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Calcareous nannofossil assemblages around the Pliensbachian/Toarcian boundary in the reference section of Peniche (Portugal)

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Resumo

***Palavras-chave*:** Nanofósseis calcários, Pliensbaquiano, Toarciano, Bacia Lusitânica, Portugal

O limite Pliensbaquiano/Toarciano (Jurássico Inferior) está bem representado na Bacia Lusitânica (Portugal), principalmente em Peniche, através de uma sucessão margo-calcária alternante. Visando contribuir para a definição do GSSP do Toarciano, são descritas aqui as associações de nanofósseis ocorrentes nesses depósitos. As análises foram realizadas em amostras de margas recolhidas 3 m abaixo e 7 m acima deste limite. Os principais nanofósseis observados foram *Biscutum finchii*, *B. grande*, *Calcivascularis jansae, Crepidolithus crassus*, *C. granulatus*, *C. impontus*, *Lotharingius hauffii*, *L. sigillatus*, *L. aff. L. velatus*, *Schizosphaerella* spp. e *Tubirhabdus patulus*. Esta associação, aliada ao aparente posicionamento das amostras acima da extinção de *Crucirhabdus primulus*, indica que o limite Pliensbaquiano-Toarciano estaria localizado na parte superior da subzona NJ5b. Os exemplares dos géneros *Schizosphaerella* e *Lotharingius* dominam no conjunto da associação, também caracterizada pela ocorrência abundante de *C. jansae* e comum de *B. grande*, indicadores de forte influência de águas do Mar de Tétis.

Résumé

***Mots-clés*:** Nanofossiles calcaires, Pliensbachien, Toarcien, Bassin Lusitanien, Portugal

La limite Pliensbachien/Toarcien (Jurassique Inférieur) est très bien représentée dans le Bassin Lusitanien (Portugal), principalement à Peniche, par une succession marno-calcaire alternante. Visant à apporter une contribution à la définition du GSSP du Toarcien, sont ici décrites les associations de nanofossiles dans ces dépôts. Des analyses ont été réalisées sur des échantillons de marnes recueillies 3 m en dessous et 7 m au dessus de cette limite. Les principaux nanofossiles signalés ont été: *Biscutum finchii*, *B. grande*, *Calcivascularis jansae, Crepidolithus crassus*, *C. granulatus*, *C. impontus*, *Lotharingius hauffii*, *L. sigillatus*, *L. aff. L. velatus*, *Schizosphaerella* spp. et *Tubirhabdus patulus*. Cette association, liée à la localisation apparent des échantillons au dessus de l'extinction de *Crucirhabdus primulus*, indique que la limite Pliensbachien-Toarcien serait localisée dans la partie supérieure de la sous-zone NJ5b. Les individus des genres *Schizosphaerella* et *Lotharingius* prédominent dans l'association, qui est aussi caractérisée par l'abondante fréquence de *C. jansae* et la présence de *B. grande,* indicateurs de forte influence des eaux de la Tethys.

Abstract

***Key-words*:** Calcareous nannofossils, Pliensbachian, Toarcian, Lusitanian Basin, Portugal

The Pliensbachian/Toarcian boundary (Lower Jurassic) is well represented in the Lusitanian Basin (Portugal), mainly in the Peniche area, recorded by a marl/limestone series. Calcareous nannofossil assemblages are described herein, with the aim to contribute to the Toarcian GSSP definition. Marly samples were collected 3 m below and 7 m above this boundary and analysed for calcareous nannofossils. The main nannofossils observed were *Biscutum finchii*, *B. grande*, *Calcivascularis jansae, Crepidolithus crassus*, *C. granulatus*, *C. impontus*, *Lotharingius hauffii*, *L. sigillatus*, *L. aff. L. velatus*, *Schizosphaerella* spp. and *Tubirhabdus patulus*. This assemblage indicates that the Pliensbachian/Toarcian boundary in Peniche lies in the upper part of the NJ5b Subzone. *Schizosphaerella* and *Lotharingius* dominate the assemblage. The abundant occurrence of *C. jansae* and the common occurrence of *B. grande* indicate a strong Tethyan influence.

