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New chronostratigraphic constraints for the Eocene uppermost marine deposits from the southeastern Pyrenean foreland basin

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The Paleogene marine infill of the southeastern Pyrenean foreland basin (Ebro basin) starts with a transgressive system composed of the shallow-marine Alveolina limestone of the Cadí Formation (Ypresian) and is normally capped by the evaporite Cardona Formation (lower Priabonian) followed by Oligocene continental deposits. At the easternmost side of the basin (Vic area) the marine succession which is sandwiched between Paleocene and Oligocene continental deposits is traditionally considered to be middle to upper Eocene in age (based mostly on larger foraminifera biostratigraphy) (Serra-Kiel *et al.*, 1997 and references therein). In that framework, the basal marine strata have been dated as middle Lutetian age (east of Vic) to Bartonian age in the southern sector of the basin, emphasizing a strong diachroneity of the base of the marine deposits, on the basis of which Puigdefàbregas et al. (1986) proposed southward migration of the south Pyrenean depocenter due to emplacement of the south Pyrenean thrust-sheets. This interpretation was controversially challenged by Taberner *et al* (1999) on the basis of magnetostratigraphic data and numerical age constraints (^{40}Ar/^{39}Ar dating on glauconite crystals) from the southern sector of the basin suggesting that marine deposition also started there in the Lutetian, some 5 My earlier than previously inferred (see also Serra-Kiel *et al* 2003). Instead, Taberner *et al*. (1999) propose that a marked basin asymmetry is observed later in its evolution as the top of the marine deposits records a northward increase in the thickness of a normal chron correlated to C17n.1n, in conjunction to the presence of additional magnetozones within marine strata at the top of the marine interval in the northern sector (Sant Bartomeu del Grau quarry section).

In an effort to clarify the chronostratigraphy of the southeastern Pyrenean foreland basin we report on new integrated magnetostratigraphic and calcareous nannofossil data for the uppermost marine sequence along several sections from the central and northern parts of the basin in the Vic area. The marine deep outer shelf sediments just below a transitional unit preceding gypsum deposits of the Cardona Formation display a conspicuous lithologic cyclicity of marl and more carbonatic layers which can be correlated bed-by-bed among at least two of the studied sections separated more than 5 km. The hierarchy of the cyclic lithological pattern seems compatible with astronomical forcing. Magnetostratigraphic data documents a relatively thick normal magnetozone below the gypsum (or equivalent recifal facies) in all studied sections and a reversal boundary that defines the base of the normal magnetozone is placed at the same stratigraphic position regarding the lithologic cyclicity. A quantitative biostratigraphic analysis based on calcareous nannofossils allowed to record common and diversified late middle/upper Eocene assemblages in the studied sections. Particularly, in the Gurb section we were able to recognize within the normal magnetozone the FO of *Istmolithus recurvus*, which identifies the base of the NP19 Zone of the zonal scheme of Martini (1971), in the Priabonian. This event occurs within C16n.2n magnetozone in several oceanic and Mediterranean sections and is calibrated at 36 Ma (Berggren *et a*l., 1995; Marino and Flores, 2002). Consequently, we challenge all previous chronostratigraphies for the uppermost marine sediments in the Vic area that assigned an upper Bartonian age to the uppermost marine sediments and a correlation to C17n.1n (Burbank *et al*, 1992, Taberner *et al*., 1999). Our current dataset does not allow confirming the diachroneity within the marine deposits beneath the evaporites as suggested by Taberner *et al.* (1999) but is in agreement with a proposed age of ∼35 Ma for the Cardona evaporite unit. Additionally, our chronological constraints allow an assessment of the lithologic cyclicity of these sediments through comparison to astronomically forced Late Eocene sediments elsewhere (Pälike *et al*, 2001) and recently developed astronomical target solutions (Varadi *et al*, Laskar *et al*., 2004).

Berggren *et al*. (1995). SEPM Spec. Publ., 54, 129-212; Burbank *et al.* (1992). GSA Bull., 104, 1101-1120; Laskar *et al*. (2004). Astron. & Astrophys, 428, 261-285; Marino and Flores (2002). Mar. Micropaleon., 45, 383-398; Martini (1971). Proc. DSDP Init. Rep., 7, 1471-1507; Serra-Kiel *et al*. (1997). Field Trip Guide, Second Meeting of the IGCP 393, 52 pp; Serra-Kiel *et al*. (2003). *GSA* Bull; 115; 249–256; Taberner *et al*. (1999). GSA Bull., 111, 1155-1174; Varadi *et al*. (2003). Astrophys. J., 592, 620-630.