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PALEOCENE/EOCENE BOUNDARY IN THE PLATFORM DEPOSITS OF THE NORTHERN PYRENEES

by

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ABSTRACT

A stratigraphic summary on the Paleocene and Lower Eocene shallow marine deposits of the northern pyrenean basin shows the alternation of marine and continental episodes both controlled by eustatic cycles and by regional compressive tectonic events. The correlations with the marine deeper deposits are not always very precise, especially between P4 and P6, when the main change occurs in the biotic shallow water assemblages. A drastic impoverishment of the fauna has not been noticed. Maybe it is hidden by a hiatus in the marine sedimentation or by a too low taxonomic resolution power of the fossil data. There is a progressive change of the various fossil populations inside every marine episode, induced by the changes in sedimentation and the progressive warming up of the climate. There is also some important renewal in the composition of the assemblages at the beginning of the main transgressive cycles, the specific diversification of the genus *Alveolina s.s.* at the base of the Ilerdian. In studies relative to the shallow marine mesogean deposits, this change - not well correlated with the planktonic foraminiferal zonation - is often mistaken for the Paleocene/Eocene boundary.

KEY WORDS

Paleocene, Eocene, Platform, Stratigraphy, Benthos, Pyrenees, France.

1. INTRODUCTION

During the Early Paleogene, the infilling of the northern Pyrenean foreland basin - limited to the South in its central and eastern part by the Paleo-Pyrenees already created (Tambareau *et al.*,1987) - was both controlled by sea level changes and by regional compressive tectonic events. As a result, the platform deposits show transgressive-regressive sedimentation cycles with alternance of marine and continental episodes not clearly correlated with the marine deeper deposits of the basin, restricted to the westernmost area (permanent Aturian Trough).

Correlations between the pyrenean strata around the Paleocene/Eocene boundary and those of more northern or oceanic basins have been a subject of discussion. The use of classic stage names has been a source of confusion and, if recently a general agreement has been reached among scientists working on the subject, many problems remain, even inside the pyrenean basin, for two main reasons : the poor recovery of planktonic foraminifera in the shallow basin and the lack of modern data in the platform deposits of the western area where planktonic and benthonic foraminifera are both present but need to be revised.

Nevertheless, the Early Paleogene deposits of the northern pyrenean basin can provide interesting information about events occuring around the Paleocene/Eocene boundary. So I will present a summary of the main data about the shallow deposits of this area, try to locate the main biotic change in the fossil record on a general time scale, then propose where to locate a main boundary if not "the" Paleocene/Eocene boundary.

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2. PALEOCENE AND EARLY EOCENE PLATFORM DEPOSITS IN THE NORTHERN PYRENEES

At the maximum of the transgressive episodes, the sea reached the Corbières (Fig. 1). The Paleocene and Early Eocene sediments exhibit a wide variety of facies : carbonate platform facies predominates in the eastern and central area changing progressively to deeper facies towards the West. During the regressive episodes, the sea withdraws westwards beyond the Lannemezan Plateau.

The shallow neritic deposits occur in two areas, the western and the central to eastern ones separated by the Lannemezan Plateau without any outcrops and very few boreholes. Correlations are therefore rather difficult. In order to give a schematic account of the biostratigraphy in the Northern Pyrenees, the Gan section completed by the Oraas section (Pyrénées-Atlantiques) in the western area and a stratigraphic frame of the central and eastern area will be separately presented.

2.1. Gan and Oraas sections, Pyrénées-Atlantiques

In the western area of the northern pyrenean basin, the Early Paleogene deposits are not very well known because of the lack of good outcrops and of recent works, except in the Gan section described by Seyve (1984) who has particularly studied planktonic foraminifera and nannoplankton (Fig. 1).

In Gan, the Thanetian is composed by sands and limestones belonging to P4 and for its upper part to NP9. The presence of *Glomalveolina primaeva* in NP9 needs to be verified because this species elsewhere is found earlier, in NP8. The so far barren "Upper Sands" separate the P4-NP9 Thanetian levels from the Cuisian "Flysch marneux" belonging to P8-NP12 equivalent to *Alveolina oblonga* zone. A similar succession occurs westwards, in the Oraas section (Gave d'Oloron valley) described by Boltenhagen (1966).

More investigations will be necessary in order to know if the gap between P4 and P8 is due to non deposition of sediments, to the lack of microfossils in the sands or to inadequate sampling of the sedimentary series. Whatever it may be, it is clear that it will not be easy to define a Paleocene/Eocene boundary in the sandy deposits of the western part of the northern pyrenean basin.

