

The Berriasian Stage and the Jurassic-Cretaceous boundary

by Viktor A. ZAKHAROV, Paul BOWN and Peter F. RAWSON

Abstract

It is recommended that the base of the Berriasian Stage be placed **either** at the base of the *Berriasella jacobi* Zone **or** at the base of the *Tirnovella subalpina* Subzone. The choice of stratotype section will depend on the choice of zone, but will be in SE France or SE Spain. Subdivision of the Berriasian Stage into 2 or 3 substages will again depend on which level is chosen to define the base of the stage.

Key-words: Berriasian, Lower Cretaceous, biostratigraphy, ammonites, calpionellids.

Résumé

Il est recommandé de placer la base de l'étage Berriasien soit à la base de la zone à *Berriasella jacobi*, soit à la base de la sous-zone à *Tirnovella subalpina*. Le choix du stratotype dépendra du choix de la zone, mais il sera situé dans le SE de la France ou dans le SE de l'Espagne. La subdivision de l'étage Berriasien en 2 ou en 3 sous-étages dépendra également du niveau choisi pour définir la base de l'étage.

Mots-clefs: Berriasien, Crétacé inférieur, biostratigraphie, ammonites, calpionellides.

Берриаский ярус и Юрско-меловая граница.

Резюме.

Основание Берриаского яруса рекомендуется определять либо по основанию зоны *Berriasella jacobi*, либо по основанию подзоны *Tirnovella subalpina*. Выбор стратотипа будет зависеть от выбора зоны, но в любом случае стратотип будет расположен на юго-востоке Франции или Испании. Разделение Берриаского яруса на 2 или 3 подъяруса будет также зависеть от уровня, выбранного для определения основания яруса.

Ключевые слова: Берриаский ярус, нижний мел, биостратиграфия, аммониты, *Calpionellida*.

Introduction

Because the base of the Cretaceous is generally placed at the base of the Berriasian stage, definition of the base of the Berriasian has been linked inextricably with the definition of the Jurassic-Cretaceous boundary. Thus the

Jurassic-Cretaceous boundary Working Group is responsible for defining the base of the Berriasian stage and of its subdivisions, as well as for determining the base of the Cretaceous. It should be stressed that some authors (e.g. WIEDMANN, 1980; RAWSON, 1990; REMANE, 1990) have indicated that the latter boundary could usefully be placed **above** the Berriasian, at the base of the Valanginian.

As no draft paper had been prepared for Working Group members prior to the Brussels meeting, this short contribution is based on notes from the Brussels meeting compiled by Viktor A. ZAKHAROV (W.G. Chairman 1992-1995) and edited by Paul BOWN (Acting Secretary), with additional material by Peter RAWSON.

The Jurassic-Cretaceous boundary

Definition of the Jurassic-Cretaceous boundary remains an intractable problem despite some 30 years of debate, over a dozen international conferences and a Working Group dedicated to the issue since 1974 (CASEY *et al.*, 1975). The problem hinges on the need to define a boundary that can be correlated over as wide an area as possible and ideally from Tethyan to Boreal realms.

The issues were discussed by Jürgen REMANE, Chairman of the Working Group from 1982 to 1992, in a paper given at an international field meeting on "The Jurassic-Cretaceous Boundary in the Northern Caucasus" in 1987 (REMANE, 1990). An English language version of this paper was circulated to Working Group members with *Newsletter 9* in October 1988, while a modified (English) version was published by *Cretaceous Research* in 1991. REMANE (1990, 1991) pointed out that the problems appear due largely to:

- (1) a lack of significant faunal turnovers at the base of the Berriasian, however defined (though some ammonite changes are discussed below);
- (2) the effects of the "Purbeckian regression".

The "Purbeckian regression" marked a major global fall in sea-level that led to an interval of high faunal and floral endemism and extreme facies differentiation across the Eurasian region. This in turn renders correlation extremely difficult.

REMANE (1990, 1991) also recalled the recommendations made by the Working Group at the 27th IGC in Moscow in 1984:

(1) The Jurassic/Cretaceous boundary should be defined in the Tethyan Realm.

(2) The first candidate for the boundary is the Tithonian/Berriasian boundary, which corresponds to the base of the combined *jacobi-grandis* Zone [following the recommendation of the 1973 Lyons Colloquium (FLANDRIN *et al.* 1975, p. 392)].

