biota, although large Realms are differentiated: the Tethyan owing to the participation in the associations of large Foraminifera which – in analogy with the actual representatives – principally require warm water for their existence, the Boreal and the Austral.

The Neuquén and Mendoza basins early Cretaceous (Berriasian-Barremian) microfauna is composed by wide geographic distributed almost cosmopolitan taxa; no provincial features can be distinguished.

During late Cretaceous time, the latitudinal distribution of microfaunas lost their accentuated cosmopolitan, or wide distributed features, such as occurred earlier. The paleogeography is modified: South America is separated from Africa approximately 50-75% with respect to the present (Berggren & Phillips 1971). As a consequence of continental migration, changes in the marine circulation pattern were

FORTIN GENERAL ROCA BAJADA DEL JAGUEL	LAGO PELLEGRINI	LOCALITY	SPECIES
			<i>Spiroplectammina laevis</i> (Roemer), 1840
			<i>Gaudryina boltovskoyi</i> Bertels, 1964 ***
			<i>Tritaxia pyramidata</i> Reuss, 1863
			<i>Dorothia bulleta</i> (Carsey), 1926
			<i>Nodosaria marcki</i> (Reuss), 1846
			<i>Nodosaria</i> sp. aff. <i>N. torsicostata</i> ten Dam, 1944
			<i>Lagena acuticostata</i> Reuss, 1863
			<i>Lagena amphora paucicosta</i> Franke, 1928
			<i>Lagena hexagona</i> (Williamson), 1848
			<i>Lagena atilai</i> Bertels, 1964 ***
			<i>Lenticulina navarroensis</i> (Plummer), 1926
			<i>Globulina inaequalis</i> Reuss, 1850
			<i>Guttulina lactea</i> (Walker and Jacob), 1784
			<i>Guttulina problema</i> d'Orbigny, 1826
			<i>Ramulina globulifera</i> Brady, 1879
			<i>Buliminella pseudeolegantissima</i> Bertels, 1972
			<i>Buliminella</i> sp. aff. <i>B. pulchra</i> (Terquem), 1882
			<i>Neobulimina argentinensis</i> Bertels, 1972 ***
			<i>Neobulimina aspera</i> (Cushman and Parker), 1940
			<i>Neobulimina canadensis</i> Cushman and Wickenden, 1928
			<i>Pyramidina rugosa</i> (Brotzen), 1945
			<i>Pyramidina proluxa</i> (Cushman and Parker), 1935
			<i>Pyramidina paleocenica</i> (Brotzen), 1948
			<i>Bolivina decurrens</i> (Ehrenberg), 1854
			<i>Bolivina incrassata</i> Reuss, 1851
			<i>Bolivina</i> sp.
			<i>Tappanina</i> ? sp.
			<i>Hiltermannella kochi</i> (Bertels), 1970 ***
			<i>Praeglobulimina jaguelensis</i> Bertels, 1972 ***
			<i>Pseudovigerina</i> sp. aff. <i>P. cimbrica</i> (Troelsen), 1937
			<i>Cassidella tegulata</i> (Reuss), 1845
			<i>Coriphostoma plaita</i> (Carsey), 1926
			<i>Stilostomella spinosa</i> (Hofker), 1956

Figure 4a – Maastrichtian Foraminifera of the Neuquén and Mendoza and Colorado basins

FORTIN GENERAL ROCA BAJADA DEL JAGUEL	LAGO PELLERINI	LOCALITY	SPECIES
•	•		"Discorbis" <i>correcta</i> Carsey, 1926
•	•		<i>Valvulinera?</i> sp.
•	•		<i>Eponides lunata</i> Brotzen, 1949
•	•		<i>Cibicides reinholdi</i> ten Dam, 1944
•	•		<i>Nonionella cretacea</i> Cushman, 1931
•	•		<i>Nonionella?</i> sp.
•	•		<i>Pullenia</i> sp.
•	•		<i>Alabamina kaaschieteri</i> Bertels, 1964 ***
•	•		<i>Anomalinooides pinguis</i> (Jennings), 1946
•	•		<i>Anomalinooides</i> sp.
•	•		<i>Gavelinella camacho</i> Bertels, 1964 ***
•	•		<i>Gavelinella jagueliana</i> Bertels, 1980 ***
•	•		<i>Gavelinella neuquense</i> Bertels, 1980 ***
•	•		<i>Ammobaculites</i> sp. cf. <i>A. implanus</i> Crespin, 1963 **
•	•		<i>Lagena hystrix</i> Reuss, 1863
•	•		<i>Lagena</i> sp.
•	•		<i>Siphogena faveolata</i> (Reuss), 1863
•	•		<i>Nodosaria obscura</i> Reuss, 1845
•	•		<i>Rectoglandulina</i> sp. cf. <i>Glandulina laevigata</i> (d'Orbigny), 1826
•	•		<i>Dentalina</i> sp. cf. <i>D. inornata</i> d'Orbigny, 1826
•	•		<i>Lenticulina gryi</i> Brotzen, 1948
•	•		<i>Planularia</i> sp.
•	•		<i>Citharina</i> sp.
•	•		<i>Glandulina acuminata</i> Costa, 1800
•	•		<i>Fissurina carinata</i> Reuss, 1863
•	•		<i>Fissurina</i> sp.
•	•		<i>Globulina gibba</i> (d'Orbigny), 1826
•	•		<i>Globulina inaequalis</i> Reuss, 1850
•	•		<i>Glottulina problema</i> var. <i>arcuata</i> Cushman, 1944
•	•		<i>Guttulina lactea</i> var. <i>elongata</i> Haynes, 1958
•	•		<i>Ramulina</i> sp.
•	•		<i>Turrispirulina</i> sp. cf. <i>T. subconica</i> Tappan, 1943
•	•		<i>Nonionella</i> sp. cf. <i>N. austinana</i> Cushman, 1932

Figure 4b - Maastrichtian foraminifera of the Neuquén and Mendoza Colorado basins (cont.)

introduced in the world's ocean as well as more pronounced latitudinal thermal gradients - than in early Cretaceous - which also modified the distribution of benthonic Foraminifera. These facts incided in the biotic differentiation at late Cretaceous times, a fact which became much more accentuated during the Cenozoic owing to the paulatine climatic deterioration.

The Boreal, Tethyan, and Austral Realm are recognized; in late Cretaceous times, in the Tethyan Realm, the Caribbean and the Mediterranean regions are distinguished in spite of their own large Foraminifera.

In Argentina, toward the end of the Cretaceous the Neuquén Mendoza and Colorado Subprovince is outlined by means of the participation in the largest part of the assemblages of endemic and bipolar distributed taxa.

**Magallanes Basins** (Figs. 9a-d, 10a-c; 11, 12, 13 and 14) It is located in the austral extreme of South America; it was an eugeosincline of SW-NE trend with a sedimentary thickness of about 6,650 m accumulated during Mesozoic time (Urien *et al.* 1981).

The sedimentary cycle is intimately related to the Araucanian (Oxfordian) diastrophic movements; the deposits are post-orogenic and in many cases they show "flyschoid" features (Urien *et al. op. cit.*).

