



International Commission on Stratigraphy (ICS)
Subcommission on Cretaceous Stratigraphy
ANNUAL REPORT 2024

1. TITLE OF CONSTITUENT BODY

Subcommission on Cretaceous Stratigraphy (SCS) <https://cretaceous.stratigraphy.org>

Submitted by: Ian Jarvis, Chair; Francesca Falzoni, Vice-Chair; Zofia Dubicka, Secretary

22 November 2024

2. OVERALL OBJECTIVES, AND FIT WITHIN IUGS SCIENCE POLICY

- To establish a standard global stratigraphic subdivision and nomenclature for the Cretaceous, as part of the ICS standard global stratigraphic scale.
- To produce a stratigraphic table displaying agreed subdivisions to stage and substage level, marking boundaries that are defined by a GSSP, supplemented by SABS where appropriate.

3. ORGANIZATION – Interfaces with other international projects/groups

SCS maintains links to important international Projects such as IODP, IGCP, Mesozoic Planktonic Foraminiferal Working Group, ICDP (International Continental Scientific Drilling Project), TIMES (Time Integrated Matrix for Earth Sciences), and the Deep-time Digital Science Program. Significant IGCP projects are: IGCP 710 Western Tethys meets Eastern Tethys (2020–24, Project Leader Prof. Michał Krobicki, Poland); IGCP 739 The Mesozoic–Palaeogene hyperthermal events (2021–25, Project Leader Prof. Xiumian Hu, China).

3a. Current Officers for 2024–2028:

Chair: Ian Jarvis; **Vice-Chair:** Francesca Falzoni; **Secretary:** Zofia Dubicka

Ian Jarvis had served as a voting member for 8 years, Francesca Falzoni was Secretary for 8 years, Zofia Dubicka has not previously served in the Subcommission.

Voting Members are 16, from most continents:

- *continuing members:* Sietske Batenburg, Paul Bown, Bruno Granier, Eduardo Koutsoukos, Josep Moreno Bedmar, Maria Rose Petrizzo, Bilal Sari, Brad Singer, Markus Wilmsen, Dangpeng Xi.

- *members starting in 2024:* James Crampton, Delphine Desmares, Polina Pavlishina, Shin-Ichi Sano, Jean Marie Self-Trail, Reishi Takashima.

Corresponding Members: Ismar de Souza Carvalho, Miguel Company, Bruno Galbrun, Takashi Hasegawa, Brian Huber, Brad Sageman, Michael Wagreich, Irek Walaszczyk.

The Stage Working Groups of the SCS in 2024 are: Berriasian, Valanginian, Aptian, and Maastrichtian. Over 150 Cretaceous scientists from all over the world and in many different disciplines belong to one or more of the Stage Working Groups and to the Kilian Group (Lower Cretaceous Ammonite Working Group).

Chairs of the Working Groups: Jacek Grabowski (Berriasian WG), Stéphane Reboulet (Valanginian WG and Kilian Group), Elisabetta Erba and Helmut Weissert (Aptian WG), Silke Voigt (Maastrichtian WG). WG Chairs are also Corresponding Members of the Subcommission.

4. EXTENT OF NATIONAL/REGIONAL/GLOBAL SUPPORT FROM SOURCES OTHER THAN IUGS

Funds from the DFG (German Research Foundation) have been secured by Silke Voigt for a 2-year project (2023–25), supporting stable isotope and elemental analysis costs for Maastrichtian GSSP samples. José Manuel Castro Jiménez and Ginés A. de Gea (Aptian WG) have been funded by Ministry of Science, Innovation and Universities/State Investigation Agency (AEI) (Spain) for a Barremian–Aptian project (2024–27) that includes study of the Cau section, the candidate Aptian GSSP.

5. CHIEF ACCOMPLISHMENTS AND PRODUCTS IN 2024

- WORKING GROUPS HAVE PROGRESSED THE DEFINITION OF GSSPs

Chairs and updated memberships of each WG are available at <http://cretaceous.stratigraphy.org/working-groups/>. Memberships are updated continuously by inviting active scientists who are willing to collaborate to the WG activities.

MAASTRICHTIAN WORKING GROUP

The current GSSP definition, ratified in 2001, is based on the level of an arithmetic mean of 12 biostratigraphic marker levels in the Tercis les Bains section of SW France, and most closely approximated by the LO of the ammonite *Pachydiscus neubergicus*. No primary marker has been designated. The LO of the marker ammonite is now known to be highly diachronous. Its position in the stratotype is likely not an FAD. Biostratigraphic markers are compromised by poor preservation of calcareous fossils and included HOs that also display inconsistent levels in multiple study sections. No magnetostratigraphy is available. The current definition of the boundary level was discussed during the SCS Business Meeting in Warsaw (11th Cretaceous Symposium) and a new WG was appointed in October 2022.

New research during the last 15 years (e.g., Voigt et al., 2012) has established a coherent carbonate carbon isotope stratigraphy spanning the Campanian – Maastrichtian boundary, the CMBE, at Tercis and elsewhere. This includes 5 levels, CMBE 1 – 5, that have been recognized at multiple sites in Europe and in deep-sea cores from the major ocean basins. Carbon isotope stratigraphy offers potential to establish a primary marker, e.g., the base of CMBE4 which is close to the base of Chron 31r, for defining the stage boundary.

