Biostratigraphy of late Sinemurian-Pliensbachian calcareous nannofossils in northern Spain (Basque-Cantabrian Basin)

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The aim of this work is to improve the knowledge of nannofossil biohorizons in the Basque-Cantabrian Basin (BCB), through comparison of our results to the scheme proposed by Bown & Cooper (1998) for NW Europe. The four ammonite-controlled successions we studied consist of Upper Sinemurian (Raricostatum Ammonite Zone) limestones of shallow platform, grading to a regular alternation of hemipelagic marlstones and limestones, Pliensbachian in age. Our results are based on semiquantitative analysis of more than 140 smear slides from the Tudanca and Santotis sections, and the re-analysis of more than 200 samples from the Camino and San Andrés sections (Perilli & Comas-Rengifo, 2002).

In the BCB, the most relevant composition changes in Pliensbachian calcareous nannofossil assemblages are the first occurrences (FO) of the genera *Similiscutum* (*jamesoni* AZ) and *Lotharingius* (*stokesi* AZ). During the late Pliensbachian, the assemblages change remarkably due to 1) the FO of the genus *Biscutum* (*davoei* AZ), 2) an increase in abundance of *Schizosphaerella*, *Calcivascularis* and *Lotharingius*, 3) a decrease in abundance of *Crepidolithus* and *Parhabdolithus* and, 4) the first common occurrence (FCO) of *C. jansae* and *L. hauffii*. Related to these composition changes, we have recognized and calibrated against the ammonite zones and subzones, two main events (the FO of *S. cruciulus* and the FO of *L. hauffii*) and six secondary events (1. FO of *B. novum*; 2. FO of *B. grandis*; 3. FO of *B. finchii*; 4. FO of *L. barozii*; 5. FCO of *C. jansae*; 6. FCO of *L. hauffii*). In the Camino and San Andrés sections, we have also identified the FOs of *B. dubium*, *Bussonius prinsii* and *L. sigillatus*.

The first zone recognized is the NJ3 *Crepidolithus crassus* (Bown, 1987) Bown & Cooper (1998), including the time interval from the FO of *C. crassus* to the FO of *S. cruciulus*. This zone is dominated by the genera *Orthogonoides* and *Schizosphaerella* spp. and shows an increase in the abundance of *Crepidolithus* and *Parhabdolithus*.

The base of the NJ4 *Similiscutum cruciulus* Zone Bown (1987), emend. Bown & Cooper (1998), is defined by the FO of *S. cruciulus* within the *jamesoni* AZ, as it is observed in NW Europe, Portugal and Italy. The assemblages of this zone show an abundance increase of the genera *Calcivascularis* and *Biscutum*, and a decrease of *Crucirhabdus*, *Crepidolithus* and *Parhabdolithus*. In this zone, the last occurrences of *C. pliensbachensis* and *P. robustus*, and the

