INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY

# Newsletter N° 23

Lyon, December 1995

A SUBCOMMISSION OF THE INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (I.U.G.S.)

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INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY (ISJS)
INTERNATIONAL COMMISSION ON STRATIGRAPHY (ICS)
A COMMISSION OF THE INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

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Lyon, le 17 janvier 1996

To all the members of the
International Subcommission
on Jurassic Stratigraphy

Dear Colleague,

Just when you receive the Newsletter's issue n° 23, we apologize for being so late to achieve it.

Unfortunately, we do not received the technical help which we had in the years gone by . We spent much time for the editing, but we were unable to replace experimented people...

This explains both we are late to send you the issue and also the too much defects you will find when you will read it.

We offer again our excuses and we hope you will be indulgent.

With our best wishes for 1996.

Sincerely yours

C. Mangold
Secretary

R. Enay
Chairman

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# NEWSLETTER N° 23

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# REPORT ON THE 4th INTERNATIONAL CONGRESS ON JURASSIC STRATIGRAPHY AND GEOLOGY

(Riccardi A.)

## 2 - REPORT ON THE 4TH INTERNATIONAL CONGRESS ON JURASSIC STRATIGRAPHY AND GEOLOGY (RICCARDI A.)

The 4th International Congress on Jurassic Stratigraphy and Geology was held in Neuquén-Mendoza, Argentina on October 15-27,1994, under sponsorship of the International Commission on Stratigraphy (ICS), the International Subcommission on Jurassic Stratigraphy (ISJS), the Geological Society of Argentina and the Argentine Stratigraphic Committee.

This meeting is a continuation of a series which began with the 1st and 2nd Jurassic Colloquia (Luxembourg, 1962, 1967), the William Smith Symposium (London, 1969) and the 1st, 2nd and 3rd Jurassic Symposia held at Erlangen (Germany, 1984), Lisboa (Portugal, 1987) and Poitiers (France, 1991). The next Congress will take place at Calgary or Vancouver (Canada, 1997). These scientific events offer an opportunity for specialists from around the world to discuss the results of the research being done, to examine classical sections, and to plan future activities.

The Congress was attended by 133 participants from 27 countries. Presentations amounted to 126, 97 of which were read at the sessions . Ten of them were part of an IGCP 322 Symposium, and 11 were posters. Additionally, there were six plenary lectures on selected topics.

The Scientific Sessions were held at the CRICYT-CONICET, Mendoza, from 19 to 23 October 1994. The Opening Ceremony was held on Wednesday, October 19th 1994, at the Convocation Hall of the Cuyo National University. It was followed by a remembrance ceremony at Cerro de la Gloria. Poster Sessions were held on Saturday October 22nd, 1994 and the IGCP 322 "Correlation of Jurassic Events in South America" had a scientific and administrative meeting on the afternoon of October 22nd and the morning of October 23rd.

On the afternoon of October 23rd there was a general meeting of the International Subcommission on Jurassic Stratigraphy (ISJS) and its Working Groups (WG). It was chaired by the Chairman, Professor Dr. R. Enay. An opening conference, by the Chairman of the International Commission on Stratigraphy (ICS), Professor Dr. J. Remane, was devoted to the guidelines of ICS and their bearing on Jurassic Chronostratigraphy. Reports by the WG chairmen were presented and are also included in this Newsletter.

Communications delivered during the Scientific Sessions were devoted to : Stratigraphy and Correlation (Definition and correlation of lower boundaries for the different Stages of the Jurassic System by different fossil groups, magnetostratigraphy and radiochronology ; Stratigraphic and geographic coverage included Lower, Middle and Upper Jurassic of Eurasia and the Circum-Pacific), Sedimentary Geology and Tectonics (Basin analysis, Sequence stratigraphy, Regional Geology and Tectonics and Environmental facies and diagenesis of the Jurassic System ; Case studies were from the Andes, Antarctica, the North Atlantic, Central-Eastern Europe, Africa and Asia).

All abstracts were published in a special volume which was distributed during the Congress. Participants giving oral presentations were invited to submit manuscripts for publication in the Congress Proceedings. By November 30th, 1994, the Organizing Committee had received 50 manuscripts, which are now being refereed. Publication of the Proceedings is expected for the second half of 1995.

Several field trips were organized for the Congress. The Pre-Congress Field Trips took place from October 15 to 18. They were attended by 53 participants and lead to the Lower Jurassic of Arroyo Lapa-Catan Lil-Chacay Melehue, the Middle Jurassic of Charahuilla-Chacay Melehue-Vega de la Veranada, and the Upper Jurassic of Vega de la Veranada-Chacay Melehue/Rahueco-Manzano Guacho sections, all in Neuquén Province. The sections exposed mostly proximal to distal marine facies. An Intra-Congress excursion took place on October 21 and was attended by 102 participants. It was devoted to visit the classic section of Puente del Inca, first studied by Ch. Darwin in 1835 ; the area displays the fold and thrust belt of the Principal Andes, where Jurassic marine and continental deposits are involved in complex imbrications. A ceremony in homage to Ch. Darwin was held at Paramillos de Uspallata. The Post-Conference excursions, attended by 40 participants, lead to the Lower Jurassic of Rio Atuel-Portezuelo Ancho-Arroyo Serrucho, the Middle Jurassic of Poti Malal-Bardas Blancas-Arroyo Loncoche, and the Upper Jurassic of Rio Salado-Poti Malal-Bardas Blancas, all in Mendoza Province. The sections exposed mostly proximal to distal marine facies. The geology and stratigraphy were described in 3 "Field Guides", prepared by C. Gulisano & A. Gutiérrez (Pre and Post-Congress Field Trips) and V. Ramos (Intra-Congress Field Trip). The Field Guides are now in press in a joint publication of the Argentinian Geological Survey and the Argentinian Geological Society and will be available to the public in March, 1995.

The Social Programme included : a Welcome Party offered by the Organizing Committee, on the evening of October 19 ; a performance of Argentinian and Southamerican music, sponsored by the Government of Mendoza province on the evening of October 20 ; an outdoor exhibition of handicrafts on the morning of October 22 ; and a Farewell Dinner, which took place on October 23.