2.2. Central and eastern Pyrenees

In the central and eastern part of the basin, some correlations between benthic and planktonic zonations have been established but uncertainties as to their age remain for the continental deposits, for example, at the top of the Thanetian and even for shallow marine deposits, particularly at the base of the Ilerdian (Fig. 3).

The stratigraphic framework shows three transgressive episodes during the Thanetian, extending more or less westwards. The first one, not well dated, belongs to *Deflandria speciosa* dinokyst zone as well as the second and the main one which corresponds to the top of P3 and to P4, for its base to NP6 and containing

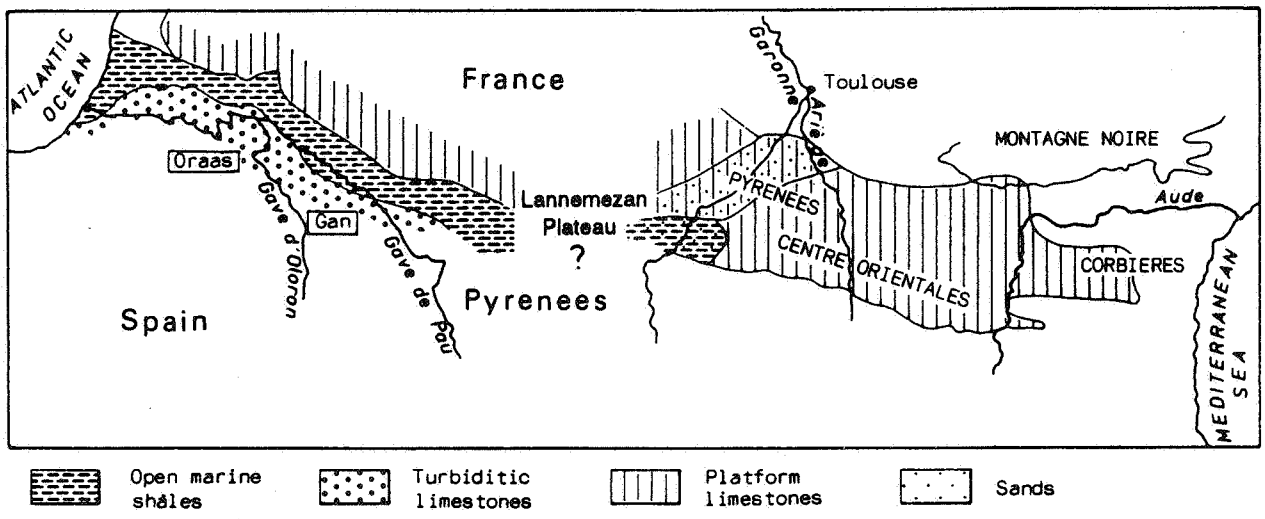

Figure 1. Geographic distribution of main Thanetian facies corresponding to the maximum of the second Thanetian transgressive episode.