The WG chaired by Silke Voigt is undertaking a detailed re-examination of the stratigraphy in the GSSP section at Tercis les Bains. In March 2023, WG members sampled the Tercis-les-Bains section, which is located in a Regional Natural Reserve, requiring a permit for any geological fieldwork and sampling. About 500 samples were taken along a 70-m interval with a resolution of 20 – 40 cm to establish modern biozonations for calcareous nannofossils, planktonic and benthic foraminifera, inoceramids and palynomorphs. Additional samples were collected to determine the mineralogical composition and microfacies of the lithologies, to resolve orbital cyclicity, and to improve the resolution of carbon isotope stratigraphy (Voigt et al., 2023)

A new high-resolution carbonate C isotope curve has been completed along with a cyclostratigraphic analysis of the stable isotope, magnetic susceptibility and XRF elemental records. A coherent cyclostratigraphic signal has been extracted from the proxy time series that enables potential correlation to previously studied Campanian – Maastrichtian boundary sections at Bidart, Sopela and Zumaia that have precise microfossil event data. Correlation will enable calibration of the CMBEs to astronomical time scales. This work is in progress. Biostratigraphic work on Tercis is proving challenging. Extraction of carbonate microfossils and nannofossils is difficult due to silicification of the sediments. Poor preservation of extracted material compromises

accurate biostratigraphic determinations. Acetic acid methods have proven unsuccessful. Other extraction methods are being assessed. Palynological studies are in progress.

The German Research Foundation DFG granted a research proposal to S. Voigt in August 2023 that will support some analytical work. The collected samples will provide students an opportunity to perform master thesis projects.

Voigt, S. et al. 2012. Global correlation of Upper Campanian - Maastrichtian successions using carbon-isotope stratigraphy: development of a new Maastrichtian timescale. NoS 45, 25–53.

Voigt, et al. 2023. Reassessment of the base of the Maastrichtian Stage at the GSSP locality Tercis-les-Bains (SW France); sciencesconf.org:strati2023, 457796.

APTIAN WORKING GROUP

The base of the Aptian Stage had been informally taken at the base of the M0 magnetic Chron for the last 20 years. This is now rejected due to new ammonite records and difficulties in placing the magnetic reversal in key sections.

Steady progress had been made by the WG chaired by Helmi Weissert and Elisabetta Erba on a redefinition of the base Aptian. The negative carbon isotope excursion associated with OAE1a has been selected to provide the primary marker – the onset of the major negative CIE identified at the C2/C3 boundary in all carbon archives, with secondary criteria provided by ammonites, planktonic foraminifera, calcareous nannofossils, other biostratigraphic data, and magnetostratigraphy.

Selection of a GSSP at Cau, SE Spain, has been agreed following two rounds of voting. Five sites were considered in Round 1 with the following votes: Cismon, Italy (13 votes), Gorgo a Cerbara, Italy (7 votes), La Bedoule, France (6 votes), Cau, Spain (13 votes), El Pui, Spain (9 votes). In Round 2 the two sites with the largest number of votes, Cau and Cismon received 17 and 9 votes, respectively. Cau was accordingly selected as the candidate GSSP.

High-quality core and adjacent outcrop sections are available from Cau with highest resolution data obtained to date from the core (Castro et al., 2021). Core is archived at Jaén University, Spain. Selection of the outcrop as the GSSP is preferred. Cismon and potentially other sites are to be considered for inclusion as SABS in the GSSP proposal. José Manuel Castro Jiménez was funded in 2024 by the Ministry of Science, Innovation and Universities/State Investigation Agency (AEI) for further study of the Cau section. A GSSP proposal is currently being written by WG members. Completion during early 2025 is planned.

Castro et al., 2021. High-Resolution C-Isotope, TOC and Biostratigraphic Records of OAE 1a (Aptian) From an Expanded Hemipelagic Cored Succession, Western Tethys: A New Stratigraphic Reference for Global Correlation and Paleoenvironmental Reconstruction. Paleoceanography and Paleoclimatology. <https://doi.org/10.1029/2020PA004004>

BERRIASIAN WORKING GROUP

The base of the Berriasian, representing the base of the Cretaceous, is the last remaining System boundary to lack a GSSP. A new WG chaired by Jacek Grabowski was set up in 2021 to address the impasse that had been reached by the previous WG with no progress towards establishment of a GSSP.

The new WG is making swift progress. In 2023, the WG completed a discussion on which level should be the best choice for the global J/K boundary definition. Three options for placing the boundary were considered: (1) moving the boundary downward into the traditional top Tithonian to the M19r/M20n1r Chron boundary (base *Crassicollaria* Zone, base *Cr. intermedia* Subzone, base NJT17 (*N. globulus minor* nannozone); (2) placing the boundary at the calpionellid ‘Alpina’

acme event; (3) placing the boundary higher, in the traditional ‘mid-Berriasian’, between base M17r and base M16r (base *C. elliptica* Subzone, base *S. occitanica* Zone, base Ryazanian, prominent climate event).

