

Report on the 2nd international meeting of the IUGS lower Cretaceous ammonite working group, the “Kilian Group” (Neuchâtel, Switzerland, 8 September 2005)

Stéphane Reboulet ^{a,*} and Philip J. Hoedemaeker ^b (reporters) and Maria B. Aguirre-Urreta ^c, Peter Alsen ^d, François Atrops ^a, Evgenij Y. Baraboshkin ^e, Miguel Company ^f, Gérard Delanoy ^g, Yves Dutour ^a, Jaap Klein ^h, Jean-Louis Latil ⁱ, Alexander Lukeneder ^j, Vasily Mitta ^k, Francisco A. Mourgues ^l, Izabela Ploch ^m, Naser Raisossadat ⁿ, Pierre Ropolo ^o, José Sandoval ^f, José M. Tavera ^f, Zdenek Vasicek ^p, Jean Vermeulen ^q,
With the participation of Hubert Arnaud ^r, Bruno Granier ^s, Isabella Premoli-Silva ^t
(chairwoman of the Subcommittee on Cretaceous Stratigraphy)

^a Université Lyon 1, UFR Géosciences, UMR CNRS 5125 PEPS, Bâtiment Géode, 2 rue Raphaël Dubois, 69622 Villeurbanne cedex, France

^b National Museum of Natural History, PO Box 9517, 2300 RA Leiden, The Netherlands

^c Departamento de Ciencias Geológicas, Universidad de Buenos Aires, Ciudad Universitaria Pabellón II, 1428 Buenos Aires, Argentina

^d Geological Institute, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark

^e Geological Faculty, Moscow State University, 119992 Leninskie Gory, Moscow, Russia

^f Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, Avda Fuentenueva s/n, 18002 Granada, Spain

^g Département des Sciences de la Terre, Université de Nice Sophia Antipolis, Parc Valrose, faculté des Sciences, 06108 Nice, Cedex 2, France

^h Demmerik 12, 3645 EC Vinkeveen, The Netherlands

ⁱ Le Maupas, 05300 Lazer, France

^j Geological-Palaeontological Department, Natural History Museum, Burgring 7, A-1010 Vienna, Austria

^k Paleontological Institute of RAS, Moscow 117997, Russia

^l IRD-LMTG, Observatoire Midi-Pyrénées, 14 Avenue Edouard Belin, 31400 Toulouse, France

^m Polish Geological Institute, Geological Museum, Rakowiecka Str 4, PL-00-975 Warszawa, Poland

ⁿ Department of Geology, Faculty of Science, Birjand University, PO Box 79/615, Birjand, Iran

^o Centre de Sédimentologie-Paléontologie, Université de Provence Campus St Charles, 13331 Marseille, Cedex 3; private address: 83,

Boulevard du Redon, Bât. E9 La Rouvière, 13009 Marseille, France

^p VSB – Technical University of Ostrava, Institute of Geological Engineering, 17 listopadu Street 15, CZ 70833 Ostrava-Poruba, Czech Republic

^q Grand Rue, 04330 Barrême, France

^r Maison des Géosciences, LGCA (UMR 5025), 38041 Grenoble cedex, France

^s UMR 6538 Paléontologie, Université de Bretagne Occidentale, UFR Sciences et Techniques, 6 Avenue Le Gorgeu, CS 93837,

FR-29238 Brest cedex, France

^t Dipartimento di Scienze della Terra “A. Desio”, Via Mangiagalli, 34, 20133 Milano, Italy

Received 20 October 2005; accepted in revised form 8 February 2006

Available online 6 June 2006

1. Introduction

Our Neuchâtel meeting of Lower Cretaceous ammonite workers was the last to be organized by Philip Hoedemaeker over a 15 year period. All members of the Kilian Group thank

him for his contribution as chairman of: (1) the Lower Cretaceous Cephalopod Team (IGCP: International Geoscience Programme, projects 262: Digne, France, 1990; Mula, Spain, 1992, and 362: Piobbico, Italy, 1994; London, UK, 1997); (2) an independent group (Vienna, Austria, 2000); and (3) the IUGS (International Union of Geological Sciences) Lower Cretaceous Ammonite Working Group, the Kilian Group (Lyon, France, 2002). Progress in constructing the Lower

* Corresponding author.