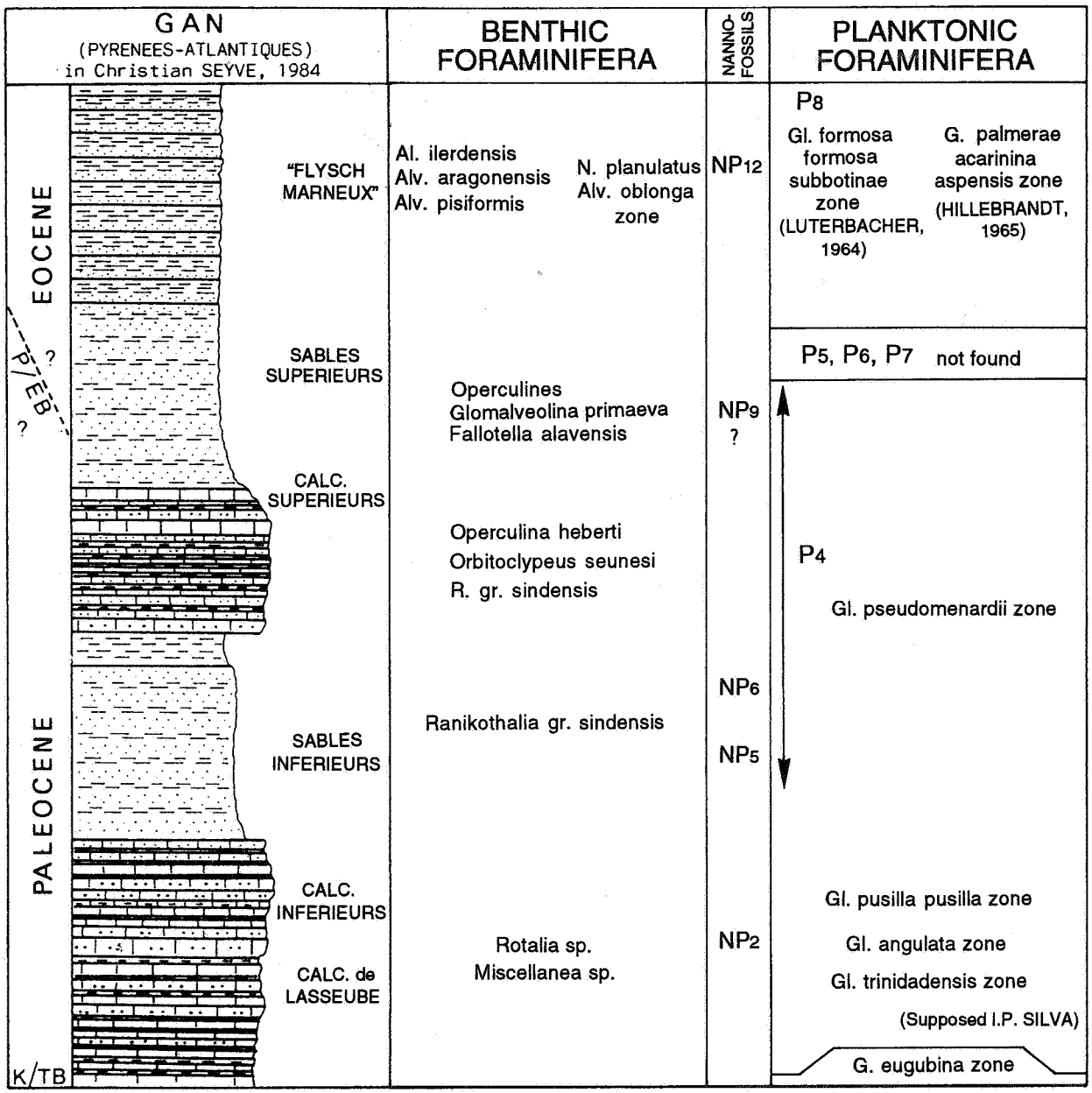

Figure 2. The Paleocene and Early Eocene of Gan (Pyrénées-Atlantiques) after Ch. Seyve (1984, tabl. 2).

in its uppermost levels *Glomalveolina primaeva.* The third Thanetian transgressive episode belongs to *Apectodinium hyperacanthum* zone, to *Glomalveolina levis* zone and, at least for its upper part in which widespread larger foraminifera as *Assilina azilensis* (Tambareau) and *A. yvettae* Schaub are found, to NP9. It has been attributed to P4 but only after the study of a very poor planktonic assemblage encountered in a single outcrop of the Petites Pyrénées (Tambareau, 1972, p. 31, Tambareau & Toumarkine, 1974, p. 183). Furthermore, *A. azilensis* level has been dated as P4 at its base and as P5 in its upper part in the South-East of Spain (Hillebrandt, 1974, p. 164).

The withdrawal of the sea at the end of the Thanetian is accompanied by erosional deposits related to a tectonic event particularly active in the eastern part of the basin but noticeable all along the chain.

The beginning of the far reaching and complex Ilerdian transgression is characterized by the development of a shallow carbonat platform over large areas where the genus *Alveolina s.s.* with numerous species and diversified shapes and sizes (*Alveolina cucumi-formis* zone) occur for the first time. They are associated with *Orbitolites,* discocyclinids, sometimes with *Assilina* or small *Nummulites.* This *A. cucumiformis* zone corre-

