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Eocene-Pliocene deep sea ostracodes from ODP site 744A, Southern Indian Ocean

CRISTIANINI T. BERGUE[1] **and ABIRAMAN GOVINDAN**[2]

[1]Universidade do Vale do Rio dos Sinos, Laboratório de Micropaleontologia
Av. Unisinos, 950, 93022-000 São Leopoldo, RS, Brasil
[2]Asian Biostratigraphic Service, H-53, Central Avenue, Korattur, Chennai, 600080, India

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ABSTRACT

The Eocene-Pliocene deep sea ostracodes from the ODP site 744A (Kerguelen Plateau) are herein studied under the taxonomic and paleoecologic aspects. 28 species are identified, being the genera *Krithe*, *Cytherella* and *Dutoitella* the most diversified. A faunal threshold was recorded in the Early Oligocene, which is tentatively explained under the knowledge of the paleoceanographical studies carried out not only in the Kerguelen Plateau but also in adjacent areas. The faunal turnover and variations in both richness and abundance possibly reflect the inception of psychrosphere and the influence of hydrological changes in the preservation of carapaces. Moreover, the influence of those changes on carbonate preservation is discussed as the cause of faunal impoverishment in the upper portion of the core.

Key words: Cenozoic, ostracodes, paleoceanography, paleozoogeography.

INTRODUCTION

Deep sea ostracode research has developed significantly in the last few decades, with improved taxonomic, ecologic and zoogeographic information. Studies carried out from 1970 onwards (see Benson 1988 and Cronin et al. 2002 revisions) brought evidence that continental slopes and oceanic basins are inhabited by well-diversified and distinct faunas. The distribution, diversity and abundance of slope and abyssal plain assemblages are strongly influenced by the local hydrologic structure as well as climatic driven oceanographic events, even over short timescales (Ayress et al. 1997, Yasuhara et al. 2008).

The Cenozoic deep sea ostracodes have their origin from Late Cretaceous shallow water stocks (Benson 1975). According to this author, a worldwide faunal change at approximately 40 Ma established an oceanic psychrosphere, which influenced the evolution of faunas adaptated to an environment that was deep, cold and poor in carbonate. However, Majoran and Dingle (2002) suggested that this model does not hold for all oceanic basins. In fact, ostracode research has lagged behind the paleoceanographic community's advances in understanding deep-sea circulations, botton water temperature and its relationship to Cenozoic climate evolution. This results in part from the limitations imposed by the ecologic characteristics of ostracodes and the research lines usually developed.

The Eocene-Oligocene Period experienced an accelerated global cooling that influenced ocean circulation, productivity and sedimentation of oceanic basins (Zachos et al. 2001a, Pälike et al. 2006). Climatic events in this interval record mainly the establishment of oceanic gateways and the beginning of the Antarctic Circumpolar Current (Diekmann et al. 2004). Due to the excellent record of these events, the Southern Indian Ocean is one of the most studied oceans for paleoceanographic purposes. The ODP site 744A, placed at the

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Correspondence to: Cristianini Trescastro Bergue
E-mail: cbergue@unisinos.br

Kerguelen Plateau, is uniquely positioned to record the climatic evolution of the Southern Ocean region and its hydrologic changes. Studies on the cored material of this site include Huber (1999) on planktonic foraminiferal biozonation, Schröder-Adams (1991) on benthic foraminifera, Caulet (1991) on radiolarian biostratigraphy, and Baldauf and Barron (1991) on diatom correlation. Details of the lithostratigraphy of this site are outlined in Barron et al. (1991). However, the Paleogene and Neogene ostracodes from this site have not been studied so far.

Recent ostracodes from the Southern Ocean have been fairly well documented since the pioneering study of Brady (1880) as reviewed by Ayress et al. (2004). Some studies on Paleogene and Neogene assemblages have also been published, such as Guernet (1985), Guernet and Galbrun (1992) and Steineck and Thomas (1996). The main objective of this article is to present a preliminary study on the ostracode fauna of Late Eocene to Pliocene from site 744A as a contribution to the knowledge of the fossil ostracodes of the Southern Ocean.

STUDY AREA

The Kerguelen Plateau is located in the Indian Ocean between 45°S and 64°S, north of the Antarctic Convergence. It lies in water depths between 1500 m and 2000 m, and about 2-3 km above the adjacent ocean basins Australian-Antarctica in the east, and African-Antarctic in the west (Fig. 1). Across the Kerguelen Plateau and along a latitudinal transect, six sites have been drilled at Ocean Drilling Program (ODP) Leg 199. Two of these (sites 738 and 744) were drilled in the southern part close to east Antarctica for documenting climatic changes imprinted in the sedimentary record.

MATERIALS AND METHODS

This study is based on the observation of 34 core samples of 10 cm^3 taken from Paleogene and Neogene sections of site 744A. The samples were disaggregated with water and diluted 100 vol. H_2O_2 for a day, washed and wet sieved through a 63μm screen and, then, dried over a hot plate. Two samples from Late Eocene (119-744A-19H-5W-5 and 119-744A-19H-2W-5) have yielded more than 25 carapaces each, in contrast with less than five in some samples from Miocene and Pliocene section (Fig. 2).

The specimens figured in this article are housed at Museum of Paleontology of Universidade do Vale do Rio dos Sinos, under the curatorial numbers 7105 to 7135. In the taxonomy section, the following abbreviations are used: V (valve), LV (left valve), RV (right valve), h (height), l (length) and mbsf (meters bellow sea floor).

TAXONOMY

Order Platycopida Sars 1866
Superfamily Cytherelloidea Sars 1866
Family Cytherellidae Sars 1866
Genus *Cytherella* Jones 1849
Type species *Cytherina ovata* Roemer 1840

Cytherella sp. 1
Fig. 3.1

1985 *Cytherella* sp. Guernet, p. 287, pl. I, figs. 2,4.
1993 *Cytherella* cf. *serratula* Brady-Guernet, p. 349, pl. 1, fig. 4.
Figured specimen: U-7105, LV, l: 0.92 mm, h: 0.55 mm.
Origin: 119-744A-19H-5W-5 (163.150 mbsf).
Age: Late Eocene.
Material: three V.
Distribution: Eocene: ODP site 744A, DSDP site 214 and ODP site 762 (Indian Ocean).