The Organizing Committee sponsored a Photo Contest of photographs taken during the Congress field trips or related to papers presented at the sessions. The deadline for entries to the photo contest was November 30, 1994, but there were no submissions.

By December 30, 1994, money received by the Congress amounted to US$ 78.825,52 of which US$ 23.325 were for Registration Fees and US$ 36.895 for Excursion Fees. Total Expenditures amounted to US$ 82.429,10 of which US$ 36.587,01 were for excursions, US$ 14.359,96 for administration, US$ 12.742,80 for printing, US$ 8.527,33 for general logistic and US $ 3.110 for Bank Charges.

The Organizing Committee acknowledges with thanks the support received from : the National Research Council of Argentina ; the Secretary of Mineral Resources ; the oil companies YPF S. A., Bridas SAPIC, Compañia General de Combustibles, Tecpetrol, Chauvco Resources (Argentina), Petrolera Argentina San Jorge, Repsol Argentina ; the governments of Mendoza and Neuquen provinces ; the cities of Mendoza, Zapala and Las Heras ; the International Science Foundation ; the Third World Academy of Sciences ; the Cuyo National University ; the Argentinian Air Force, the bus company Cayetano Caruso S. A. ; CORMINE S. E. P. ; the phone company Telefónica de Argentina ; the Argentinian Post Office ; the newspaper Los Andes, the Argentinian Travel Bureau and the Argentinian Touring Club.

# THE REVISED GUIDELINES OF THE I.C.S.
(Remane J.)

## 3 - THE REVISED GUIDELINES OF THE I. C. S. - (REMANE J.)

### 3.1. INTRODUCTION

3.1.1. Origin of the chronostratotype concept as we use it to-day

The first question is of course : Do we really need stratotypes in chronostratigraphy, and if so, why do we need them? The answer was given very brilliantly on the occasion of the International Symposium on Cretaceous stage boundaries at Copenhaguen, 1983: Without a binding decision taken by an international organization (in our case ICS and IUGS) and materialized in a type-section, stratigraphers would never agree to use the same boundaries. This means that there is also a good deal of psychology involved in stratigraphic problems.

The first boundary to be formally defined by a stratotype was the Silurian/Devonian boundary in 1972. Most of the principles which were developed there, have been taken up in the first guidelines of ICS (COWIE *et al.*, 1986). It seems therefore legitimate to talk about the Silurian/Devonian boundary even here on a Jurassic congress.

The problem was that the top of the Silurian was originally defined (more or less precisely) by the transition from marine Silurian to the fluviatile-continental Old Red Sandstone, whereas the base of the Devonian was defined by a marine transgression in the Ardennes. Two very beautiful "natural" boundaries, representing in theory exactly the same moment of Earth history, but which were, unfortunately, absolutely uncorrelatable. The problem was solved when stratigraphers (1) understood that the boundary should be defined in a continuous marine succession and (2) realized that graptolites were not conscious of the paramount importance of the S/D boundary, and did not die out at this level but continued up into the Devonian.

This photo[1] shows the critical portion of the type section at Klonk in the Barrandian near Prague; the boundary was placed in the middle of bed 20. The first appearance of *Monograptus uniformis* served as a guidance for the boundary definition. This boundary definition had several important and far reaching consequences: (1) The boundary does not correspond to a change in lithology, it is, so to say no natural boundary; (2) the idea that chronostratigraphic units could be defined by unit stratotypes was abandoned; (3) even though the boundary definition is based on one single species, other biostratigraphic events close to the boundary play an important role. As these points are important even for the revised guidelines, two of them shall be discussed in some detail.

3.1.2. Consequences of the boundary stratotype concept

3.1.2.1. The concept of unit stratotypes for chronostratigraphic units was abandoned, because this would not lead to a standard scale of strictly contiguous units, without gaps or overlaps. This point was also made in the International Stratigraphic Guide (HEDBERG, 1976) but without drawing the necessary conclusion that unit stratotypes have to be abandoned altogether.

[1] Note of the editors : not here included

With the S/D boundary definition the principle has been firmly established that chronostratigraphic units are defined by their lower boundary only, the upper boundary being determined by the lower boundary of the succeding unit. In practice this means that in most cases lower and upper boundary of the same unit will be defined at different places. In such a case, no material chronostratigraphic unit exists and we will have to examine if the distinction between parallel material chronostratigraphic and immaterial geochronologic units is still meaningful.

Another consequence is that we have "open" chronostratigraphic units, as long as only the lower boundary is defined. This is the case with the Cambrian, the Carboniferous, and the Paleogene.

3.1.2.2. Apparently, the definition of the S/D boundary is only tied to one single marker species and the reproach has often been made, also in the case of recent boundary definitions, that such a boundary cannot be recognized if this marker is absent. A closer look at the succession of Klonk reveals, however, that there are several biostratigraphic events close to the boundary, which all will allow to determine the boundary with a high degree of precision. These additional markers are from different fossil groups, Conodonts and Trilobites in the present case.

This principle is also well illustrated by the definition of the base of the Middle Devonian, as shown by the comparison of the type section (Wetteldorf) with a section from the Barrandian. Here we deal with different conodont species and Dacryoconarids.

### 3.2. -THE GUIDELINES OF ICS - THEIR ORIGINAL VERSION AND THE POINTS TO BE REVISED

#### 3.2.1. Basic principles

The two basic principles underlying the original guidelines of ICS (COWIE *et al.*, 1986) were that (1) correlation has to precede definition - otherwise the definition would be of no practical value - and (2) that all chronostratigraphic boundaries have to be defined by a Global Boundary Stratotype Section and Point, a GSSP as it was called.

It was the first condition which forced us to give up the second one in certain cases. In the Precambrian it was impossible to establish chronocorrelations in the classical way without fossils. Therefore the Precambrian Subcommission introduced a completely new subdivision of the Proterozoic eon in eras and systems whose boundaries were defined in terms of absolute ages. This proposal obtained a large majority in ICS and was ratified by IUGS on the 28th International Geological Congress at Washington, 1989. Obviously, the guidelines have to be completed in this sense.

The other changes are more subtle and concern more or less technical problems.