The stratigraphy and microfaunas are principally known from the Argentina-Chile Andes and from extraandean

AGE	RESULTS									
	Nr. RECORDED SPECIES	Nr. SPECIES IN OPEN NOMENCLATURE	Nr. ENDEMIC SPECIES	Nr. SPECIES OF THE AUSTRAL REALM	Nr. WIDE DISTRIBUTED SPECIES	PI (FOR THE BASIN ENDEMIC SPECIES)	PI (FOR THE AUSTRAL REALM SPECIES)	SC = SIMPSON COEFFICIENT	% ENDEMIC SPECIES	% AUSTRAL REALM SPECIES
Maastrichtian	66	11	10	11	37	1.85	1.68	67.27	18.18	20
-Barremian Hauterivian-	25	12	-	1	12	-	6	92.30	0	8.33
Early Hauterivian	55	23	-	2	30	0	7.5	92.75	-	6.25
Early Hauterivian Late Valanginian-	13	5	1	1	7	3.5	3.5	87.50	12.50	12.50
Berriasian	12	9	2	2	1	0.25	0.25	33.33	66.66	66.66

Figure 5 - Quantitative results obtained from the benthonic Foraminifera analysis of the Neuquén and Mendoza (Berriasian-Barremian) and Neuquén, Mendoza and Colorado (maastrichtian) basins

boreholes; they were investigated by Malumian (1968), Sigal *et al.* (1970), Malumian *et al.* (1971), Flores *et al.* (1974), Natland *et al.* (1974) Cañón & Ernst (1974), Malumian & Masiuk (1975, 1977), Kielbowicz *et al.* (1983), and Malumian & Nález (1983).

The chronostratigraphic correlation of the sedimentary succession is in general very broad, being difficult to conciliate the several authors criterion. The used discernment is explained in Bertels (1986). The analyzed intervals are shown in figures 9a-d and 10a-c; the results in figures 11, 12, 13 and 14.

**OXFORDIAN-BARREMIAN** The main character is the presence of wide distributed and the participation of malgachian taxa, although northern hemisphere species surpass widely in number the Madagascar ones. In the Austral Realm the Malgachian Region is recognized; having into account the obtained values, but in particular the percentage of endemic taxa, the Magallanes Subprovince can be recognized for the Oxfordian-Hauterivian, whereas the decreasing of endemics indicate a lower rank unit - Endemic Center - for the Barremian.

**APTIAN-ALBIAN** The specific diversity is low; only 15 taxa are cited; nevertheless, the obtained values allow to infere provincial features for the interval. The absence of African and Australian species is remarkable; in the incipient South Atlantic, Scheibnerova (1978) noted Australian influences, whereas Sliter (1974) postulated for the regional faunas provincial features, low temperatures, and restricted oceanic interchange.

**ALBIAN-LATE TURONIAN** The slow income of Australian species as well as the increase of edemic taxa is registered; the resting assemblage is composed by wide distributed species. Having into account all obtained quantitative results in the Austral Realm and the Malgachian Region the Magallanes Province is neatly differentiated (Fig. 12, 13 and 14).

**CONIACIAN-CAMPANIAN** When compared with Albian-Late Turonian assemblages an increase of Australian taxa, proportional to the total community, as well as a diminution of endemic taxa, is registered. The obtained quantitative values (Figs. 12, 13 and 14), but particularly the percentage of endemics, reflect a similar trend than since Aptian times.

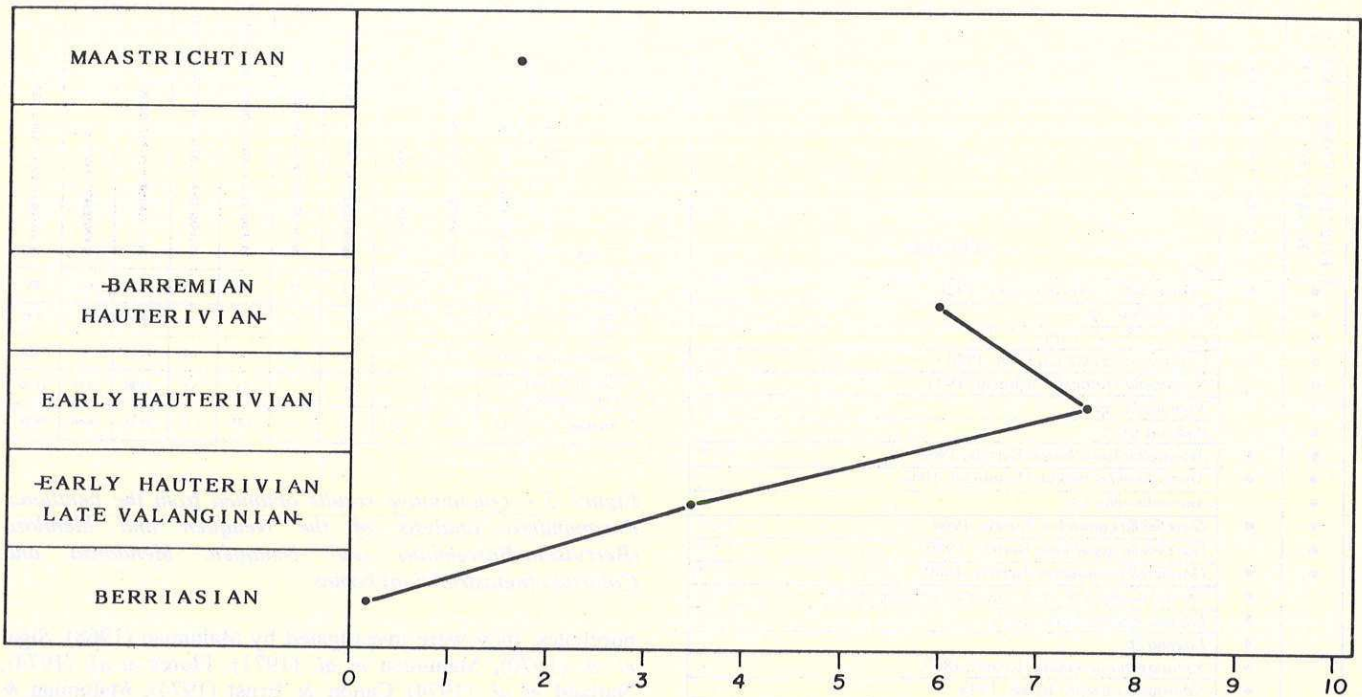


Figure 6 - Provincial Index plotted values for the Neuquén and Mendoza (Berriasian-Barremian) and Neuquén, Mendoza and Colorado (Maastrichtian) basins (total austral species)