Cytherella sp. 2
Fig. 3.2

1985 *Cytherella* sp. gr. *ovata*? – Guernet, p. 287, pl. I, fig. 1.
Figured specimen: U-7106, LV, l: 0.82 mm, h: 0.53 mm.
Origin: 119-744A-18H-3W-6 (150.660 mbsf).
Age: Late Eocene.
Material: one V.
Distribution: Eocene: ODP site 744A and DSDP site 214 (Indian Ocean).

Cytherella sp. 3
Fig. 3.3

Figured specimen: U-7107, RV, l: 1.08 mm, h: 0.74 mm.
Origin: 119-744A-20H-1W-6 (166.668 mbsf).
Age: Late Eocene.
Material: three V.

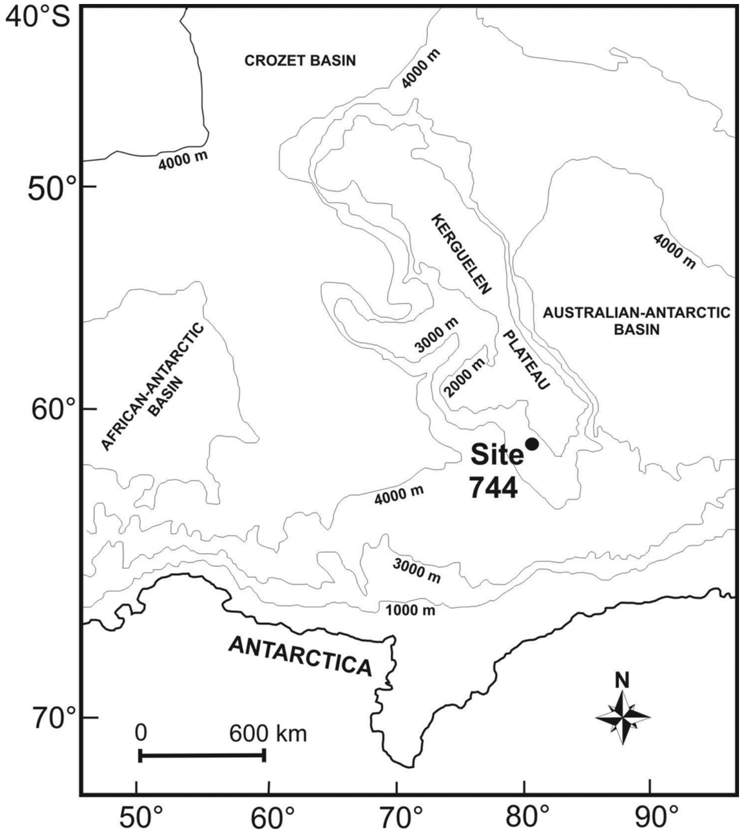

Fig. 1 – Map of the study area and the location of the ODP site 744A.

Genus *Cytherelloidea* Alexander 1929
Type species *Cythere (Cytherella) williamsoniana* Jones 1849
Cytherelloidea sp.
Fig. 3.4

Figured specimen: U-7108, LV, l: 0.95 mm, h: 0.55 mm.
Origin: 119-744A-18H-3W-6 (150.660 mbsf).
Age: Late Eocene.
Material: one V.

Order Podocopida Sars 1866
Superfamily Cypridoidea Baird 1845
Family Pontocyprididae Müller 1894
Genus *Australoecia* McKenzie 1967
Australoecia sp.
Fig. 3.5

Figured specimen: U-7109, LV, l: 0.58 mm, h: 0.37 mm.
Origin: 119-744A-16H-5W-4 (143.240 mbsf).
Age: Early Oligocene.
Material: one juvenile V.

Superfamily Bairdioidea Sars 1887
Family Bairdiidae Sars 1887
Genus *Bairdoppilata* Coryell, Sample and Jennings 1935
Type species *Bairdoppilata martini* Coryell, Sample and Jennings 1935
Bairdoppilata hirsuta (Brady 1880)
Fig. 3.6

1880 *Bairdia hirsuta* Brady, p. 51, pl. 8, figs. 3a-d.
1969 *Bairdoppilata (Bairdoppilata?) hirsuta* (Brady) – Maddocks, p. 81, fig. 43; pl. 2, figs. 1, 2.
1976 *Bairdia hirsuta* Brady-Puri and Hulings, pl. 4, figs. 4, 5.
1983 *Bairdoppilata hirsuta* (Brady) – Cronin, p. 106, pl. I, figs. A-C.
1996 *Bairdoppilata hirsuta* (Brady) – Whatley et al., p. 71, pl. 1, fig. 4.
2008 *Bairdoppilata* ex. gr. *hirsuta* (Brady) – Bergue and Coimbra, pl. 1, fig. 13.
Figured specimen: U-7110, RV, l: 0.92 mm, h: 0.55 mm.