Introduction

The high biostratigraphic potential of the Lower Jurassic calcareous nannofossils is well documented in the papers of P. Bown (1987), P. Bown & *al.* (1988), P. Bown & M. Cooper (1998), E. de Kaenel & *al.* (1996) and E. Mattioli & E. Erba (1999), among others. They are based on calcareous nannofossil record recovered from many sections located in NW Europe and Mediterranean areas. The biohorizon succession and the calcareous nannofossil zones and subzones proposed for NW Europe (from Hettangian to Tithonian) and Italy/South France (from Hettangian to Callovian) are discussed by P. Bown & M. Cooper (1998) and E. Mattioli & E. Erba (1999), respectively.

As a part of a multidisciplinary work, are also available data on Pliensbachian to Aalenian calcareous nannofossil assemblages recovered from different sections selected along the western (Lusitanian Basin) and northeastern (Basque-Cantabrian area and Iberian Range) margins of the Iberian Massif. In particular, the Pliensbachian-Toarcian calcareous nannofossil data set achieved for the Basque-Cantabrian area (Perilli, 1999; Perilli & Comas-Rengifo, 2002) is discussed in the paper of N. Perilli & *al.* (2004). Previously studied by G. Hamilton (1977, 1979), P. Bown (1987) and Bergen (*in* de Kaenel & *al.*, 1996), the calcareous nannofossil contents of the Toarcian succession cropping out in the Lusitanian Basin has been investigated by N. Perilli & L. Duarte (2003), L. Duarte & *al.* (2004) and N. Perilli & L. Duarte (2006). The ongoing works are focused on the Sinemurian-Pliensbachian and Aalenian calcareous nannofossils recovered from other key-sections located in the Lusitanian Basin.

Samples and methods

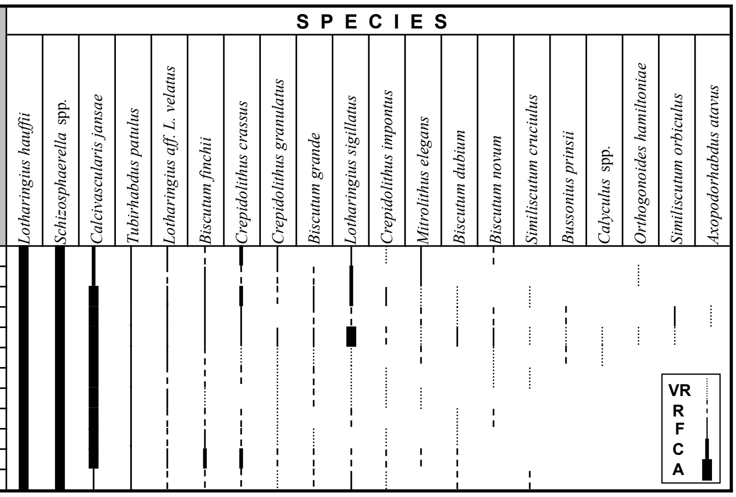
For the aim of this meeting, the preliminary data on calcareous nannofossil analyses recovered from the calcareous-marly succession exposed at Ponta do Trovão (Cabo Carvoeiro, Peniche) is here summarized. 12 analyzed marly samples were collected from 3 meters below to 7 meters above the Pliensbachian/Toarcian Stage Boundary. The slides were prepared in the Petrobras Research Center (CENPES – BPA) laboratories, applying the Petrobras standard methodology (Antunes, 1997; Oliveira, 1997). The analysis was performed with a ZEISS Axioplan 2 imaging microscope, using 1600X magnification. 500 fields of view were examined on each slide. The relative abundance of the assemblages and the relative abundance of each species (Table I) were based on the scheme presented by A. Concheryo & S. Wise Jr. (2001). The preservation degree was based on the classification of P. Roth & H. Thierstein (1972).