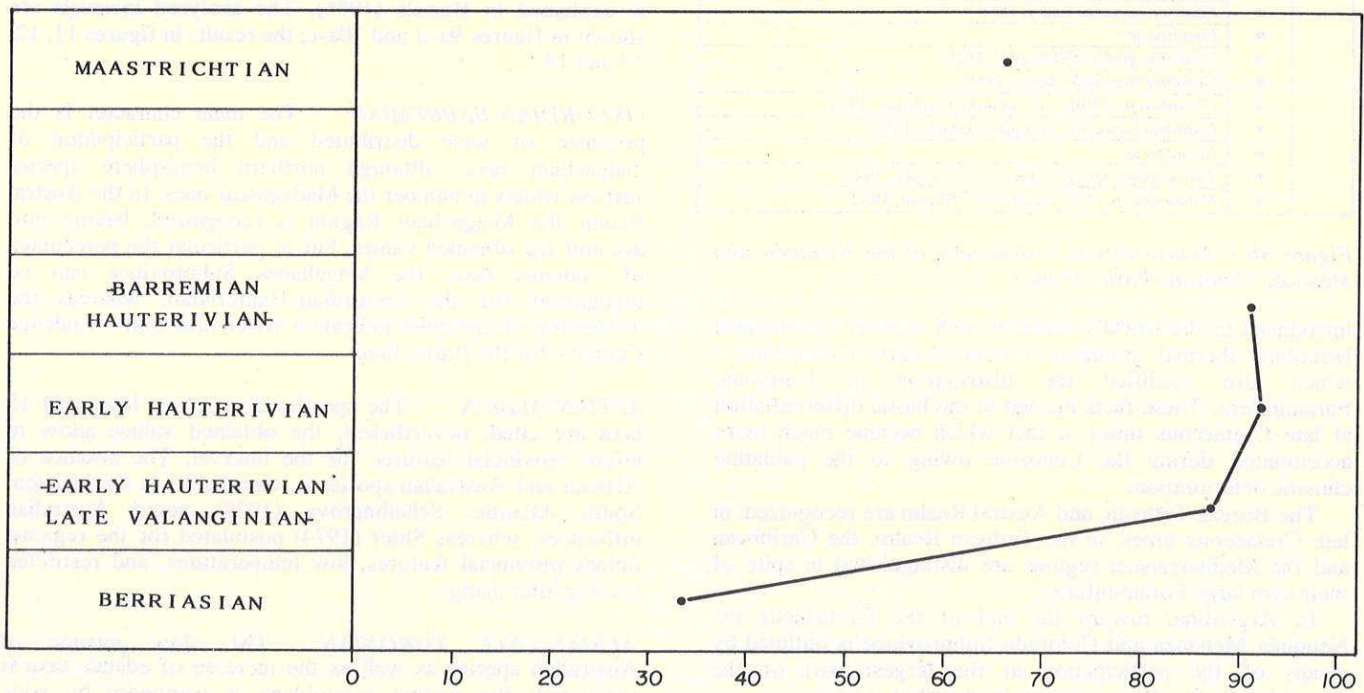


Figure 7 - Simpson Coefficient plotted values for the Neuquén and Mendoza (Berriasian-Barremian) and Neuquén, Mendoza and Colorado (Maastrichtian) basins

**MAASTRICHTIAN** All obtained quantitative data indicate cosmopolitan features for the time; nevertheless the bipolar distribution of the assemblages is remarkable, such it occurred since the beginning of the Late Cretaceous; only two taxa are endemic and 12 are restricted to the Austral Realm. The bipolar distribution contributes for the recognition of the Magallanes Subprovince.

**PALAEOBIOGEOGRAPHIC TENDENCES IN THE MAGALLANES BASIN** The specific diversity, expressed in their simplest form (number of taxa), is always low, particularly when compared with the Boreal and Tethyan Realms benthonic Foraminifera assemblages. In the Magallanes Basin this fact is the result of several factors being the most important the evolutionary immaturity of the

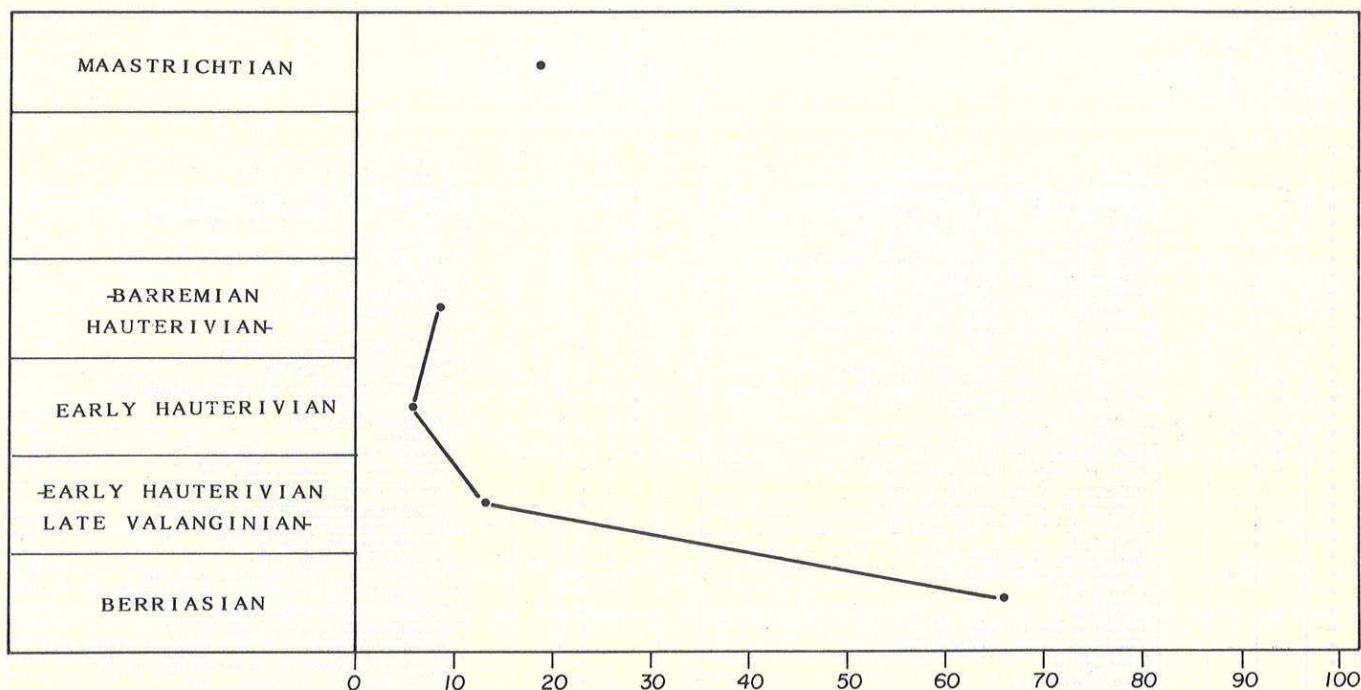


Figure 8 – Percentage of endemic taxa of the Neuquén and Mendoza (Berriasian-Barremian) and Neuquén, Mendoza and Colorado (Maastrichtian) basins (total austral species)

area, lack of tectonic stability, sedimentary conditions, existence of geographic barriers, preservation and in some geologic times the prevailing anoxic conditions in the proto South Atlantic.

During the Neocomian, the Magallanes Basin benthonic Foraminifera assemblage is peculiarized by the marked participation of afromalgachian elements (cf. Espitalié & Sigal 1963, McLachlan *et al.* 1976); nevertheless the malgachian participation, beside the endemics, the association has a remarkable contribution of wide distributed, almost cosmopolitan, taxa. The more uniform world marine ecologic conditions and lesser latitudinal thermal gradients allowed the dispersal of benthonic Foraminifera over wide marine areas and their life in all Realms.

In spite of the endemic taxa the Magallanes Subprovince is recognized for the Oxfordian-Hauterivian interval, whereas the decreasing of peculiar species in Barremian times provides quantitative data for the recognition of an Endemic Center.

The Aptian-Late Turonian interval, having into account all the obtained values, is characterized by a marked provincialism and small contribution of Australian taxa in Albian-Late Turonian times. Obviating the low diversity, the biogeographic feature is the result of the endemic species percentage; in the interval, the existence of the Magallanes Province is recognized, considering principally Kauffman (1973) proposed ranks.