SPECIES	AGE	LATE EOCENE					EARLY OLIGOCENE											L. OLIGOCENE	E. MIOCENE		M. MIOCENE		L. MIOCENE	PLIO - HOL
	SAMPLE	119-744A-20H-1W-6	119-744A-19H-5W-5	119-744A-19H-2W-5	119-744A-18H-3W-6	119-744A-18H-1W-4	119-744A-16H-5W-4	119-744A-16H-4W-5	119-744A-16H-2W-4	119-744A-16H-1W-4	119-744A-15H-1W-6	119-744A-15H-3W-6	119-744A-15H-2W-6	119-744A-15H-5W-6	119-744A-14H-3W-6	119-744A-14H-4W-6	119-744A-14H-5W-6	119-744A-13H-5W-6	119-744A-11H-1W-7	119-744A-9H-1W-6	119-744A-8H-3W-90	119-744A-8H-2W-90	119-744A-6H-2W-6	119-744A-2H-1W-90
Dutoitella suhmi		2	1	1																				
***Cytherella* sp. 1**		1	1	1																				
***Cytherella* sp. 2**		1																						
***Cytherella* sp. 3**		1	1	1																				
Anebocythereis hostizea		3	17	17	8	6	4		1	1	1	2	2	1	1	1	5				1			
Bradleya johnsoni		1	1	2		1			1								1							
***Taracythere* sp.**				1			1																	
Bairdoppilata hirsuta			1																					
Bradleya thomasi																						1		
***Krithe* sp. 3**			2		1		2																	
***Krithe* sp. 6**				4																				
***Cytherelloidea* sp.**					1																			
***Krithe* sp. 7**					1																			
***Krithe* sp. 8**					1																			
Legitimocythere presequenta						1		1									1							
Pennyella praedorsosserrata						1																		
***Krithe* sp. 4**				1			2		1															
***Henryhowella* sp. 2**								1																1
***Australoecia* sp.**							1																	
Henryhowella asperrima			1				2								2									
***Henryhowella* sp. 1**							1		1	1					1									
***Krithe* sp. 1**							1																	
***Krithe* sp. 5**						1						1								1				
Pseudobosquetina nobilis							1																	
***Dutoitella* sp. 2**																		1						
Agrenocythere hazelae																			1		1			
***Dutoitella* sp. 3**																					1			
***Krithe* sp. 2**																							1	
NUMBER OF SPECIES		6	8	8	5	5	9	2	4	2	1	2	1	1	3	1	3	1	1	1	3	1	1	1

Fig. 2 – Occurrence and abundance of species in the samples studied. The shadowed column refer to the faunal threshold.

Origin: 119-744A-19H-5W-5 (163.150 mbsf).
Age: Late Eocene.
Material: one V.

Discussion: Maddocks (1969), in the revision on Bairdiidae, states that this is a widespread deep sea species with some degree of variability in the length and position of the posterior caudate extension, which could even correspond to more than one species or subspecies. The present specimen has both the hinge and duplicature poorly developed, being characterized as a juvenile.

Distribution: Eocene: ODP site 744A (Indian Ocean). Recent: Kerguelen Island (Pacific Ocean), Gulf of Mexico, Forida-Hatteras slope (Atlantic Ocean), Strait of Magellan (South America), Brazilian Southeast slope (Atlantic Ocean).

Superfamily Trachyleberidoidea Liebau 2005
Family Trachyleberididae Sylvester-Bradley 1948
Genus *Agrenocythere* Benson 1972
Type species *Agrenocythere spinosa* Benson 1972
Agrenocythere hazelae (Bold 1946)
Fig. 3.7

1946 *Cythereis hazeli* (sic) Bold, p. 92, pl. 10, figs. 4a-c.
1972 *Agrenocythere hazelae* (Bold) – Benson, p. 66-72, figs. 31-38.
1978 *Agrenocythere hazelae* (Bold) – Benson, p. 785, pl. 1, figs. 7-8.
1987 *Agrenocythere hazelae* (Bold) – Whatley and Coles, p. 96, pl. 6, fig. 7.
1998 *Agrenocythere hazelae* (Bold) – Guernet, p. 530, pl. 2, fig. 1.

2003 *Agrenocythere hazelae* (Bold) – Dall'Antonia, p. 36, pl. 2, fig. 18.
Figured specimen: U-7111, LV, l: 1.45 mm, h: 0.79 mm.
Origin: 119-744A-11H-1W-7 (89.770 mbsf).
Age: Early Miocene.
Material: one adult and one juvenile V.
Distribution: Miocene: ODP site 744A (Indian Ocean), DSDP III 14 (South Atlantic) Hyblean Plateau (Mediterranean), East Oriente Province (Cuba), Cipero Formation (Trinidad), ODP Site 960 (Gulf of Guinea), DSDP site 372 (Mediterranean). Pliocene: DSDP Site 608 (North Atlantic). Recent: Malpelo Rise (Pacific Ocean).

Genus *Anebocythereis* Bate 1972
Type species *Anebocythereis amoena* Bate 1972
Anebocythereis hostizea (Hornibrook 1952)
Figs. 3.8-12

1952 *Cythereis hostizea* Hornibrook, pl. 5, figs. 72, 75, 78.
1993 *Henryhowella melobesioides* Brady-Guernet, p. 354, pl. 3, figs. 8, 11, 12, 14.
Non 1869 *Henryhowella melobesioides* Brady, p. 162, pl. 12, figs. 10-12.
1995 *Anebocythereis hostizea* (Hornibrook) – Ayress, p. 910, pl. 9, fig. 9.
Figured specimens and origin: U-7112 (RV, l: 1.13 mm, h: 0.66 mm, 119-744A-16H-5W-4); U-7113 (RV, l: 1.05 mm, h: 0.63 mm, 119-744A-18H-1W-4); U-7114 (LV, l: 1.02 mm, h: 0.63 mm, 119-744A-19H-2W-5), U-7115 (LV, l: 1.16 mm, h: 0.66 mm, 119-744A-15H-1W-6).
Age: Eocene-Oligocene.
Material: seven adults and 65 juveniles V.
Dicussion: Bate (1972) proposed the genus *Anebocythereis* for the Cretaceous of Australia stressing the similarity between the type species *A. amoena* and *Cythereis hostizea* Hornibrook. Although they are indisputably different species, *C. hostizea* seems to fit better into the diagnosis of *Anebocythereis* than into the one of *Cythereis* Jones. Whatley and Millson (1992) proposed the genus *Marwickcythereis* for Eocene/Oligocene species from New Zealand, electing *Cythereis marwicki* Hornibrook the type species. In our opinion, however, the diagnosis of *Marwickcythereis* does not differ significantly from the one of *Anebocythereis*, and Bate's proposal fits well for the present species.