Calcareous assemblages

All the samples analyzed yielded common to abundant and moderate to good preserved nannofossil assemblages, that allows to recognized 12 genera and 18 species (Table I; figs. 1 and 2). The genera *Schizosphaerella* along with *Lotharingius hauffii* and *Calcivascularis jansae* dominate the assemblages, which are also characterized by the continuous presence of *Tubirhabdus patulus*, *Biscutum finchii*, *Biscutum grande, Lotharingius* aff. *L. velatus*, *Crepidolithus crassus*, *Crepidolithus granulatus*. Ranging in abundance from very rare to few, *Biscutum dubium*, *Biscutum novum*, *Bussonius prinsii*, *Calyculus* spp., *Mitrolithus elegans*, *Orthogonoides hamiltoniae*, *Similiscutum cruciulus* and *Similiscutum orbiculus* are, instead, discontinuously present. Few specimens of *Axopodorhabdus atavus* has been identified only in one sample. Present from the bottom of the sampled interval, the relative abundance of *Crepidolithus impontus* and *Lotharingius sigillatus* slightly increase upwards, in particular that of *Lotharingius sigillatus*.

Table I – Calcareous nannofossil distribution in the studied interval.

Stages	Ammonites zones	Nannofossils zones Bown & Cooper (1998)	Sample	Sample abundance	Preservation
Lower Toarcian	polymorphum	NJ5b	P 0019	A	G
			P 0015M	A	G
			P 0013B	A	G/M
			P 0005T	A/C	G/M
			P 004	A	G
			P 001	A	G
Upper Pliensbachian	spinatum		PE 0983T	A	G
			PE 0979	A	G
			PE 0975	A	G
			PE 0965	A	G
			PE 0951	A	G
			PE 0947	A	G



Relative abundance of species
VR =Very rare (1 specimen per 201 – 500 fields of view)
R = Rare (1 specimen per 51 – 200 fields of view)
F = Frequent (1 specimen per 11 – 50 fields of view)
C = Common (1 specimen per 2 – 10 fields of view)
A = Abundant (1-10 specimens per fields of view)
The same definitions were used to estimate total abundance of each sample.
Lotharingius umbriensis is grouped along with *Lotharingius hauffii*

Preservation
P = Poor. Severe dissolution and overgrowth. Most primary features have been destroyed.
M = Moderate. Dissolution and overgrowth are evident. Up to 25% of the specimens cannot be identified to species level.
G = Good. Little dissolution and overgrowth. Diagnostic characteristics are preserved and all specimens are identified.
E = Excellent. Without dissolution or overgrowth.