#### 3.2.2. The necessary technical qualities of a GSSP

Practically all of the historical type localities of stages are unsuitable for an unequivocal boundary definition, as the boundaries were placed in condensed intervals or at gaps and/or facies changes. The conditions to be fulfilled by a type-section had to be reformulated. They were enumerated in an appendix to the original guidelines. Many of them had already been stated in the ISG (HEDBERG, 1976), and most of them concern the biostratigraphic qualities of the type-section. This becomes apparent if we change the order of criteria a little bit. Most of these conditions are obvious and only some of them merit further discussion.

Postulating that the boundary level shall not correspond to a facies change in the type section means that paleoecological background noise is to be excluded as far as possible. In the field, such a boundary will of course not correspond to what is normally called a "natural" boundary.

The sedimentary documentation of the critical interval should be complete (no unconformity, no condensation) and give a correct image of the succession of events (no reworking, no structural complications). And, as fossils are the most important tool for interregional correlation in the Phanerozoic, the fauna of the type section should provide as many of the relevant biostratigraphic data as possible.

All these basic demands will not be changed by a revision of the guidelines.

3.2.3. New elements to be taken up in the guidelines.

Except one, all Devonian stage boundaries are now defined by a GSSP. All intradevonian boundaries as well as the base of the Carboniferous were based on Conodonts. This led to the formulation of a new principle: As everybody knows, first appearances of species are often diachronous from one section to another, for various reasons. But if the gradual emergence of a new species can be followed, we know that we have really found its very first representatives. So e. g. in the case of the Devonian/Carboniferous boundary.

The problem is, however, that the determination of boundaries which are placed in a continuous transformation series (a grade) is inevitably to a certain degree subjective. Thus it appeared, after the GSSP for the base of the Upper Devonian had been ratified that the conodont specialist who had studied this section had a very personal view about what were the first representatives of the decisive marker. The GSSP did therefore not correspond to the zonal boundary which it was meant to represent. This sounds dramatic, but in reality, this case is the best possible demonstration that stratotypes are necessary : The type section will show without ambiguity where in a given grade the chronostratigraphic boundary is to be placed, independently from all nomenclatural problems.

But the most important point of the revised guidelines will be that non-biostratigraphic methods have to be given more weight. To give just one example: Magnetic reversals are geologically instantaneous worldwide events, they were ideal markers - if they were time specific. But once we were able to identify, with the help of fossils, the magnetic zones of the oceanic standard in a given region, the magnetic reversals will allow us to test the isochrony of biostratigraphic boundaries, as was done in the Tithonian-Valanginian Biancone of the Italian Apennines. In such a case, magnetostratigrahy allows to test the isochrony of biostratigraphic boundaries.

3.2.4. Summing up

We may thus conclude, that the revision of the ICS guidelines will not lead to fundamental changes in the way Phanerozoic chronostratigraphic units have to be defined. The GSSP concept remains valid. None of the old criteria of a good type-section is abandoned, i. e. as before, we have to look for sections providing a complete (no gaps, no condensation) and unbiased (no reworking, no tectonic disturbances) succession. In the future, we should, however, use preferably marker species whose phylogentic origin is documented in the type-section. And, especially for the late Mesozoic and the Cenozoic, non biostratigraphic methods as magnetostratigraphy geochemical markers etc should be taken into consideration as they have allowed far reaching correlations, as soon as they could be calibrated by fossils or radiometric dating.

## 3.3 - THE GUIDELINES OF ICS AND THEIR RELATION TO JURASSSIC CHRONOSTRATIGRPHY

### 3.3.1. The Jurassic : a biochronology based nearly exclusively on ammonites

So far none of the Jurassic stage boundaries has been formally defined. On the other hand, thanks to the Luxemburg colloquia in the 1960s, there is general agreement on Jurassic stage nomenclature - except for the uppermost stage where Tethyan-Boreal correlations are very uncertain due to a strong paleobiogeographic provincialism. Therefore it is surprising that no agreement has been attained as to a precise definition of stage boundaries with the help of GSSPs. Especially if we consider that it was in the Jurassic where A. Oppel laid the foundations of modern biostratigraphy in introducing the zone concept, nearly 150 years ago.

Oppel's zonation of the Jurassic was largely based on ammonites, and at present, ammonites are so to say the very standard markers in Jurassic biochronology. Due to the short life spans of individual species, precise and far reaching correlations are possible even without knowing phylogenetic relationships in detail - as in Oppel's times. But this is probably also the reason why theoretical concepts have been somewhat neglected. It is symptomatic that the ISG in 1976 did not give a correct definition of the Oppel zone. This was only achieved rather recently, in the works of J. Guex, who recognized that Oppel zones are discrete units, with indeterminate intervals of separation between them. This is due to the discontinuous biostratigraphic record, which is by the way the normal case with macrofossils[2]. Guex's approach, the creation of unitary associations, is most promising, but did so far not receive general support from ammonite workers.

Microfossils would provide continuous zonal scales, but neither dinocysts nor nannoplankton can rival with ammonites in precision. Perhaps, one day Radiolaria will be concurrential.

### 3.3. 2. Application of the ICS Guidelines to Jurassic chronostratigraphy

The Jurassic appears indeed to be a period with very specific problems concerning the biostratigraphic support of precise boundary definitions through GSSPs: (1) A multiple approach, based on different groups of guide fossils, as e. g. in the Devonian, does not seem to be possible in a near future; (2) With their discontinuous documentation, ammonite grades are normally not available as a support for boundary definitions[3].

On the other hand, the same is true for *Monograptus uniformis* at the Silurian/Devonian boundary, whose definition has not been questioned since more than 20 years. Thus the absence of other markers might be the more serious problem. As to non-biostratigraphic methods, magnetostratigraphy should certainly be taken into consideration, but unfortunately no oceanic standard exists for the Early and Middle Jurassic.

Paradoxically, the Jurassic System which was at the origin of modern biochronology, now seems to be the most problematic case. But let's be optimistic and hope that this 4th International Congress on Jurassic Stratigraphy and Geology will open the way for a number of formal, definite boundary definitions. It would be a pity if we had to wait until ammonites can be replaced by another fossil group as primary markers, as was the case in the Devonian, where all boundary definitions are derived from conodonts.