The outline, shape, ornamentation and the presence of normal pore canals in the tubercles, clearly seen in Figure 11, plate 3 of Guernet (1993), led us to identify the species *Henryhowella melobesioides* (Brady) recorded by him as *Anebocythereis hostizea* (Hornibrook).

Distribution: Late Eocene: Canterbury (New Zealand); Eocene-Miocene: ODP site 744A (Indian Ocean); Eocene-Pleistocene: ODP sites 762 and 763 (Indian Ocean).

Genus *Pseudobosquetina* Guernet and Moullade 1994
Type species *Cytheropteron mucronalatum* Brady 1880
Pseudobosquetina nobilis Jellinek et al. 2006
Fig. 3.13

2006 *Pseudobosquetina nobilis* Jellinek, Swanson and Mazzini, p.42, fig. 6a-h (see this for a complete synonymic list).
Figured specimen: U-7116, RV, l: 1.12 mm, h: 0.67 mm.
Origin: 119-744A-16H-5W-4 (143.240 mbsf).
Age: Early Oligocene.
Material: one V.
Discussion: The only specimen found in this study is broken; however, the morphological elements of the carapace allowed a specific identification.
Distribution: Oligocene: ODP site 744A (Indian Ocean). Miocene-Quaternary: DSDP site 609 (North Atlantic). Recent: Angola Basin.

Genus *Henryhowella* Puri 1957
Type species *Cythere evax* Ulrich and Bassler 1904
Henryhowella asperrima (Reuss 1850)
Fig. 3.14

1850 *Cypridina asperrima* Reuss, p. 74, pl. 10, figs. 5a-b.
1988 *Henryhowella* cf. *evax* Ulrich and Bassler-Guernet and Fourcade, p. 148, pl. 3, figs. 18-20.
2005 *Henryhowella asperrima* Reuss-Mazzini, p. 51, figs. 26a-d (see this for a more complete synonimic list).
Figured specimen: U-7117, LV, l: 0.79 mm, h: 0.5 mm.
Origin: 119-744A-14H-3W-6 (127.260 mbsf).
Age: Early Oligocene.
Material: three adults V.
Discussion: The taxonomy of the genus *Henryhowella* has been the subject of intense discussion. The accurate identification of the species *H. asperrima* and *H. evax*,

for instance, is hardly achieved in many studies, due to either the poorly precise descriptions of the type material or the inadequacy of their original illustrations. The widespread use of the taxonomic terms *aff.*, *cf.* or *gr.* is a testimony of this problem. The present material is considered cospecific to the topotypic material figured by Mazzini (2005).

Henryhowella sp. 1
Fig. 3.15

Figured specimen: U-7118, RV, l: 0.81 mm, h: 0.42 mm.
Origin: 119-744A-14H-3W-6 (127.260 mbsf).
Age: Early Oligocene.
Material: four V.

Henryhowella sp. 2
Fig. 3.16

Figured specimen: U-7119, LV, l: 0.92 mm, h: 0.61 mm.
Origin: 119-744A-16H-2W-4 (138.740 mbsf).
Age: Early Oligocene.
Material: one juvenile V.

Genus *Pennyella* Neale 1974
Type species *Pennyella pennyi* Neale 1974
Pennyella praedorsoserrata Coles and Whatley 1989
Fig. 3.17

1989 *Pennyella praedorsoserrata* Coles and Whatley, p. 119, pl. 5, figs. 1-5.
Figured specimen: U-7120, LV, l: 0.73 mm, h: 0.44 mm.
Origin: 119-744A-18H-1W-4 (147.640 mbsf).
Age: Late Eocene.
Material: one juvenile V.
Dicussion: The specimen here studied differs a little from the holotype. However, its size and internal features reflect its juvenile condition, which explains these differences.

Genus *Legitimocythere* Coles and Whatley 1989
Type species *Cythere acanthoderma* Brady 1880
Legitimocythere presequenta (Benson 1977)
Fig. 3.18

1977 *Acantocythereis?* presequenta Benson, p. 883, pl. 2., fig. 5.
1978 "*Hyphalocythere*" sp. Benson, p. 787, pl. 2, fig. 1.
1989 *Legitimocythere presequenta* (Benson) – Coles and Whatley, p. 116, pl. 4, figs. 10, 11.
2002 *Legitimocythere presequenta* (Benson) – Majoran and Dingle, p. 146, fig. 3.21.
2003 *Legitimocythere presequenta* (Benson) – Dall'Antonia et al., p. 98, fig. 3.1.
Figured specimen: U-7121, LV, l: 0.79 mm, h: 0.47 mm.
Origin: 119-744A-16H-4W-5 (141.756 mbsf).
Age: Early Oligocene.
Material: three V.
Dicussion: *Legitimocythere presequenta* is a widespread deep-sea species with some degree of morphological variation. Coles and Whatley (1989) argue that this species became bigger, more spinose and less robust from the Miocene onwards.
Distribution: Eocene: DSDP Site 549 (North Atlantic). Eocene-Oligocene: Italy. Oligocene: ODP Site 357 (South Atlantic). Miocene: DSDP Sites 372 (Mediterranean) and 574 (Pacific Ocean).

Genus *Taracythere* Ayress 1995
Type species *Trachyleberis proterva* Hornibrook 1953
Taracythere sp.
Fig. 3.19

Figured specimen: U-7122, RV, l: 0.97 mm, h: 0.52 mm.
Origin: 119-744A-19H-2W-5 (158.560 mbsf).
Age: Late Eocene.
Material: one adult and one juvenile V.
Discussion: Jellinek and Swanson (2003) sustain that the subdivision of trachyleberids into natural groups might be possible only through a detailed study of soft parts. The spinosity, reticulation and a ventro-lateral spinose ridge in the present species would allow its inclusion in *Legitimocythere* Coles and Whatley. However, based on the discussion presented by Jellinek and Swanson *op. cit.* about the age of the genotype elected for this genus, we prefer not to adopt it for the present species. According to the age and geographic distribution, the genus *Taracythere* Ayress seems to be a more suitable option.