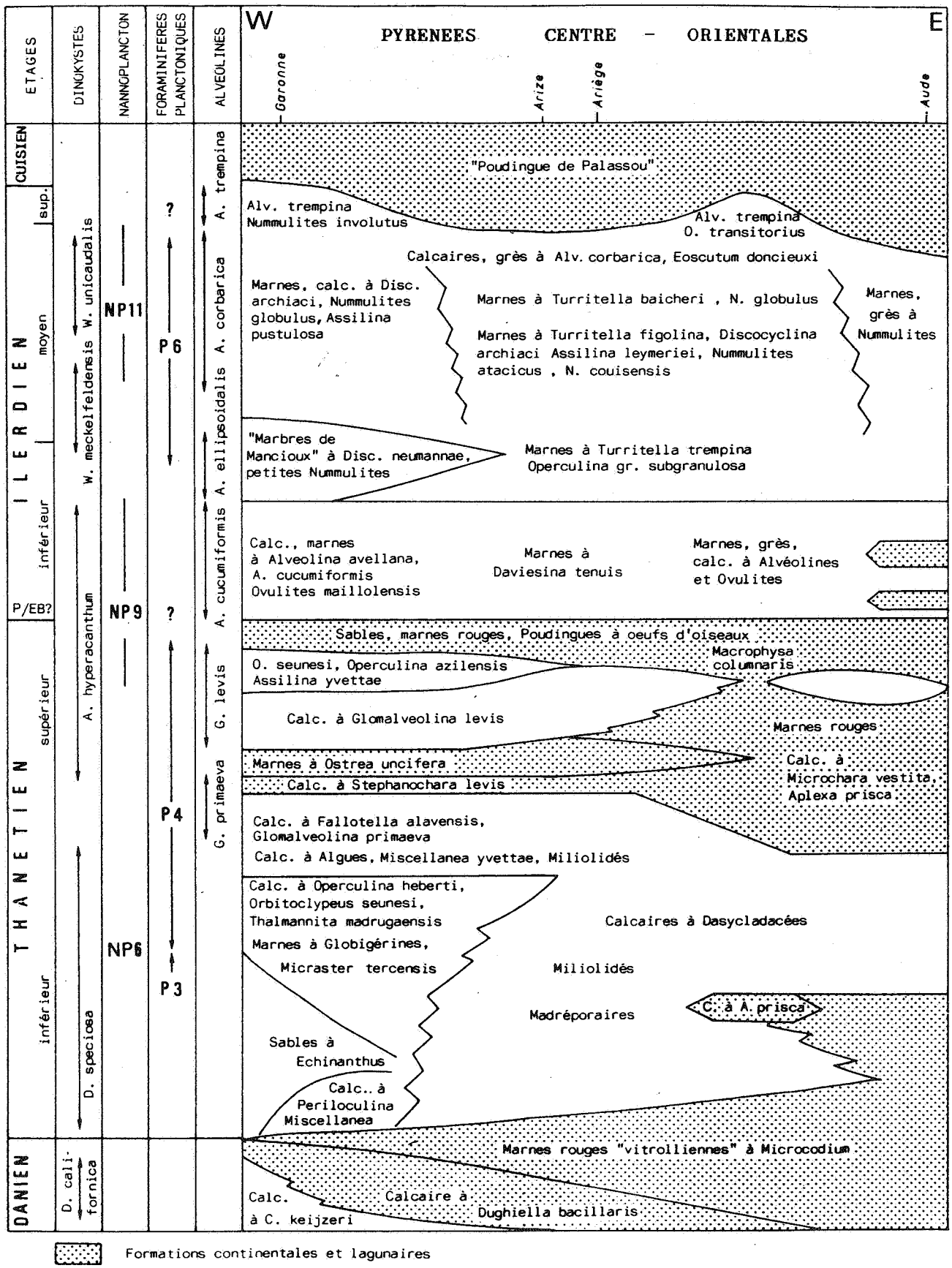

Figure 3. The stratigraphic framework of the Paleocene and the Early Eocene of the central and eastern part of the northern Pyrenean Basin.

sponds, like the top of the marine Thanetian, to NP9 and *A. hyperacanthum* dinokyst zone but it is not yet directly correlated with a planktonic foramini-feral zone.

The transgression progressed during the Uppermost Early Ilerdian and the Lower Middle Ilerdian (*Alveolina ellipsoidalis* zone to *A. corbarica* zone pars) when *Turritella* and/or "*Operculina*" marls overlie the shallow carbonate platform which moves northwards to the edge of the Montagne Noire. This complex transgressive episode is dated as P6 and, for its lower part, to *Wetzelliella meckelfeldensis* zone, for its upper part to *W. unicaudalis* zone and to NP11.

During the Late Middle Ilerdian (P6, NP11) siliclastic deposits became dominant. Deltaïc depositional systems were developed at the southern and eastern margins of the basin during a major regressive phase when the shoreline was definitively displaced towards the West of the Lannemezan Plateau at the end of the Ilerdian. The central and eastern basin was filled up with syntectonic Molasses (Poudingue de Palassou) related to tectonic activity in the whole northern Pyrenees.

