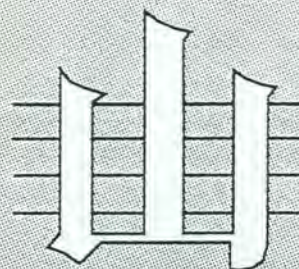




IGCP 286

**EARLY
PALEOGENE
BENTHOS**

Fourth meeting, September 7-11, 1994
ASPET, Haute-Garonne, France



IUGS

COMMISSION ON STRATIGRAPHY

International Subcommittee
on Paleogene Stratigraphy

MEETING IN ASPET

September 7-10, 1994

FIELD TRIP IN THE PYRENEES

September 11, 15, 1994

Organizer : Yvette Tambareau

 UNIVERSITE PAUL SABATIER

Laboratoire de
GEOLOGIE STRUCTURALE
et TECTONOPHYSIQUE



38 rue des 36-Ponts - 31400 - TOULOUSE - FRANCE

published with the participation of
elf aquitaine production



THURSDAY 15th SEPTEMBER 1994

EXCURSION TO BÉARN: NARP, NOUTS-ORAAS, GAVE D'OLORON VALLEY

Y. Tambareau, J. Canudo, C. Gruas-Cavagnetto, L. Hottinger, E. Molina

and the collaboration of

B. Crochet, P. Eichène and N. Guerrero

In the western area of the northern Pyrenees, the Paleogene is not so well known than eastwards of the Lannemezan Plateau, for several reasons :

1st : there is a severe restriction in good outcrops;

2nd : there is a lack of recent studies except on the Atlantic coast where there are only oceanic Paleocene deposits without larger foraminifera, and in the Gan section, S of Pau, described by Seyve, 1984 who has particularly studied planktonic foraminifera and nannoplankton.

Similar successions occur westwards of Gan, in the Gave d'Oloron valley, found and described by C. Boltenhagen (1966). We will study them in the Pont de Narp quarry, S of Narp, and in Nouts, near Oraas, in the river banks (fig. 16). Some of the fossil identifications recorded in Boltenhagen, particularly the identification of the planktic faunas and their attributions to planktonic zonations, need to be revised.

The Béarn Paleocene fossil record represents a key to the correlation of shallow and deeper benthos. Obviously transported over the edge of a narrow shelf, the benthic species of various shallow habitats mix with deeper and planktonic ones and are found, now, deposited in marly sediments, in a thanatocoenosis of exceptional diversity and remarkable preservation. reworking of late cretaceous plankton and benthos and probably also of earlier Paleocene faunas hamper an easy identification of the species. Moreover, some key smaller benthic foraminifera of the Paleocene, and in particular species originally described in the middle East, need a thorough taxonomic revision based on topotypes. However, a preliminary survey of the faunas suggests its potential for transtethyan and transatlantic correlation by means of selected taxa of deeper neritic or epibathyal habitat such as *Thalmanita* or of less oligotrophic environments as *Cincoriola*. A monographic treatment of this unique fossil record including foraminifera, dinoflagellates, nannoplankton, ostracods echinids and molluscs will be worked out in the near future by a common effort.

I. NOUTS-ORAAS : RIGHT SIDE OF THE GAVE

The first Paleocene formation, the so-called "Calcaires inférieurs", overlies the thick and monotonous Maastrichtian "Marnes de Nay" which are very rich in Upper Maastrichtian planktonic microfauna. These folded limestones (10m thick) contain reworked Cretaceous fossils and a Paleocene fauna. Boltenhagen (1964) recognized Danian planktonic and benthic foraminifera, such as *Laffiteina* and *Miscellanea*.

We have not found any *Laffiteina* but some *Miscellanea* associated with *Coleites* and some well known foraminifera of the Northern Danian : *Conicovalvulina keijzeri* and *Scarificatina reinholdi*, also recorded in the Petites Pyrénées.

Among the ostracods, deep sea forms such as *Cretaceratina*, *Phacorhabdotus* associated with *Bairdia*, *Cytherella* and *Trachyleberidea* coexist with shallower ones, such as *Mosaeleberis canaliculata* known since the Pyrenean Uppermost Cretaceous to the Thanetian *Gl. primaeva* Zone and in the Montian of the Franco-Belgian Basin.

