Cretaceous Research 32 (2011) 786–793

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

Report on the 4th International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Dijon, France, 30th August 2010)

Stéphane Reboulet [a,*,1,2], Peter F. Rawson [b,c,1,2], Josep A. Moreno-Bedmar [d,1,2], Maria B. Aguirre-Urreta [e,2], Ricardo Barragán [d,2], Yuri Bogomolov [f,2], Miguel Company [g,2], Celestina González-Arreola [d,2], Vyara Idakieva Stoyanova [h,2], Alexander Lukeneder [i,2], Bertrand Matrion [j,2], Vasily Mitta [k,2], Hasina Randrianaly [l,2], Zdenek Vašiček [m,2], Evgenij J. Baraboshkin [n,3], Didier Bert [o,3], Stéphane Bersac [p,3], Tamara N. Bogdanova [q,3], Luc G. Bulot [r,3], Jean-Louis Latil [s,3], Irina A. Mikhailova [t,3], Pierre Ropolo [r,u,3], Ottilia Szives [v,3]

[a] CNRS-UMR 5276, Laboratoire de Géologie de Lyon: Terre, Planètes, Environnement, Université Claude Bernard Lyon 1, Bâtiment Géode, 2 rue Dubois, 69622 Villeurbanne, France
[b] Centre for Marine and Environmental Sciences, University of Hull (Scarborough Campus), Filey Road, Scarborough, YO11 3AZ, United Kingdom
[c] Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, United Kingdom
[d] Departamento de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán, 04510 México, D.F., Mexico
[e] Departamento de Ciencias Geologicas, Universidad de Buenos Aires, Ciudad Universitaria Pabellon II, 1428 Buenos Aires, Argentina
[f] Rustaveli, 13/12, 104, Moscow 127254, Russia
[g] Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, E-18002 Granada, Spain
[h] Sofia University St Kliment Ohridski, Faculty of Geology and Geography, Department of Geology and Paleontology, 15 Tzar Osvoboditel Bd, 1504 Sofia, Bulgaria
[i] Geological-Palaeontological Department, Natural History Museum, Burgring 7, A-1010 Vienna, Austria
[j] 26 avenue Jules Guesde, 10150 Pont Sainte Marie, France
[k] Paleontological Institute of RAS, Profsoyuznaya 123, Moscow 117997, Russia
[l] Département de Paléontologie et d'Anthropologie Biologique, Université d'Antananarivo, Faculté des Sciences, BP 906, Antananarivo 101, Madagascar
[m] Institute of Geonics, Academy of Sciences of the Czech Republic, Studentská 1768, CZ-70800 Ostrava-Poruba, Czech Republic
[n] Geological Faculty, Moscow State University, 119992 Leninskie Gory, Moscow, Russia
[o] Université de Bourgogne, Laboratoire Biogéosciences, UMR CNRS 5561, 6 bd Gabriel, 21000 Dijon, France
[p] 945 route de Gattières, 06640 Saint Jeannet, France
[q] Federal State Unitary Enterprise, "A. P. Karpinsky Russian Geological Research Institute", (FGUP "VSEGEI"), 74, Sredny prospect, 199106 St. Petersburg, Russia
[r] Géologie des Systèmes Carbonatés, EA 4234, Université de Provence Aix-Marseille 1, Centre de Sédimentologie-Paléontologie, case 67, 3 place Victor Hugo, 13331 Marseille, France
[s] Le Maupas, 05300 Lazer par Laragne, France
[t] Department of Paleontology, Geological Faculty, Moscow State University, Vorobjovy Gory, 119899 Moscow, Russia
[u] 83 Boulevard du Redon, Bâtiment E9, La Rouvière, 13009 Marseille, France
[v] Hungarian Natural History Museum, Department of Paleontology, 1088 Ludovika ter 2, H-1431 Budapest, Hungary

ARTICLE INFO

Article history:
Received 8 February 2011
Accepted in revised form 11 May 2011
Available online 23 May 2011

Keywords:
Kilian Group
Lower Cretaceous
Ammonites
Standard zonation
Aptian
Albian

ABSTRACT

The 4th Kilian Group meeting (Dijon, France, 30th August 2010) focused on the Aptian and Albian Stages. For the Aptian, a two-fold division of the stage was adopted for the Mediterranean area with a boundary between the *Dufrenoyia furcata* and *Epicheloniceras martini* Zones. The main changes to the zonal scheme concern the Lower Aptian with: the introduction of a *Deshayesites luppovi* Subzone in the upper part of the *Deshayesites oglanlensis* Zone; the replacement of *Deshayesites weissi* by *Deshayesites forbesi* as new index-species of the second interval zone; the introduction of a *Roloboceras hambrovi* Subzone in the upper part of the *D. forbesi* Zone; and the subdivision of the *D. furcata* Zone into the *D. furcata* and *Dufrenoyia dufrenoyi* Subzones. For the Albian, the upper part of the *Douvilleiceras mammillatum* Zone (Lower Albian) is now characterized by a *Lyelliceras pseudolyelli* Subzone. The main amendments concern the Upper Albian. The base of this substage is defined by the base of the *Dipoloceras cristatum* Zone. Above it, the Upper Albian zonal scheme comprises in stratigraphic order the *Mortoniceras pricei*, *Mortoniceras inflatum*, *Mortoniceras fallax*, *Mortoniceras rostratum*, *Mortoniceras perinflatum* and *Arrhaphoceras briacensis* Zones.

© 2011 Elsevier Ltd. All rights reserved.

* Corresponding author. Fax: +33 4 72 43 15 26.
E-mail address: stephane.reboulet@univ-lyon1.fr (S. Reboulet).

[1] Reporters.
[2] Participants at the meeting.
[3] Absents at the meeting but provided written contribution.

0195-6671/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.cretres.2011.05.007

1. Introduction

The 4th meeting of the IUGS Lower Cretaceous Ammonite Working Group (the Kilian Group) took place on Monday 30th August 2010 at the University of Burgundy at Dijon (France). The workshop was attended by 14 members from 10 countries (first list of authors, see footnote 2). Some colleagues who could not attend submitted contributions that were taken into account during the discussions (see "written contribution") and their names are added here as a second list of authors (see footnote 3). After a first draft of this report was circulated to participants some further comments were made which are included below as "subsequent contribution".

The discussion focused on the Aptian and Albian zonal schemes of the Mediterranean region, which have long been taken as the "standard" ammonite zonation (Tables 1a and 1b) with which others are compared. The chairman recapped briefly previous decisions made by the successive Lower Cretaceous Cephalopod Team (Hoedemaeker et al., 1990, 1993, 1995; Rawson et al., 1999; Hoedemaeker and Rawson, 2000) and Kilian Group (Hoedemaeker et al., 2003; Reboulet et al., 2006, 2009) meetings, and highlighted some outstanding problems. In subsequent discussion several amendments were introduced to both Aptian and Albian schemes and the changes are shown in Table 1b; the numbers in the text refer to the numbers in Table 1b. These changes reflect the decision of the participants at the meeting; it is important to note that some colleagues who could not attend but sent written contributions had sometimes different points of view. Due to the absence at this meeting of most of the specialists on Albian zonation, the Kilian Group agreed that no change should be made to the more problematic points of the Albian zonal scheme, which are outlined below.