(3) If this boundary level cannot be correlated from the Tethyan to the Boreal realm, a level close to it should be selected [the base of the *occitanica* Zone might be a good solution (HOEDEMAEKER, 1987)].

(4) Until a final decision is made on the Jurassic-Cretaceous boundary, the Berriasian should be placed in the Cretaceous.

Although REMANE concentrated on biochronology, he mentioned the possible role of magnetostratigraphy in future efforts to define the boundary. At the same (1987) conference, RAWSON (1990) suggested the need to consider the applicability of non-biological "events", while at Brussels ERBA (1995) challenged palaeontologists to consider the role of magnetostratigraphy, chemostratigraphy, sequence stratigraphy and cyclostratigraphy

Table 1.

Relationship between the Mediterranean ammonite and calpionellid zones, and possible correlation of the Boreal ammonite zones with the Mediterranean "standard".

Stages	Substages	Mediterranean region		Northern Siberia		Substages	Stages		
		ammonites	calpionellids	ammonites					
Berriasian	Upper	<i>Fauriella boissieri</i>	<i>Timovella alpillensis</i>	D3	<i>Tollia tolli</i>		Upper	Boreal Berriasian	
			<i>Picteticeras picteti</i>	D2	<i>Bojarkia mезezhnikovi</i>				
			<i>Malbosiceras paramimounum</i>	D1	<i>Surites analogus</i>	<i>Surites subquadratus</i>			
	Middle	<i>Timovella occitanica</i>	<i>Dalmasiceras dalmasi</i>	C	<i>Hectoroceras kochi</i>	<i>Surites praeanalogus</i>	Lower		
			<i>Berriasella privasensis</i>		<i>Borealites constans</i>	<i>Hectoroceras kochi</i>			
			<i>Timovella subalpina</i>		<i>Chetaites sibiricus</i>	<i>Chetaites sibiricus</i>			
					<i>Praetollia maynci</i>				
	Lower	<i>Berriasella jacobi</i>	<i>Pseudosubplanites grandis</i>	B	<i>Chetaites chetae</i>		Upper		
			<i>Berriasella jacobi</i>		<i>Craspedites taimyrensis</i>	<i>Craspedites okensis</i>			<i>C. originalis</i>
					<i>Craspedites okensis</i>	<i>C. okensis</i>			<i>C. exoticus</i>
Tithon.	Upper		A (pars)		<i>Epivirgatites variabilis</i>	Middle	Volgian		

note: The single and double question marks indicate degrees of uncertainty in correlation of the boreal sequences with the two candidate boundaries for the base of the Berriasian.

in defining Cretaceous stage boundaries. Despite this, debate has continued to concentrate on the biostratigraphic aspects.

The base of the Berriasian Stage

At the Brussels meeting, the Working Group discussed a number of proposals for boundary points and sections. The conclusions are summarised below.

BOUNDARY CRITERIA

It was agreed that the base of the Berriasian should be defined on the appearance of a new fossil taxon, and that the stratotype section should be in the Mediterranean region. Two possible faunal events were proposed:

- base of the *jacobi* ammonite Zone
- base of the *subalpina* ammonite Subzone (*occitanica* Ammonite Zone)

base of the *jacobi* Zone

This is essentially the level suggested at the 1973 Lyons Colloquium, as adopted by the Lower Cretaceous Cephalopod Working Group of IGCP Project 262 (HOEDEMAEKER & BULOT, 1990; HOEDEMAEKER, COMPANY *et al.*, 1993). According to HOEDEMAEKER & BULOT (1990), the index species first appears at the base of the zone – a level that corresponds to a major event in ammonite evolution, i.e. at the family level. It is also closely approximated by an important calpionellid event, marking the base of the B Calpionellid Zone (Table 1). However, the *jacobi* Zone is virtually impossible to correlate with boreal areas.

base of the *subalpina* Subzone

The subzone is dominated by the abundance of *Tirnovella subalpina*, which first appears at the base of the subzone (LE HÉGARAT, 1973, table 12, p. 176). This level marks a

significant ammonite turnover, and has good correlation potential. The level is coincident with, or approximates to, the base of the *Praetollia maynci/Runctonia runctoni* ammonite Zone and the *Buchia okensis* buchiid Zone in the Boreal area.