3. MAIN CHANGE IN FAUNAS AND SEDIMENTATION AROUND THE PALEOCENE/EOCENE BOUNDARY

In the western part of the northern Pyrenees, the best opportunities to correlate open sea and shelf deposits could be found but stratigraphic work will have to be carried out more to complete the inventory of the Early Paleogene faunas. In the central and eastern area where the data are more numerous and more recent but where the marine successions are less complete, it clearly appears that the sedimentation has been closely controlled by sea level changes and may be overprinted by the continued tectonical deformation of the basin's subsurface. The progressive warming up of the climate from the Upper Thanetian to the Ilerdian documented by the rise of tropical elements in the palynoflora of the Middle Ilerdian (Gruas *et al.*, 1988) may also have had some effect on the faunal assemblages and on the sedimentation.

No simultaneous extinctions have been noticed in neritic benthic assemblages, but they may be hidden because of the lack of continuous marine sections or because of insufficient resolution power of the fossil record. During the Thanetian and the Ilerdian, progressive changes are observed in the faunas but it is clear that the main change both in sedimentation and in faunas occurs between the upper part of the Thanetian and the base of the Ilerdian, that is to say above P4 *i.e.* within NP9.

This change is most noticeable in species diversity of the genera *Alveolina, Assilina, Nummulites* and in "Orthophragminids". While during Thanetian, these groups of larger foraminiferas are represented by mono- or oligospecific assemblages, we observe during the Ilerdian period at first a spectacular diversification of *Alveolina s.s.* In the lowermost marine Ilerdian level at least six species have been recorded *A. cucumiformis* HOTT, *A. avellana* HOTT., *A. piper* HOTT., *A. varians* HOTT., *A. globula* HOTT., *A. dolioliformis* (SCHWAGER) associated to *Glomalveolina subtilis* HOTT. and *Gl. pilula* HOTT. During the Ilerdian, progressive evolu-tionnary changes are observed in numerous lineages without any dramatic break, for example in the *cucumiformis* group, the *pastillata* group, the *avellana* group, the *subpyrenaica* group, the *decipiens* group, etc... (Hottinger, 1960).

Nummulitic diversification develops a little later and more gradually (Schaub 1981, Hottinger 1990). Presently avalaible data on smaller foraminifera generally concern only some biostratigraphic indicator species characteristic enough to be easily identified. The incomplete knowledge of their associations, particularly for agglutinated groups, does not allow any analysis of the evolution of their diversity. Nevertheless, some last occurences have been noticed at the end of the *Gl. primaeva* zone such as *Thalmannita madrugaensis* (CUSHMAN & BERMUDEZ) a widespread mesogean species, or *Vacuovalvulina keijzeri* (VAN BELLEN), a species common to mesogean and nor thern basins (Tambareau, 1972).

The data about Ostrados are more complete. The main disappearances occur during the Thanetian, at the end of *Glomalveolina primaeva* zone : they concern, as for smaller foraminifera, species common to mesogean and more northern basins, *Mosaeleberis canaliculata* (APOSTOLESCU) or *Curfsina fragilis* (SZCCZECHURA) for example. This change coincides with the beginning of an obvious warming up and of an increasing provincialism of the pyrenean realm. As for *Alveolina* the main first appearances occur with the main transgression, that is to say at the beginning of the Ilerdian, particularly with the dominant Ilerdian genera *Echinocythereis* and *Pokornyella* (Tambareau, 1972) which show evolutionnary specific renewal probably induced by environmental fluctuations : in the case of the *Echinocythereis* lineage studied by Lété (1987), climatic changes are held responsible for the evolution of species.