2. The standard zonation

2.1. Aptian

1. Base of the stage (1a) and its subdivision (1b).

1a In terms of ammonites, the base of the Aptian is marked by the first appearance of *Prodeshayesites* (= base of *Prodeshayesites fissicostatus* Zone) in NW Europe (Rawson, 1983; Birkelund et al., 1984; Erba et al., 1996) and by the first appearance of *Deshayesites* (= base of *Deshayesites oglanlensis* Zone) in the Mediterranean area (Delanoy et al., 1997; Bogdanova and Mikhailova, 2004; Ropolo et al., 1999, 2006). According to Bogdanova and Tovbina (1995), Raisossadat et al. (2008) and García-Mondéjar et al. (2009), the *P. fissicostatus* Zone should be correlated with the *D. tuarkyricus* Zone (= *D. oglanlensis* Zone). Moreover, Kemper (1995) and García-Mondéjar et al. (2009) suggested that *Prodeshayesites* is a synonym of *Deshayesites*. Moreno-Bedmar agreed with this point of view.

1b The meeting adopted a two-fold division of the Aptian stage for the Mediterranean area with a boundary between the *Dufrenoyia furcata* and *Epicheloniceras martini* Zones. This has several advantages as it allows us:
- to have an agreement with the two-fold division of the NW European scheme (see Fig. 3 in Erba et al., 1996);
- to identify this boundary on a large scale as an important change in the ammonite fauna that is recorded in Tethyan

Table 1a
Ammonite standard zonation of the Berriasian–Hauterivian stages reproduced from Reboulet et al. (2009).

STAGES		ZONES	SUBZONES	HORIZONS
HAUTERIVIAN	Upper	*"Pseudothurmannia ohmi"*	*Pseudothurmannia picteti*	
			Pseudothurmannia catulloi	
			"P. ohmi"	
		Balearites balearis	*Spathicrioceras seitzi*	
			Crioceratites krenkeli	
			Binelliceras binelli	
			B. balearis	
		Plesiospitidiscus ligatus		
		Subsaynella sayni		*Subsaynella begudensis*
				Cruasiceras cruasense
	Lower	*Lyticoceras nodosoplicatum*		
				Olcostephanus (Olcostephanus) variegatus
		Crioceratites loryi	*Olcostephanus (Jeannoticeras) jeannoti*	
			C. loryi	
		Acanthodicus radiatus		*Breistrofferella castellanensis*
VALANGINIAN	Upper	*Criosarasinella furcillata*	*Teschenites callidiscus*	
			C. furcillata	
		Neocomites peregrinus	*Olcostephanus (Olcostephanus) nicklesi*	
			N. peregrinus	
		Saynoceras verrucosum	*Karakaschiceras pronecostatum*	
			S. verrucosum	
	Lower	*Busnardoites campylotoxus*	*Karakaschiceras biassalense*	*Neocomites platycostatus*
				Saynoceras fuhri
			B. campylotoxus	
		Tirnovella pertransiens		
BERRIASIAN	Upper	*Subthurmannia boissieri*	*Thurmanniceras otopeta*	
			Tirnovella alpillensis	
			Berriasella picteti	
			Malbosiceras paramimounum	
	Middle	*Subthurmannia occitanica*	*Dalmasiceras dalmasi*	
			Berriasella privasensis	
			Subthurmannia subalpina	
	Lower	*Berriasella jacobi*		

Table 1b
Ammonite standard zonation of the Barremian-Albian stages; the bold numbers refer to the numbers in the text.

STAGES		ZONES	SUBZONES	HORIZONS
ALBIAN	Upper	*Arrhaphoceras briacensis* **(13)**		
		Mortoniceras perinflatum **(12)**		
		Mortoniceras rostratum **(12)**		
		Mortoniceras fallax **(12)**		
		Mortoniceras inflatum **(12)**		
		Mortoniceras pricei **(12)**		
		Dipoloceras cristatum **(11)**		
	Middle	*Euhoplites lautus*		
		Euhoplites loricatus		
		Hoplites dentatus	*Hoplites spathi*	
			Lyelliceras lyelli **(10)**	
	Lower	*Douvilleiceras mammillatum* **(9)**	*Lyelliceras pseudolyelli* **(9)**	
		Leymeriella (L.) *tardefurcata* **(8)**		
APTIAN	Upper (1b)	*Hypacanthoplites jacobi* **(7)**		
		Acanthohoplites nolani		
			Diadochoceras nodosocostatum	
		Parahoplites melchioris		
		Epicheloniceras martini **(6)**	*Epicheloniceras buxtorfi*	
			Epicheloniceras gracile	
			Epicheloniceras debile	
	Lower (1a)	*Dufrenoyia furcata* **(5)**	*Dufrenoyia dufrenoyi* **(5)**	
			D. furcata **(5)**	
		Deshayesites deshayesi **(4)**	*Deshayesites grandis* **(4)**	
		Deshayesites forbesi **(3)**	*Roloboceras hambrovi* **(3)**	
		Deshayesites oglanlensis **(2)**	*Deshayesites luppovi* **(2)**	
BARREMIAN	Upper	*Imerites giraudi*	*Pseudocrioceras waagenoides*	
			Martelites sarasini	
				Leptoceratoides puzosianum
			I. giraudi	*Heteroceras emerici*
				I. giraudi
		Gerhardtia sartousiana	*Hemihoplites feraudianus*	
			Gerhardtia provincialis	
			G. sartousiana	
		Toxancyloceras vandenheckii	*Barrancyloceras barremense*	
			T. vandenheckii	
	Lower	*Moutoniceras moutonianum*		*Heinzia caicedi*
				Coronites darsi
		Kotetishvilia compressissima		*Subtorcapella defayae*
				Heinzia communis
				Nicklesia didayana
				Holcodiscus fallax
		Nicklesia pulchella		
		Kotetishvilia nicklesi		
		Taveraidiscus hugii auctorum	*Psilotissotia colombiana*	
			T. hugii auctorum	

(From Transcaspian to Caribbean areas) and sub-boreal realms (Bogdanova and Tovbina, 1995; Casey, 1996; Dauphin, 2002; Hoedemaeker and Donovan, 2004; Dutour, 2005; Raisossadat *in* Reboulet et al., 2006 (Neuchâtel meeting)); consequently, the Deshayesitinae (*Deshayesites* + *Dufrenoyia*) are restricted to the Lower Aptian *sensu* this work;

- to find a general agreement on the problem relating to the *D. furcata* Zone and its position in the Lower or Middle Aptian (previous discussions at the 1990 Digne, 2002 Lyon and 2005 Neuchâtel meetings did not reach a final solution; see Hoedemaeker et al., 1990, 1993, Reboulet et al., 2006);
- to avoid the correspondence between the French substages Bedoulian, Gargasian and Clansayesian and the Lower, Middle and Upper Aptian respectively, taking into account that some disagreements (Atrops *versus* Ropolo; Neuchâtel meeting, Reboulet et al., 2006) exist for the Gargasian (see also Conte, 1995; Dutour, 2005; Moullade et al., 2009). It would be preferable to abandon the terms Bedoulian, Gargasian, Clansayesian as they are not recognized internationally, but mainly used in France as previously evoked during the Neuchâtel meeting (Reboulet et al., 2006; see also Bersac, Bert and Ropolo, written contributions). Moreover, the type sections of these French substages do not offer good prospects (low number and/or bad preservation of ammonoids) and they are not well exposed, being partly or completely inaccessible because of urbanization (see examples in Moullade et al., 2004, 2006). Baraboshkin (subsequent contribution) agrees that the French substages may not be

appropriate even though Baraboshkin, Bogdanova and Mikhailova (written contribution) recognize a three-folder subdivision for the North Caucasus, Transcaspian and Russian Aptian zonal schemes.