E-mail address: stephane.reboulet@univ-lyon1.fr (S. Reboulet).

Cretaceous standard ammonite zonation for the Mediterranean region can be followed by reading the successive reports.

In the months before our meeting, Peter Rawson (vice chairman of the Kilian Group and former chairman of the IUGS Subcommission on Cretaceous Stratigraphy) and Hoedemaeker sought nominations for a new chairman of the Kilian Group. They asked Stéphane Reboulet whether he would be willing. As none of the 20 participants of the second meeting of the group raised any objection he was duly appointed. They were pleased that he was prepared to take the lead, especially since the group has gained recognition in the stratigraphic world. Rawson will continue to be vice chairman and to deal with the Lower Cretaceous ammonites of the Boreal Realm. Unfortunately Maria Aguirre-Urreta, who has been concerned with the Austral realm, resigned from her role as a vice chairwoman shortly after the meeting. The members of the Kilian Group thank her for her valuable contributions. Following discussions with Hoedemaeker and Rawson, Reboulet appointed Jaap Klein as her replacement.

2. The standard zonation

The current Lower Cretaceous standard ammonite zonation was established during the 1st International Workshop of the IUGS Lower Cretaceous Ammonite Working Group in Lyon (11 July 2002) and was summarized by Hoedemaeker and Reboulet et al. (2003). It was adopted in its entirety by Gradstein et al. (2004), editors of “A Geological Timescale”. During the workshop in Neuchâtel, the zonation of the Berriasian, Valanginian, Hauterivian and Albian stages (Tables 1 and 2) was not discussed, but several amendments were introduced to the Barremian and Aptian stages. These are recorded in Table 2; the numbers below refer to those in the table.

2.1. Barremian

Following the investigations of Delanoy (1994a, 1997a, b), Company et al. (2005) and Vermeulen (2005), it was decided to add the *Holcodiscus uhligi* Zone, the *Heinzia sayni* and *Barrancyloceras barremense* subzones, and the *Imerites giraudi*, *Heteroceras emerici* and *Leptoceratoides puzosianum* horizons to the scheme.

1. No change. Vermeulen (2002, 2005) proposed to change the name of the *Taveraidiscus hugii* auctorum Zone to the *Avramidiscus kiliani* Zone, but according to Company, *A. kiliani* and *Avramidiscus vandeckii* could be senior synonyms of *Avramidiscus intermedius*, which would be the valid species. The meeting participants agreed that further taxonomic studies are necessary before changing the name of this zone.
2. The *Holcodiscus uhligi* Zone proposed by Vermeulen (2002, 2005) was adopted. This zone fills the gap between the top of the *Coronites darsi* Zone and the first appearance of *Toxancyloceras vandenheckii*. Therefore, the Lower/Upper Barremian boundary is shifted to the base of the *Holcodiscus uhligi* Zone.