The planktonic foraminifera suggest (J.C & E.M.) that the base of the "Calcaires inférieurs" already belong to *P. trinidadensis* zone, and seems to be transgressive. Their main part belongs to *M. angulata* zone (passage Danian-Selandian) and their uppermost part to *I. pusilla* Zone, that is to say to the Selandien. Thus, the Lower Danian is missing in this section.

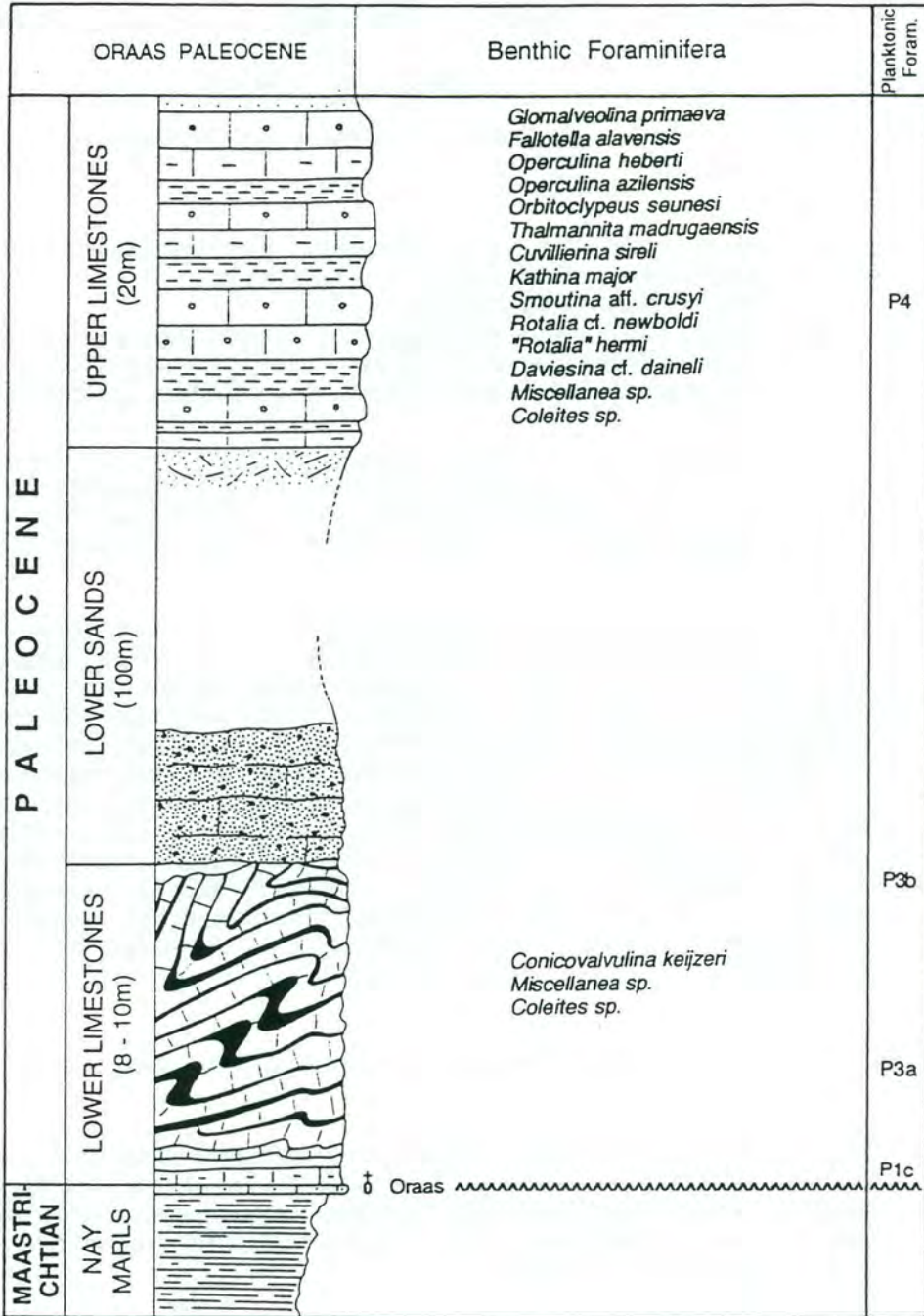
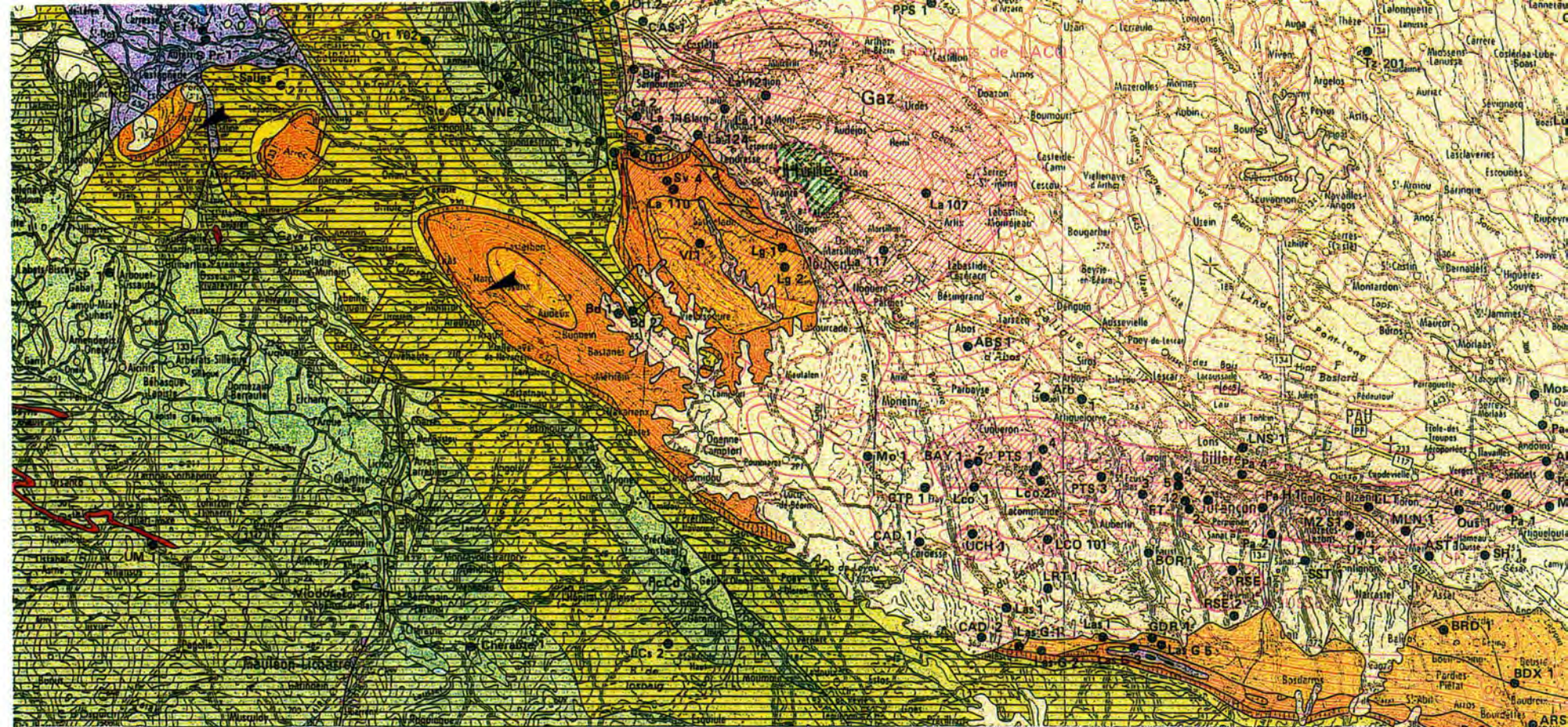