2. *D. oglanlensis* Zone.

Moreno-Bedmar's proposal to recognize a *Deshayesites luppovi* Subzone in the upper part of the *D. oglanlensis* Zone was accepted. This index-species has been recognized in the Iberian peninsula (in the Subbetic (Aguado et al., 1997) and Prebetic (Moreno-Bedmar, 2010; Moreno-Bedmar et al., 2010) Domains and in the Organyà Basin (Moreno-Bedmar, 2010)), and in the Vocontian Basin (SE France) where forms that Delanoy (1995, 1997) identified as *Deshayesites* sp. (= *Prodeshayesites* cf. *tenuicostatus in* Delanoy, 1991), were reidentified by Aguado et al. (1997) as *D.* cf. *luppovi* (see also Moreno-Bedmar, 2010; Moreno-Bedmar et al., 2010). Ropolo (subsequent contribution) considers that the *D. luppovi* Subzone is not justified as this index-species appears at the base of the *D. oglanlensis* Zone at the Cassis-La Bédoule section (Ropolo et al., 2006). Bersac and Bert (subsequent contribution) suggest that *D. oglanlensis* and *D. luppovi* are in need of revision.

3. *Deshayesites forbesi* Zone.

Considering that *Deshayesites weissi* is a *nomen dubium* (further explanation *in* Reboulet et al., 2006, 2009), *D. forbesi* is chosen as the new index-species for the interval zone. This solution was previously adopted by Moreno-Bedmar et al. (2010). Bersac and Bert (written contribution) are in accordance with this scheme. According to Bogdanova and Tovbina (1995), Raisossadat et al. (2008) and García-Mondéjar et al. (2009), the *D. weissi* and *D. forbesi* Zones are coeval. For Baraboshkin, Bogdanova and Mikhailova (written contribution), the *D. weissi* and *D. forbesi* Zones are correlated (Transcaspian zonation). These authors also correlated the *D. weissi* and *Deshayesites volgensis* Zones (North Caucasus, Mangyshlak and Russian zonations); although Casey (1964) considered that *D. forbesi* and *D. volgensis* are different species, Baraboshkin and Mikhailova (2002) suggested that *D. forbesi* could be a junior synonym of *D. volgensis* (see also Baraboshkin, 2005).

Ropolo (written contribution) suggested replacing *D. weissi* by *Deshayesites consobrinus* as the zonal index. For this author, *Deshayesites* aff. *consobrinus* and *D. consobrinus* (*s.s.*) are respectively restricted to the lower (*D. oglanlensis* Zone) and upper (former *D. weissi* Zone) parts of the calcareous interval at the Cassis-La Bédoule section (Ropolo et al., 2000, 2006). Two main objections can be made: 1) *D. consobrinus* was already chosen as index-species for a zone that corresponds to a different interval (lower part of the calcareous interval at the Cassis-La Bédoule section; Busnardo, 1984); 2) there is a problem of identification between "true" *D. consobrinus* and *D.* aff. *consobrinus*.

The problem relating to the *Roloboceras hambrovi* Subzone and its position in the *Deshayesites deshayesi* Zone (just below the *Deshayesites grandis* Subzone; Ropolo et al., 2000, 2006, 2008a) or in the *D. forbesi* Zone (former *D. weissi* Zone; Moreno et al., 2007; Moreno-Bedmar et al., 2009, 2010; García-Mondéjar et al., 2009) was discussed. Ropolo (written contribution) suggested that, provisionally, a chronostratigraphic significance should not be assigned to the *R. hambrovi* Subzone because there are many divergences of opinion on its real position between outcrops in Spain and France (in Ardèche department and La Bédoule section). However, taking into account data presented by Moreno-Bedmar (based on Moreno et al., 2007; Moreno-Bedmar et al., 2009, 2010; Moreno-Bedmar, 2010; see also Najarro et al., 2011), the Kilian Group accepted a *R. hambrovi* Subzone in the upper part of the *D. forbesi* Zone (Bersac and Bert (subsequent contribution) have a similar point of view). As Roloboceratinae probably occurred only in shallow palaeoenvironments (Moreno-Bedmar et al., 2009), the identification of this subzone in deeper palaeoenvironments could be limited or impossible. In previous meetings, the Kilian Group agreed to use some species as indices of subzones even if they were rare or absent in one of these two palaeoenvironments (platform *versus* basin; for instance: *Thurmanniceras otopeta*, *Teschenites callidiscus*, Hoedemaeker et al., 2003; *Pseudocrioceras waagenoides*, Reboulet et al., 2009). A discussion took place about whether a zone could contain only one named subzone and an unnamed interval (rather than giving that interval a subzonal name, here a *D. forbesi* Subzone); the group ended up accepting an unnamed interval. It is important to underline that the *Roloboceras* beds include the record of Oceanic Anoxic Event 1a (= OAE 1a; Renard et al., 2005; Moreno-Bedmar et al., 2008, 2010; Bover-Arnal et al., 2010; Moreno-Bedmar, 2010, see also Najarro et al., 2011; for the different proposals of the age of OAE 1a see Fig. 1 in Moreno-Bedmar et al., 2009).

4. *D. deshayesi* Zone.

No change. According to Moreno and Company (2007) and Moreno-Bedmar et al. (2009), this index-species is characterized by a high intraspecific variability: *D. grandis* Spath (1930), *Deshayesites involutus* Spath (1930), *Deshayesites latilobatus* (Sinzow, 1909) and possibly *Deshayesites multicostatus* Swinnerton (1935) could be interpreted as the macroconchs of *D. deshayesi* (Orbigny, 1841); while its microconch could be represented by *Deshayesites vectensis* Spath (1930), *Deshayesites wiltshirei* Casey (1964) and *Deshayesites geniculatus* Casey (1964). In this case, the *D. grandis* Subzone should be abandoned as the index-species would be considered as a junior synonym of *D. deshayesi*. For Bersac and Bert (written contribution), *D. deshayesi* and *D. grandis* can be distinguished and they are not dimorphs of the same species (see also Ropolo, subsequent contribution). Consequently, the Kilian Group decided that further investigations on the dimorphism of *D. deshayesi* and the ranges of different taxa are necessary before it can accept a change.

5. *D. furcata* Zone.

The group agreed to divide this zone into the *D. furcata* and *Dufrenoyia dufrenoyi* Subzones. This subdivision was proposed by Dutour (2005) for French sequences (Vocontian basin), and has been recognized recently in Spain (Maestrat basin, Moreno-Bedmar et al., 2010; Prebetic domain, Moreno-Bedmar, 2010). The *D. dufrenoyi* Subzone is also recognized in México by Barragán-Manzo and Méndez-Franco (2005). Bersac and Bert (subsequent contribution) agree with this subdivision of the *D. furcata* Zone.

6. *E. martini* Zone.

No change. The three subzones *Epicheloniceras debile*, *Epicheloniceras gracile* and *Epicheloniceras buxtorfi* of Casey (1961), introduced in the standard zonation during the Neuchâtel meeting (Reboulet et al., 2006) following a proposal of Atrops and Dutour (see also Dutour, 2005), have also been recognized by Ropolo et al. (2008b).

7. *Hypacanthoplites jacobi* Zone.