3. Vermeulen noted that the name of the *Ancyloceras vandenheckii* Zone should be changed to the *Toxancyloceras vandenheckii* Zone.
4. Following the proposal of Company, the *Toxancyloceras vandenheckii* Zone was subdivided into two subzones: *Heinzia sayni* for the lower part, introduced as a zone by Vermeulen (1997, 2002, 2005), and *Barrancyloceras barremense* in the upper part. Company et al. (2005, p. 62) noted that the upper part of the Vandenheckii Zone is characterized by the co-occurrence of *T. vandenheckii* and *B. barremense*.
5. The *Imerites giraudi* Zone contains two horizons: an *I. giraudi* Horizon at the base and a *Heteroceras emerici* Horizon above it; these were introduced by Delanoy (1997a, b).
6. The name of the *Colchidites sarasini* Zone has been changed to the *Martelites sarasini* Zone (Delanoy 1994b, 1997a).
7. The lower part of the Sarasini Zone is now characterized by the *Leptoceratoides puzosianum* Horizon, which was introduced by Delanoy (1997a, b). This species has also been recognized by Hoedemaeker (unpublished data) in the Rio Argos succession in Spain.
8. The former zone of *Pseudocrioceras waagenoides* has been lowered in rank to subzone and occupies the upper part of the Sarasini Zone. It was stressed by Company and Delanoy that *P. waagenoides* mainly occurs on the platforms and is very rare in the basins. Taking into account the palaeobiogeographic distribution of species in these two environments, a similar reasoning was adopted by the Kilian Group concerning the lowering in rank to subzone of some Valanginian index-species (*Thurmanniceras otopeta* and *Teschentites callidiscus*) (Hoedemaeker and Reboulet et al., 2003).

2.2. Aptian

Ropolo and Atrops gave introductory talks on the Bedoulian (Lower Aptian) and Gargasian (Middle Aptian), respectively. Ropolo presented new results on a recent study of Deshayesitidae, which characterize Lower Aptian zones of the Cassis-La Bédoule area (southeast France) and proposed a local zonal scheme that confirmed the previous zonation of Ropolo et al. (2000). Atrops presented the thesis of Yves Dutour on the Gargasian Substage. This provided the basis for animated discussion on the *Dufrenoyia furcata* Zone, the Bedoulian/Gargasian boundary and the two- or three-fold division of the Aptian Stage (see 11).

9. In agreement with Casey (pers. comm. 2000) and Bogdanova and Mikhailova (2004), Ropolo emphasized that the term “*Deshayesites weissii* Zone” should be considered unacceptable. *Deshayesites weissii* is a nomen dubium because the examples figured by Neumayr and Uhlig (1881) and von Koenen (1902) cannot be matched with any specimen figured in later publications and are now lost. However, pending the finding of a new acceptable index species, we conserved the *Deshayesites weissii* Zone.

Table 1
Ammonite zonation of the Berriasian–Hauterivian stages

STAGES	ZONES	SUBZONES	HORIZONS	
HAUTERIVIAN	Upper	<i>Pseudothurmannia ohmi</i>	<i>Pseudothurmannia picteti</i>	
			<i>Pseudothurmannia catulloi</i>	
		<i>Balearites balearis</i>		
		<i>Plesiospirodiscus ligatus</i>		
	<i>Subsainella sayni</i>		<i>Cruasiceras cruasense</i>	
	Lower	<i>Lyticoceras nodosoplicatum</i>		<i>Olcostephanus (O.) variegiatus</i>
<i>Crioceratites loryi</i>		<i>Olcostephanus (Jeannoticeras) jeannoti</i> <i>C. loryi</i>		
<i>Acanthodiscus radiatus</i>			<i>Breistrofferella castellanensis</i>	
VALANGINIAN	Upper	<i>Criosarasinella furcillata</i>	<i>Teschenites callidiscus</i>	
			<i>C. furcillata</i>	
		<i>Neocomites peregrinus</i>	<i>Olcostephanus (O.) nicklesi</i> <i>N. peregrinus</i>	
	Lower	<i>Busnardoites campylotoxus</i>	<i>Karakaschiceras pronocostatum</i>	<i>Neocomites platycostatus</i>
			<i>S. verrucosum</i>	<i>S. verrucosum</i>
		<i>Tirnovella pertransiens</i>	<i>B. campylotoxus</i>	
BERRIASIAN	Upper	<i>Subthurmannia boissieri</i>	<i>Thurmanniceras otopeta</i>	
			<i>Tirnovella alpillensis</i>	
			<i>Berriasella picteti</i>	
			<i>Malbosiceras paramimounum</i>	
	Middle	<i>Subthurmannia occitanica</i>	<i>Dalmasiceras dalmasi</i>	
			<i>Berriasella privasensis</i>	
Lower	<i>Berriasella jacobi</i>	<i>Subthurmannia subalpina</i>		