The ‘Alpina event’, a level promoted by members of the previous WG, was rejected. This is an ill-defined acme level not an LO or HO of a taxon. Independent specialists were unable to provide consistent placement of the level in sections. The level would potentially be highly diachronous if employed as the primary GSSP criterion.

Selection of a high ‘upper Tithonian’ level of the magnetic reversal is favoured, with a clear majority of votes by WG members during 2 voting rounds. The chosen level approximates to the Portland/Purbeck boundary traditionally adopted in the UK, with a small offset. It corresponded to a major aridification event and marked marine regression. Many fossil groups underwent rapid evolution at this time and offer potential secondary levels. Radiolaria are being re-investigated. Sections at Torre de Busi in the Lombardy Basin (currently most favoured) and the Bosso Valley of the Apennine Basin, Italy, are being considered as potential GSSPs. A SABS in the Neuquén Basin of Argentina is likely. A special issue of Cretaceous Research is planned to publish results of new studies on the stratigraphy of the candidate sites

<https://www.sciencedirect.com/journal/cretaceous-research/about/call-for-papers#jurassic-cretaceous-boundary-interval-global-correlation-and-palaeoenvironmental-background>. These will guide final site selection.

Additional work is still required, with boundary criteria and sites to be further evaluated in 2025. A GSSP proposal is projected to be completed within 2 years.

- **GSSP CEREMONIES HAVE BEEN SUCCESSFULLY COMPLETED**
BARREMIAN GOLDEN SPIKE CEREMONY

The golden spike ceremony for the Barremian GSSP was held in Caravaca SE Spain on the 9th November 2024 and was organized by the Chair of the WG - Miguel Company.

The GSSP of the base of the Barremian Stage [at the base of bed 171 of the Rio Argos section, near Caravaca, SE Spain (Company et al., 2024), marked by the first appearance of the ammonite *Taveriaidiscus hugii*], was ratified by IUGS in March 2023. Secondary criteria include: bioevents (foraminifera, calcareous nannofossils), C-isotope stratigraphy, sequence stratigraphy, and astrochronology. A new calibration of the Hauterivian/Barremian boundary against the magnetostratigraphic scale is proposed. The protection of the Río Argos section is ensured by the municipality of Caravaca, and its recognition at the regional and national level is being progressed. Company et al., 2024. *Episodes* 47, 335–379.

- **HAUTERIVIAN and ALBIAN GOLDEN SPIKE CEREMONIES**

The golden spike ceremony for the Hauterivian and Albian GSSPs was held on June 29th 2024 in Arnayon and La Charce in southeast France.

The GSSP that defines the base of the Hauterivian Stage was ratified by IUGS in December 2019 (Mutterlose et al. 2021). The GSSP is placed at the base of bed 189 of the La Charce section, Drôme, southeast France (Vocontian Basin). This level is marked by the FAD of the ammonite genus *Acanthodiscus*, which defines the base of the *Acanthodiscus radiatus* Zone. Complementary data include 13 ammonite and nannofossil events, and magnetostratigraphic and C-isotope events. The GSSP that defines the base of the Albian Stage was ratified by IUGS in April 2016 (Kennedy et al. 2017). The base of the Albian Stage is defined at the FAD of the planktonic foraminifera *Microhedbergella renilaevis* at a level 37.4 metres above the base of the Marnes Bleues Formation and 40 cm above the base of the Niveau Kilian marker bed in the section SSE of the Col de Pré-

Guittard, Arnayon, Drôme, France. The LO of *Microhedbergella renilaevs* is placed within a 100-m section of argillaceous sediments with 28 secondary markers including calcareous nannofossils, planktonic foraminifera, an inoceramid bivalve, ammonites, stable carbon isotopes, and local marker beds.

Mutterlose et al., 2021. *Episodes* 44, 129–150; Kennedy et al., 2017. *Episodes* 40, 177–188.

- **THE VALANGINIAN GSSP PROPOSAL WAS APPROVED**

A GSSP proposal to define the base of the Valanginian in the Vergol section (Drôme, SE France) with a SABs at Cañada Luenga (Cehegín, Spain) was unanimously approved by the Cretaceous Subcommission on the 15th August 2024. The proposal was voted by 95% of the eligible voters (19/20, one member did not cast a vote) and received the 100% agreement (19/19 of “yes” votes). The International Commission on Stratigraphy unanimously approved the Valanginian GSSP proposal on the 8th November 2024. The result was 17 votes in favour, 0 against, and 3 abstentions. The base of the Valanginian stage is defined at a point indicated by the FAD of the ammonite species “*Thurmanniceras*” *pertransiens*. The site met all criteria required for a GSSP. An age of 137.05 Ma was proposed for the boundary based on cyclostratigraphy – astrochronology age modelling. The GSSP proposal has been submitted to the IUGS Executive for ratification. If approved, a GSSP golden spike ceremony will be scheduled for summer 2026.