Genus *Dutoitella* Dingle 1981
Type species *Dutoitella dutoiti* Dingle 1981
Dutoitella suhmi (Brady 1880)
Fig. 3.20

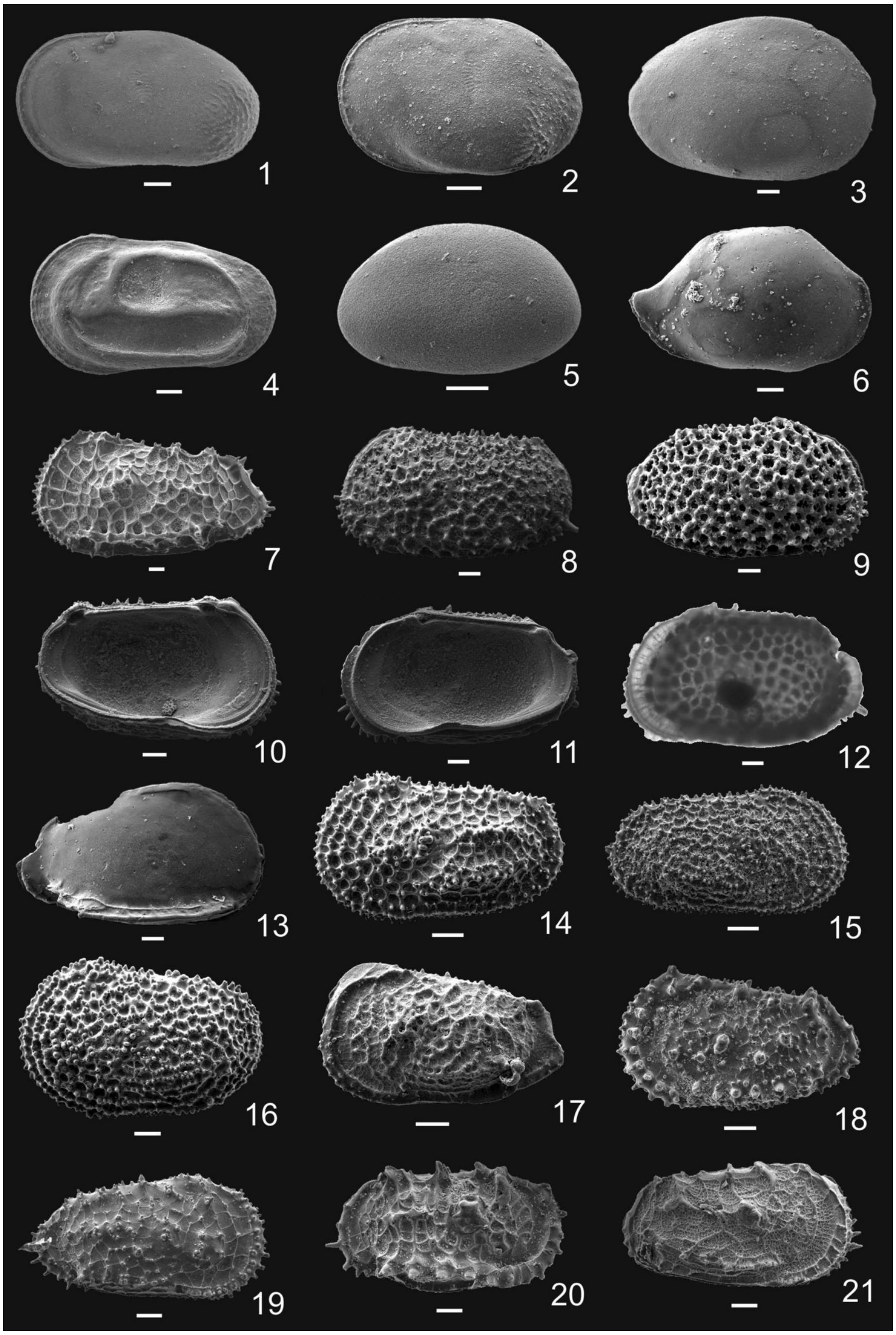

Fig. 3 – 1. *Cytherella* sp. 1, LV, 119-744A-19H-5W-5; 2. *Cytherella* sp. 2, LV, 119-744A-18H-3W-6; 3. *Cytherella* sp. 3, RV, 119-744A-20H-1W-6; 4. *Cytherelloidea* sp., LV, 119-744A-18H-3W-6; 5. *Australoecia* sp., LV, 119-744A-16H-5W-4; 6. *Bairdoppilata hirsuta* (Brady), RV, 119-744A-19H-5W-5; 7. *Agrenocythere hazelae* (Bold), LV, 119-744A-11H-1W-7; 8-12. *Anebocythereis hostizea* (Hornibrook). 8. LV, 119-744A-19H-2W-5; 9. RV, 119-744A-16H-5W-4. 10. LV internal view, 119-744A-15H-1W-6; 11. RV internal view, 119-744A-18H-1W-4. 12. RV internal view in optical microscopy. 13. *Pseudobosquetina nobilis* Jellinek et al., RV, 119-744A-16H-5W-4; 14. *Henryhowella asperrima*, LV, 119-744A-14H-3W-6. 15. *Henryhowella* sp. 1, RV, 119-744A-14H-3W-6; 16. *Henryhowella* sp. 2, LV, 119-744A-16H-2W-4; 17. *Pennyella praedorsosserata* Coles and Whatley, LV, 119-744A-18H-1W-4; 18. *Legitimocythere presequenta* (Benson), LV, 119-744A-16H-4W-5; 19. *Taracythere* sp., RV, 119-744A-19H-2W-5; 20. *Dutoitella suhmi* (Brady), RV, 119-744A-20H-1W-6; 21. *Dutoitella* sp. 1, RV, 119-744A-13H-5W-6. 21. (Scale 100μm).