No change. It is underlined that there are different interpretations of the systematics of this index-species. For Kennedy et al. (2000), *H. jacobi* (Collet, 1907) should be interpreted as

a synonym of *Hypacanthoplites plesiotypicus* (Fritel, 1906). Owen (*in* Mutterlose et al., 2003) considered that *H. plesiotypicus* and *H. jacobi* are distinct. For Bulot (2007), the original of *H. plesiotypicus* is far more closely related to *Hypacanthoplites clavatus* (Fritel, 1906), *Hypacanthoplites nodosicostatus* (Fritel, 1906) and *Hypacanthoplites sarasini* (Collet, 1907) complex (= a strongly tuberculated group) than to *H. plesiotypicus* Casey *non* Fritel and to *H. jacobi* (Collet) (belonging to a feebly tuberculated group with *Hypacanthoplites anglicus* and *Hypacanthoplites trivalis*). This author added that *Hypacanthoplites* is a "trash taxon". Consequently, a complete revision of *Hypacanthoplites* is needed in order to define its content, the exact range of species and their palaeobiogeographic distribution. A similar work would be also necessary for *Acanthohoplites*. Baraboshkin (subsequent contribution) emphasized that the interval around the former Middle/Upper Aptian boundary (*Parahoplites*/*Acanthoplites*) needs further study. As suggested by the chairman, a working group could be focused on these problems.

2.2. Albian

Up to this Kilian Group meeting, the Albian standard zonation for the Mediterranean region corresponded to the zonal scheme developed by Spath and Owen. It has not been modified since the first meeting of the Lower Cretaceous Cephalopod Team (Hoedemaeker et al., 1990), except for the introduction of the *Dipoloceras cristatum* Subzone at the base of the *Mortoniceras inflatum* Zone during the London meeting (Rawson et al., 1999). As most of the specialists on the Albian zonation were absent at the Dijon meeting, the discussion was shortened and the Kilian Group considered that it was impossible to make good decisions for most of the proposals sent to the chairman by different colleagues. Consequently, the main changes concern the Upper Albian alone.

8. *Leymeriella (Leymeriella) tardefurcata* Zone.

No change. In their discussion about the Aptian/Albian boundary, Bulot and Latil (written contribution) propose a *L. (L.) tardefurcata* Assemblage Zone that can be recognized by the co-occurrence of the Acanthohoplitinae with the genera *Douvilleiceras*, *Mirapelia*, *Prolyelliceras*, *Parengonoceras* and/or *Parabrancoceras* when *Leymeriella* is not present. Even if their suggestion would maintain stability in the stratigraphic nomenclature, their proposal has not been accepted because it raises some drawbacks:

- as the range of this biostratigraphic unit neither corresponds to the *L. (L.) tardefurcata* Zone *sensu* Kennedy et al. (2000) nor to that *sensu* Owen (2002); this third definition of the *L. (L.) tardefurcata* Zone could introduce some problems of correlation and communication;
- the Kilian Group usually prefers to use interval zones to build the Lower Cretaceous standard zonation;
- more detailed data should be presented before this option can be accepted by the Kilian Group, and as previously evoked, the Acanthohoplitinae are in need of complete revision.

9. *Douvilleiceras mammillatum* Zone.

Since its introduction in the standard zonation (Hoedemaeker et al., 1990), the *D. mammillatum* Zone has always been considered as a total range zone *sensu* Owen (1988). The range of the index-species seems difficult to define taking into account that a large intraspecific variability can be recognized (*D. mammillatum s.s. vs D. mammillatum s.l.*; Amédro, 1992). Bulot and Latil (written contribution) suggested to interpret this unit as an interval zone, with a base and a top defined by the last occurrence of Acanthohoplitinae and the first appearance of *Lyelliceras*, respectively. Their proposal was not accepted by the Kilian Group. The acceptance of the *D. mammillatum* Zone *sensu* Bulot and Latil in the zonal scheme of the Mediterranean region could raise some problems of correlation with the NW European zonation where the *D. mammillatum* Zone *sensu* Owen (1988) is classically used. Moreover, the range of Acanthohoplitinae cannot yet be defined precisely as this subfamily is in need of complete revision (see point 7).

Bulot and Latil (written contribution) proposed a *Lyelliceras pseudolyelli* Total Range Zone at the top of the Lower Albian. This index-species, introduced in the zonal Mediterranean scheme by Latil (1995; *L. pseudolyelli* Subzone), has a wide distribution (NW Europe, Mediterranean region, Madagascar, South Africa, Venezuela and Colombia). *L. pseudolyelli* has been recently recognized in Peru (Andean basin; Robert, 2002) and Tunisia (Chihaoui et al., 2010). It is also present in the material that Coquand collected from Algeria in the 19th century (Szives, subsequent contribution). Taking into account its high potential for correlation, the Kilian Group decided to consider *L. pseudolyelli* as the index-species of a subzone at the top of the *D. mammillatum* Zone (*sensu* Owen, 1988) in order to avoid a change in the concept of this zone (which would be shortened in its upper part with the separation of a *L. pseudolyelli* Zone; see problem of correlation with the NW European zonation). In the Anglo-Paris basin, it seems that *L. pseudolyelli* precedes *Lyelliceras lyelli* without an overlap but in the Andean Basin both these species co-occur in part of their range (Robert, 2002). Consequently, the *L. pseudolyelli* Subzone must be defined as an interval subzone with the base defined by the first appearance of its index-species and the top by the first occurrence of *L. lyelli*, index-species of the overlying subzone (see point 10).

10. *L. lyelli* Subzone.

No change. Bulot and Latil (written contribution) emphasized that the Middle Albian zonal scheme formerly accepted by the Lower Cretaceous Cephalopod Team (Hoedemaeker et al., 1990) and based on the European Hoplitidae zones of Spath (1941) and Owen (1971) does not work in the Mediterranean region. Consequently, they propose subdividing this substage into a lower *L. lyelli* Zone and an upper *Oxytropidoceras* spp. Zone. This division was first agreed for the "Tethyan Province" during the London meeting (Rawson et al., 1999) to be used in parallel with the hoplitid zones of the "European Province". But subsequent meetings made no reference to the proposal and continued using only the "European Province" zonation. Considering the wide distribution of *L. lyelli* (Western Europe, North Africa, Japan, Iran, Venezuela, California, Madagascar and South Africa) and the fact that this species is used to define the base of the Middle Albian (Hart et al., 1996), Bulot and Latil suggested raising the rank of the *L. lyelli* Subzone to that of a zone that would be defined by the total range of its index-species (Latil, 1995). These authors consider the *Oxytropidoceras* spp. Zone as an interval zone marked at its base by the last occurrence of *L. lyelli* and its top by the first occurrence of *D. cristatum*. However, as is well underlined by Bulot (2010), "our understanding of the oxytropidoceratid stratigraphic distribution is still at a preliminary stage and is handicapped by their spot occurrence in the standard successions of Western Europe". Consequently, the Kilian Group decided that more detailed data should be presented before it can accept changes in the Middle Albian zonation as the Mediterranean ammonite faunas of this interval are still very poorly know.

11. *D. cristatum* Zone.

This is the first zone of the zonal scheme of the Anglo-Paris basin (Amédro, 1992; Amédro and Matrion, 2004; Amédro et al., 2004). The index-species has a very wide distribution (Kennedy et al., 1999; Amédro et al., 2004) and its appearance is used to define the base of the Upper Albian (Hart et al., 1996). The *D. cristatum* Zone is the first zone of the Upper Albian in the Northern Caucasus (Baraboshkin, Bogdanova and Mikhailova, written contribution; Baraboshkin, 1999). *D. cristatum* is usually a minor component of the fauna and where the species is absent, the interval can be determined adequately by other faunas as the interval is marked by a major faunal turnover (entrance of Mortoniceratinae and Stoliczkaiinae). The Kilian Group agreed to include the *D. cristatum* Zone in the standard zonation as this point of view is supported by Bulot and Latil (written contribution).