At Turonian times, the North and South Atlantic communication was definitively established and the free dispersion of organisms was feasible throughout this migratory way.

The microfauna of the Coniacian-Campanian is characterized by the participation of some Australian elements and the presence of Foraminifera of essentially bipolar distribution. Johnson Provincial Index and Simpson Coefficient indicate values near the boundary of provincial-endemic situations, whereas the percent of endemics reflect provincial rank; thus the Magallanes Province persisted since Aptian time.

In Maastrichtian time, endemic species percentage reduce slowly as well as the participation of Australian elements; this fact is directly related to the increment of preferently bipolar distributed taxa; although the quantitative results indicate cosmopolitan situation, the bipolar features of the benthonic Foraminifera indicate the existence of the Magallanes Subprovince. In the basin it is remarkable the decline in rank in the Late Cretaceous.

At the end of the Cretaceous, the palaeogeographic features in the South Atlantic differed markedly from those of Early Cretaceous times; sea floor spreading and continental drift influenced greatly in the South Atlantic natural history. This fact brought progressive changes in the circulation pattern which probably lead to the decrease of water temperatures and a more prominent marine climatic zonation, which restricted the geographic distribution of benthonic Foraminifera to some climatic belts, giving rise to bipolar distributions such is the case in the basin.

**COMPARISON BETWEEN THE ASSOCIATIONS OF THE NEUQUÉN AND MENDOZA (+ COLORADO) AND MAGALLANES BASINS** Early Cretaceous (Berriasian-Barremian) assemblage which colonized the Neuquén and Mendoza and Magallanes basins allow to infer several differences between both microfaunistic communities for same chronostratigraphic intervals.

For the considered time, (42) valid species are known from the Neuquén and Mendoza basins whereas (47) valid taxa were recorded from the Magallanes Basin; the minor association is that of the Neuquén and Mendoza basin.

Common species to both basins, mentioned until the present, are only nine: *Planularia madagascariensis* Espitalié & Sigal, *Lenticulina (L.) nodosa nodosa* (Reuss), *Saracenaria tsaramandrosoensis* Espitalié & Sigal, *Lenticulina* sp. cf. *L. subtilis* (Wisniowski), *Lenticulina crepidularis* (Roemer), *Eoguttulina* sp. cf. *E. anglica* Cushman & Ozawa, *Nodosaria fontannesi* (Berthelin), *Dentalina linearis* (Roemer), and *Lingulina nodosaria* Reuss.

-VALANGINIAN- OXFORDIAN-	-HAUTERIVIAN- VALANGINIAN-	BARREMIAN	-ALBIAN- APTIAN-	AGE	SPECIES
•					<i>Marssonella metaformis</i> Espitalié and Sigal, 1963 *
•					<i>Lenticulina</i> sp. aff. <i>L. dincantos</i> Espitalié and Sigal, 1963 *
•					<i>Planularia madagascariensis</i> Espitalié and Sigal, 1963 *
•					<i>Vaginulina instabilis</i> var. <i>micro</i> Subbotina and Datta, 1960
•					<i>Reinholdella</i> sp. cf. <i>R. quadricula</i> Subbotina and Datta, 1960
•					<i>Haplophragmoides</i> sp. cf. <i>H. haesleri</i> Lloyd, 1959
•					<i>Annobaculites</i> sp. cf. <i>A. cobani</i> Loeblich and Tappan, 1950
•					<i>Annobaculites</i> sp. cf. <i>A. humei</i> Nauss, 1947
•					<i>Annobaculites</i> sp. cf. <i>A. infravolgensis</i> Myatlyuk, 1939
•					<i>Annobaculites</i> sp. cf. <i>A. bulayi</i> Loeblich and Tappan, 1950
•					<i>Annobaculites</i> sp. cf. <i>A. spongiphilus</i> Seibold and Seibold, 1960
•					<i>Lenticulina</i> sp. cf. <i>L. atheria</i> Dain, 1960
•					<i>Astacolus</i> sp. cf. <i>A. agalmatus</i> Loeblich and Tappan, 1950
•					<i>Saracenaria pravoslavlevi</i> Fursenko and Polenova, 1960
•					<i>Astacolus microdictyotus</i> Espitalié and Sigal, 1963 *
•					<i>Astacolus stillus</i> (Terquem), 1866
•					<i>Astacolus tricarinelus</i> (Reuss), 1863
•					<i>Lenticulina reyesi</i> Cañón and Ernst, 1974 ***
•					<i>Polymorphina martinezi</i> Cañón and Ernst, 1974 ***
•					<i>Hoeglundina porcellanea</i> (Brückmann), 1904
•					<i>Reinholdella fuezaldai</i> Cañón and Ernst, 1974 ***
•					<i>Astacolus multatus</i> Espitalié and Sigal, 1963 *
•					<i>Bullopore</i> sp.
•					<i>Bullopore tuberculata</i> (Sollas), 1877
•					<i>Citharina sparsicostata</i> (Reuss), 1863
•					<i>Conorboides</i> sp.
•					<i>Dentalina</i> sp.
•					<i>Dentalina terquemi</i> d'Orbigny, 1850
•					<i>Fronducularia simplicissima</i> ten Dam, 1946
•					<i>Fronducularia</i> sp.
•					<i>Haplophragmoides</i> sp.
•					<i>Lagena hauteriviana cylindracea</i> Bartenstein and Brand, 1951
•					<i>Lenticulina ambanjohensis</i> Espitalié and Sigal, 1963

-VALANGINIAN- OXFORDIAN-	-HAUTERIVIAN- VALANGINIAN-	BARREMIAN	-ALBIAN- APTIAN-	AGE	SPECIES
					<i>Lenticulina</i> sp. aff. <i>L. Espitalié</i> and Sigal, 1963 *
					<i>Lenticulina muensteri</i> (Roemer), 1839
					<i>Lenticulina (L.) nodosa nodosa</i> (Reuss), 1863
					<i>Lenticulina (L.) nodosa malumiani</i> Aubert and Bartenstein, 1976
					<i>Lenticulina (L.) nodosa s.l.</i> (Reuss), 1863
					<i>Lenticulina</i> sp. nov? ***
					<i>Lenticulina pulchella</i> (Reuss), 1863
					<i>Lenticulina</i> sp. A
					<i>Lingulina bettenstaedti</i> (Zedler), 1961
					<i>Marssonella kurumi</i> Zedler, 1961
					<i>Marssonella subrotunda</i> Bartenstein, 1962
					<i>Pseudonodosaria humilis</i> (Roemer), 1841
					<i>Ramulina oculata</i> Wright, 1866
					<i>Saracenaria tsaramandrosoensis</i> Espitalié and Sigal, 1963 *
					<i>Tristix acutangulus</i> (Reuss), 1863
					<i>Tristix insignis</i> (Reuss), 1863
					<i>Vaginulina</i> sp.
					<i>Webbinella subhemisphaerica</i> Franke, 1936
					<i>Annobaculites barrowensis</i> (Tappan), 1960
					<i>Lenticulina besairiei</i> Espitalié and Sigal, 1963 *
					<i>Spiroplectammina annectens</i> (Parker and Jones), 1863
					<i>Dorothis mardojevichi</i> Cañón and Ernst, 1974 ***
					<i>Lenticulina biexavata</i> (Myatlyuk), 1939
					<i>Gyroidina infrajosa</i> Finlay, 1949 **
					<i>Lenticulina</i> sp. cf. <i>L. ataktos</i> Espitalié and Sigal, 1963 *
					<i>Falsopalmula</i> sp. aff. <i>F. malakialiensis</i> Espitalié and Sigal, 1963 *
					<i>Cyatharina</i> gr. <i>flexuosa</i> Bruckmann, 1904
					<i>Epistomina alveata</i> Espitalié and Sigal, 1963
					<i>Haplophragmium inconstans</i> var. <i>erectus</i> Bartenstein and Brand, 1951
					<i>astacolus</i> sp. cf. <i>A. embaensis</i> (Fursenko and Polenova), 1960
					<i>Astacolus planulariformis</i> (Kuznetsova), 1961
					<i>Marginulinopsis supera</i> Kuznetsova, 1961
					<i>Epistomina</i> sp. cf. <i>caracolla</i> (Roemer), 1841