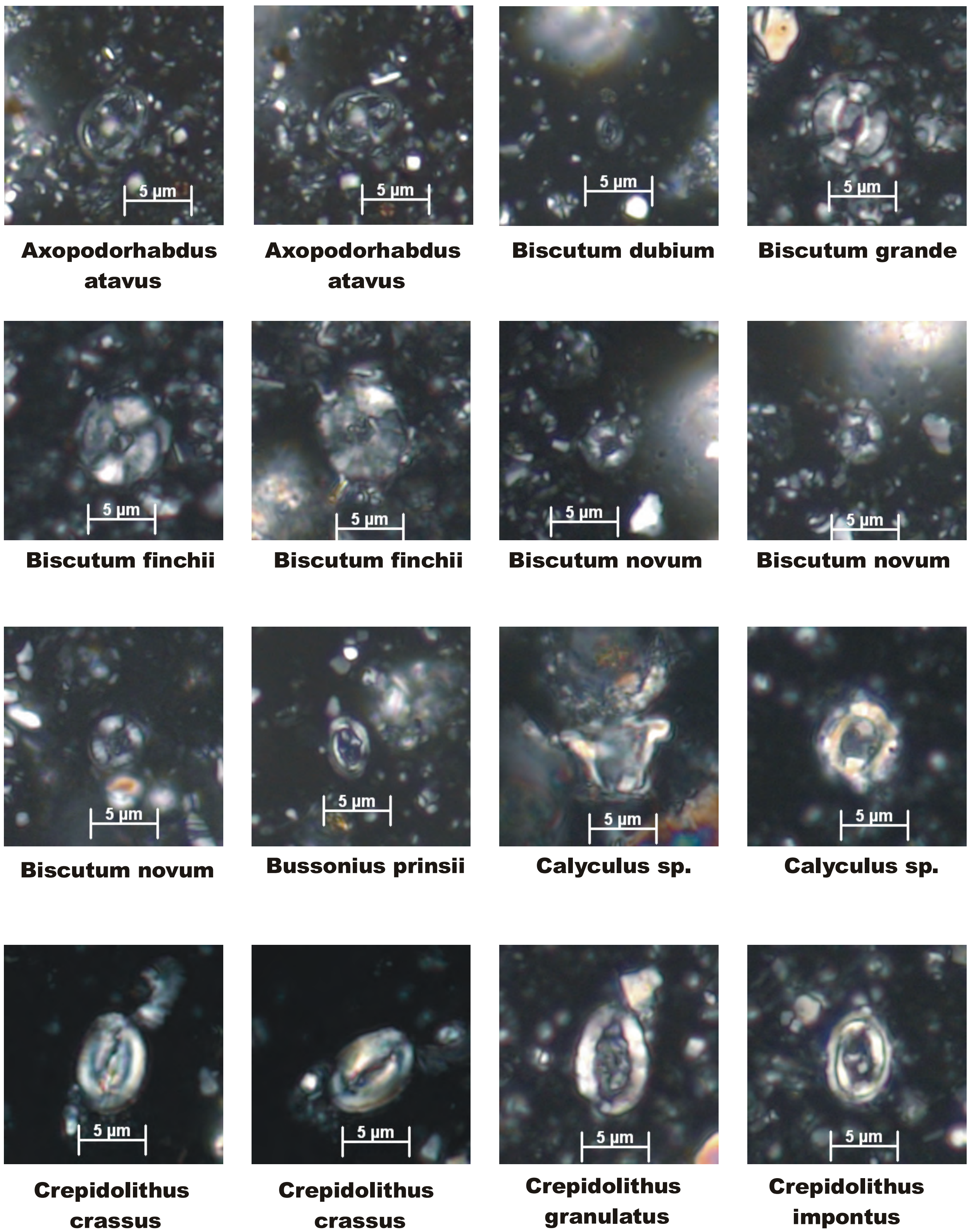


Fig. 1 – Some calcareous nannofossils species observed in the studied interval.