1880 *Cythere suhmi* Brady, p. 106, pl. 26, fig. 3a-h.
1976 *Cythere suhmi* Brady-Puri and Hulings, pl. 17, figs. 7-12.
1985 "*Cythereis" crassinodosa* Guernet, p. 291, pl. III, figs. 8, 9, 11, 12.
1987 "*Sumhmicythere" suhmi* (Brady) – Whatley and Coles, p. 96, pl. 6, figs. 18-21.
1990 *Dutoitella suhmi* (Brady) – Dingle et al., p. 290, fig. 27e-f.
2003 *Dutoitella suhmi* (Brady) – Dingle, p. 149, pl. 5, fig. 1.
Figured specimen: U-7123, RV, l: 0.95 mm, h: 0.55 mm.
Origin: 19-744A-20H-1W-6 (166.668 mbsf).
Age: Late Eocene.
Material: two adults and one juvenile V.
Distribution: Eocene: DSDP Site 214 (Indian Ocean). Recent: Prince Edward Island (Indian Ocean), Southwest Africa, DSDP site 609 (Atlantic Ocean).

Dutoitella sp. 1
Fig. 3.21

Figured specimen: U-7124, RV, l: 0.95 mm, h: 0.5 mm.
Origin: 119-744A-13H-5W-6 (114.760 mbsf).
Age: Late Oligocene.
Material: one V.

Dutoitella sp. 2
Fig. 4.1

Figured specimen: U-7125, LV, l: 1.08 mm, h: 0.61 mm.
Origin: 119-744A-13H-5W-6 (114.760 mbsf).
Age: Late Oligocene.
Material: one V.

Family Thaerocytheridae Hazel 1967
Subfamily Bradleyinae Benson 1972
Genus *Bradleya* Hornibrook 1952
Type species *Cythere arata* Brady 1880
Bradleya johnsoni Benson and Peypouquet 1983
Fig. 4.2

1983 *Bradleya johnsoni* Benson and Peypouquet, p. 816, pl. 3, fig. 8.
1988 *Bradleya johnsoni* Benson and Peypouquet – Steineck and Yozzo, p. 193, pl. 1, figs. 6-10; p. 195, pl. 2, figs. 1-11.
1993 *Bradleya johnsoni* Benson and Peypouquet – Guernet, p. 351, pl. 2, fig. 10.
Figured specimen: U-7126, LV, l: 0.97 mm, h: 0.55 mm.
Origin: 119-744A-16H-2W-4 (138.740 mbsf).
Age: Early Oligocene.
Material: two V.
Dicussion: The specimen here figured is slightly different from the holotype (Lower Miocene, South Atlantic), which has a more robust reticulation. However, it is more similar to the specimen recorded by Steineck and Yozzo (1988) in the Equatorial Pacific.
Distribution: Eocene-Miocene: ODP sites 762 and 763 (Indian Ocean). Oligocene-Miocene: Central Equatorial Pacific. Miocene: ODP Site 516 (South Atlantic).

Bradleya thomasi Steineck and Yozzo 1988
Fig. 4.3

1983 *Bradleya* cf. *B. dictyon* Cronin, p. 109, pl. III, fig. D.
1988 *Bradleya thomasi* Steineck and Yozzo, p. 197, pl. 3, figs. 1-11.
Figured specimen: U-7127, RV, l: 0.92 mm, h: 0.51 mm.
Origin: 119-744A-8H-2W-90 (65.100 mbsf).
Age: Miocene
Material: one V.
Distribution: Miocene-Quaternary: DSDP Sites 572, 573, 574. Recent: Florida-Hatteras slope (Atlantic Ocean).

Superfamily Cytherideoidea Liebau 2005
Family Krithidae Mandelstam 1960
Genus *Krithe* Brady, Crosskey and Robertson 1874
Type species *Cythere (Cytherideis) barthonensis* Jones 1857
Krithe sp. 1
Figs. 4.4-5

Figured specimen: U-7128, LV, l: 0.87 mm, h: 0.44 mm.
Origin: 119-744A-16H-5W-4 (143.240 mbsf).
Age: Early Oligocene.
Material: one V.

Krithe sp. 2
Figs. 4.6-7

?1985 *Krithe* sp. 1- Guernet, p. 287, pl. I, fig. 16.
Figured specimen: U-7129, RV, l: 1.0 mm, h: 0.50 mm.

