

The lower Eocene Sopelana section: new insights into environmental effects and biotic response of astronomically driven climate change

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The lower Eocene Sopelana section (Basque-Cantabrian basin) contains approximately 30m of a rhythmic alternation between pelagic marls and limestones that are organized in thirteen well defined bundles, each generally containing five limestone-marl couplets. This arrangement strongly suggests that the couplet formation was driven by astronomical precession cycles (21ky each) and the bundles by eccentricity cycles (100ky) (Martinez-Braceras *et al.*, 2017). The studied section was assigned by Elorza *et al.* (1984) to the early Ypresian *Morozovella subbotinae* planktonic foraminiferal Zone.

The aims of this study were to investigate the orbitally controlled sedimentary cyclicity of the Sopelana section using geochemical proxies, to define a detailed chronology based on calcareous nannofossil biostratigraphy, and to characterize the nannofloral assemblage changes. The geochemical analysis, based on the carbonate content of the beds, was performed with a resolution of 1–1.5ky and allowed reliable identification of orbital cycles as the main forcing mechanism that controlled sedimentation. Semiquantitative calcareous nannofossil analyses were performed on 66 samples, which provided a more accurate age for the Sopelana section. *Rhombaster* spp. and *Fasciculithus* spp. were present from the base of the section, which suggests placement of the lowermost part of the section in Zone CNE1, just above the Paleocene-Eocene boundary. Using the well-documented *Rhombaster-Tribrachiatus* lineage, the section extends from Zones CNE1 to CNE3 of Agnini *et al.* (2014) or Zones

NP10 to NP11 (Martini, 1971), a span of about 1Ma, which confirms the age obtained by counting short eccentricity bundles.

The bio-litho-cyclostratigraphic data of the Sopelana section can be correlated with the coeval Zumaia section, which is located 60 km to the east. This confirms that the studied beds are the result of supra-regional sedimentary processes rather than due to local diagenesis, and that there was homogeneity of the sedimentary and biotic processes throughout the Basque-Cantabrian basin in Ypresian times.

References

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