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[2] Note of the editors : this is the author's opinion

[3] Note of the editors : author's statement does not reflect the opinion of the majority of ammonite specialists.

# MEETING OF THE TRIASSIC/JURASSIC BOUNDARY W.G.
(Warrington G.)

## 4 - MEETING OF THE TRIASSIC/JURASSIC BOUNDARY W.G. - (WARRINGTON G.)

Chairman : Professor R. Mouterde, Université Catholique de Lyon
Secretary : Dr G. Warrington, British Geological Survey

**Minutes of the Triassic-Jurassic Boundary Working Group (TJBWG) business meeting, Mendoza, Argentina ; 23 October 1994**

by the Secretary

The meeting, held during the 4th International Congress on Jurassic Stratigraphy and Geology (4IJC), was organised by the TJBWG Secretary who, in the absence of the TJBWG Chairman, also acted as the meting chairman (MC).

**AGENDA**

1. Apologies for absence
2. Report by the Secretary
3. Objectives of the TJBWG
4. The definition of the base of the Jurassic
5. Candidate Global Stratotype Sections and Points (GSSPs)
6. Schedule for TJBWG activity leading to a GSSP proposal
7. Membership of the TJBWG
8. Selection of Voting Members
9. Contact with the IUGS Subcommission on Triassic Stratigraphy
10. Future meetings
11. Any other business

MC declared the meeting open at 09. 45 and welcomed those attending [participants included Bloos, Bown, Callomon, Carter, Dagys, El-Shaarawy, Elmi, Enay (Chairman, ISJS), Guy-Ohlson, Hall, Hesselbo, Hirsch, Hull, Morton, Ogg, Pessagno, Poulsen, Remane (Chairman, ICS), Rosenfeld, Weitschat, Westermann and Whalen].

**Agenda item 1 :**

Apologies had been received from Begg, Boomer, Donovan, Dumont, Gaetani, Gilliland, Grant-Mackie, Guex, Hallam, Hillebrandt, Johnson, Krystyn, Lord, Mangold, Michalik, Michelson, Mouterde*, Polubotko, Prinz-Grimm, Repin, Rieber, Roniewicz, Stevens, Tipper, Vörös, and Zeiss**.

*Professor Mouterde (TJBWG Chairman) had requested the TJBWG Secretary to conduct the meeting in his absence.
** Professor Zeiss had sent greetings to all participants.

**Agenda item 2 :**

MC presented summaries of the report on TJBWG activities published in ISJS Newsletter 22,September 1994 (Annexe 1*), and that made by the Chairman at the First French Congress on Stratigraphy, Toulouse, France, 12-14 September 1994 (Annex 2).

No discussion of this item ensued.

* Note from the editor : Annexe 1 not included - Refer to ISJS Newsletter 22.

**Agenda item 3 :**

MC stated that the meeting was a timely opportunity to restate the objective of the TJBWG. This is the selection and recommendation, to the International Commission on Stratigraphy (ICS), of a candidate Global Stratotype Section and Point (GSSP) for the base of the Hettangian Stage, thus defining the boundary of the Jurassic with the underlying Triassic. The selection and recommendation of a candidate GSSP would follow ICS guideline criteria (Cowie *et al.* , 1986 ; *Cour. Forsch. Senkenberg.*, **83** : 1-14) concerning access, conserved status, completeness of exposure of an adequate thickness of sediment, demonstrable correlation potential through an abundance and diversity of well-preserved fossils in a facies suitable for widespread correlation, freedom from metamorphism and structural complication, and potential for additional studies (e. g. isotopic, magnetic, geochronometric).

No discussion of this item ensued.

**Agenda item 4 :**

MC stated that the meeting was a timely opportunity to restate the definition adopted for the base of the lowest Jurassic stage. At the 1962 Luxembourg Jurassic Colloquium the recommendation had been made that the Rhaetian Stage be placed in the Triassic and that the Hettangian should be the lowest Jurassic Stage, with its base marked by the base of the *Psiloceras planorbis* Zone ; this recommendation was repeated at the 1967 Luxembourg Jurassic Colloquium, with the base of the *P. planorbis* Zone being defined as marked by the base of the *planorbis* Subzone. The use of these recommended definitions was confirmed at the TJBWG meeting held during the International Symposium on Jurassic Stratigraphy, Erlangen (September 1984), and remains TJBWG policy.

No discussion of this item ensued.

**Agenda item 5 :**

MC stated that the report of the TJBWG meeting held during the Erlangen Jurassic Symposium (1984) referred to possible GSSP sites in the USA (New York Canyon, Nevada), Slovakia (Krizna), Chile/Peru, Austria, Great Britain, and France (Ardèche, Lorraine). More recently, British Columbia (Queen Charlotte Islands) has been added to this list and notifications of a possible candidate section in Mexico (Sonora), and a standard for the Boreal region have been received. However, only one section in Great Britain, has so far been proposed, in a publication (Warrington *et al.*, 1994 ; *Geol. Mag.*, **131** : 191-200), as a candidate GSSP.

In advance of the 4IJC the TJBWG Secretary distributed the business meeting agenda to working group members in an attempt to assess the likely attendance at the meeting, and to afford those unable to attend the opportunity of submitting comments on agenda items ; the majority of the comments from members not present at the business meeting related to this agenda item :

Discussion -
**Professor Donovan** submitted a ten-point analysis of the proposal (Warrington *et al.*, 1994) of St Audrie's Bay, Somerset, England, as a candidate GSSP, and of related issue ; his comments are summarized below :

a) . The entry of *Psiloceras planorbis* in the Lias is a good event for biostratigraphical correlation in Europe.

b) . Though the immediate ancestor of *Psiloceras planorbis* is not known, the identification of a small ammonite from the Penarth Group as 'psiloceratid' (Donovan *et al.*, 1989 ; *Paleontology* **32 :** 231-235) suggests that the group had an earlier history.