10. The *Deshayesites grandis* Subzone of Casey (1961) has been recognized recently in the stratotype area of Gargas (La Tuilière, southeast France) by Atrops and Dutour.
11. On account of the evolution of the ammonite fauna in the Vocontian Basin (southeast France), Atrops and Dutour (2002) proposed to draw the Bedoulian/Gargasian boundary at the base of the *D. furcata* Zone. The Kilian Group decided that more data should be presented before it could accept a shift in the boundary (Hoedemaeker and Reboulet et al., 2003). A more recent study in the La Tuilière area near the stratotype of Gargas enabled Atrops and Dutour to reinforce their proposal. This will be discussed fully in a paper to be published in Cretaceous Research at a later date. According to them, the marls of Gargas correspond to the Furcata Zone and this stratigraphic interval is dominated by *D. furcata* and *Aconeceras nissus*. Both of these species were listed by Kilian (1887, 1889) when he defined the Gargasian Substage for the marls of Gargas with pyriteous fossils. Atrops and Dutour consider the base of the Furcata Zone to be characterized by a major turnover of the ammonite fauna (last occurrence of *Deshayesites*; first occurrence of *Dufrenoyia*, *Gargasiceras*, *Eotetragonites* and *Colombiceras*). They stressed that this stratigraphic interval corresponds to the beginning of an important transgression. Considering these

Table 2
Ammonite zonation of the Barremian–Albian stages

STAGES	ZONES	SUBZONES	HORIZONS		
ALBIAN	Upper	<i>Stoliczkaia (S.) dispar</i>	<i>S. (S.) dispar</i>		
			<i>Stoliczkaia (Faraudiella) blancheti</i>		
	Middle	<i>Mortoniceras inflatum</i>		<i>Diploceras cristatum</i>	
			<i>Euhoplites lautus</i>		
		<i>Euhoplites loricatus</i>		<i>Hoplites spathi</i>	
		<i>Hoplites dentatus</i>		<i>Lyelliceras lyelli</i>	
Lower	<i>Douvilleiceras mammillatum</i>				
		<i>Leymeriella tardefurcata</i>			
APTIAN	Upper	<i>Acanthohoplites nolani</i>	<i>Hypacanthoplites jacobi</i>		
				<i>Diadochoceras nodosocostatum</i>	
	Middle	<i>Parahoplites melchioris</i>		<i>Epicheloniceras buxtorfi (13)</i>	
			<i>Epicheloniceras martini (12)</i>	<i>Epicheloniceras gracile (13)</i>	
				<i>Epicheloniceras debile (13)</i>	
	Lower	<i>Dufrenoyia furcata (11)</i>		<i>Deshayesites grandis (10)</i>	
<i>Deshayesites deshayesi</i>					
<i>Deshayesites weissii (9)</i>					
<i>Deshayesites ogranlensis</i>					
BARREMIAN	Upper	<i>Martelites sarasini (6)</i>	<i>Pseudocrioceras waagenoides (8)</i>		
				<i>Leptoceratoides puzosianum (7)</i>	
		<i>Imerites giraudi</i>		<i>Heteroceras emerici (5)</i>	
			<i>Hemihoplites feraudianus</i>		<i>I. giraudi (5)</i>
			<i>Gerhardtia sartousiana</i>	<i>Gerhardtia provincialis</i>	
				<i>G. sartousiana</i>	
Lower	<i>Toxancyloceras vandenheckii (3)</i>	<i>Barrancyloceras barremense (4)</i>			
		<i>Heinzia sayni (4)</i>			
	<i>Holcodiscus uhligi (2)</i>				
	<i>Coronites darsi</i>				
	<i>Kotetishvilia compressissima</i>				
	<i>Nicklesia pulchella</i>				
<i>Kotetishvilia nicklesi</i>					
<i>Taveraidiscus hugii auctorum (1)</i>					