STRATOTYPE SECTION

The choice of boundary stratotype section is dependent upon the final choice of the defining event. The base of the *jacobi* ammonite Zone is well represented in the Puerto Escano section (Prov. Cordoba, Spain). The base of the *subalpina* ammonite Subzone may be best defined at La Faurie, Ravin de Dreymien (Alpes-de-Provence, France) or Section Z, Berrancode de Tollo (Rio Argos, Caravaca, Prov. Murcia, Spain).

Substage definitions

Substage definitions are dependent on the final stage-boundary event decision. If the base of the *jacobi* Zone is chosen, then the base of the Middle Berriasian may be defined by the base of the *subalpina* Subzone, and the Upper Berriasian by the base of the *boissieri* ammonite Zone. If the base of the *subalpina* Subzone is chosen as the base of the stage, then an Upper Berriasian substage can be defined by the base of the *boissieri* Zone, and no middle substage should be retained.

Recommendations

The working group concluded that further documentation of these potential stratotype sections is required and interdisciplinary teams should investigate the correlation potential of the biostratigraphic events proposed. To improve Tethyan/Boreal correlation, such teams should investigate sections in northern California and northern Siberia.

References

- CASEY, R., ALLEN, P., DÖRHÖFER, G., GRAMANN, F., HUGHES, N. F., KEMPER, E., RAWSON, P. F. & SURLYK, F., 1975. Stratigraphical subdivision of the Jurassic-Cretaceous boundary beds in NW Germany. *Newsletters on Stratigraphy* **4**: 4-5.
- ERBA, E., 1995. Cretaceous chronostratigraphy of the third millennium: ammonite-based or something else-based? Second International Symposium on Cretaceous Stage Boundaries: abstracts, 39.
- FLANDRIN, J., SCHAER, J. P., ENAY, R., REMANE, J., RIO, M. M., KUBLER, M. B., LE HÉGARAT, G., MOUTERDE, R., & THIEULOY, J.-P., 1975. Discussion générale préliminaire au dépôt des motions. *Colloque sur la limite Jurassique-Crétacé. Mémoires du Bureau de Recherches géologiques et minières* **86**: 386-393.
- HOEDEMAEKER, P. J., 1987. Correlation possibilities around the Jurassic-Cretaceous boundary. *Scripta Geologica*, **84**: 1-55.
- HOEDEMAEKER, P. J. & BULOT, L., 1990. Preliminary ammonite zonation for the Lower Cretaceous of the Mediterranean region: report. *Géologie Alpine*, **66**: 123-127.
- HOEDEMAEKER, P. J., COMPANY, M. R. (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. Ammonite zonation for the Lower Cretaceous of the Mediterranean region; basis for the stratigraphic correlation within I.G.C.P. Project 262. *Revista Española de Paleontología*, **8**: 117-120.

LE HÉGARAT, G., 1971. Le Berriasien du Sud-Est de la France. *Documents du Laboratoire Géologique de la Faculté des Sciences de Lyon*, **43**, 576 pp.

RAWSON, P. F., 1990. Event stratigraphy and the Jurassic-Cretaceous boundary. *Transactions of the Institute of Geology and Geophysics, Academy Sciences USSR, Siberian branch*, **699**: 48-52 [In Russian with English summary].

REMANE, J., 1990. The Jurassic-Cretaceous boundary: problems of definition and procedure. *Transactions of the Institute of Geology and Geophysics, Academy Sciences USSR, Siberian branch*, **699**: 7-17 [In Russian with English summary].

REMANE, J., 1991. The Jurassic-Cretaceous boundary: problems of definition and procedure. *Cretaceous Research*, **12**: 447-453.

WIEDMANN, J., 1980. Paläogeographie und Stratigraphie im Grenzbereich Jura-Kreide Südamerikas. *Münster. Forschung Geologie Paläontologie*, **51**: 27-61.

Viktor A. ZAKHAROV
Institute of Geology, Siberian Branch of
the Russian Academy of Sciences,
630090 Novosibirsk 90, Russia

Paul R. BOWN & Peter F. RAWSON
Department of Geological Sciences,
University College London,
Gower Street, London WC1E 6 BT, U.K.