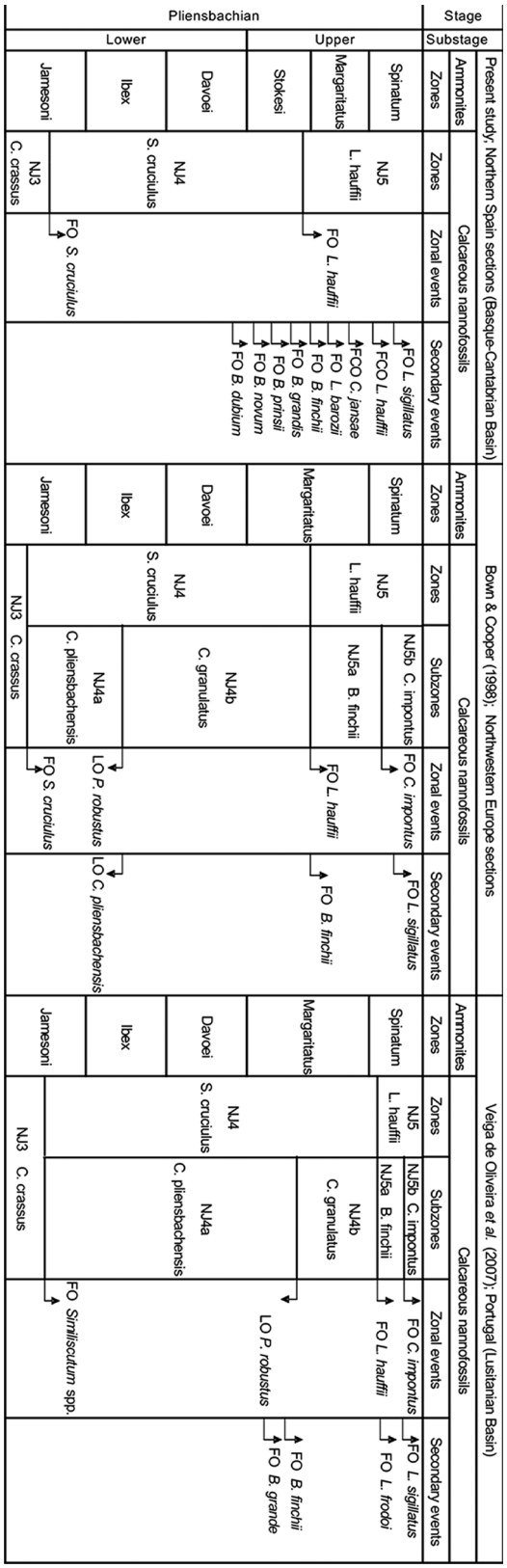

Figure 1: Sketch showing ammonite zones and calcareous nannofossil zones, with zonal and secondary events, in the Basque-Cantabrian Basin (present study), NW Europe (Bown & Cooper, 1998), and the Lusitanian Basin (Veiga de Oliveira *et al*., 2007)

FO of the genus *Biscutum* have been identified. In NW Europe and Portugal, the NJ4 Zone is divided in two subzones based on the LO of *P. robustus*, that in the BCB shows low abundances and a discontinuous record. In our sections, the NJ4 Zone can be subdived using the FO of *B. novum*.

The base of the NJ5 *Lotharingius hauffii* Zone Bown (1987) is defined by the FO of *L. hauffii* (*stokesi* AZ). In NW Europe, this event lies in the *margaritatus* AZ, which includes the *stokesi* and *margaritatus* AZs of the BCB. In Portugal, it has been recognized in the uppermost levels of the *spinatum* AZ. The lower part of the NJ5 Zone is characterized by the abundance decrease of *Crepidolithus* and *Similiscutum*, and the increase of *Calcivascularis*, *Biscutum* and *Lotharingius*. This last genus shows an increase in abundance and diversity along the late Pliensbachian, related to the FOs of *L. barozii* and *L. umbriensis* (*margaritatus* AZ), and the FCO of *L. hauffii* and FO *L. sigillatus* (*spinatum* AZ). In NW Europe, the NJ5 Zone is divided in two subzones, based on the FO of *C. impontus* also used in Portugal. Because of the difficulty to distinguish *C. impontus* from *C. cavus*, and the low abundance and discontinuous record of the first species in the BCB, it seems to be useful to divide this zone using the FO of *L. sigillatus*, as proposed by Mattioli & Erba (1999) for the NJT5b subzone.

In summary, the scheme of Bown & Cooper (1998) for NW Europe is reproducible also in the BCB, where it is possible to calibrate the bases of NJ4 and NJ5 zones with respect to the ammonite subzones. Though in the BCB, the NJ4a/NJ4b and NJ5a/NJ5b boundaries are not easily recognizable. The FOs of *B. novum* and *L. sigillatus* are helpful to subdivide the NJ4 and NJ5 zones, respectively.

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