c) . Page (*in* Page *et al.* , 1994) ; *Proc. Ussher Soc.*, **8 :** 338-344) notes a sequence of morphologies in *Psiloceras* assemblages in west Somerset but states that it is 'virtually impossible' to correlate this with sequences elsewhere because the Somerset specimens are crushed. Donovan regards this as 'a counsel of despair', noting that the sequence apparently occurs consistently in extra-Alpine Europe and is already known from other British successions, such as those at Bristol and in the Cheshire Basin ; he considers that the specimen referred to by Page as a presumed juraphyllitid is indeterminable.

d) . *Primapsiloceras primulum*, found below occurrences of *Psiloceras* cf. *planorbis* in Russia, is probably correcty excluded from *Psiloceras*. It does not appear to be a potential ancestor of *P. planorbis*, though examination of Russian specimens by workers familiar with European *Psiloceras* is needed.

e) . The identication (Guérin-Franiatte & Muller, 1979 ; *Ann Soc. géol. Belg.*, **101 :** 399-403) of primitive schlotheimiids immediately below specimens identified as *Psiloceras* is an unresolved question. He (Donovan) and Ivimey-Cook were unable to identify these specimens which Polubotko & Repin (1981, Rep. USSR Acad. Sci., **261 :** 1394-1398) regarded a indistiguishable from *Primapsiloceras*.

f) . If the *Psiloceras planorbis* Zone is taken as the basal Hettangian zone, the *Primapsiloceras primulum* Zone of Russian workers will presumably be Triassic ; Donavan urges discussion with Russian workers about this.*

g) . Tozer (pers comm. to Donovan 1984) does not regard *Primapsiloceras* as a Triassic ammonoid.*

f, g* ; see Dagys, 4IJC Abstract volume : 43 (Annex 3 : MC)

h) . After examining the German material which formed the basis for the distinction of *Neophyllites antecedens* from *Psiloceras planorbis*, he (Donovan) concluded that *N. antecedens* is a variant of *Psiloceras* sp.

i-k) . He urges study of all fossil groups in a proposed type section, and the study of variation within ammonite populations.

**Professor Hallam** considers that the GSSP should contain both the latest Triassic *Choristoceras* and the earliest Jurassic *Psiloceras* faunas ; for this reason he cannot accept the Somerset, England, section proposed by Warrington *et al.*, (1994), and regards the Kendelbach, Austria, and New York Canyon, Nevada, sections as the only serious candidates.

**Professor von Hillebrandt** expressed concern that *Psiloceras* has been found in beds below that used by Warrington *et al.* (1994) as the base of the *planorbis* Subzone. He suggested that the boundary be placed either at the level of the new (lower) occurences of *Psiloceras*, or, preferably, at the base of Lias Group, stating that almost no geologist "would understand why the lower part of the "Lias Group" is of Triassic age"*. A paper on the boundary sequence in northern Peru is in press [A. von Hillebrandt, The Triassic/Jurassic boundary and Hettangian biostratigraphy in the area of the Utcubamba Valley (Northern Peru) ; Geobios].

* **MC** commented that, on almost the same day that the proposal of a section in Somerset, England, as a candidate GSSP was published, Dr P. Hodges (National Museum of Wales) had found specimens of *Psiloceras* up to 0,5m lower in that section. The level proposed for the base of the *planorbis* Zone in the candidate section would be amended in accordance with the results which Dr Hodges had kindly made available to him and which were presented to the meeting with Dr Hokges' approval.

* **Professor J. Remane** (ICS Chairman) said that Professor von Hillebrandt's preference for placing the boundary at a lithostratigraphic change was not acceptable ; the system boundary should be separated from any lithostratigraphic change.

**Dr A. L. A. Johnson**, referring to Dr P. Hodges' as yet unpublished findings*, doubted whether southern Britain is a suitable area for a GSSP, "at least if ammonites are used to define the boundary".

* published November 1994, *Geol. Mag.*, **131**, 841-844 (MC)

**Professor A. R. Lord** supported the proposal (Warrington *et al.*, 1994) of the St Audrie's Bay section, Somerset, England, as a candidate GSSP and said that it should be decided whether or not that section is acceptable as a GSSP and whether more information is needed from that section. If the section is not acceptable a work plan for other candidate sites is required.*

* see Agenda item 6 (MC)

**Drs I. V. Polubotko and v. Ja. Repin** propose a section on the Kedon River, north-eastern Russia, as a standard for the Triassic-Jurassic boundary formations of Boreal type (see *Cah. Univ. Cath. Lyon, ser. sci.* **3** : 191-206 ; 1990) but say that additional comprehensive research is needed on radiolarians, conodonts, foraminifers, bivalves and ammonoids.

**Professor A. Zeiss** commented, with regard to the candidate GSSP proposed by Warrington *et al.* (1994), that correlation between it and the sections, with latest Triassic conodonts, in Nottinghamshire, must be demonstrated. He suggested that sections in the Alps, the USA or, especially, Peru, may be more suitable, as they contain Triassic ammonites also.

There was no further discussion of this item.

**Agenda item 6 :**

MC refered to the outline of TJBWG activity presented in the report in ISJS Newsletter **22** (September 1994) and summarised the stages in the procedure leading to ratification of a GSSP :

a) . compilation of a list of candidate sections, together with documentation of each section.

b) . conduct of an initial postal vote on all candidate sections.

c) . conduct of a second postal vote to confirm the selection of the candidate section chosen outright or by a majority in the initial postal vote.

d) . recommendation of the chosen candidate section to the ICS for its vote.

e) . following a vote in favour by the ICS, consideration of the proposed section by the IUGS Executive Commitee (leading to ratification of the proposal if accepted).

The TJBWG still needs to carry out the work necessary to achieve the first stage of this process. It is 32 years since the base of the Hettangian was recommended as the base of the Jurassic, and many of the areas with potential candidate GSSPs have been identified and discussed for over 10 years ; however, only one proposal of a section as a candidate GSSP has been made (Warrington *et al.*, 1994). It is possible to continue working on sections indefinitely but this situation is clearly unacceptable ; a realistic programme and schedule is required that will promote tangible progress by the TJBWG. Workers who have suggested sites for candidate GSSPs should now confirm their interest and intention by compiling the data, published or unpublished, that is available on the sections concerned. This should be done within a common format, based upon the ICS guideline criteria for selection of GSSPs, and be a requirement for any section, including that proposed by Warrington *et al.* (1994), to be considered as a candidate GSSP.