Figure 9a – Stratigraphic distribution of Early Cretaceous benthonic Foraminifera in the Magallanes Basin

Figure 9b – Stratigraphic distribution of Early Cretaceous benthonic Foraminifera in the Magallanes Basin (cont.)

-VALANGINIAN- OXFORDIAN-	-HAUTERIVIAN- VALANGINIAN-	BARREMIAN	-ALBIAN- APTIAN-	AGE	SPECIES
					<i>Annobaculites</i> sp.
					<i>Astacolus</i> sp.
					<i>Rectoglandulina</i> sp.
					<i>Astacolus explicatus</i> Espitalié and Sigal, 1963 *
					<i>Astacolus gibber</i> Espitalié and Sigal, 1963 *
					<i>Lenticulina</i> sp. = <i>L. subtilis</i> (Wisniewski) var. 3260 Espitalié and Sigal, 1963
					<i>Lenticulina dincantos</i> Espitalié and Sigal, 1963 *
					<i>Lenticulina</i> sp. cf. <i>L. hiernmanni</i> Bettenstaedt, 1952
					<i>Lenticulina</i> sp. cf. <i>L. praegaulina</i> Bartenstein, Bettenstaedt and Bolli, 1957
					<i>Lenticulina ataktos</i> Espitalié and Sigal, 1963 *
					<i>Lenticulina crepidularis</i> (Roemer), 1842
					<i>Nodosaria obscura</i> Reuss, 1845-46
					<i>Saracenaria</i> sp.
					<i>Saracenaria compacta</i> Espitalié and Sigal, 1963 *
					<i>Tristix</i> sp.
					<i>Eogutulina</i> sp. cf. <i>E. anglica</i> Cushman and Ozawa, 1930
					<i>Globulina inflata</i> (Espitalié and Sigal), 1963 *
					<i>Pseudopolymorphina</i> sp.
					<i>Palmula</i> sp. cf. <i>P. malakialiensis</i> (Espitalié and Sigal), 1963 *
					<i>Nodosaria fontanesi</i> (Berthelin), 1880
					<i>Nodosaria lornetana</i> (d'Orbigny), 1840
					<i>Nodosaria?</i> sp.
					<i>Dentalina nana</i> Reuss, 1863
					<i>Dentalina linearis</i> (Roemer), 1841
					<i>Dentalina</i> sp.
					<i>Lingulina nodosaria</i> Reuss, 1863
					<i>Globulina prisca</i> Reuss, 1863
					<i>Lenticulina hiernmanni</i> Bettenstaedt, 1952
					<i>Lenticulina</i> sp.
					<i>Astacolus gibber</i> cf. <i>A. barremianus</i> (Michael), 1967
					<i>Astacolus</i> sp.
					<i>Marginulina robusta robusta</i> (Reuss), 1863
					<i>Marginulina</i> ex. gr. <i>M. bronni</i> (Roemer), 1841

-VALANGINIAN- OXFORDIAN-	-HAUTERIVIAN- VALANGINIAN-	BARREMIAN	-ALBIAN- APTIAN-	AGE	SPECIES
					<i>Marginulinopsis bettenstaedti</i> (Bartenstein and Brand), 1951
					<i>Marginulinopsis</i> sp.
					<i>Ceratobulimina?</i> sp.
					<i>Tritaxia</i> sp.
					<i>Lenticulina</i> sp.
					<i>Gavelinella belorussica</i> (Akimets), 1966
					<i>Anomalina</i> sp. nov. ***
					<i>Anomalinoides</i> sp.
					<i>Vaginulina kochi</i> Roemer, 1841
					<i>Lenticulina gaulina</i> (Berthelin), 1880
					<i>Palmula</i> sp. cf. <i>P. asiatica</i> Fursenko, 1958
					<i>Spiroplectammina gutierrezii</i> Cañón and Ernst, 1974 ***
					<i>Discorbis minima</i> Vieaux, 1941
					<i>Cibicides</i> sp. cf. <i>C. djaffaensis</i> Sigal, 1952
					<i>Pullenia natlandi</i> Cañón and Ernest, 1974 ***

Figure 9d – Stratigraphic distribution of Early Cretaceous benthonic Foraminifera in the Magallanes Basin (cont.)

Applying formulae which conduce to the numerical expression of provincialism such as the Provincial Index and Simpson Coefficient, the following results are obtained:

PI = 0.13      SC = 21.42

values which indicate clearly the different behaviour and the remarkable provincial situation of both basins. The obtained data reflect some interesting aspects:

Figure 9c – Stratigraphic distribution of Early Cretaceous benthonic Foraminifera in the Magallanes Basin (cont.)



-Cenomanian Albian-	Late Turonian	-Campanian Coniacian-	Maastrichtian	AGE	SPECIES
•					<i>Spiroplectinata annectens</i> (Parker and Jones), 1863
•					<i>Spiroplectinata complanata</i> (Reuss), 1860
•					<i>Gaudryina</i> sp.
•					<i>Pleurostomella reussi</i> Berthelin, 1880
•					<i>Valvulinera</i> sp. nov. ***
•					<i>Tristix</i> sp.
•					<i>Lingulogavelinella</i> sp. cf. <i>L. arachnoidea</i> Gawor-Biedowa, 1972
•					<i>Gyroidinoides nitidus</i> (Reuss), 1846
•					<i>Dorothia</i> sp. nov. ***
•					<i>Gavelinella</i> spp.
•					<i>Dentalina</i> spp.
•					<i>Saraceneria</i> sp.
•					<i>Marssonella oxycona</i> (Reuss), 1860
•					<i>Fronicularia</i> spp.
•					<i>Polymorphina</i> sp.
•					<i>Anomalinoidea</i> sp.
•					<i>Tritaxia</i> sp. nov. ***
•					<i>Discorbis</i> sp. cf. <i>Discorbis</i> sp. <i>Scheibnerova</i> , 1972 **
•					" <i>Conorbina</i> " sp. nov. ***
•					<i>Cyclammina cancellata</i> Brady, 1897
•					<i>Spiroplectammina gutierrezii</i> Cañón and Ernst, 1974 ***
•					<i>Tritaxia porteri</i> Cañón and Ernst, 1974 ***
•					<i>Dorothia mordojovichi</i> Cañón and Ernst, 1974 ***
•					<i>Astaculus skyringensis</i> Todd and Knicker, 1952 ***
•					<i>Astaculus tricarinelus</i> (Reuss), 1863
•					<i>Discorbis minima</i> Vieaux, 1941
•					<i>Allomorphina conica</i> Cushman and Todd, 1949
•					<i>Gyroidina infrafofa</i> Finlay, 1940 **
•					<i>Haplophragmoides</i> sp. nov. ***
•					<i>Amnibaculites</i> sp.
•					<i>Glomospira corona</i> Cushman and Jarvis, 1928