6. SUMMARY OF EXPENDITURES IN 2024:

Contribution to the Berriasian, Aptian, Maastrichtian Working Groups for fieldwork and analysis of GSSPs	1250.00 Euro
Contribution attendance cost to Albian and Hauterivian GSSP ceremonies in France, travel and accommodation for 5 members (Petrizzo, Falzoni, Jarvis, Gale, Mutterlose)	1959.00 Euro
Contribution attendance cost to Barremian GSSP ceremony in Spain, travel and accommodation for 3 members (Jarvis, Petrizzo, Falzoni)	928.42 Euro
Contribution for secretarial work	400.00 Euro
Contribution for updating the website	67.54 Euro
Bank fees for bank transfer	5.00 Euro
TOTAL expenditure in 2024 = 4609.96 Euro	

7. SUMMARY OF INCOME IN 2024:

ICS Subvention for 2024	US dollars 5000.00 = 4609.96 Euro
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8. BUDGET REQUESTED FROM ICS FOR 2025:

Contribution to Stage Working Groups for fieldwork, analysis and meetings	1500 Euro
Contribution for the organization of the Valanginian GSSP ceremony, meetings with local authorities (France)	800 Euro
Contribution, attendance costs at Cretaceous Subcommission WGs and General Meeting at the 12 th Cretaceous Symposium, Hannover, 31 Aug – 5 Sept 2025	1500 Euro
Contribution for secretarial work and updating of the website	500 Euro

TOTAL budget request from ICS in 2025 = 4300 Euro

9. WORK PLAN, CRITICAL MILESTONES, ANTICIPATED RESULTS AND COMMUNICATIONS TO BE ACHIEVED IN 2025

- submission of the Aptian GSSP proposal to SCS with subsequent voting (early 2025) and approval.
- ratification of the Valanginian GSSP (end 2024/early 2025), submission of *Episodes* article (April 2025), planning for golden spike ceremony to be held during summer 2026.
- research activities toward selection of the J/K System boundary criteria and site identification – fieldwork, sample collection, processing, analyses and data acquisition, critical appraisal and interpretation. Consideration of large-scale climatic events and trends and their correlation potential will be continued, as well as possible identification of the VOICE C-isotope event in Tethyan records. Dating of volcanic rocks is planned, and possibilities for astrochronological calibration of the J-K boundary interval.
- research activities toward revision of Maastrichtian stage boundary criteria – sample processing, analyses and data acquisition, critical appraisal and interpretation of the GSSP. A second part of the work plan deals with data compilation for the development of SABS for correlation. Potential candidates are the Vistula and Krons Moor sections (Poland, Germany), Gubbio (Italy), and the stratigraphic record of ODP Site 1210 (Pacific Ocean).
- meeting of the Cretaceous WGs: – 12th Cretaceous Symposium, Hannover (Germany), August 31 – September 5, 2025 with submission of papers to international scientific journals, including *Cretaceous Research*. A dedicated session ‘*Integrated stratigraphy and refining the Cretaceous time scale*’ convened by the Subcommittee officers will solicit papers on Cretaceous GSSPs and SABS. The congress will include a mid-symposium field trip to the several nearby Cretaceous outcrops, including the Coniacian GSSP.
- initiation of new WGs on selected Cretaceous substage boundaries. Initial discussion via email and online workshops. WGs to be confirmed following in-person meeting at the Hannover Cretaceous meeting.

9a. Potential funding sources external to IUGS:

The SCS does not envisage being able, as an organization, to obtain significant funding from outside IUGS/ICS sources. Individual WG members may be allocated limited funds from their host institutions and/or their personal research funds. Funding have been secured by Voigt and Castro Jiménez to contribute to analyses of the Maastrichtian and Aptian GSSPs, respectively.

10. OBJECTIVES AND WORK PLAN FOR THE PERIOD (2024–2028)

- finalization of the GSSP proposal for the Aptian base, vote within the WG and SCS and ratification.
- selection of a Berriasian (J/K) GSSP and subsequent approval and ratification.
- finalization of the GSSP proposal for the Maastrichtian base, voting within the WG and SCS and ratification.
- establishment of selected Substage WGs to progress the subdivision of major intervals of Cretaceous time.
- research activities toward the selection of the Cretaceous substages boundary criteria, particularly for longer stages such as the Albian and Campanian, with the identification of reference sections.

APPENDICES

Names and Addresses of Current Officers for 2024–2028:

Chair: Jarvis Ian. ian.jarvis@kingston.ac.uk, Department of Geography, Geology and the Environment, Kingston University London, Penrhyn Road, Kingston upon Thames KT1 2EE, UK, Phone: +44 7711 047954.

Vice-Chair: Francesca Falzoni. francesca.falzoni@cnr.it, Istituto di Geologia Ambientale e Geoingegneria (IGAG), Consiglio Nazionale delle Ricerche, via Mario Bianco 9, 20131 Milano, Italy. Phone: +39 02 283 11436.

Secretary: Zofia Dubicka. z.dubicka@uw.edu.pl, Faculty of Geology, University of Warsaw, ul. Zwirki i Wigury 93, 02-089 Warszawa, Poland, Phone: +48 69 683 0393.

Webmaster: Maria Rose Petrizzo, mrose.petrizzo@unimi.it, Dipartimento di Scienze della Terra "A. Desio" Università degli Studi di Milano, via Mangiagalli 34, 20133 Milano, Italy, Phone: +39 02 503 15531

Names and Addresses of Current Voting Members (2024–25):

Batenburg, Sietske J. sbatenburg@ub.edu, University of Barcelona, Martí i Franqués, 08028 Barcelona, Spain, Phone: +34 698963831.