12. *Mortoniceras pricei*, *M. inflatum*, *Mortoniceras fallax*, *Mortoniceras rostratum and Mortoniceras perinflatum* Zones.

According to Bulot and Latil (written contribution), the former subdivision of the Upper Albian into a lower *M. inflatum* Zone and an upper *Stoliczkaia dispar* Zone does not reflect the knowledge of the evolution of ammonite faunas above the *D. cristatum* Zone. Bulot, Latil and Matrion favour the phyletic zonation of Amédro (1980, 1981, 1992, 2002), Amédro and Matrion (2004) and Amédro et al. (2004), amended by Kennedy and Latil (2007; cf. *M. rostratum* Zone). It is based on the evolution of *Mortoniceras* (cf. variation in the number of lateral tubercules), which disappears at the top of the *M. perinflatum* Zone. Each zone is defined by the first appearance of the index-species. *Mortoniceras pricei*, *M. inflatum*, *M. fallax*, *M. rostratum* and *M. perinflatum* have a wide distribution (Kennedy et al., 1999, 2008; Amédro et al., 2004; Amédro and Robaszynski, 2005; Kennedy and Latil, 2007; Mosavinia et al., 2007; Szives, 2007). Consequently, this zonation was adopted at the Kilian Group meeting.

13. *Arrhaphoceras briacensis* Zone.

Bulot and Latil (written contribution) support the use of an *A. briacensis* Zone *sensu* Gale et al. (1996), for the interval from the last occurrence of *Mortoniceras* to the first occurrence of *Mantelliceras* (see also Amédro, 2002). According to Amédro (2002; Fig. 4), it seems that the last occurrence of *M. perinflatum* is immediately followed by the first occurrence of *A. briacensis*. In this case, it would be preferable to define the base of the *A. briacensis* Zone with the first appearance of its index-species in order to follow the zonal scheme of Amédro (1992), in which each interval zone is defined by the first appearance of the index-species. However, it seems difficult to precisely define the base of this zone with the first appearance of the index-species as it is rare. Until now, *A. briacensis* has been recorded only from South-East France (Scholz, 1973; Delanoy and Latil, 1988; Gale et al., 1996; Amédro and Robaszynski, 2000). However the genus *Arrhaphoceras* is also reported from Hungary (Szives, 2007). Szives (written contribution; Szives, 2007) emphasized that intermediate forms between *Stoliczkaia* and *Mantelliceras* have been found in Hungary and she suggested that they can be used as possible markers of the topmost Albian.

3. Next meeting of the Kilian Group

This will be in Ankara (Turkey) in September 2013, together with the 9th International Symposium on the Cretaceous System. In this planned meeting, the Kilian Group is expected to focus on the Berriasian, Valanginian and Hauterivian stages and to calibrate different ammonite zonations of the Tethyan, Boreal and Austral realms with the "standard" Mediterranean region zonation.

Acknowledgements

Sincere thanks are extended to Pascal Neige (Biogéosciences, CNRS-UMR 5561; University of Burgundy at Dijon, France) for the local organization of the Kilian Group meeting. The study made in Spain by Moreno-Bedmar and collaborators was funded by the Projects CGL2008-04916, (Spanish Ministry of Education and Science) the Consolider-Ingenio 2010 program (under CSD 2006-0004 Topo-Iberia) and the Grup Consolidat de Recerca "Geologia Sedimentària" (2009SGR 1451). We thank the anonymous reviewers for their comments.

References

Aguado, R., Company, M., Sandoval, J., Tavera, J.M., 1997. Biostratigraphic events at the Barremian/Aptian boundary in the Betic Cordillera, southern Spain. Cretaceous Research 18, 309–329.

Amédro, F., 1980. Ammonites. In: Robaszynski, F., Amédro, F (coordinateurs), Foucher, J.C., Gaspard, D, Magniez-Jannin, F, Manivit, H, Sornay, J., Synthèse biostratigraphique de l'Aptien au Santonien du Boulonnais à partir de sept groupes paléontologiques: foraminifères, nannoplancton, dinoflagellés et macrofaunes. Zonations Micropaléontologiques intégrées dans le cadre du Crétacé boréal nord-européen. Revue de micropaléontologie, vol. 22, 4, 195–321.

Amédro, F., 1981. Actualisation des zonations d'Ammonites dans le Crétacé moyen du bassin anglo-parisien. Essai de zonation phylétique de l'Albien au Turonien. Cretaceous Research 2, 261–269.

Amédro, F., 1992. L'Albien du bassin anglo-parisien: Ammonites, zonation phylétique, séquences. Bulletin des Centres de Recherches Exploration-Production, Elf-Aquitaine 16 (1), 187–233.

Amédro, F., 2002. Plaidoyer pour un étage Vraconnien entre l'Albien sensu stricto et le Cénomanien (système Crétacé). Académie Royale de Belgique, Classe des Sciences 3ème Série 4, 1–128.

Amédro, F., Matrion, B., 2004. L'Aptien-Albien du bassin de Paris: un nouveau regard à l'aube du XXIe siècle. Bulletin d'Information des Géologues du Bassin de Paris 41 (2), 3–23.

Amédro, F., Matrion, B., Tomasson, R., Magniez-Jannin, F., Colleté, C., 2004. L'Albien supérieur de Vallentigny dans la région stratotypique (Aube, F.): nouvelles données et révision de l'ammonite *Mortoniceras (M.) inflatum* (J. Sowerby, 1818). Bulletin de la Société Géologique de Normandie et des Amis du Muséum du Havre 90 (2), 5–28.

Amédro, F., Robaszynski, F., 2000. La formation des argiles silteuses de Marcoule dans les sondages ANDRA du Gard rhodanien (SE France): La limite Albien terminal (« Vraconnien ») – Cénomanien au moyen des ammonites et comparaison avec les affleurements de Salazac. Géologie Méditerranéenne 27 (3–4), 175–201.

Amédro, F., Robaszynski, F., 2005. Corrélation des successions de l'Albien par les ammonites entre la Province Nord-Pacifique et les Provinces européenne et arctique du Domaine boréal: zonation, eustatisme et paléobiogéographie. Geobios 38, 585–607.

Baraboshkin, E.J., 1999. Albian ammonite biostratigraphy of the Northern Caucasus. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen 212, 175–210.

Baraboshkin, E.J., 2005. Boreal-Tethyan correlation of Lower Cretaceous ammonite scales. Moscow University. Geology Bulletin 59 (6), 9–20.

Baraboshkin, E.J., Mikhailova, I.A., 2002. New stratigraphic scheme of the Lower Aptian in the Volga river Middle courses. Stratigraphy and Geological Correlation 10 (6), 603–626. Translated from Stratigrafiya. Geologicheskaya Korrelyatsiya 10, 6, 82–105.

Barragán-Manzo, R., Méndez-Franco, A.L., 2005. Towards a standard ammonite zonation for the Aptian (Lower Cretaceous) of northern Mexico. Revista Mexicana de Ciencias Geológicas 22, 39–47.

Birkelund, T., Hancock, J.M., Hart, M.B., Rawson, P.F., Remane, J., Robaszynski, F., Schmid, F., Surlyk, F., 1984. Cretaceous stage boundaries – proposals. Bulletin of the Geological Society of Denmark 33 (1–2), 3–20.