Figure 10a - Stratigraphic distribution of Late Cretaceous benthonic Foraminifera in the Magallanes basin

-Cenomanian Albian-	Late Turonian	-Campanian Coniacian-	Maastrichtian	AGE	SPECIES
					<i>Citharina geisendoerferi</i> (Franke), 1928
					<i>Fronicularia disjuncta</i> Belford, 1960 **
					<i>Fronicularia mucronata</i> Reuss, 1845
					<i>Marginulinopsis</i> sp.
					<i>Saraceneria triangularis</i> (d'Orbigny), 1840
					<i>Ramulina</i> sp. A
					<i>Ramulina</i> sp. B
					<i>Stilostomella aspera</i> (Reuss), 1845
					<i>Praebulmina kickapoensis</i> (Cole), 1938
					<i>Valvulinera</i> sp. cf. <i>V. lenticula</i> (Reuss), 1845
					<i>Quadriformina allomorphinoides</i> (Reuss), 1860
					<i>Gyroidinoides nodus</i> (Belford), 1960 **
					<i>Notoplanulina rakauoana</i> (Finlay), 1939 **
					<i>Gavelinella eriksdalensis</i> (Brotzen), 1936
					<i>Allomorphina paleocenica</i> Cushman, 1948
					<i>Gyroidinoides globosus</i> (Hagenow) var. <i>orbicella</i> Bandy, 1951
					<i>Marginulina</i> sp. A
					<i>Marginulina</i> sp. B
					<i>Marginulina bullata</i> Reuss, 1845
					<i>Nonionella austinana</i> Cushman, 1933
					<i>Pseudonodosaria manifesta</i> (Reuss), 1851
					<i>Pyramidina minima</i> (Brotzen), 1936
					<i>Anomalinoidea</i> sp. cf. <i>A. piripaua</i> (Finlay), 1939 **
					<i>Haplophragmoides?</i> sp.
					<i>Spiroplectammina?</i> sp.
					<i>Psamopelta minima</i> (Cushman and Renz), 1946
					<i>Spiroplectammina grybowski</i> Frizzell, 1943
					<i>Bolivina incrassata</i> Reuss, 1851
					<i>Bolivina incrassata</i> Reuss var. <i>gigantea</i> Wicher, 1949
					<i>Epistominella texana</i> (Cushman), 1938
					<i>Anomalina rubiginosa</i> Cushman, 1926
					<i>Bolivinoidea draco dorreni</i> Finlay, 1939 **

Figure 10c - Stratigraphic distribution of Late Cretaceous benthonic Foraminifera in the Magallanes basin (cont.)

-Cenomanian Albian-	Late Turonian	-Campanian Coniacian-	Maastrichtian	AGE	SPECIES
					<i>Gaudryina Juliana</i> Malumián and Masiuk, 1977 ***
					<i>Pseudospiroplectinata ona</i> Malumián and Masiuk, 1977 ***
					<i>Fronicularia</i> sp.
					<i>Valvulinera</i> sp. cf. <i>V. lenticula</i> (Reuss), 1845
					<i>Alabamina australis australis</i> Belford, 1960 **
					<i>Stensioina</i> sp. cf. <i>S. infrafofa</i> (Finlay), 1940 **
					<i>Gavelinella</i> sp. nov. ***
					<i>Gavelinella</i> (Berthelina) ex. gr. <i>berthelini</i> (Keller), 1935
					<i>Sphaeroidina bulloides</i> d'Orbigny, 1826
					<i>Praebulmina pupoides</i> (d'Orbigny), 1846
					<i>Planulina popenoi</i> (Trujillo), 1960
					<i>Cibicoides semibulbicus</i> (Toukovski), 1887
					<i>Hoeglundina elegans</i> (d'Orbigny), 1826
					<i>Spiroplectammina</i> sp. cf. <i>S. laevis</i> Roemer, 1841
					<i>Ammodiscus cretaceus</i> (Reuss), 1845
					<i>Glomospirella</i> sp.
					<i>Gaudryina healyi</i> Finlay, 1939 **
					<i>Dorothia bulleta</i> (Carsey), 1926
					<i>Pseudosigmoilina</i> sp. cf. <i>P. antiqua</i> Franke, 1928
					<i>Lenticulina crepidularis</i> (Roemer), 1842
					<i>Fronicularia</i> sp. cf. <i>F. archiaciana</i> d'Orbigny, 1840
					<i>Pullenia cretacea</i> Cushman, 1936
					<i>Gyroidinoides</i> sp.
					<i>Globorotalites</i> sp.
					<i>Notoplanulina australis</i> Malumián and Masiuk, 1977 ***
					<i>Gavelinella murchisonensis</i> Belford, 1960 **
					<i>Textularia?</i> sp.
					<i>Gaudryina</i> p. cf. <i>G. laevigata</i> Franke, 1914
					<i>Astaculus</i> sp. cf. <i>A. mundus</i> (Cushman), 1938
					<i>Astaculus</i> sp.
					<i>Lenticulina</i> sp.

Figure 10b - Stratigraphic distribution of Late Cretaceous benthonic Foraminifera in the Magallanes basin (cont.)

AGE	RESULTS									
	Nr. RECORDED SPECIES	Nr. SPECIES IN OPEN NOMENCLATURE	Nr. ENDEMIC SPECIES	Nr. SPECIES OF THE AUSTRAL REALM	Nr. WIDE DISTRIBUTED SPECIES	PI (FOR THE BASIN ENDEMIC SPECIES)	PI (FOR THE AUSTRAL REALM SPECIES)	SC = SIMPSON COEFFICIENT	% ENDEMIC SPECIES	% AUSTRAL REALM SPECIES
Maastrichtian	54	12	2	12	28	7	1.16	66.66	4.74	28.57
-Campanian Coniacian-	34	3	7	12	19	1.35	0.79	61.29	22.58	38.70
Late Turonian	25	2	8	11	14	0.87	0.63	60.87	34.78	47.82
-Cenomanian Albian-	28	8	8	10	10	0.62	0.50	50	40	50
Aptian - Albian	15	3	4	4	8	1	-	66.66	33.33	-
Barremian	33	6	2	8	19	4.75	1.18	70.37	7.47	29.62
-Hausterian Valanginian-	41	6	3	17	18	3	0.52	51.42	8.47	48.57
-Valanginian Oxfordian-	51	7	5	12	32	3.20	0.94	72.72	11.36	38.63

Figure 11 - Quantitative results obtained from the benthonic Foraminifera analysis of the Magallanes basin

1. During a large part of the Neocomian, between both basins, an important barrier existed on the occidental margin of the continent which did not allow the free migration of organisms; the barrier could probably be represented by a similar to the present Chile ridge.
2. The existence of climatic belts, which could affect the faunal distribution, is rejected; evaluating each faunal assemblage separately, the taxa present in both basins have