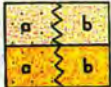






Fig. 17 - Nouts - Oraas Paleocene, Escos syncline, Béarn, from Boltenhagen, 1965, modified.

The main part of the "Calcaires inférieurs" is devoid of organic matter. No pollen nor dinoflagellates have been found except in an outcrop situated at the top of the formation, just below the Lower Sands; it contains an interesting nannoflora with (C.G.-C.) :



 <p>T2</p> <p>Lutétien - Cuisien</p> <p>a) Grès et conglomérats fluviatiles b) Calcaires c) Marnes bleues d) Flysch</p>	 <p>T1</p> <p>Paléocène (Pays Basque Français)</p> <p>a) Grès et Marnes b) Calcaires</p>	 <p>j1</p> <p>Dogger - Lias</p> <p>Calcaires, dolomies, marnes, évaporites</p>
 <p>T2B</p> <p>Lutétien post phase 2 (Pays Basque Français)</p> <p>a) Poudingues de Palassou (Continental) b) Calcaire gréseux conglomérats, marnes</p>	 <p>cs2</p> <p>Sénonien supérieur</p> <p>a) Faciès plate-forme, calcaires, grès, marnes b) Flysch</p>	 <p>k</p> <p>Keuper - Muschelkalk</p> <p>Argiles à évaporites, calcaires, dolomies, carnéules, ophite</p>
 <p>T2A</p> <p>Yprésien (pays Basque Français)</p> <p>a) Grès et conglomérats fluviatiles b) Faciès marins</p>	 <p>cs1</p> <p>Sénonien inférieur à Albien supérieur</p> <p>a) Faciès carbonaté urgonien b) Faciès argileux</p>	 <p>rt</p> <p>Buntsandstein à Westphalien terminal</p> <p>Série détritique post hercynienne, conglomérats, grès marnes, coulées andésitiques</p>
 <p>T1</p> <p>Illerdién à Danien</p> <p>a) Grès et conglomérats fluviatiles, calcaires lacustres b) Calcaires c) Marnes gréseuses d) Flysch.</p>	 <p>ci</p> <p>Néocomien à Albien moyen</p> <p>a) Continental (Wealdien de la Chaîne Ibérique) b) Faciès argileux c) Faciès calcaires</p>	<p>ROCHES IGNÉES</p>  <p>λ</p> <p>Crétacé supérieur</p> <p>Lherzolites, dolérites, pillow-lavas, épisynéites, picrites</p>

Société Nationale des Péroles d'Aquitaine



CARTE GÉOLOGIQUE DES PYRÉNÉES EN 4 FEUILLES

FEUILLE N° 1 ECHELLE: 1/250 000

Fig. 16- Geologic map of Béarn

Dinoflagellates

- Frequent forms

Alisocysta margarita HARLAND
Alisocysta reticulata DAMASSA
Impagidinium sp.
Hystrichokolpoma cinctum KLUMPP
Pyxidinosia sp.

- Other forms

Achomosphaera crassipellis STOVER & EVITT
A. ramulifera EVITT
Amphrosphaeridium multispinosum SARJEANT
Areoligera senonensis LEJEUNE-CARPENTIER
A. vermiculata CORRADINI
Cerodinium leptodermum LENTIN & WILLIAMS
C. speciosum LENTIN & WILLIAMS
C. striatum LENTIN & WILLIAMS
Cordosphaeridium exilimurum DAVEY & WILL.
C. inodes EISENACK
Exochosphaeridium bifidum CLARKE & al.
Fibrocysta axialis STOVER & EVITT
F. variabilis MEHROTRA & SARJEANT
Florentinia ferox DUXBURY
Glaphyrocysta ordinata STOVER & EVITT
Homotryblium abbreviatum EATON
H. bifurcatum CARO
Hystrichokolpoma cinctum KLUMPP
Hystrichosphaeridium tubiferum DEFL.
Pervosphaeridium monasteriense YUN
Phthanoperidinium crenulatum LENTIN & WILL.
Riculacysta sp.
Spiniferites cornutus cornutus GERLACH
S. katatonos CORRADINI
S. membranaceus SARJEANT
S. multibrevis BELOW
S. ramosus LOEBLICH & LOEBLICH

Pollen and Spora

Polypodiaceoisporites sp. Pteridaceae
Stereisporites sp. *Sphagnum*
Ephedripites sp. *Ephedra*
Milfordia incerta W. KR. Restoniaceae
Extratropipollenites pseudogranifer PFLUG
Interpollis supplingensis W. KR.
Nudopollis exemploides W. KR. & VANH
Pseudoculopollis sp.
Stephanoporopollenites hexaradiatus semitribinae W. KR.
S. hexaradiatus tribinae W. KR.
Tripoporopollenites robustus PFLUG
T. wehmingensis PFLUG
Triatropipollenites perplexus PFLUG
T. roboratus PFLUG
Platycaryapollenites trisolutionis W. KR. & VANH
Compositoipollenites minimus W. KR. & VANH
C. medius W. KR. & VANH
Subtripoporopollenites constans PFLUG
S. magnoporatus baculatus W. KR. & VANH
S. subporatus magnus W. KR.
S. subporatus subporatus W. KR.
Pentapollenites sp.
Tricolporopollenites feugueuri (in KEDVES)

This assemblage is as rich in pollen as in dinoflagellates. Representative species date this assemblage as Late Danian. The pollen belong to plants now extinct and are the same as pollen recorded in the Petites Pyrenees and in Western Europe in formations related to Late Danian. The Dinoflagellates are also the same as those occurring in Denmark. Therefore, at this time, the franco-belgian basin and the Pyrenean basin might belong to the same realm.