Bogdanova, T.N., Mikhailova, I.A., 2004. Origin, evolution and stratigraphic significance of the superfamily Deshayesitaceae Stoyanow, 1949. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique 74, 189–243.

Bogdanova, T.N., Tovbina, S.Z., 1995. On development of the Aptian ammonite zonal standard for the Mediterranean region. Géologie Alpine, Mémoire Hors Série 20, 51–59.

Bover-Arnal, T., Moreno-Bedmar, J.A., Salas, R., Skelton, P.W., Bitzer, K., Gili, E., 2010. Sedimentary evolution of an Aptian syn-rifting carbonate system (Maestrat Basin, E Spain): effects of accommodation and environmental change. Geologica Acta 8 (3), 249–280.

Bulot, L.G., 2007. The adaptative radiation of the Acanthoplitinae across the Aptian/Albian boundary: Tethyan *vs* Boreal evolution. Réunions thématiques du Groupe Français du Crétacé, Corrélations entre domaines téhysien et boreal au Crétacé, Paris, 3–4 Décembre 2007, Volume des résumés, 1–9.

Bulot, L.G., 2010. Appendix: systematic paleontology of Aptian and Albian ammonites from southwest Iran. In: Vincent, B., van Buchem, F.S.P., Bulot, L.G., Immenhauser, A., Caron, M., Baghbani, D., Huc, A.Y. (Eds.), Carbon-isotope Stratigraphy, Biostratigraphy and Organic Matter Distribution in the Aptian – Lower Albian Successions of Southwest Iran (Dariyan and Kazhdumi Formations), vol. 4. GeoArabia Special Publication, pp. 139–197. 1.

Busnardo, R., 1984. Crétacé inférieur: échelles biostratigraphiques. In: Debrand Passard, S., et al. (Eds.), Synthèse géologique du Sud-Est de la France; volume 1, Stratigraphie et paléogéographie, vol. 125. Mémoire du Bureau de Recherches Géologiques et Minières, pp. 291–294.

Casey, R., 1961. The stratigraphical paleontology of the Lower Greensand. Paleontology 3, 487–621.

Casey, R., 1964. A monograph of the Ammonoidea of the Lower Greensand, part 5. Palaeontographical Society 117, 289–398.

Casey, R., 1996. Lower Greensand ammonites and ammonite zonation. Proceedings of the Geologists' Association 107, 69–74.

Chihaoui, A., Jaillard, E., Latil, J.L., Zghal, I., Susperregui, A.S., Touir, J., Ouali, J., 2010. Stratigraphy of the Hameima and lower Fahdene Formations in the Tadjerouine area (Northern Tunisia). Journal of African Earth Sciences 58 (2), 387–399.

Collet, L.W., 1907. Sur quelques espèces de l'Albien inférieur de Vöhrum (Hanovre). Mémoires de la Société de Physique et d'Histoire Naturelle de Genève 35 (3), 519–529.

Conte, G., 1995. La limite Bédoulien-Gargasien dans la coupe stratotypique de Cassis-La Bédoule (Bouches-du-Rhône, France). Géologie Alpine, Mémoire Hors Série 20, 321–326.

Dauphin, L., 2002. Litho-, bio-, et chronostratigraphie comparées dans le bassin Vocontien à l'Aptien. Doctoral thesis, Université de Lille I, 1–451 (Unpublished).

Delanoy, G., 1991. Sur la présence du genre *Prodeshayesites* Casey, 1961 (Ammonoidea) dans l'Aptien inférieur du Bassin Vocontien. Cretaceous Research 12, 437–441.

Delanoy, G., 1995. About some significant ammonites from the Lower Aptian (Bedoulian) of the Angles-Barrême area (South-East France). Memorie Descrittive della Carta Geologica d'Italia 51, 65–101.

Delanoy, G., 1997. Biostratigraphie des faunes d'Ammonites à la limite Barrémien-Aptien dans la région d'Angles-Barrême-Castellane. Etude particulière de la famille des Heteroceratina Spath, 1922 (Ancyloceratina, Ammonoidea). Annales du Muséum d'Histoire Naturelle de Nice 12, 1–270.

Delanoy, G., Busnardo, R., Ropolo, P., Gonnet, R., Conte, G., Moullade, M., Masse, J.P., 1997. The "*Pseudocrioceras* beds" at La Bédoule (SE France) and the position of the Barremian-Aptian boundary in the historical lower Aptian stratotype. Compte Rendu de l'Académie des Sciences de Paris, Sciences de la Terre et des planètes 325, 593–599.

Delanoy, G., Latil, J.L., 1988. Découverte d'un nouveau gisement Albien dans les environs de Drap (Alpes-Maritimes, France) et description d'une riche ammonitofaune d'âge Albien terminal. Geobios 21 (6), 749–771.

Dutour, Y., 2005. Biostratigraphie, évolution et renouvellement des ammonites de l'Aptien supérieur (Gargasien) du bassin vocontien (Sud-Est de la France). Doctoral thesis, Université Claude Bernard Lyon I, 1–302 (Unpublished).

Erba, E. (reporter) Aguado, R., Avram, E., Baraboshchkin, E.J., Bergen, J.A., Bralower, T.J., Cecca, F., Channel, J.E.T., Coccioni, R., Company, M., Delanoy, G., Erbacher, J., Herbert, T.D., Hoedemaeker, P., Kakabadze, M., Leereveld, H., Lini, A., Mikhailova, I.A., Mutterlose, J., Ogg, J.G., Premoli-Silva, I., Rawson, P.F., von Salis, K., Weissert, H., 1996. The Aptian stage. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre 66 (Suppl.), 31–43.

Fritel, P.H., 1906. Sur les variations morphologiques d'*Acanthoceras Milletianum* d'Orb. sp. Le Naturaliste 28 (472), 245–247.

Gale, A.S., Kennedy, W.J., Burnett, J.A., Caron, M., Kidd, B.E., 1996. The late Albian to Early Cenomanian succession at Mont Risou near Rosans (Drôme, S.E. France); an integrated study (ammonites, inoceramids, planktonic foraminifera, nannofossils, oxygen and carbon isotopes). Cretaceous Research 17, 515–606.

García-Mondéjar, J., Owen, H.G., Raisossadat, N., Millán, M.I., Fernández-Mendiola, P.A., 2009. The Early Aptian of Aralar (northern Spain): stratigraphy, sedimentology, ammonite biozonation, and OAE1. Cretaceous Research 30, 434–464.

Hart, M., Amédro, F., Owen, H. (reporters) Avram, E., Baraboshkin, E.J., Bengston, P., Czaszar, G., Dias-Brito, D., Erba, E., Gale, A.S., Görög, A., Kauffman, E.G., Kopaevich, L.F., Kotetishvili, E., Leereveld, H., Machado Brito, I., Martinez, R., Melinte, M.C., Mikhailova, I.A., Mutterlose, J., Obradovich, J.D., Pons, J.M., Premoli Silva, I., Tewari, A., Tröger, K.A., Venkatachalapathy, R., 1996. The Albian stage and substage boundaries. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre 66 (Suppl.), 45–56.