Bown, Paul. p.bown@ucl.ac.uk, University College London, Gower Street, London, WC1E 6BT, UK, Phone: +44 20-7485-3257.

Crampton, James. James.crampton@vuw.ac.nz, Te Herenga Waka Victoria University of Wellington School of Geography, Environment & Earth Sciences, PO Box 600 Wellington, New Zealand, Phone: +64 44636198

Desmares, Delphine. delphine.desmares@sorbonne-universite.fr, Sorbonne Université, CR2P (Centre de Recherche en Paléontologie - Paris), Campus Pierre et Marie Curie – Jussieu Couloir 46-56, 75252 Paris cedex 05, France, Phone:

Granier, Bruno. bgranier@univ-brest.fr, Département des Sciences de la Terre et de L'Univers, UFR Sciences et Techniques, Université de Bretagne Occidentale, 6 avenue, Le Gorgeu – CS 93837, F – 29238 Brest cedex 3, France.

Koutsoukos, Eduardo A.M. ekoutsoukos@gmail.com, Institut für Geowissenschaften Universität Heidelberg Im Neuenheimer Feld 234, 69120 Heidelberg, Germany.

Moreno Bedmar, J.A. josepamb@geologia.unam.mx, Instituto de Geología, Universidad Nacional Autónoma de México (UNAM), Coyoacán, 04510, Ciudad de México, México.

Pavlishina, Polina. polina@gea.uni-sofia.bg, Sofia University 'St. Kliment Ohridski, Department of Geology, Paleontology and Fossil Fuels, 15 Tzar Osvoboditel Blvd. 1504 Sofia, Bulgaria, Phone: +359 887896791

Petrizzo, Maria Rose. mrose.petrizzo@unimi.it, Dip. Scienze della Terra "A. Desio", Università degli Studi di Milano, via Mangiagalli 34, 20133 Milano, Italy, Phone: +39 0250315531

Sano, Shin-Ichi. ssano@sus.u-toyama.ac.jp, Department of Earth System Science, University of Toyama, 3190 Gofuku, Toyama-Shi, Toyama 930-8555, Japan

Sari, Bilal. bilal.sari@deu.edu.tr, Dokuz Eylul University, Department of Geological Engineering, Tinaztepe Campus, 35160 Buca-Izmir, Turkey, Phone: +90 232.4127342.

Self-Trail, Jean Marie. jstrail@usgs.gov, U.S. Geological Survey, Florence Bascom Geoscience Center 12201 Sunrise Valley Dr. MS926A, Reston, VA 20192, USA, Phone: 703-648-6013.

Singer, Brad S. bsinger@wisc.edu, Department of Geoscience, University of Wisconsin-Madison, 1215 W. Dayton Street, Madison, WI 53706, USA, Phone: +1 608 265 8650.

Takashima, Reishi. reishi.takashima.a7@tohoku.ac.jp, Center for Academic Resources and Archives, Tohoku University Museum, Aramaki Aza Aoba 6-3, Aoba-ku, Sendai, 980-8578, Japan, Phone: +81 22 795 6620

Wilmsen, Markus. Markus.Wilmsen@senckenberg.de, Senckenberg Naturhistorische Sammlungen, Dresden, Museum für Mineralogie und Geologie Königsbrücker Landstrasse 159, 01109 Dresden, Germany. Phone: +49 351 795841 4273.

Xi, Dangpeng. xidp@cugb.edu.cn, China University of Geosciences, Xueyuan Lu 29, Beijing 100083, China, P. R., Phone: +86 15810903538.

Working groups and leaders

MAASTRICHTIAN WG

Chair: Voigt Silke, s.voigt@em.uni-frankfurt.de, Institute of Geosciences, Goethe-University Frankfurt, Altenhöferallee 1, 60438 Frankfurt am Main, Germany, phone: +49 69798 40190.

WG Members:

Batenburg. Sietske J. sbatenburg@ub.edu, Faculty of Earth Sciences, University of Barcelona, Martí i Franqués s/n, 08028 Barcelona, Spain.

Bornemann, André Andre.Bornemann@bgr.de, Federal Institute for Geosciences and Natural Resources (BGR), Stilleweg 2, 30655 Hannover, Germany.

Desmares, Dephine. delphine.desmares@sorbonne-universite.fr, Sorbonne Université, Campus Pierre et Marie Curie- Jussieu, UMR 7207 CR2P - Centre de Recherche en Paléontologie Paris, 4 place Jussieu, 75252 Paris cedex 05, France.

Huber, Brian T. huberb@si.edu, Department of Paleobiology National Museum of Natural History, Smithsonian Institution, Washington, DC 20560, U.S.A.

Jurkowska, Agata. jurkowska.a@gmail.com, Faculty of Geology, Geophysics and Environmental Protection AGH, University of Science and Technology, Kraków, Poland.

Martinez, Mathieu. mathieu.martinez@univ-rennes1.fr, UMR CNRS 6118 Géosciences Rennes, Bât.15 OSUR, campus de Beaulieu, Université de Rennes, Rennes 35042, France.