Though published accounts of several potential candidate GSSPs are available, comparison between such accounts is not always easy ; the accounts are not necessarily comprehensive, nor do they cover all of the ICS criteria. A common format for the presentation of the available data on a candidate GSSP would facilitate objective assessment and comparison with other candidate sections. The MC suggested that a common format document should be devised by the TJBWG Chairman and Secretary and distributed to those actively concerned with potential candidate GSSPs as soon as possible. The MC felt that, with so many years work apparently already undertaken on various sections, a cut-off target date of 31 December 1995 for the return of data compilations was not unreasonable. Inevitably, as emphasised by Dr Hodges' discovery of *Psiloceras* at a slightly lower level than that recognized by Warrington *et al.* (1994) in the candidate GSSP proposed from Somerset, England, future research may necessitate minor amendment to the specification of a GSSP ; such amendment is acceptable, even after ratification. Selection of a GSSP should not inhibit further research which, if resulting in radical advances, may require the selection of a new GSSP, a procedure which would require a repeat of the ratification process, involving ICS and IUGS.

Discussion -
**Professor J. Remane** (ICS Chairman) considered that comparison and assessment of candidate sections using the common format approach suggested by the MC was fair. He asked about the definition of the base of the *planorbis* Subzone and emphasised that work should focus upon establishing the correlatability of the boundary level proposed in the different candidate section.

**Dr G. Bloos** commented that the boundary lies between two faunas and that there is difficulty in correlating between levels characterized by different forms. The Jurassic Ammonitina fauna succeeds the Triassic Ceratitina fauna. It is necessary to find a section in which the relationship of these two faunas is seen. He suggested that the boundary might be placed within a sequence of Ammonitina, possibly between *Neophyllites* and *Psiloceras* assemblages, if the stratigraphic relationship of these can be clearly demonstrated.

**Professor J. Remane** commented on the coincidence, or near-coincidence, of extinctions and stratigraphic boundaries ; he felt there was no problem in such coincidence, nor in the use of a level within a gradational succession of fossils, as in the conodont faunas around the Devonian-Carboniferous boundary.

**Dr E. S. Carter** said that the target date (end 1995) suggested for the presentation of data compilations would be too early for the inclusion of results of further necessary work on the sections in the Queen Charlotte Islands, British Columbia.

**Dr. P. A. Whalen** felt that end 1995 should be kept as the target date.

**Dr. W. Weitschat** said that more work was required on the New York Canyon section, Nevada.

**Professor R. Enay** (ISJS Chairman) said that Professor J. Guex is preparing New York Canyon data for publication in 1995.

**Agenda item 7 :**

MC noted that the TJBWG did not have a formal membership of voting and corresponding members, as required by ICS. He had compiled, from information provided by Dr Guex, the previous TJBWG Secretary, and ICS, a list of 77 workers considered as members of the TJBWG. One person on this list had died ; a questionnaire and the business meeting agenda had been circulated to the remaining 76. Up to the time of the meeting the MC had received 34 responses*, mostly from people who were unable to attend the meeting. All but one of those responding wished to retain contact with TJBWG activities, but most did not indicate an interest in active participation.

The MC stated that the membership of the TJBWG must be radically overhauled in order to comprise workers currently or recently involved with potential candidate GSSPs or relevant research topics. A significant number of such people are not on the current 'membership list' which will be revised by the TJBWG Chairman and Secretary.

No discussion of this item ensued.

* including one by telephone ; two further responses were received during the 4IJC and a further three after the congress, making a total of 39, or 51% of the distribution list (TJBWG Secretary).

**Agenda item 8 :**

MC stated that ICS requires the TJBWG to have, in its membership, up to 20 voting members who will vote upon candidate GSSPs. Selection of the required voting members would necessarily follow the revision of the TJBWG membership as a whole and would be made by the TJBWG Chairman and Secretary, possibly in consultation with the chairmen of the ICS, ISJS and the Subcommission on Triassic Stratigraphy (STS). He felt that the voting membership should comprise, in addition to people involved with the candidate GSSPs, experts not directly involved with particular sections but who would provide impartial and objective assessments and act as moderators in the selection process.

No discussion of this item ensued.

**Agenda item 9 :**

MC said that the TJBWG was originally administered by the STS but was transferred to the ISJS in 1991. He expressed the view that it is very necessary to maintain a dialogue with workers active on latest Triassic sequences, and that this was facilitated by his involvements with the TJBWG, as Secretary, and with the STS, as a Voting Member. Notices and reports can be placed in both the ISJS Newsletter and in *Albertiana*, the STS newsletter in order to inform relevant workers in both groups.

Discussion -

**Professor R. Enay** (ISJS Chairman) supported the maintenance of strong contact with the STS and felt that this should be reflected in the composition of the revised membership.

**Agenda item 10 :**

Future meetings of interest to TJBWG members, or where the TJBWG should be represented, are :

a) . International Congress on Triassic Biostratigraphty ; Brisbane, Australia ; 9-12 April, 1996.

b) . 30 th International Geological Congress ; Beijing, People's Republic of China, 4-14 August 1996.

Discussion -

**MC** said that he had learnt of the Brisbane meeting whilst attending the 'Shallow Tethys 4' symposium in Austria in September 1994 ; the Triassic-Jurassic boundary is a topic included in the Brisbane programme. As far as he was aware there had been no contact with the TJBWG and he would be writing to the organisers for further information, which would be passed on to TJBWG members ; he would also point out that the meeting is planned for the same year as an IGC (in Beijing), but at a time which does not allow delegates from other parts of the world to combine the two in a travel itinerary. Early, and widespread, notification of plans to hold such international meetings, in order to avoid conflicting scheduling, was a request voice during the business meeting of the Jurassic Microfossil Group (JMG) which preceded the TJBWG meeting ; this request was supported by the MC.

**Agenda item 11 :**

**Dr F. Hirsch** suggested that study of the reasons for the changes in biota which are associated with boundaries such as that between the Triassic and the Jurassic should be part of the activity of the relevant boundary working groups.