Hoedemaeker, P.J., Bulot, L., (reporters) Avram, E., Busnardo, R., Company, M., Delanoy, G., Kakabadze, M., Kotetishvili, E., Krishna, J., Kvantaliani, I., Latil, J.L., Memmi, L., Rawson, P.F., Sandoval, J., Tavera, J.M., Thieuloy, J.P., Thomel, G., Vasicek, Z., Vermeulen, J., 1990. Preliminary Ammonite zonation for the Lower Cretaceous of the Mediterranean region. Géologie Alpine 66, 123–127.

Hoedemaeker, P.J., Cecca, F., (reporters) Avram, E., Company, M., Delanoy, G., Erba, E., Ettachfini, M., Faraoni, P., Kakabadze, M., Landra, G., Marini, A., Memmi, L., Pallini, G., Rawson, P.F., Ropolo, P., Sandoval, J., Tavera, J.M., Vašiček, Z., 1995. Report on the 3rd International Workshop on the Standard Lower Cretaceous Ammonite Zonation of the Mediterranean Region. Memorie Descrittive della Carta Geologica d'Italia 51, 213–215.

Hoedemaeker, P.J., Company, M., (reporters) Aguirre-Urreta, M.B., Avram, E., Bogdanova, T.N., Bujtor, L., Bulot, L., Cecca, F., Delanoy, G., Ettachfini, M., Memmi, L., Owen, H.G., Rawson, P.F., Sandoval., J., Tavera, J.M., Thieuloy, J.P., Tovbina, S.Z., Vasicek, Z., 1993. Ammonites zonation for the Lower Cretaceous of the Mediterranean region; basis for the stratigraphic correlation within IGCP-Project 262. Revista Espanola de Paleontologia 8 (1), 117–120.

Hoedemaeker, P.J., Donovan, S.K., 2004. Early Cretaceous ammonites from Colombia. Scripta Geologica (Thematic Issue) 128, 1–558.

Hoedemaeker, P.J., Rawson, P.F., 2000. Report on the 5th International Workshop of the Lower Cretaceous Cephalopod Team (Vienna, 5 September 2000). Cretaceous Research 21, 857–860.

Hoedemaeker, P.J., Reboulet, S., (reporters) Aguirre-Urreta, M.B., Alsen, P., Aoutem, M., Atrops, F., Barragan, R., Company, M., González Arreola, C., Klein, J., Lukeneder, A., Ploch, I., Raisossadat, N., Rawson, P.F., Ropolo, P., Vašiček, Z., Vermeulen, J., Wippich, M., 2003. Report on the 1st International Workshop of the IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Lyon, 11 July 2002). Cretaceous Research 24 (89–94) and erratum (p. 805).

Kemper, E., 1995. Die Entfaltung der Ammoniten und die Meeresverbindungen im Borealen unter-und Mittel-Apt. Geologisches Jahrbuch A 141, 171–199.

Kennedy, W.J., Gale, A.S., Bown, P.R., Caron, M., Davey, R.J., Gröcke, D., Wray, D.S., 2000. Integrated stratigraphy across the Aptian-Albian boundary in the Marnes Bleues, at the Col Pré-Guittard, Arnayon (Drôme), and at Tartonne (Alpes-de-Haute-Provence), France: a candidate Global Boundary Stratotype Section and Boundary Point for the base of the Albian Stage. Cretaceous Research 21, 591–720.

Kennedy, W.J., Gale, A.S., Hancock, J.M., Crampton, J.S., Cobban, W.A., 1999. Ammonites and inoceramid bivalves from close to the Middle-Upper Albian boundary around Fort Worth, Texas. Journal of Paleontology 73 (6), 1101–1125.

Kennedy, W.J., Jagt, J.W.M., Amédro, F., Robaszynski, F., 2008. The late Albian (*Mortoniceras fallax* Zone) cephalopod fauna from the Bracquegnies Formation at Strépy-Thieu, southern Belgium. Geologica Belgica 11, 35–69.

Kennedy, W.J., Latil, J.L., 2007. The Upper Albian ammonite succession in the Montlaux section, Hautes-Alpes, France. Acta Geologica Polonica 57 (4), 453–478.

Latil, J.L., 1995. Les Lyelliceratinae Spath, 1921 (Ammonitina, Ammonoidea) de l'Albien inférieur et moyen dans le basin de Paris et sur les bordures du bassin vocontien: stratigraphie, paléobiogéographie et taxinomie. Géologie Alpine, Mémoire Hors-Série 20, 327–381.

Moreno, J.A., Company, M., 2007. Caracterización de dimorfismo morfodimensional en *Deshayesites deshayesi* (Leymerie in d'Orbigny) (Ancyloceratina, Ammonoidea). XXIII Jornadas de la Sociedad Española de Paleontología. Libro de Resúmenes, 153–154.

Moreno, J.A., Company, M., Delanoy, G., Grauges, A., Martínez, R., Salas, R., 2007. Precisiones sobre la edad, mediante ammonoideos y nautiloideos, de la Fm. Margas del Forcall en la subcuenca de Oliete (Cadena Ibérica, España). Geogaceta 42, 75–78.

Moreno-Bedmar, J.A., 2010. Ammonits de l'Aptià inferior de la península Ibèrica. Biostratigrafia i aportacions a l'estudi del Oceanic Anoxic Event 1a. Doctoral thesis published online in http://www.tdx.cat/TDX-0316110-140631, Universitat de Barcelona, 1–331.

Moreno-Bedmar, J.A., Bover-Arnal, T., Salas, R., Company, M., 2008. The early Aptian oceanic anoxic event in the Maestrat Basin (NE Iberian Chain). Geo-Temas 10, 159–162.

Moreno-Bedmar, J.A., Company, M., Bover-Arnal, T., Salas, R., Delanoy, G., Martínez, R., Grauges, A., 2009. Biostratigraphic characterization by means of ammonoids of the lower Aptian Oceanic Anoxic Event (OAE 1a) in the eastern Iberian Chain (Maestrat Basin, eastern Spain). Cretaceous Research 30, 864–872.

Moreno-Bedmar, J.A., Company, M., Bover-Arnal, T., Salas, R., Delanoy, G., Maurrasse, F.J.-M.R., Grauges, A., Martínez, R., 2010. Lower Aptian ammonite biostratigraphy in the Maestrat Basin (Eastern Iberian Chain, Eastern Spain). A Tethyan transgressive record enhanced by synrift subsidence. Geologica Acta 8 (3), 281–299.

Mosavinia, A., Wilmsen, M., Asghar Aryai, A., Reza Chahida, M., Lehmann, J., 2007. Mortoniceratinae (Ammonitina) from the Upper Albian (Cretaceous) of the Atamir Formation, Koppeh Dagh Mountains, NE Iran. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen 246 (1), 83–95.

Moullade, M., Tronchetti, G., Balme, C., Kouyoumontzakis, G., 2006. The Gargasian (Middle Aptian) of La Tuilière – St-Saturnin-lès-Apt (area of the Aptian historical stratotype, Vaucluse, SE France): geographical setting and outcrop correlation. Carnets de Géologie/Notebooks on Geology, Letter 2006/01 (CG2006_L01), 1–7.

Moullade, M., Tronchetti, G., Granier, B., 2009. Ammonites, microfaunes, stratonomie et géochimie de l'Aptien-type. Avant-propos. Annales du Muséum d'Histoire Naturelle de Nice 24 (1), 1–3.

Moullade, M., Tronchetti, G., Kuhnt, W., Renard, M., Bellier, J.P., 2004. The Gargasian (Middle Aptian) of Cassis-La Bédoule (Lower Aptian historical stratotype, SE France): geographic location and lithostratigraphic correlations. Carnets de Géologie/Notebooks on Geology, Letter 2004/02 (CG2004_L02), 1–4.