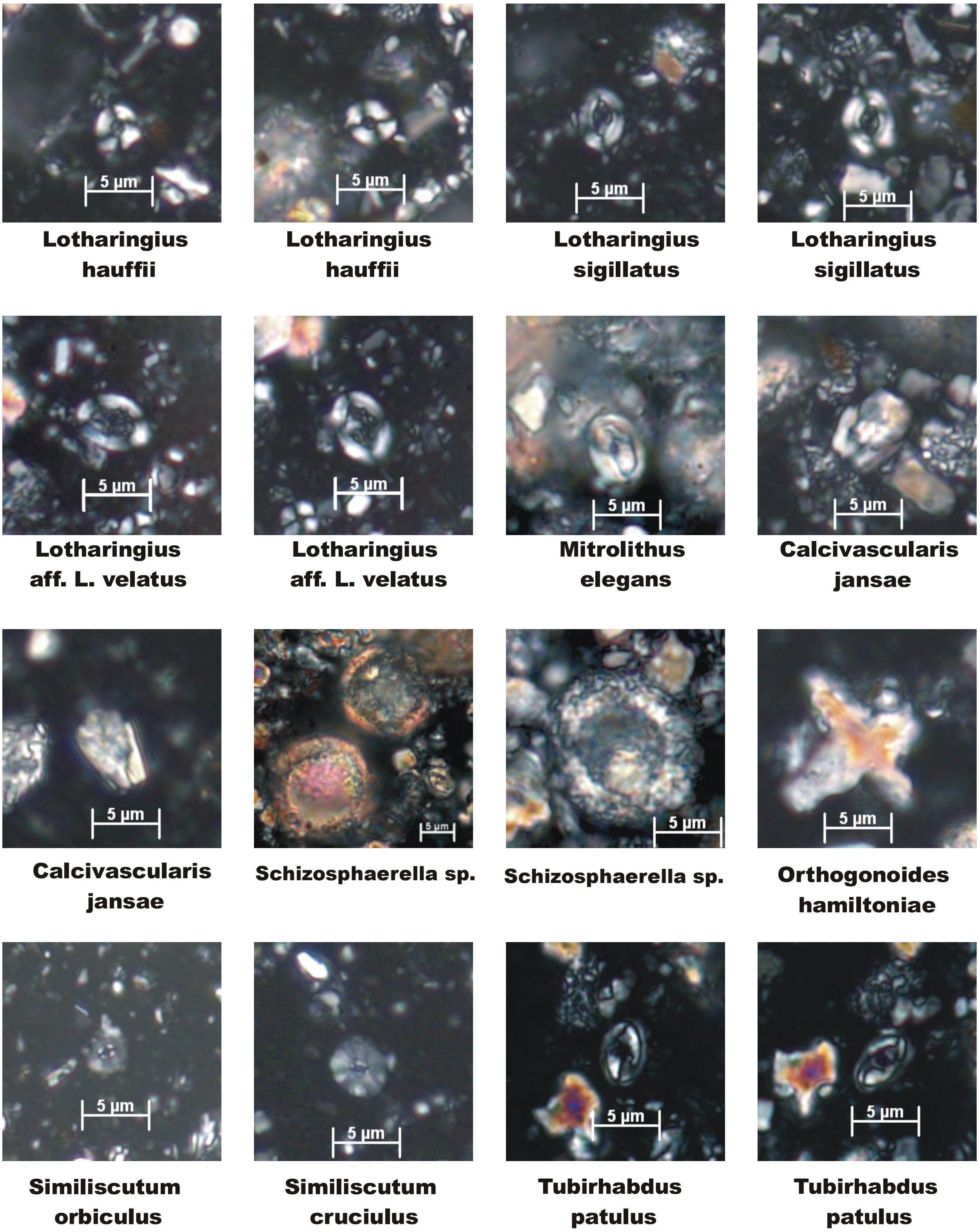


Fig. 2 – Other calcareous nannofossils species observed in the studied interval.

Remarks

In figure 3 is redraw the Upper Pliensbachian-Lower Toarcian portion of the biostratigraphic schema proposed by P. BOWN & M. COOPER (1998) and E. MATTIOLI & E. ERBA (1999) and the zonal markers utilized to define their calcareous nannofossil zone and subzones boundaries. The figure is implemented with the biohorizons and calcareous nannofossil zones recognized in the Basque-Cantabrian area (PERILLI & *al*. 2004, *cum bibliografia*) well calibrated with respect to the ammonite subzones. In NW Europe and Italy/S France, the Pliensbachian/Toarcian boundary lies in the *Lotharingius hauffii* Zone (i.e., Zone NJ5 and NJT5), that is, within the NJ5b *Crepidolithus impontus* Subzone of P. BOWN & M. COOPER (1998) or coincides with the NJT5a *Biscutum finchii*/NJT5b *Lotharingius sigillatus* Subzone boundary of E. MATTIOLI & E. ERBA (1999). In the Basque-Cantabrian area, the successive FCO[1] *Lotharingius hauffii* and the LCO[1] of *Calcivascularis jansae* allow to divide the NJ5 *Lotharingius hauffii* Zone in three portions, and the Pliensbachian/Toarcian boundary is comprised between the FCO *Lotharingius hauffii* and the LCO of *Calcivascularis jansae.* Since the FCO of *L. hauffii* roughly approaches the NJ5a/NJ5b Subzone boundary of P. BOWN & M. COOPER (1998), the Pliensbachian/Toarcian boundary lies within the NJ5b Subzone, in the Basque-Cantabrian area.