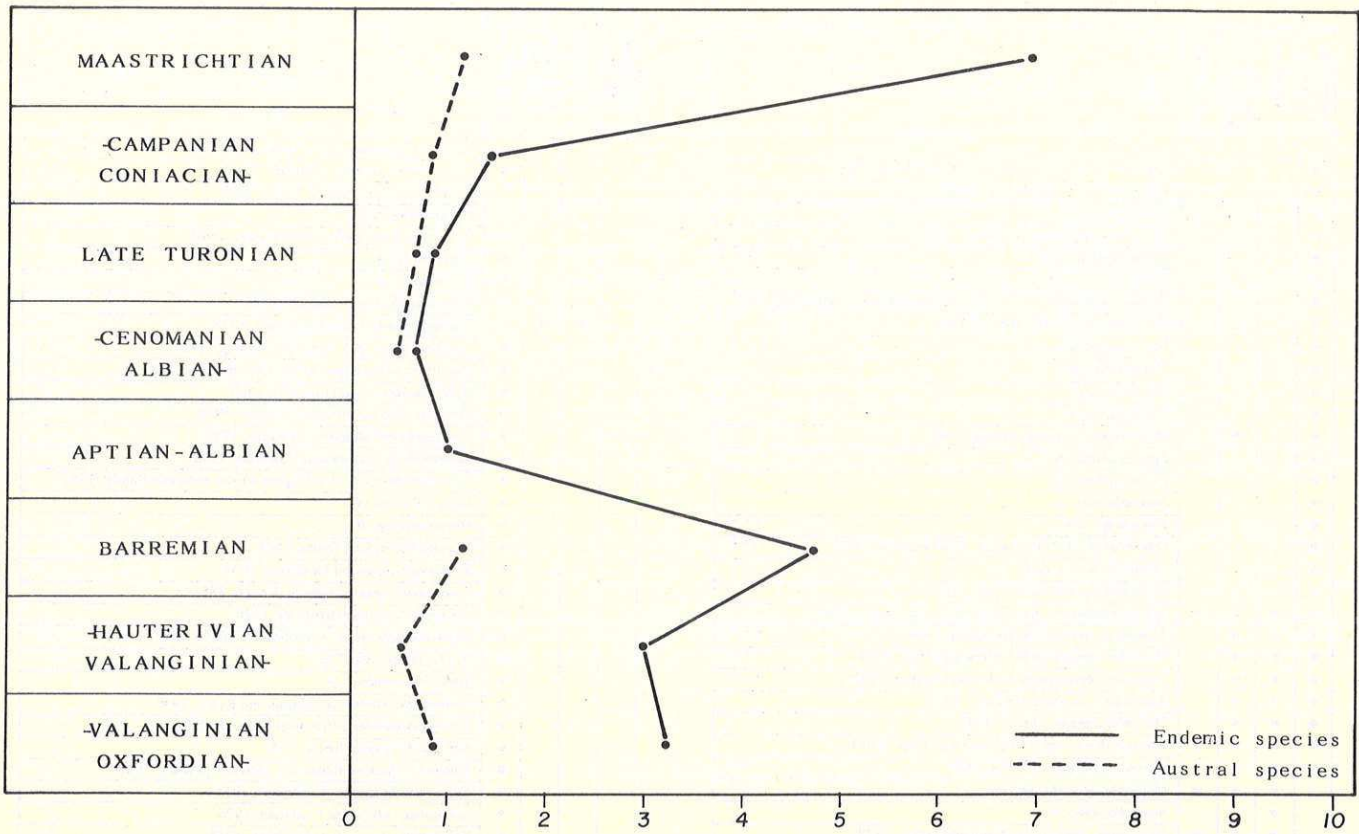


Figure 12 – Provincial Index plotted values for the Magallanes Basin.