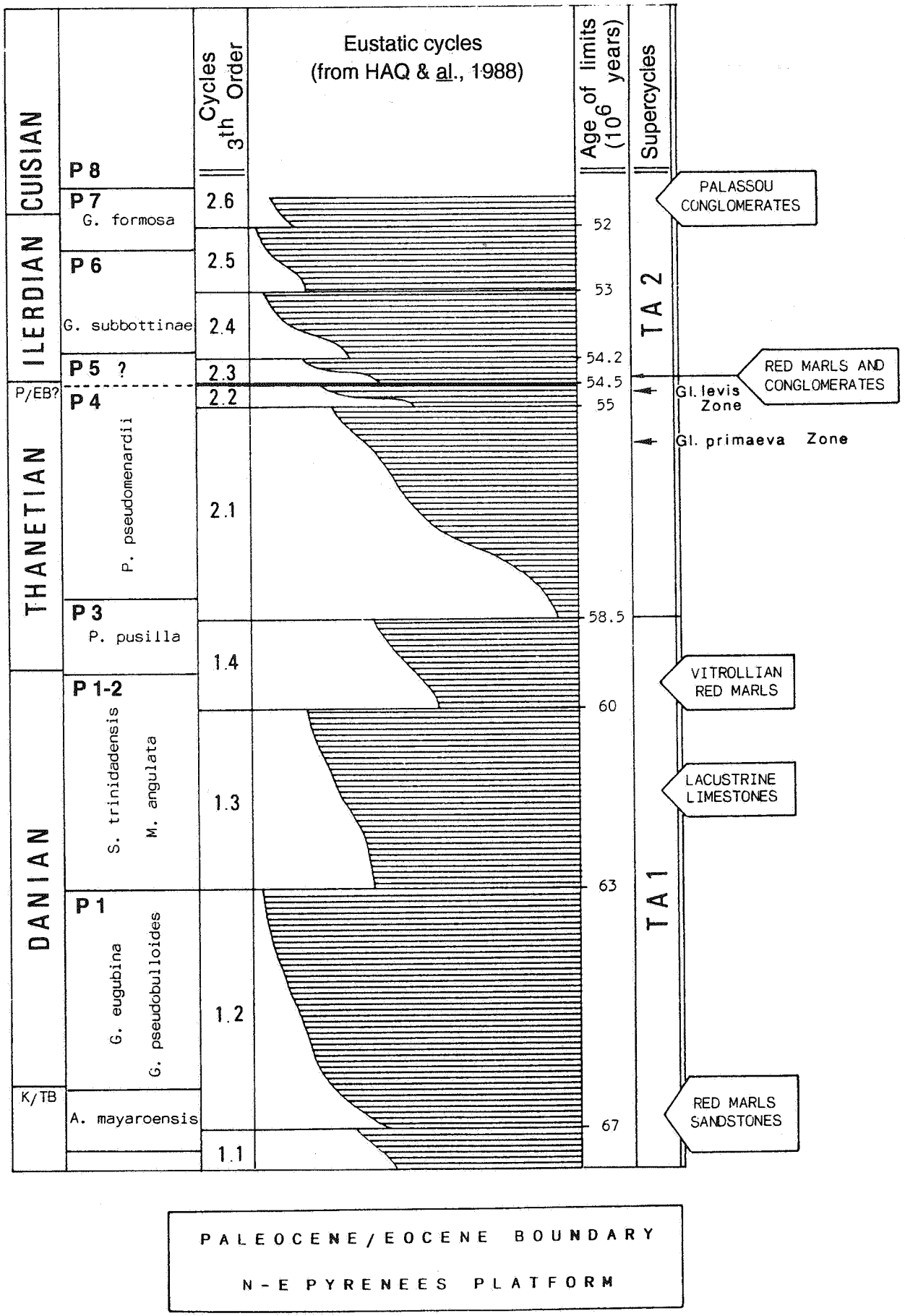

Figure 4. Main transgressive cycles in the northern Pyrenean Basin tentatively correlated with the eustatic cycles of Haq *et al.* chart (1988).

4. CONCLUSION

In the northern Pyrenees, the main Paleocene-Eocene biotic change consists of a rapid increase of diversity in larger foraminifera and a turnover of ostracode assemblages coinciding with Ilerdian transgression The rapid change of assemblages reflects a rising pyrenean provincialism as is further confirmed by the Pollen do (Gruas *et al.*, 1988). It succeeds to an important detritic episode and a gap in the marine sedimentation not yet estimated as to its duration in time. P5 has not been directly identified in the pyrenean platform deposits and is not yet related by first order correlation to the benthic zonations. However, applying the sea level change as supplementary instrument for correlation to the northern pyrenean sedimentation, this change may occur between cycles 2.2 and 2.3 of the Haq *et al.* chart (1988), (Fig. 4) despite the incertainties about planktonic zonations.

Although the present knowledge of macro and microfaunas of this area allows us to follow fluctuations in composition and character of successive fossil populations, we have not detected any global events during the Ilerdian, it is to say inside P6, which may corresponds to the impoverishment described in oceanic environments. Our main change occurs earlier, between the Thanetian and the Ilerdian. This change, reflecting global sea level fluctuations and/or an important tectonic event and/or a gap in marine sedimentation, is generally taken as the Paleocene/Eocene boundary by most specialists of the mesogean platform deposits.

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