Niechwedowicz, Mariusz. niechwedowicz.m@uw.edu.pl, University of Warsaw, Faculty of Geology, S.J. Thugutt Geological Museum, Żwirki i Wigury 93, 02-089 Warszawa, Poland.

Petrizzo, Maria Rose. mrose.petrizzo@unimi.it, Dipartimento di Scienze della Terra “A. Desio”, Università degli Studi di Milano, via Mangiagalli 34, 20133 Milano, Italy.

Thibault, Nicolas. nt@ign.ku.dk, Department of Geography and Geology, University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen C., Denmark.

Wagreich, Michael. michael.wagreich@univie.ac.at, Department of Geology, University of Vienna, Josef Hlaubek Platz 2, Vienna, A-1090, Austria.

Walasczyk, Irek. i.walaszczuk@uw.edu.pl, Faculty of Geology, University of Warsaw, Al. Żwirki i Wigury 93, 02-089 Warszawa, Poland.

Wilmsen, Markus. Markus.Wilmsen@senckenberg.de, Senckenberg Naturhistorische Sammlungen, Dresden Museum für Mineralogie und Geologie, Königsbrücker Landstrasse 159, D-01109 Dresden, Germany.

APTIAN WG

Chair: Erba Elisabetta, elisabetta.erba@unimi.it, Dip. Scienze della Terra “A. Desio”, Università degli Studi di Milano, via Mangiagalli 34, 20133 Milano, Phone: +39 0250315530.

Chair: Weissert Helmut, weissert@erdw.ethz.ch, Department of Earth Science, ETH-Z CH-8092 Zürich, Switzerland, Phone: +41 44 632 37 15.

WG Members:

Amodio, Sabrina. sabrina.amodio@uniparthenope.it, Department of Science and Technology, Parthenope University of Naples, Napoli, Italy.

Batenburg, Sietske. sbatenburg@ub.edu, Univ Barcelona, Spain.

Bodin, Stéphane. stephane.bodin@geo.au.dk, Department of Geoscience, Aarhus University, Århus, Denmark.

Bornemann, Andre. andre.bornemann@bgr.de, Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover, Germany

Bottini, Cinzia. cinzia.bottini@unimi.it, Università degli Studi di Milano, Milano, Italy.

Castro, Jiménez José Manuel. secform@ujaen.es, Department of Geology, University of Jaén, Jaén, Spain.

Coccioni, Rodolfo. rodolfo.coccioni@uniurb.it, Dipartimento di Scienze della Terra, della Vita e dell'Ambiente, Università degli Studi di Urbino "Carlo Bo", Urbino, Italy.

Company, Miguel. mcompany@ugr.es, Departamento de Estratigrafía y Paleontología, Universidad de Granada, Granada, Spain.

Erbacher, Jochen. jochen.erbacher@bgr.de, Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany.

Frau, Camille. Camille_FRAU@hotmail.fr, Groupement d'Intérêt Paléontologique, Science et Exposition, 60 bd Georges Richard, 83000 Toulon, France.

Frijia, Gianluca. gianluca.frijia@unife.it, Dipartimento di Fisica e Scienze della Terra, Univ. Ferrara, Italy.

Gale, Andy. andy.gale@port.ac.uk, Earth Sciences, University Portsmouth, GB.

Gambacorta Gabriele. gabriele.gambacorta@eni.com, ENI, Milano, Italy,

Gaona, Tatiana. Tatiana.Gaona@fiu.edu, College of Arts and Science, Florida Int. University, USA.

Granier, Bruno. bgranier@univ-brest.fr, Fac. Sci. Tech. Univ. Brest, France

Heimhofer, Ulrich. heimhofer@geowi.uni-hannover.de, Institut für Geologie, Univ. Hannover, Germany.

Huber, Brian. huberb@si.edu, Natural History Museum Smithsonian, Washington DC, USA.

Jarvis, Ian. ian.jarvis@kingston.ac.uk, Department of Geography, Geology and the Environment, Kingston University London, Kingston upon Thames KT1 2EE, UK.

Kuhnt, Wolfgang. wk@gpi.uni-kiel.de, Institute of Geosciences, Christian-Albrechts-University, 24118 Kiel, Germany.

Lima, Henrique. henrique@petrobras.com.br, Petrobras, Rio de Janeiro, Brazil,

Moreno-Bedmar, Josep Anton. josepamb@geologia.unam.mx, Instituto de Geología, Universidad Nacional Autónoma de México, Coyoacán, México, Ciudad de México, C.P. 04510.

Maurasse, Florentin. maurrass@fiu.edu, College of Arts and Science, Florida Int. University, USA

Nieto, Luis. lnieto@ujaen.es, Univ. Jaen, Spain,

Olierook, Hugo. hugo.olierook@curtin.edu.au, Department of Applied Geology, Curtin University, GPO Box U1987, Perth, WA 6845, Australia.

Parente, Mariano. maparent@unina.it, Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli Federico II, Napoli, Italy.

Patrino, Stefano. patrino.s@unic.ac.cy, School of Sciences and Engineering, Univ. Nicosia, Cyprus.

Pearce, Martin A. martin.a.pearce@gmail.com, Department of Earth Sciences, Natural History Museum, Cromwell Road, London SW7 5BD, UK.

Premoli Silva, Isabella. isabella.premoli@unimi.it, Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Milano, Italy.