However, after the study of the planktonic foraminifera (J.C. & E.M.), this horizon is considered to be in P 3b, *Igorina pusilla* Zone with *M. conicotruncata*, *M. angulata*, *S. quadrilocula*, *S. velascoensis*, *S. trilocolinoides*, *P. compressa*, *P. haunsbergensis*, *G. inconstans*.

As a preliminary result, we can notice that this slumped "Calcaires inférieurs", like the same formation occurring in Gan (Seyve 1984), are characterized by a stratigraphic gap above the K/T boundary, the gap of the *fringa-eugubina* Zones in Gan, a more important one in Oraas where the Paleocene begins by the *trinidadensis* Zone. It is interesting to recall that a complete Danian succession occurs westwards, in Bidart, Atlantic coast (Haslett, 1994) but that, eastwards, the only Danian precisely dated in platform environment, in the Petites Pyrénées, is correlated with the "non basal" Danian (Gruas, Tambareau & Villatte, 1988) known in more northern basins.

These "Calcaires inférieurs" are separated from the "Calcaires supérieurs" by the "Sables inférieurs" (100m), very poor in fauna and which are not continuously exposed.

II. ORAAS : LEFT SIDE OF THE GAVE AND PONT DE NARP QUARRY, NARP

The "Calcaires supérieurs" (about 20m), separates the "Sables inférieurs" from another very thick and not very well dated detritic formation the "Sables supérieurs" (fig. 17). These limestones observed in Oraas, in the left side of the Gave and in the Pont de Narp quarry contain a characteristic level with abundant benthic fossils, particularly larger and smaller foraminifera mixed with planktonic forms and rich nannoflora..

Nannoflora (C.G-C)

The nannoflora of the larger foraminifera horizon is composed of (C.G.-C.):

Dinoflagellates

- FREQUENT FORMS

Achomosphaera alvicornu DAVEY & WILLIAMS
Glaphyrocysta pastielsi STOVER & EVITT
Adnatosphaeridium multispinosum WILL & DOW.
Impagidinium sp.
Operculodinium tiara STOVER & EVITT

Operculodinium centrocarpum WALL
O. uncinispinosum ISLAM
O. divergens S
O. microtriainum ISLAM
Renidinium vitilare STOVER & EVITT
Spiniferites hyperacanthus COOKSON & EISENACK
S. membranaceus SARJEANT
S. multibrevis BELOW
S. pseudofurcatus SARJEANT
S. ramosus granosus LENTIN & WILLIAMS

- Other forms

Achomosphaera ramulifera EVITT
A. crassipellis STOVER & EVITT
Alisocysta margarita HARLAND
Areoligera senonensis LEJEUNE-CARPENTIER
Cerodinium striatum LENTIN & WILLIAMS
Cordosphaeridium exilimurum DAVEY & WILL.
C. gracile DAVEY & WILLIAMS
Dapsilidinium pseudocolligerum BUJAK & al
Deflandrea denticulata ALBERTI
Fibrocysta axialis STOVER & EVITT
Fibrodinium annetor pense MORGENROTH
Glaphyrocysta exuberans STOVER & EVITT

Pollen and spora

Psittacopsis elaeagnoides KDS.
Plicapollis pseudoexcelsus W.KR.
Pompeckjoidaepollenites subhercynicus W.KR.
Subtriporopollenites magnoporatus W.KR.
Tetracolporopollenites fsp., *Sapotacées*
Triporopollenites robustus PF.

This is essentially a dinoflagellate assemblage with species common in the whole western Europa; it is different from the underlying Danian assemblage essentially because of its dominant forms. Pollen is quite rare.

Planktonic Foraminifera (J.C. & E.M.)

Samples from Nouts-Oraas in the left side of the Gave with abundant larger foraminifera belong to the *P. pseudomenardii* Zone as the samples of the Pont de Narp quarry (J.C. & E.M.).