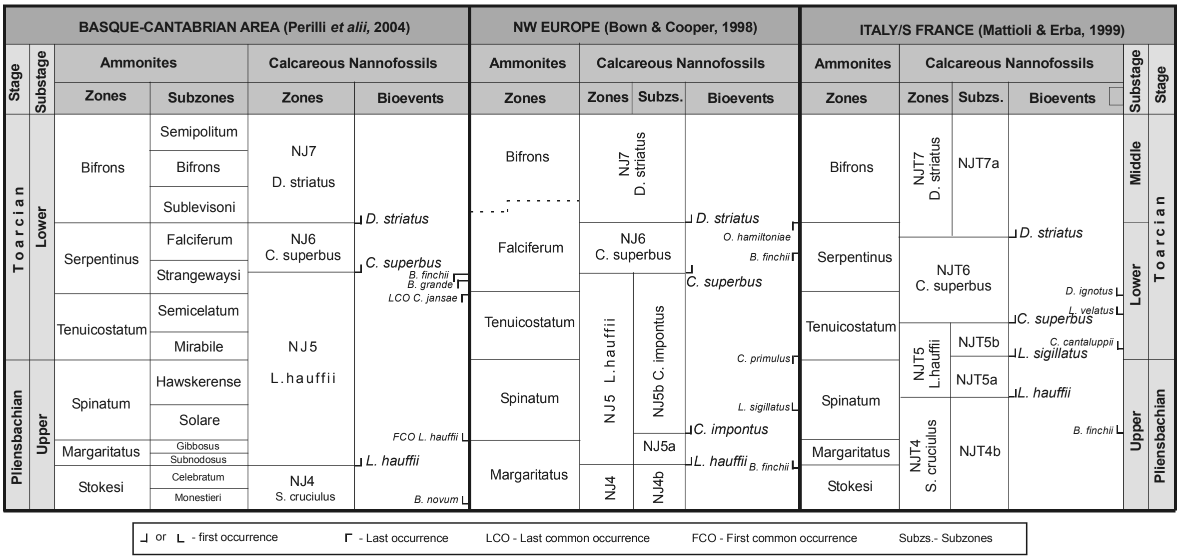


Fig. 3 – Ammonite and calcareous nannofossil zone and subzones for Basque-Cantabrian area, NW Europe and Italy/S. France around the Pliensbachian/Toarcian boundary (modified from PERILLI & *al*., 2004).

On the basis of the presence of *Crepidolithus impontus* and the absence of *Carinolithus superbus*, the Pliensbachian/Toarcian boundary, exposed in the reference section of Peniche, is comprised in the NJ5b Subzone. With respect to the schema proposed by E. MATTIOLI & E. ERBA (1999) it lies within the NJT5b *Lotharingius sigillatus* Subzone, because *Lotharingius sigillatus* is present from the base of the sampled interval. Also in the Basque-Cantabrian area the first specimens of *Lotharingius sigillatus* is present from the Spinatum Zone.

The common and continuous presence of *Calcivascularis jansae* along with the presence of *B. grande* support the tethyan affinity of the calcareous nannofossils assemblages recovered from the Pliensbachian-Toarcian transition sampled at Peniche. In particular, *Calcivascularis jansae* is the most striking tethyan marker (BOWN, 1987, 1992).

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[1] FCO = First Common Occurrence; LCO = Last Common Occurrence.

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