Ruiz Ortiz, Pedro Alejandro. paruiz@ujaen.es, Department of Geology, University of Jaén, Jaén, Spain.
 Skelton, Peter. peterskelton361@gmail.com, Department of Environment, Earth and Ecosystems, The Open University, Milton Keynes, UK.
 Triantaphyllou, Maria. mtriant@geol.uoa.gr, University of Athens, Department of Historical Geology-Paleontology, Panepistimiopolis 15784, Athens, Greece
 Vahrenkamp, Volker. volker.vahrenkamp@kaust.edu.sa, KAUST, Saudi Arabia.
 van Buchem, Frans. frans.vanbuchem@kaust.edu.sa, KAUST, Jeddah, Saudi Arabia.
 Zhang, Yang. zhangy@uni-bremen.de, Marine Geophysik, Univ. Bremen, Germany.

BERRIASIAN (J/K BOUNDARY) WG

Chair: Grabowski, Jacek. jacek.grabowski@pgi.gov.pl, Polish Geological Institute, National Research Institute, Warsaw, Poland, Phone: +48 22 45 92 350.

Secretary: Szives, Ottilia. szives.ottilia@nhmus.hu, Department of Palaeontology and Geology, Hungarian Natural History Museum, Budapest, Hungary.

WG Members:

Alsen, Peter. pal@geus.dk, Geological Survey of Denmark and Greenland.

Aguirre-Urreta, Beatriz. aguirre@gl.fcen.uba.ar, Department of Geological Sciences, University of Buenos Aires, Argentina.

Deconinck, Jean-Francois. jean-francois.deconinck@u-bourgogne.fr, Université de Bourgogne, Dijon, France.

Erba, Elisabetta. elisabetta.erba@unimi.it, Università degli Studi di Milano, Dipartimento di Scienze della Terra A. Desio, Milano, Italy.

Frau, Camille. camille_frau@hotmail.fr, Groupement d'Intérêt Paléontologique, Science et Exposition, Toulon, France.

Galloway, Jennifer. jennifer.galloway@canada.ca, Geological Survey of Canada, Canada.

Li, Gang. gangli@nigpas.ac.cn, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China.

Martinez, Mathieu. mathieu.martinez@univ-rennes1.fr, Géosciences Rennes, Université de Rennes 1, France.

Matsuoka, Atsushi. amatsuoka@geo.sc.niigata-u.ac.jp, Department of Geology, Niigata University, Niigata, Japan.

Michalik, Jozef. Jozef.Michalik@savba.sk, Earth Science Institute, Slovak Academy of Sciences, Bratislava, Slovakia.

Mutterlose, Joerg. joerg.mutterlose@rub.de, Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, Germany.

Pellenard, Pierre. pierre.pellenard@u-bourgogne.fr, Université de Bourgogne, Dijon, France.

Petrova Silviya, silviya_p@geology.bas.bg, Institute of Geology, Bulgarian Academy of Sciences, Sofia, Bulgaria.

Price, Gregor., g.price@plymouth.ac.uk, School of Geography, Earth and Environmental Sciences, University of Plymouth, UK.

Pruner, Petr. pruner@gli.cas.cz, Institute of Geology, Czech Academy of Sciences, Praha, Czech Republic.

Reháková, Daniela. daniela.rehakova@uniba.sk, Faculty of Natural Sciences, Comenius University, Bratislava, Slovakia.

Schmitz, Mark D. markschmitz@boisestate.edu, Department of Geosciences, Boise State University, Boise, USA.

KILIAN WG

Chair: Reboulet, Stéphane. stephane.reboulet@univ-lyon1.fr, Laboratoire de Géologie de Lyon, CNRS-UMR 5276, Observatoire de Lyon, 2 rue Raphaël Dubois, Bâtiment Géode, Université Claude Bernard Lyon 1, 69622 Villeurbanne, France, Phone: +33 472446244.

Vice-Chair: Klein, Jaap. jaap.klein@naturalis.nl, Naturalis Biodiversity Center, 429 Chemin du Thuve, 04700 Oraison, Alpes de Haute Provence, France.

Vice-Chair: Moreno-Bedmar, Josep A. josepamb@geologia.unam.mx, Departamento de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán, CP 04510, México, D.F., Mexico.

Vice-Chair: Rawson, Peter. peter.rawson1@btinternet.com, Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, UK, Centre for Marine and Environmental Sciences, University of Hull, Scarborough Campus, Filey Road, Scarborough YO11 3AZ, United Kingdom.

Vice-Chair: Szives, Otilia. sziveso@nhmus.hu, Hungarian Natural History Museum, Department of Paleontology, 1088 Ludovika ter 2, H-1431 Budapest, Hungary.

WG Members:

Aguirre-Urreta, Beatriz. aguirre@gl.fcen.uba.ar, Instituto de Estudios Andinos Don Pablo Groeber (UBA-CONICET), Universidad de Buenos Aires, Ciudad Universitaria, pabellón 2, 1428 Buenos Aires, Argentina.