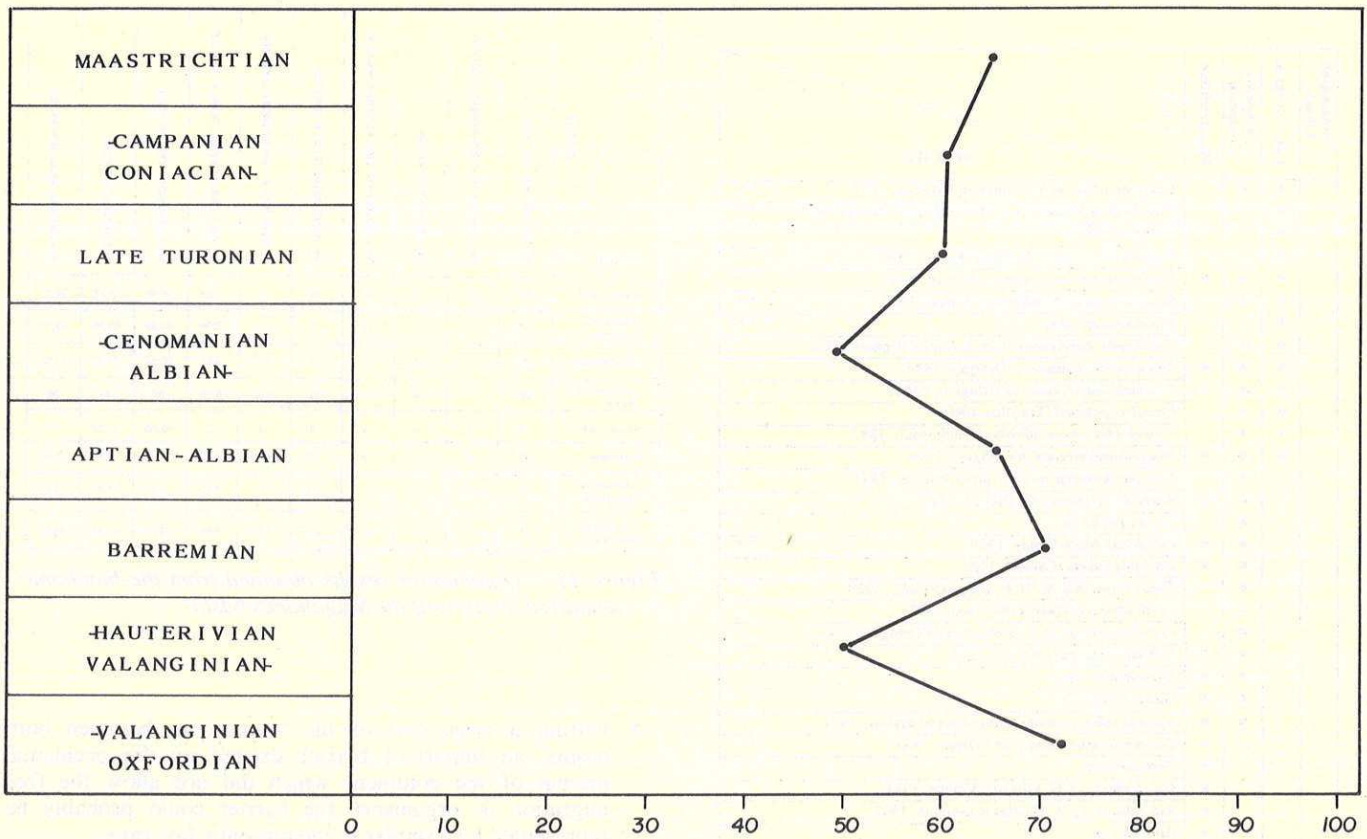


Figure 13 – Simpson Coefficient plotted values for the Magallanes Basin

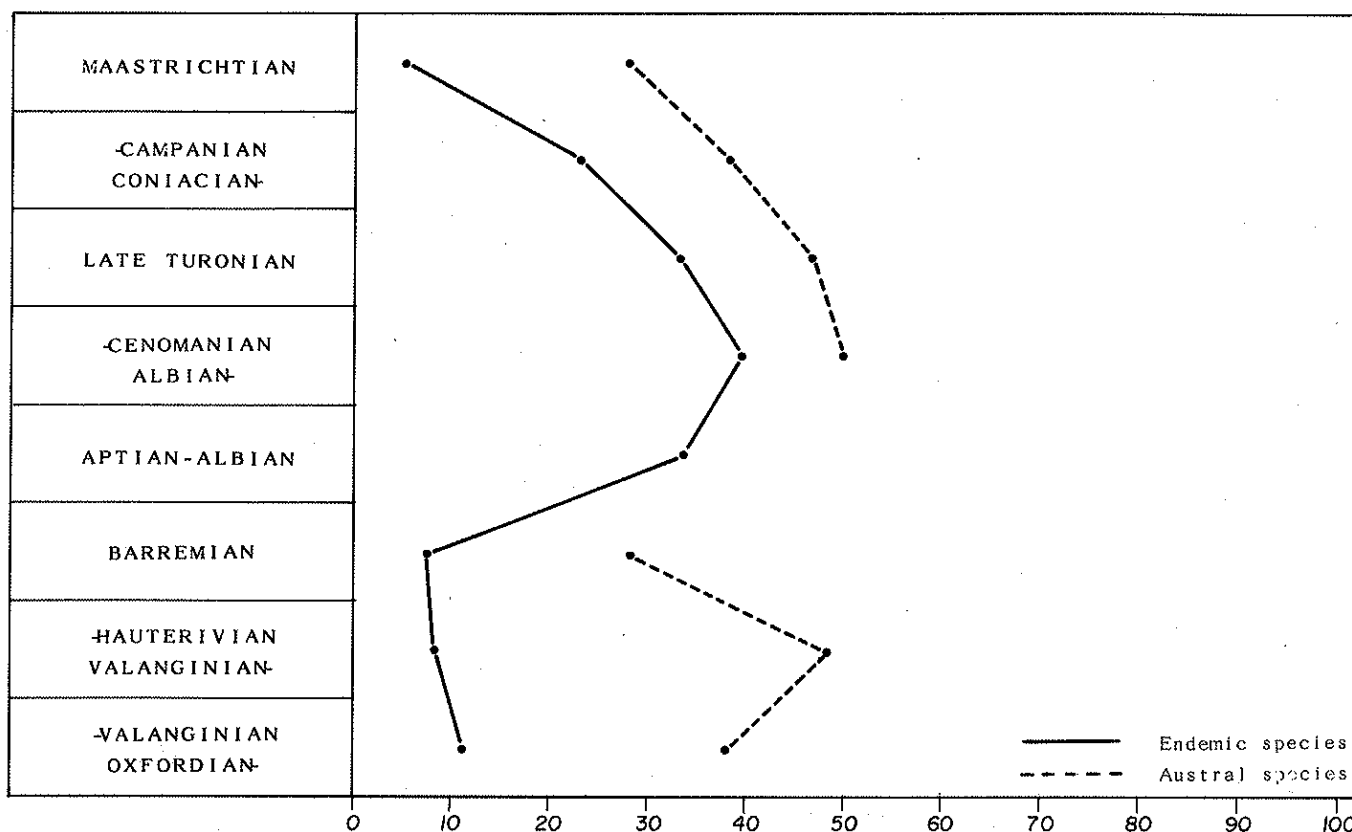


Figure 14 – Percentage of endemic taxa of the Magallanes Basin.

wide geographic distribution.

3. The Magallanes Basin microfauna show marked afroalgachian contributions whereas these are small in the Neuquén and Mendoza basins.

During the Maastrichtian, 55 valid species from the Neuquén and Mendoza (plus Colorado) basin were recorded; from the Magallanes Basin (42). Both have only three common species: *Dorothia bulleta* (Carsey), *Bolivina incrassata* Reuss, and *Nonionella* sp. cf. *N. austriana* Cushman.

The obtained provincial values are:

$$PI = 0.04 \quad SC = 7.14$$

which indicate a high provincial degree and substantial differences at the terminal Cretaceous. The feature induce to assume the restricted or null communication between both basins; in fact, the Río Mayo-Río Chico-Punta Dúngenes hight (Urien *et al.* 1980) was practically an unsurmountable barrier for the benthonic Foraminifera interchange, beside other ecological factors, such as more marked thermal gradients; these in Late Cretaceous times probably acquired more importance, specially when compared with those of early Cretaceous, which could impede a similar behavior in both basins.

**CONCLUSIONS**

1. Along the Cretaceous period, the Boreal, Tethyan, and Austral Realms are recognized; the Tethyan based mainly on the participation in the associations of larger Foraminifera; the Austral based on the marked endemism of the assemblages of Madagascar and Australia. At the end of the Cretaceous in the Tethyan Realm the Caribbean and Mediterranean regions become differentiated; 2. In Argentina, the Cretaceous biogeographic trends of the Neuquén and Mendoza basins (plus Colorado in Maastrichtian time) and the Magallanes Basin assemblages show the following features:

a. Neuquén and Mendoza (plus Colorado in Maastrichtian time) basins; a.1. Early Cretaceous (Berriasian-Barremian). Quantitative analysis demonstrate absence of provincial features. The assemblages have a wide geographic distribution being present species of the Boreal and Tethyan Realms; a.2. Late Cretaceous (Maastrichtian). It is characterized by the increase of endemic taxa and the preferential bipolar distribution of the community; b. Magallanes Basin; b.1. Early Cretaceous (Neocomian). It is peculiarized by the wide geographic distributed taxa and the participation of malgachian species; b.2. Aptian-Campanian. It is peculiarized by the relative large ammount of endemic taxa and the paulatine increase of Australian elements since Albian-Cenomanian times; b.3. Maastrichtian. It is distinguished by the presence of bipolar distributed species, the participation of Australian taxa, and the reduction of endemic species; 3. Comparison based on quantitative analysis between the assemblages present in the Neuquén and Mendoza (plus Colorado in Late Maastrichtian times) and the Magallanes basins reflect a marked provincial degree. It is probable that during Early Cretaceous time a barrier, similar to the present Chile ridge, impeded a free migration. At Maastrichtian times, on the Atlantic margin, the Río Mayo-Río Chico-Punta Dúngenes hight could be responsible for the restricted to null interchange between both basins, beside some ecological factors such as somewhat stronger thermal gradients; 4. In Argentina, within the Austral Realm, the following palaeobiogeographic units are recognized: a. Neuquén and Mendoza basins (plus Colorado in Maastrichtian time); a.1. Neocomian = Wide distributed or cosmopolitan association; a.2. Maastrichtian = Subprovince; b. Magallanes Basin; b.1. Neocomian = Subprovince to Endemic Center; b.2. Aptian-Campanian = Province; b.3. Maastrichtian = Subprovince.

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