The following species have been identified:

- In Oraas: *M. velascoensis*, *M. kolchidica*, *S. triangularis*, *S. velascoensis*, *E. trivialis*, *P. troelseni*, *P. haunsbergensis*, *Panorotalites pseudomenardii*, *P. compressa*..
- in the Pont de Narp quarry: *Planorotalites troelseni*, *Morozovella kolchidica*, *Morozovella velascoensis*, *Muricoglobigerina mcknii*, *Subbotina velascoensis*, *S. triangularis*, *S. triloculinoïdes*.

Ostracoda (Y.T.)

The Ostracod assemblage is essentially composed with species occurring generally on the shelf as *Limburgina foncirguensis*, *Quadracythere persica*, *Quadracythere volpensis*, *Mosaeleberis canaliculata* mixed with deeper ones such as *Trachyleridea* sp., *Bairdia cymbula* and a rare psychrospheric form: *Dutoitella* sp. The ratio between neritic and deep sea forms is different than in the "Calcaires inférieurs" where the last ones are dominant.

Benthic Foraminifera (L.H.)

So far, the associations of benthics collected in the so-called "Calcaires supérieurs", respectively in Oraas and in Pont de Narp quarry have been submitted to a preliminary study. The two associations are essentially the same and therefore not separated here :

Nummulitids - This group of planispiral larger shells with a marginal cord is represented by *Operculina heberti*, *O. azilensis* and possibly *Ranikothalia sindensis*. The latter species is subject of a general revision of the species in the genus while the generic identity of the former need further discussion, *O. heberti* having trabeculae at least in a considerable number of specimens. It would therefore belong to *Nummulites* in harmony with *O. semiinvoluta* (Hottinger, 1977).

Orthophragminiforms - The so-called *Orbitoclypeus seunesi* is represented here with distinctly lenticular and very flat shells with or without umbo forming possibly more than a single taxon.

True rotaliids - This rotaliids, with an interocular canal system and an umbilical plate producing foliar cavities, are particularly abundant. The following taxa have been identified : *Kathina major* SMOUT, *Smoutina* aff. *cruysi* DROOGER, (?) *Cuvillierina sireli* INAN, *Daviesina* cf. *danieli* SMOUT, *Neorotalia* sp. (of the *alicantina* COLOM - *viennoti* GREIG lineage), *Miscellanea* sp., *Rotalia* s. str. cf. *newboldi* DAVIES and, maybe not related to true rotaliids, "*Rotalia*" *hermi* HILLEBRANDT belonging to the *R. hensoni* - *R. saxorum* lineage.

Kathina occurs in the Middle East, *Smoutina* in the Central Americas and hopefully will deliver additional elements of transcontinental correlation. No *Lokartha* have been found so far.

As far as Alveolinids are concerned, *Glomalveolina primaeva* is present, maybe in company of decorticated *Gl. dachelensis* needing additional sectioning and comparison with topotypes from Egypt.

The agglutinated conicals are represented by numerous well preserved shells of *Fallotella alavensis* and some *Cribobulimina* sp.

Among the smaller benthics, the cosmopolitan *Thalmanita madrugeensis* and rare tethyan *Cincoriola* sp. are of particular importance. If the *Mississipina* group, present by two species, has index value or not remains to be cleared. *Coleites* sp., *Linaseria* cf. *danica* and related species, some glandulinids, particular nodosariids and various specialized agglutinated species refer to the North-european early Paleogene. If the shells of *Aragonia* and *Neoflabellina* recovered in these samples are reworked from the late Cretaceous substrate or belong to early Paleocene associations has still to be worked out.

The rotaliid fauna in particular can be compared with an assemblage collected in Ciment Lafarge quarry, Cassagnau (Tambareau, Crochet *et al*, 1992, p. 18). Here no reworking can be observed. The facies is influenced by land-derived detritus and therefore dominated by the agglutinated conical *Fallotella alavensis*. the latter is associated with few, particularly large and very low conical specimens representing probably the microspheric generation. This would document optimal living conditions for this species at this particular location, where also *Glomalveolina primaeva* and *Gl. dachelensis* occur. Huge *Cincoriola ovoidea* (= *Reedella* ?) and *C. patalensis* are abundant. *Smoutina* aff. *cruysi*, *Kathina* cf. *major* and "*Rotalia*" cf. *hermi* are equally frequent.

Still more investigations and detailed studies of the faunas are necessary to precise the environmental conditions and the stratigraphic position of these Thanetian "Calcaires supérieurs" belonging to the *P. pseudomenardii* Zone. They are dated by the presence of *Operculina azilensis* to the *Gl. levis* zone but they contain numerous species restricted to the *Gl. primaeva* Zone in the Petites Pyrénées, such as *Mosaeleberis canaliculata*, *Thalmanita madrugeensis* for example.