Discussion -

**Professor J. Remane** said that this was possible but that it was not a primary matter for consideration by the working groups. New ICS guidelines on GSSPs are being prepared ; for Phanerozoic sequences these will not differ greatly from those published by Cowie *et al.* (1986), but they will emphasize what are the necessary criteria, as distinct from those which are desirable, and will stress that correlation must precede definition.

No other points of additional business were raised. The MC thanked those attending for their interest and contributions and declared the meeting closed at 11.00.

• **Short report by the Chairman presented at the First French Congress on Stratigraphy,** Toulouse, France, 12-14 Septembre 1994 - Translate from French by R. Enay

"The (Triassic-Jurassic) WG has the onus to propose the best section to define the Triassic-Jurassic boundary and to realize world-wide correlations.

Some resutls have been gathered during the last years, J. Guex (Lausanne) being the secretary of the W.G. Some have been presented in 1990 and published in the *Cahiers de l'Université catholique de Lyon*, série Sciences, n° 3. Since this time, the survey is to be proceeded, G. Warrington taking turn with J. Guex as Secretary.

List of the section proposed or liable to be proposed as boundary stratotype (fig. A-D) :

WESTERN EUROPE

• **Great-Britain** : In Somerset, on the coast of the Bristol Channel, exactly St Andries Bay [A], near Watchet, has been proposed as a reference point for the base of the Jurassic System (cf. Warrington *et al., Geol. Mag.*, 131/2,, 1994, pp. 191-200, fig.). Lower Hettangian rocks outcrop well and studies on microfaunas and microfloras as well as nannofossils and bivalvia etc... have been completed circumstancially ; the already well known ammonites have been revised recently (K. Page, in press). That is the section which presently offer the best data for correlations. Nevertheless, Hettangian deposits are transgressive deposits and the underlying Triassic rocks (Rhetian) do not yield any ammonites, but only bivalvia including *Rhaetavicula contorta*.

• **France** : In the Ardèche Département, Elmi and Mouterde (1965) described, between Pont d'Ussel and St. Julien du Serre, a thick and complete, fossil-rich section of the Lower Hettangian, with bivalvia and ammonites. Here also, the underlying Triassic rocks yield only a bivalves fauna of Rhetian age. Recent studies concerned the microfloras and nannofloras of the passage beds.

ALPINE EUROPE

In the Austrian Alps, are also suitable sections including fossiliferous Triassic-Jurassic passage beds with ammonites, especially the Kendelbachgraben section [B]. But, here some problems have been noticed recently just in the passage beds (cf. Hallam, 1990, *Journ. Geol. Soc. London*, 147, pp. 421-424, fig. 1a,b).

It would be important to obtain the greatest data on this section and the other nearest ones and to organize a field trip of the W.G. on the sections.

NORTH WESTERN AMERICA.

There are exposed sections with open sea ammonites-bearing deposits in the Triassic-Jurassic transition. The sections are currently studied.

• **Nevada :** New York Canyon section (Gabbs Valley Range, Nevada) [D] expose a good succession of ammonite faunas in the Upper Triassic (*Choristoceras* beds) and the Lower Hettangian (*Psiloceras* beds) with well exposed outcrops.

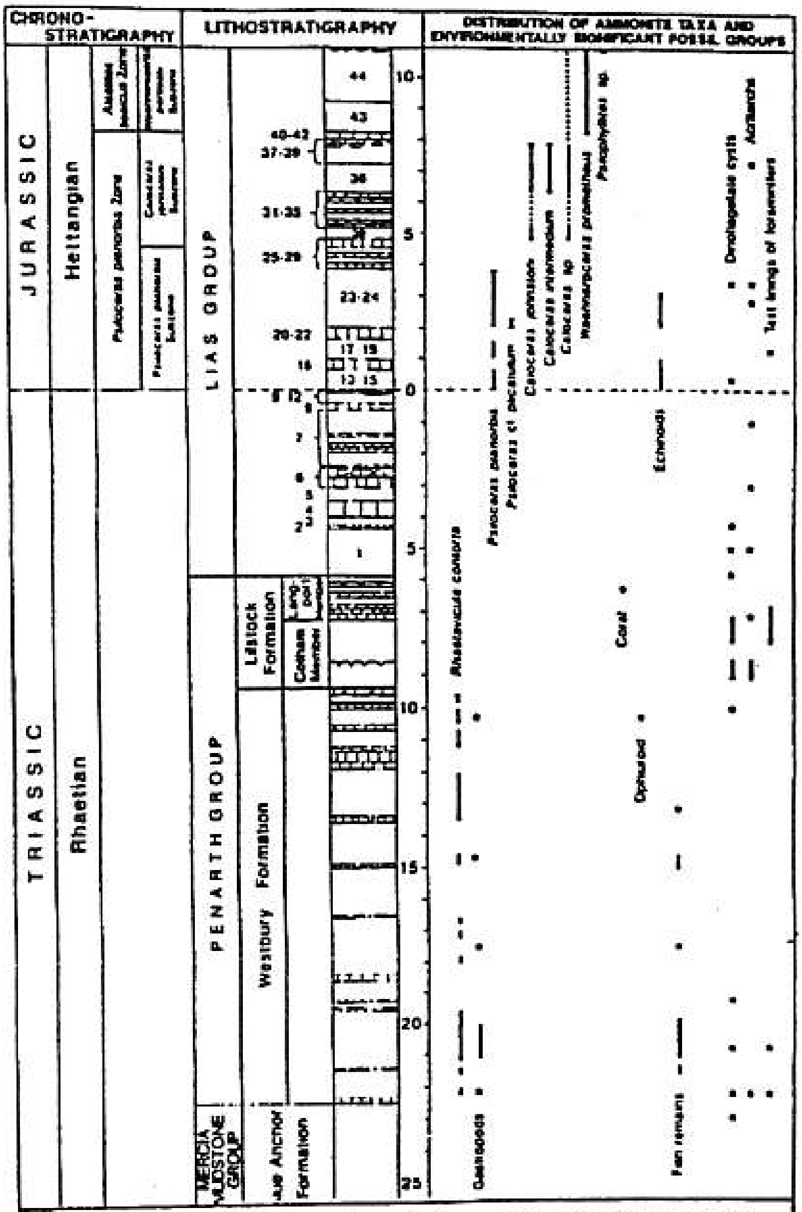
Preliminary data on lithology, ammonites fauna, and other fossils groups have been already published (J .Guex, 1980, *Bull. Soc. Vaudoise Sc. Nat.,* 75/238 : 127-140 and 1982 ; Taylor *et al.*, 1983, *Canadian Journ. Earth Sci.*, 20/10 : 1598-1608). The detailed study of the ammonites faunas will be completed in 1995, J. Guex said.