palaeontological and sedimentological data and the historical approach, it appears necessary to include the Furcata Zone in the Gargasian (and hence to put the Lower/Middle Aptian boundary at the base of the Furcata Zone) in order to keep the stratotype of this substage. However, Ropolo noted that, as a result of the work of Conte (1995), the Furcata Zone should be included in the Lower Aptian, at the top of the La Bédoule section. He defended the ideas that were presented in a detailed description of the Bedoulian stratotype by Ropolo et al. (2000). The main issue of his talk was the fact that in the Bedoulian stratotype the limestone beds with calcareous fossils of *Dufrenoyia furcata* and other species of *Dufrenoyia* are overlain by Gargasian marls

with pyritized fossils containing *A. nisus* without *Dufrenoyia*. He therefore proposed to include the Furcata Zone in the Bedoulian, and to begin the Gargasian with the *Epicheloniceras subnodosocostatum* Zone (see 12). He interpreted the top of the Furcata Zone as a major turnover of the ammonite fauna (last occurrence of *Dufrenoyia*, *Gargasicerias* and *Cheloniceras*; first occurrence of *Colombicerias* and *Epicheloniceras*).

The problem relating to the Furcata Zone and its position in Lower or Middle Aptian led the Kilian Group to a lively discussion about the subdivision of the stage. It did not arrive at a solution and decided that further investigations are necessary prior to the next meeting. Company noted that he would prefer to abandon the Bedoulian, Gargasian and Clansayesian substages, which are not recognised internationally. This led to a discussion of the problem of the two or three-fold division of the Aptian Stage and the need to look for worldwide events to define boundaries of stages and substages. In the case of a two-fold subdivision, some members suggested that the Lower/Upper Aptian boundary could be placed at the top of the Furcata Zone. According to Raisossadat, this boundary would correspond to the disappearance of all species of Deshayesitinae (*Deshayesites* and *Dufrenoyia*), which would characterize the Lower Aptian, and the inception of *Epicheloniceras*. Hoedemaeker (Hoedemaeker and Donovan, 2004) considered that this boundary has the advantage that it can be identified worldwide because in the Caribbean and East Pacific regions *Deshayesites* is absent, but *Dufrenoyia* and *Epicheloniceras* are present.

12. Atrops and Dutour suggested that the *Epicheloniceras subnodosocostatum* Zone should be changed to the *Epicheloniceras martini* Zone. Indeed, the range of *E. subnodosocostatum* is limited to the *Epicheloniceras gracile* Subzone. The *Epicheloniceras martinoides* Zone of Casey (1961) should not be used because this species is a junior synonym of *Epicheloniceras martini*, the holotype of which comes from the Gargas section.
13. The subzones *Epicheloniceras debile*, *Epicheloniceras gracile* and *Epicheloniceras buxtorfi* of Casey (1961) have been recognized by Atrops and Dutour in the Martini Zone of southeast France.

3. Membership and future work of the Kilian Group

All Lower Cretaceous ammonite workers are welcome to join the Kilian Group. They should contact the chairman should they so wish. The next meeting has still to be arranged. In the meantime, Reboulet intends to organize several workshops to deal with the zonation of a particular stage/substage or the boundaries of some stages/substages. Even if a particular problem concerns only a few members of the group, reports of the discussions will be e-mailed to all. The main results of these deliberations will be submitted for acceptance at the next meeting of the group.

Acknowledgements

We thank Peter Rawson (University College London) for his contribution to this English version of our report.