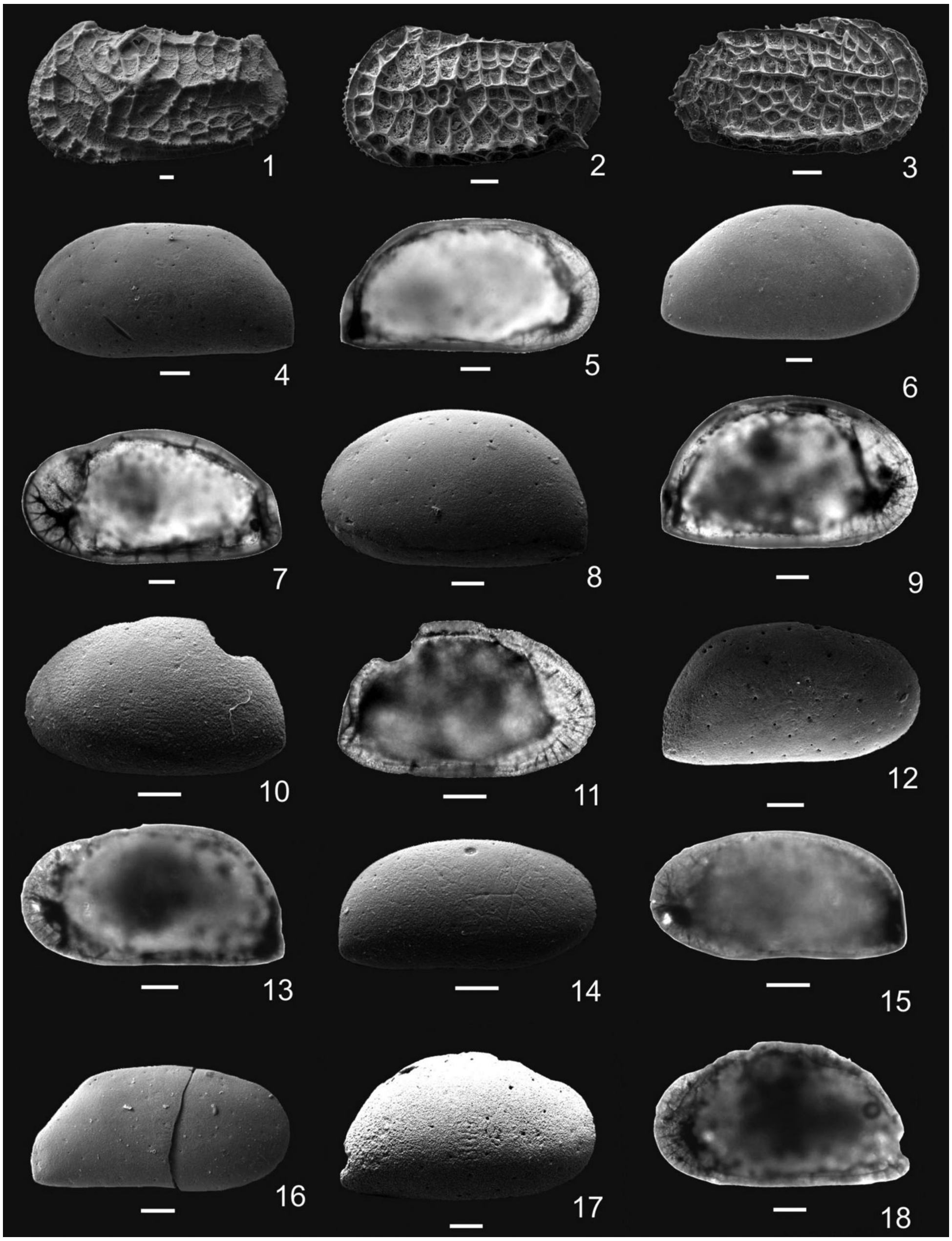

Fig. 4 – 1. *Dutoitella* sp. 2, LV, 119-744A-13H-5W-6. 2. *Bradleya johnsoni* Benson, LV, 119-744A-16H-2W-4; 3. *Bradleya thomasi* Steineck and Yozzo RV, 119-744A-8H-2W-90; 4-5. *Krithe* sp. 1. 4. LV, 119-744A-16H-5W-4. 5. Same specimen in optical microscopy; 6-7. *Krithe* sp. 2, 6. RV, 119-744A-6H-2W-6. 7. Same specimen in optical microscopy; 8-9. *Krithe* sp. 3, 8, LV, 119-744A-18h-3W-6. 9. Same specimen in optical microscopy. 10-11. *Krithe* sp. 4. 10. LV, 119-744A-16H-2W-4. 11. Same specimen in optical microscopy. 12-13. *Krithe* sp. 5. 12. LV, 119-744A-16H-1W-4. 13. Same specimen in optical microscopy. 14-15. *Krithe* sp. 6. 14. RV, 119-744A-19H-2W-5. 15. Same specimen in optical microscopy. 16. *Krithe* sp. 7, RV, 119-744A-18H-3W-6. 17-18. *Krithe* sp. 8. 17. RV, 119-744A-18H-3W-6. 18. Same specimen in optical microscopy. (Scale 100μm).

Origin: 119-744A-6H-2W-6 (43.670 mbsf).
Age: Late Miocene.
Material: one V.
Discussion: This species has an unusual set of anterior radial pore canals that could not be matched with any of the types figured either by Peypouquet (1979) or Coles et al. (1994).

Krithe sp. 3
Figs. 4.8-9

Figured specimen: U-7130, LV, l: 0.79 mm, h: 0.47 mm
Origin: 119-744A-18H-3W-6 (150.660 mbsf).
Age: Late Eocene.
Material: five V.

Krithe sp. 4
Figs. 4.10-11

Figured specimen: U-7131, LV, l: 0.60mm, h: 0.39 mm.
Origin: 119-744A-16H-2W-4 (138.740 mbsf).
Age: Early Oligocene
Material: four V.

Krithe sp. 5
Figs. 4.12-13

Figured specimen: U-7132, LV, l: 0.71 mm, h: 0.39 mm.
Origin: 119-744A-19H-2W-5 (158.650).
Age: Late Eocene
Material: three V.

Krithe sp. 6
Figs. 4.14-15

Figured specimen: U-7133, RV, l: 0.60 mm, h: 0.31 mm.
Origin: 119-744A-18H-3W-6 (150.660 mbsf).
Age: Late Eocene.
Material: four V.

Krithe sp. 7
Figs. 4.16

Figured specimen: U-7134, RV, l: 0.76 mm, h: 0.36 mm.
Origin: 119-744A-18H-3W-6 (150.660 mbsf).
Age: Late Eocene.
Material: one V.

Krithe sp. 8
Figs. 4.17-18

Figured specimen: U-7135, RV, l: 0.79 mm, h: 0.44 mm.
Origin: 119-744A-19H-2W-5 (158.650 mbsf).
Age: Late Eocene.
Material: one V.

RESULTS

In this study, 28 species belonging to 14 genera and six families were identified. *Krithe* is the most diversified genus (eight spp.), followed by *Cytherella* and *Dutoitella* (three spp. for each). The ostracode incidence decreases from the bottom to the top of the section, being the peak of abundance and richness between the Late Eocene and the Early Oligocene. From the sample 119-744A-16H-4W5 of Early Oligocene age and younger ones there is a significant reduction in the richness and abundance. In most of these samples, the richness oscillates between one and two species, and the total abundance of this section is only 36 specimens (Fig. 2).

The Early Oligocene threshold also depicts a faunal turnover, where 16 species only occur before this age, and six after it. *Anebocythereis hostizea* (Hornibrook) is the most abundant species and, with *Bradleya johnsoni* Benson, *Legitimocythere presequenta* (Benson), *Krithe* sp. 4, *Krithe* sp. 5, *Henryhowella asperrima* and *Henryhowella* sp., constitute the only species occurring both before and after the threshold. Some juvenile specimens of *Krithe* which were found in the majority of the studied samples, were not identified in the eight groups here presented, and their occurrences were not included in Figure 2.