These "Calcaires supérieurs" are overlaid by the very thick "Sables supérieurs" and, at the passage between the two formations, the nannoflora has been investigated (C. G.-C.) and allow the following remarks. The occurrence of *Stephanopropollenites hexaradiatus*

tribinae clearly indicates the belonging of these sands to the Paleocene. The first occurrence of *Apectodinium*, index of the Lower Eocene in Western Europe, recorded in the Petites Pyrenees in the Oyster marls, passage between the *Glomalveolina primaeva* and the *Glomalveolina levis* Thanetian Zones, is however noticeable.

If most of the present species of dinoflagellates are recorded both in the northern basins and in the Pyrenees, the occurrence of *Homotryblium bifurcatum* indicates presumably some regionalization of the Pyrenean realm.

The "Sables supérieurs" end with a pebbly sandstone with poorly preserved and decorticated *Nummulites* and *Alveolina* which might correspond to species from the Middle Ilerdian according to J. Samsø.

Remark - Underlying the quite complete Maastrichtian succession of the "Marnes de Nay" (Boltenhagen, 1966), the Paleocene of the Gave d'Oloron valley attests of an important environment change leading, above the K/T boundary, to more instable conditions throughout the duration of the early Paleogene times. The hiatus between the uppermost Maastrichtian and the Late Danian formations, the sedimentological structures indicative of a turbiditic depositional environment (slumped limestones) as already identified by Boltenhagen (1966) but also eastwards, in Gan, by Seyve (1984) and westwards, in the Atlantic coast, by Haslett (1994), indicates an increased activity on the slope, maybe related to the tectonic uplifts recorded eastwards, in the Plantaurel. This activity makes possible that faunas yielded by the Paleocene deposits are likely to be reworked or not in situ, that increases the difficulties of their interpretation.

BIBLIOGRAPHY

- BOLTENHAGEN C., 1966 - Contribution à l'étude stratigraphique et structurale du flanc nord de l'anticlinal de Saint-Palais (Basses-Pyrénées), *Thèse 3^{ème} cycle*, Paris, 248 p., 22 fig., 15 pl.
- CROCHET B., 1991 - Molasses syntectoniques du versant nord des Pyrénées : la Série de Palassou. *Document du B.R.G.M.*, 387 p., 129 fig.
- CROCHET B., TAMBAREAU Y. & VILLATTE J., 1976 - Modalités de la régression ilerdienne entre l'Ariège et l'Aude. Les plages à *Eoscutum doncieuxi* (LAMBERT). *C. R. somm. Soc. géol. Fr.*, 2, p. 35-37.
- CROCHET B., TAMBAREAU Y. & VILLATTE J., 1977 - Un témoin méridional de la sédimentation ilerdienne dans les Pyrénées ariégeoises : la butte de Montsec. *Bull. Soc. Hist. nat. Toulouse*, 113, 50-68.
- GRUAS-CAVAGNETTO C., TAMBAREAU Y. & VILLATTE J., 1988 - Données paléoécologiques nouvelles sur le Thanétien de l'avant-pays pyrénéen et de la Montagne Noire. Actes Xe Symposium APLF, Bordeaux, 1987, *Inst. fr. Pondichéry, trav. sec. sci., tech.*, XXV, p. 219-235.
- HAQ B.U., HARDENBOL J. & VAIL P.R., 1988 - Mesozoic and Cenozoic chronostratigraphy and cycles of sea-level change. *SEPM Special Publication*, 42, p. 71-108.
- HASLETT S., 1994 - Planktonic foraminiferal biostratigraphy and palaeoceanography of the Cretaceous-Tertiary boundary section at Bidart, south-west France. *Cretaceous Research*, 15, 179-192
- HOTTINGER L., 1960 - Recherches sur les Alvéolines du Paléocène et de l'Eocène. *Mém. suisses Paléont.*, 75-76, 244p., 117 fig., 18 pl., 1 tabl.
- HOTTINGER L., 1977 - Foraminifères operculiniformes. *Mém. Muséum Hist. nat.*, Paris, C, XL, 159 p., 66 pl.