References

- Atrops, F., Dutour, Y., 2002. Nouvelles données biostratigraphiques sur l'Aptien moyen et supérieur du sud-est de la France, à la lumière de la succession des ammonites du domaine vocontien. Abstracts, Strati 2002, third French Congress on Stratigraphy. Documents des Laboratoires de Géologie de Lyon 156, 23–24.
- 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.
- Casey, R., 1961. The stratigraphical paleontology of the Lower Greensand. Palaeontology 3, 487–621.
- Company, M., Sandoval, J., Tavera, J.M., Aoutem, M., Ettachfani, M., 2005. Barremian ammonite biostratigraphy in the Western High Atlas (Morocco). In: Godet, A., Mort, H., Linder, P., Bodin, S. (Eds.), Abstracts, Seventh International Symposium on the Cretaceous 5–9th September 2005, 61–62.
- 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.
- Delanoy, G., 1994a. Les zones à Feradianus, Giraudi et Sarasini du Barrémien supérieur de la région stratotypique d'Angles-Barrême-Castellane (sud-est de la France). Géologie Alpine, Mémoire Hors Série 20, 279–319.
- Delanoy, G., 1994b. Nouvelles conceptions génériques au sein de la famille des Heteroceratidae Spath, 1922 (Ammonoidea, Ancyloceratina). Comptes Rendus de l'Académie des Sciences, Paris 318, 543–548.
- Delanoy, G., 1997a. Biostratigraphie des faunes d'Ammonites à la limite Barremien-Aptien dans la région d'Angles-Barrême-Castellane. Etude particulière de la Famille des Heteroceratidae (Ancyloceratina, Ammonoidea). Annales du Muséum d'Histoire Naturelle de Nice 12, 1–270.
- Delanoy, G., 1997b. Biostratigraphie haute résolution du Barrémien supérieur du sud-est de la France. Comptes Rendus de l'Académie des Sciences, Paris 325, 689–694.
- Gradstein, F.M., Ogg, J.G., Smith, A.G., 2004. A Geological Timescale. Cambridge University Press, Cambridge, i–xix + 589 pp.
- Hoedemaeker, P.J. and Reboulet, S., (reporters) et al. (16 other authors), 2003. Report on the First International Workshop of the IUGS Lower Cretaceous Ammonite Working Group, the "Kilian Group" (Lyon, 11 July 2002). Cretaceous Research 24, 89–94 and 805 (Erratum).
- Hoedemaeker, P.J., Donovan, S.K. (compilers and editors), 2004. Early Cretaceous ammonites from Colombia. Scripta Geologica (thematic issue) 128, 1–558.
- Kilian, W., 1887. Note géologique sur la chaîne de Lure. Feuille des Jeunes Naturalistes, 17ème année 196, 48–55.
- Kilian, W., 1889. Description géologique de la montagne de Lure. Thèse, Paris, 1–458.
- von Koenen, A., 1902. Die Ammonitiden des norddeutschen Neocom. Abhandlungen der Königlich Preussischen Geologischen Landesanstalt und Bergakademie, Neue Folge 4, 1–451.
- Neumayr, M., Uhlig, V., 1881. Ueber Ammonitiden aus den Hilsbildungen Norddeutschlands. Palaeontographica, Neue Folge 3 (27), 129–203.
- 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). Géologie Méditerranéenne 25 (for 1998), 167–175.
- Vermeulen, J., 1997. Origine, classification et évolution des Pulchelliinae (Douvillé) 1911 emend. Vermeulen 1995 (Pulchelliidae, Endemocerataceae, Ammonoidea). Géologie Alpine 72, 101–115.
- Vermeulen, J., 2002. Etude stratigraphique et paléontologique de la famille des Pulchelliidae (Ammonoidea, Ammonitina, Endemocerataceae). Géologie Alpine, Mémoire Hors Série 42, 1–333, 57 pls.
- Vermeulen, J., 2005. Boundaries, ammonite fauna and main subdivisions of the stratotype of the Barremian. In: 7th International Symposium on the Cretaceous 5–9th September 2005, Field Trip Guidebook. Géologie Alpine, Série Spéciale "Colloques et excursions", 7, 147–173.