Mutterlose, J., Bornemann, A., Luppold, F.W., Owen, H.G., Ruffell, A., Weiss, W., Wray, D., 2003. The Vöhrum section (northwest Germany) and the Aptian/Albian boundary. Cretaceous Research 24, 203–252.

Najarro, M., Rosales, I., Moreno-Bedmar, J.A., de Gea, G.A., Barrón, E., Company, M., Delanoy, G., 2011. High-resolution chemo- and biostratigraphic records of the Early Aptian oceanic anoxic event in Cantabria (N Spain): Palaeoceanographic and palaeoclimatic implications. Palaeogeography, Palaeoclimatology, Palaeoecology 299, 137–158.

Orbigny d', A., 1841. Paléontologie française. Description zoologique et géologique de tous les animaux mollusques et rayonnés fossiles de France. Tome 1. Terrains Crétacés. Céphalopodes. Paris, Masson, Part II (1841), 121–430.

Owen, H.G., 1971. Middle Albian stratigraphy in the Anglo-Paris Basin. Bulletin of the British Museum Natural History (Geology), Supplement 8, 1–164.

Owen, H.G., 1988. The ammonite zonal sequence and ammonite taxonomy in the *Douvilleiceras mammillatum* Superzone (Lower Albian) in Europe. Bulletin of the British Museum Natural History (Geology) 44 (3), 177–231.

Owen, H.G., 2002. The base of the Albian Stage; comments on recent proposals. Cretaceous Research 23, 1–13.

Raisossadat, S.N., Owen, H.G., García-Mondéjar, J., Rawson, P.F., 2008. The Early Aptian ammonite biozonation in Mediterranean Province. 1st International Meeting on Correlation of Cretaceous Micro- and Macrofossils, Vienna (Austria), 16th–18th April, 2008. Berichte der Geologischen Bundesanstalt 74, 87–88.

Rawson, P.F., 1983. The Valanginian to Aptian stages – current definitions and outstanding problems. Zitteliana 10, 493–500.

Rawson, P.F., Hoedemaeker, P.J., (reporters), Aguirre-Urreta, M.B., Avram, E., Ettachfini, M., Kelly, S.R.A., Klein, J., Kotetishvili, E., Owen, H.G., Ropolo, P., Thomson, M.R.A., Wippich M., Vašíček, Z., 1999. Report on the 4th International Workshop of the Lower Cretaceous Cephalopod Team (IGCP-Project 362). Scripta Geologica, Spec. Issue 3, 3–13.

Reboulet, S., Hoedemaeker, P.J., (reporters) Aguirre-Urreta, M.B., Alsen, P., Atrops, F., Baraboshkin, E.Y., Company, M., Delanoy, G., Dutour, Y., Klein, J., Latil, J.L., Lukeneder, A., Mitta, V., Mourgues, F.A., Ploch, I., Raisossadat, N., Ropolo, P., Sandoval, J., Tavera, J.M., Vasicek, Z., Vermeulen, J., 2006. Report on the 2nd international meeting of the IUGS Lower Cretaceous ammonite working group, the "Kilian Group" (Neuchâtel, Switzerland, 8 September 2005). Cretaceous Research 27, 712–715.

Reboulet, S., Klein, J., (reporters) Barragán, R., Company, M., González-Arreola, C., Lukeneder, A., Raisossadat, S.N., Sandoval, J., Szives, O., Tavera, J.M., Vašíček, Z., Vermeulen, J., 2009. Report on the 3rd International Meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Vienna, Austria, 15th April 2008). Cretaceous Research 30, 496–502. doi:10.1016/j.cretres.2008.12.009.

Renard, M., de Rafelis, M., Emmanuel, L., Moullade, M., Masse, J.P., Kuhnt, W., Bergen, J.A., Tronchetti, G., 2005. Early Aptian δ13C and manganese anomalies from the historical Cassis-La Bédoule stratotype sections (S.E. France): relationship with a methane hydrate dissociation event and stratigraphic implications. Carnets de Géologie/Notebooks on Geology, Article 2005/04 (CG2005_A04), 1–18.

Robert, E., 2002. La transgression albienne dans le bassin andin (Pérou): biostratigraphie, paléontologie (ammonites) et stratigraphie séquentielle. Actes du Laboratoire de Géologie Sédimentaire et Paléontologie de l'Université Paul-Sabatier, Toulouse, Strata Série 2, 38, 1–380.

Ropolo, P., Conte, G., Gonnet, R., Masse, J.P., Moullade, M., 2000. Les faunes d'Ammonites du Barrémien supérieur/Aptien inférieur (Bédoulien) dans la région stratotypique de Cassis-La Bédoule (SE France): état des connaissances et propositions pour une zonation par Ammonites du Bédoulien-type. In: Moullade, M., et al. (Eds.), Le stratotype historique de l'Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (SE France). Géologie Méditerranéenne, vol. 25, pp. 167–175. 3–4.

Ropolo, P., Conte, G., Moullade, M., Tronchetti, G., Gonnet, R., 2008b. The Douvilleiceratidae (Ammonoidea) of the Lower Aptian historical stratotype area at Cassis-La Bédoule (SE France). Carnets de Géologie/Notebooks on Geology, Memoir 2008/03 (CG2008_M03), 1–60.

Ropolo, P., Gonnet, R., Conte, G., 1999. The "*Pseudocrioceras* interval" and adjacent beds at La Bédoule (SE France): implications to highest Barremian/lowest Aptian biostratigraphy. Scripta Geologica, Special Issue 3, 159–213.

Ropolo, P., Moullade, M., Conte, G., Tronchetti, G., 2008a. About the stratigraphic position of the Lower Aptian R*oloboceras hambrovi* (Ammonoidea) level. Carnets de Géologie/Notebooks on Geology, Letter 2008/03 (CG2008_L03), 1–7.

Ropolo, P., Moullade, M., Gonnet, R., Conte, G., Tronchetti, G., 2006. The *Deshayesitidae Stoyanov*, 1949 (Ammonoidea) of the Aptian historical stratotype region at Cassis-La Bédoule (SE France). Carnets de Géologie/Notebooks on Geology, Memoir 2006/01 (CG2006_M01), 1–43.

Scholz, G., 1973. Sur l'âge de la faune d'ammonites au Château près de St-Martin-en-Vercors (Drôme) et quelques considérations sur l'évolution des Turrilidés et des Hoplitidés vracono-cénomaniens. Géologie Alpine 49, 119–129.

Sinzow, I., 1909. Beiträge zur Kenntnis des südrussischen Aptien und Albien. Verhandlungen der Russisch-Kaiserlichen Mineralogischen Gesellchaft zu St.-Petersburg (série 2) 47, 1–48.

Spath, L.F., 1930. On some Ammonoidea from the Lower Greensand. Annals and Magazine of Natural History 10 (5), 417–464.

Spath, L.F., 1941. A Monograph of the Ammonoidea of the Gault. Monographs of the Palaeontographical Society part 14 609–668.

Swinnerton, H.H., 1935. The Rocks below the Red Chalk of Lincolnshire and their Cephalopod Faunas. The Quarterly Journal of the Geological Society of London 91, 1–46.

Szives, O., 2007. Albian stage. In: Szives, O., Csontos, L., Bujtor, L., Fősy, I. (Eds.), Aptian-Campanian Ammonites of Hungary. Geologica Hungarica, Series Palaeontologica, vol. 57, pp. 1–187.