- HOTTINGER L. & SCHAUB H., 1960, -. Zur Stufeneinteilung des Paleocaens und des Eocaens. Einführung des Stufen Ilerdien und Biarritzien. *Ecl. geol. Helv.*, 53, 1, 210-213
- KAPELLOS C. & SCHAUB H., 1973 - Zur Korrelation von Biozonierungen mit Grossforaminiferen und Nannoplankton im Paläogen der Pyrenäen. *Ecl. geol. helvetiae*, 66, 3, 687-737.
- LEYMERIE A., 1881 - Description géologique et paléontologique des Pyrénées de la Haute-Garonne. In 8° de 1010 p., 1 carte au 1/200000, 1 atlas de XX+29 pl., *Privat ed.*, Toulouse.
- MASSIEUX M., TAMBAREAU Y. & VILLATTE J., 1981 - Charophytes paléocènes et eocènes du versant nord des Pyrénées. *Rev. Micropal.*, 24,2, 69-82.
- MASSIEUX M., TAMBAREAU Y. & VILLATTE J., 1989 - Nouveaux gisements à Charophytes du Dano-Montien nord-pyrénéen. *Rev. Micropal.*, 32, 2, 140-150.
- SCHAUB H., 1981 - Nummulites et Assilines de la Téthys paléogène. Taxonomie, phylogenèse et biostratigraphie. *Mém. suisses Paléont.*, 104, 105, 106, 238 p., 116 fig., 18 tabl., 97 pl.
- SEYVE CH., 1984 - Etude micropaléontologique du passage Crétacé/Tertiaire, du Paléocène et de l'Yprésien au Sud de Pau. *Thèse 3^{ème} cycle*, Paris, 187 p., , 39 fig., 34 pl.
- TAMBAREAU Y., 1972 - Thanétien supérieur et Ilerdien inférieur des Petites Pyrénées, du Plantaurel et des Chaînons audois. *Thèse Doct. Etat*, Toulouse, 377p., 25 fig., 5 tabl., 20 pl., 1 carte.
- TAMBAREAU Y., 1976 - Sur l'âge des dernières assises marines de l'Eocène sous-pyrénéen au mur du poudingue de Palassou. *C. R. somm. S.G.F.*, 5, 210-212.
- TAMBAREAU Y., 1992 - Paleocene/Eocene boundary in the platform deposits of the northern Pyrenees. *Bull. Soc. géol. belge* (in press).
- TAMBAREAU Y., CROCHET B., DÉRAMOND J., CAUS E., VILLATTE J., BESSIÈRE G., GUERRERO N., EICHÈNE P., 1992 - Stratigraphie, paléoenvironnements et tectonique des plateformes paléogènes nord et sud pyrénéennes. *Livret-guide*, Excursion du Groupe d'Etude du Paléogène, 17-21 sept. 1992, 86 p., 35 fig.
- TAMBAREAU Y. & TOUMARKINE M., 1974 - Position de l'Ilerdien des Petites Pyrénées et du Plantaurel dans la zonation des Foraminifères planctoniques. Signification de sa limite inférieure. *Bull. Soc. géol. France*, (7), XVII, 2, p. 183-186.
- TAMBAREAU Y. & VILLATTE J., 1985 - Tertiaire du Synclinal de Couiza - Arques *in* Tambareau *et al*, *Bull. Soc. Etudes sc. de l'Aude*, XXXV, 13-47.
- TAMBAREAU Y. & VILLATTE J., 1992 - Stratigraphical and geographical distribution of the Paleocene Larger Foraminifera in the northern Pyrenees (France). *Slov. Akad. Znanosti in Umetnosti, Dela Opera*, Ljubljana (in press).
- TAMBAREAU Y., VILLATTE J. & CROCHET B., 1987 - Mise en évidence d'un rivage méridional du golfe marin ilerdien au nord des Pyrénées centrales et orientales. *C. R. Acad. Sc. Paris*, 304, II, 13, 725-728.
- TOUMARKINE M. & VILLATTE J., 1973 - Position des couches à *Micraster tercencis* COTTEAU du Thanétien de la Haute-Garonne dans l'échelle biostratigraphique des Foraminifères planctoniques. *C. R. somm. Soc. géol. Fr.*, 104-105.
- VILLATTE J., 1962 - Etude stratigraphique et paléontologique du Montien des Petites Pyrénées et du Plantaurel. *Thèse Doct. Etat*, Toulouse, Privat édit., 331 p., 35 fig., 22 pl., 1 carte.