The assemblages studied at this site present some similarity with the other faunal record of DSDP/ODP sites, in particular with the site 214, from Indian Ocean, studied by Guernet (1985). Three species are common to these two regions: *Cytherella* sp. 1, *Cytherella* sp. 2, and *Dutoitella suhmi* (Brady). *Krithe* sp. 2 is possibly cospecific with *Krithe* sp. 1 of Guernet (*op. cit.*, p. 287, pl. 1, fig. 16) but, due to the complex morphology of this genus, it is hard to sustain this assumption based only on Guernet's SEM pictures. Some slight variation in size was noticed in the species *Bradleya johnsoni* Benson, *Agrenocythere hazelae* (Bold) and *Legitimocythere presequenta* (Benson), and this is probably related to environmental conditions.

DISCUSSION AND CONCLUSIONS

OCEANOGRAPHIC EVENTS RECORDED AT ODP SITE 744A AND ADJACENT AREAS

In the Cenozoic, several climatic changes driven by orbital oscillations and their influences in the carbon cycle and glaciations have been recorded, which correspond to the transition from the Cretaceous greenhouse to the Cenozoic icehouse (Barker and Thomas 2004, Zachos et al. 2001a). The Oligocene experienced a long glacial interval, except close to the Oligocene/Miocene boundary. Considering both geochemichal and orbital data, Zachos et al. (2001b) divided the Oligocene into four phases; the interval corresponding to the second and third ones (31 to 27 Ma) shows more positive ^{18}O signals, a factor that could explain at least in part the faunal threshold seen in the site 744A.

Positive peaks of ^{18}O in sea water are caused either by ice formation or cooling. Both have had different weight during Cenozoic events, and to find out which one was the most influent is not always straightforward (Lear et al. 2000). Considering that the ostracode faunal composition results from historic and oceanographic events, the cooling of the water and circulation changes in periods marked by ^{18}O peaks may influence both the evolution and migration of taxa prompting faunal turnovers.

Similar faunal trends have been found in the ostracodes from other ODP sites. Majoran and Dingle's (2002) study at the site 689 (Antarctica) recorded high values of richness and abundance in the Eocene-Oligocene interval, which they attributed to either taphonomic or hydrologic processes that resulted from the progressive cooling of Antarctica during that time. Guernet and Galbrun (1992) recorded at site 762 a high diversity and abundance of ostracodes from the Eocene to the Lower Miocene, and a sharp reduction from the Upper Miocene and younger ages. They did not propose any plausible explanation for this trend, but supposed that it could be a result of fluctuations of sedimentation rate linked to variations in the surface productivity.

The reduction in abundance seen in the upper portion of the studied section might be explained either by a preservational bias or a faunal impoverishment. Diester-Hass (1996) noticed a strong covariance between carbonate preservation and productivity in the Eocene-Oligocene interval in the Kerguelen Plateau: the increase in productivity was normally linked to an increase in carbonate dissolution, except when the region was under the influence of a warm, carbonate saturated water mass (WSDW- warm saline deep water). Hence, the carbonate preservation is strongly marked by the remodelation of oceanic circulation and productivity, and might have strongly influenced the fossil record in the upper portion of the section here studied. The presence of specimens (mainly *Krithe*) with a variable degree of dissolution sustains this hypothesis. A similar cause could explain the scarcity of fossils in the younger samples studied (Late Oligocene onwards), in as much as no other process would easily explain the fossil record pattern.

INTRASPECIFIC VARIATION IN DEEP SEA OSTRACODES

The discussion on the intraspecific variation in ostracodes pervades the fields of ecology and systematics. In their discussion on deep sea ostracodes diversity, Jellinek and Swanson (2003) state that a precise taxonomic approach would not be achieved based exclusively on the carapace morphology, at least in some ostracod groups (Trachyleberididae, for instance). The refinement of the taxonomic knowledge on deep sea ostracodes is the basis for their paleoceanographical use, and recent studies show that much has to be done in this field. Schornikov (2005), for instance, concluded that at least five species were lumped under the name *Pedicythere polita* Colalongo and Pasini around the world, making them so called composite species.

However, species such as *Krithe dolichodeira* Bold, *Legitimocythere presequenta* (Benson) and *Agrenocythere hazelae* (Bold), actually have near global distributions in the deep ocean. In these species, slight morphological variations are present especially on size and ornamentation, as can be seen even in this study. Evidences from the previously discussed studies sustain that intraspecific variation could also be a common phenomenon in deep sea faunas, which is resulted not only from clinal variation, but also induced by change in temperature, dissolved oxygen and salinity.

Considering that climatic changes exert influence on deep sea ostracodes even for a short geological duration (Cronin et al. 1999, Yasuhara et al. 2008), it would be plausible to find climatically driven ecophenotypic variants of a species in these environments. This can be achieved only through an accurate taxonomic knowledge and the understanding of the intraspecific variation processes, reinforcing the use of ostracode diversity as a proxy for hydrological changes.

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RESUMO

Ostracodes do intervalo Eoceno-Plioceno do sítio 744A do ODP (Platô Kerguelen) são aqui estudados sob o aspecto taxonômico e paleoecológico. 28 espécies são identificadas, sendo os gêneros *Krithe*, *Cytherella* e *Dutoitella* os mais diversificados. Uma transição faunística registrada no Eoligoceno é investigada com base em estudos paleoceanográficos realizados no Platô Kerguelen e em áreas adjacentes. A transição e as variações de riqueza e abundância possivelmente refletem o estabelecimento da psicrosfera e mudanças hidrológicas associadas, na composição da fauna. Além disso, a influência destas mudanças na preservação do carbonato é discutida como possível causa do empobrecimento da fauna na porção superior do testemunho.

Palavras-chave: Cenozóico, ostracodes, paleoceanografia, paleozoogeografia.

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