Alsen, Peter. pal@geus.dk GEUS, Voldgade 10, Copenhagen 1350, Denmark

Barragán, Ricardo. ricardor@geologia.unam.mx, Departamento de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán, CP 04510, México, D.F., Mexico

Bert, Didier. paleo-db@orange.fr, Didier.BERT@le04.fr, Laboratoire du Groupe de recherche en paléobiologie et biostratigraphie des Ammonites, Bois-Mésanges, quartier Saint-Joseph, 04170 La Mure-Argens, France.

Company, Miguel. mcompany@ugr.es, Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, Campus de Fuentenueva s/n, 18002 Granada, Spain.

Főzy, István. fozy@nhmus.hu, semiformiceras@gmail.com, Hungarian Natural History Museum, Department of Paleontology, 1088 Ludovika ter 2, H-1431 Budapest, Hungary.

Frau, Camille. Camille_frau@hotmail.fr, Groupement d'Intérêt Paléontologique, Science et Exposition, 60 bd Georges Richard, 83000 Toulon, France

González-Arreola, Celestina. arreola@unam.mx, Departamento de Paleontología, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Delegación Coyoacán, CP 04510, México, D.F., Mexico.

Hoedemaeker, Philip. flip.hoedemaeker@naturalis.nl, National Museum of Natural History, P.O.Box 9517, 2300 RA Leiden, Netherlands

Idakieva, Vyara. idakieva@gea.uni-sofia.bg, v_idakieva@mail.bg, Sofia University St Kliment Ohridski, Faculty of Geology and Geography, Department of Geology, Paleontology and Fossil Fuels, 15 Tzar Osvoboditel Bd, 1504 Sofia, Bulgaria.

Ivanov, Marin. mivanov@gea.uni-sofia.bg, Sofia University St Kliment Ohridski, Faculty of Geology and Geography, Department of Geology, Paleontology and Fossil Fuels, 15 Tzar Osvoboditel Bd, 1504 Sofia, Bulgaria.

Kakabadze, Mikheil V. mishakakab@hotmail.com, Djanelidze Institute of Geology, Polytkovskaja St. 5, 0186 Tbilisi, Georgia.

Latil, Jean-Louis. g.r.e.g.b@wanadoo.fr, Le Maupas, 05300 Lazer par Laragne, France.

Lukeneder, Alexander. alexander.lukeneder@NHM-WIEN.AC.AT, Geological-Palaeontological

Department, Natural History Museum, Burgring 7, A-1010 Vienna, Austria.
 Matrimon, Bertrand. bertrand.matrimon@sfr.fr, -26 avenue Jules Guesde, 10150 Pont Sainte Marie, France.
 Pictet, Antoine. Chemin du Battoir 7, 1337 Vallorbe, Suisse.
 Ploch, Izabela. iplo@pgi.gov.pl, Polish Geological Institute, Geological Museum, Rakowiecka Str 4, PL-00-975 Warszawa, Poland
 Raisossadat, Seyed N. snaser_rais@yahoo.co.uk, Geology Department, Faculty of Science, Birjand University, PO Box 97175/615, Birjand, Iran.
 Sandoval, José. sandoval@ugr.es, Dpto Estratigrafía y Paleontología, Universidad de Granada, 18002 Granada, Spain.
 Tavera, José M. jtavera@ugr.es, Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, Campus de Fuentenueva s/n, 18002 Granada, Spain.
 Vašíček, Zdeněk. zdenek.vasicek@vsb.cz, zdenvas@email.cz, Institute of Geonics, Academy of Sciences of the Czech Republic, Studentská 1768, 708 00, Ostrava-Poruba, Czech Republic.

Corresponding members (simple list of names as known)

Ismar de Souza, Carvalho. ismar@geologia.ufri.br, Universidade Federal do Rio de Janeiro, CCMN – Igeo Av. Athos da Silveira Ramos 274, Cidade Universitária - Ilha do Fundão 21.941-916 Rio de Janeiro, RJ, Brasil, Phone: 21 3938 9405.
 Galbrun, Bruno. bruno.galbrun@upmc.fr, Université Pierre et Marie Curie, ISTE, Institut des Sciences de la Terre Paris, UMR-CNRS 7193, 4 place Jussieu, 75252 Paris CEDEX 5, France.
 Hasegawa, Takashi. jh7ujr@staff.kanazawa-u.ac.jp, Department of Earth Sciences, Faculty of Science, Kanazawa University, Kakuma, Kanazawa, 920-1192 Japan. Phone: 076 264 6508.
 Huber, Brian T. huberb@si.edu, Department of Paleobiology, PO Box 37012, MRC-121, Smithsonian Institution, Washington, DC 20013-7012, Phone: 1 202 633 1328.
 Sageman, Bradley. brad@earth.northwestern.edu, Department of Earth and Planetary Sciences, Northwestern University, 2145 Sheridan Road, Evanston, Illinois 60208-3130, U.S.A., Phone: +1-847-467-2257.
 Wagneich, Michael. michael.wagneich@univie.ac.at, Department of Geology, University of Vienna, Josef Hlaubek Platz 2, Vienna, A-1090, Austria, Phone: +43 14277 53465
 Walaszczyk, Irek. i.walaszczyk@uw.edu.pl, Faculty of Geology, University of Warsaw, Al. Zwirki i Wigury 93, 02-089 Warszawa, Poland, Phone: +48 22 5540482.