• **Canada :** The Queen Charlotte Island, on the west coast (Tipper *et al.*, Jurassic Symposium in Poitiers, 1991) provides important data on the Triassic-Jurassic boundary, but the access to the island and outcrops are not easy and so the area will be best for comparison.

SOUTHERN AMERICA

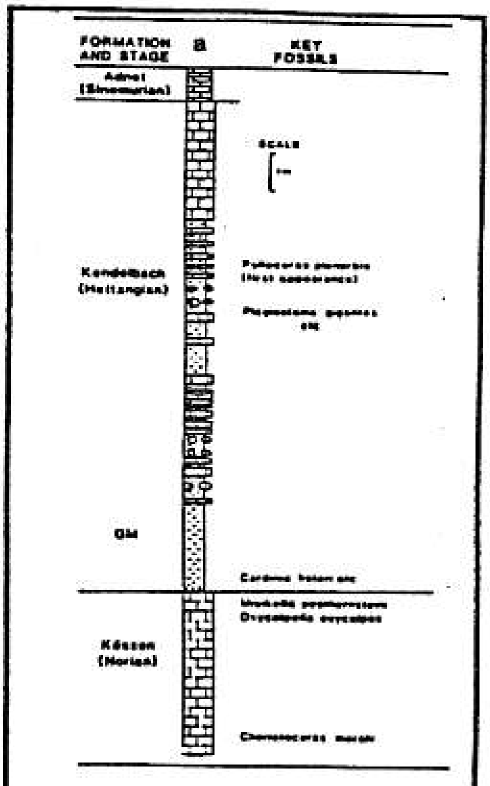
The Andes mountains, especially in Chile and Northern Peru, there are a lot of sections with good exposures of the Triassic-Jurassic passage beds. Several has been described by A. v. Hillebrandt (1987, 1988, 1990, 1991 etc...) and faunas associated to the ammonite are currently studied.

A.v. Hillebrandt has proposed to present the Utcuhamba Valley section, Northern Peru [C], during the IVth Congress on Jurassic Stratigraphy and Geology in Argentina, October 1994. The date of the Congress was unsuitable for the access to the section which is situated in high altitude.



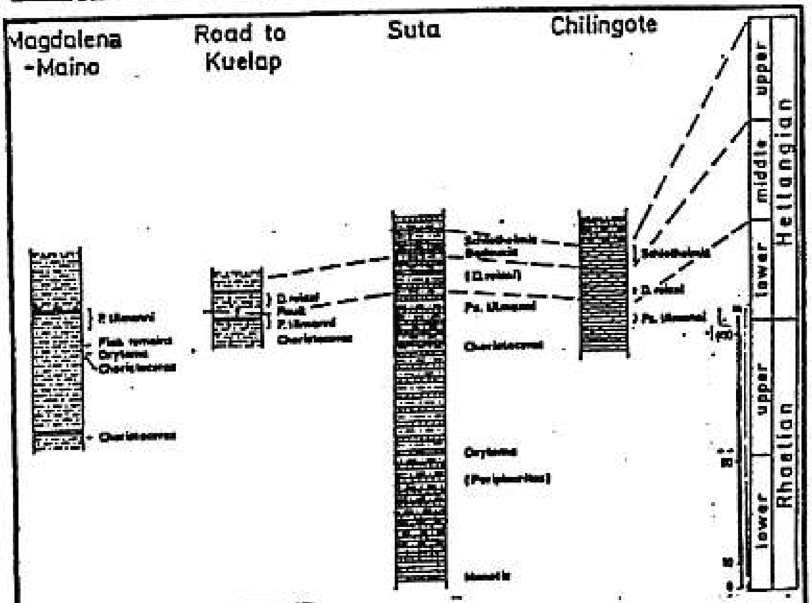

A

Lithostratigraphic succession and chronostratigraphy at St Andries Bay (Warrington et all 1994)




The Kendelbach section from the Kössen to Adnet Limestone, with rock types indicated by conventional symbols. GM, Grenzmergel (A.Hallam,1990)

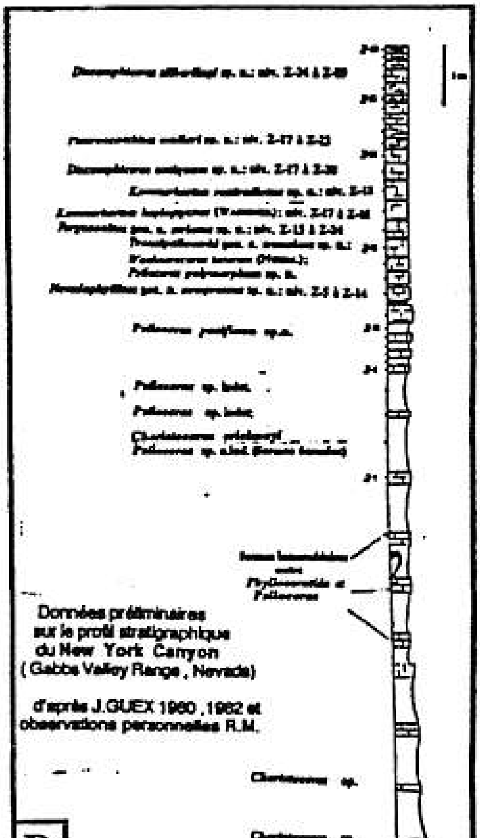
B




C

Coupes dans Utcubamba Valley (Nord Perou)

d'après V.Hillebrandt 1991/94 simplifié




D

# MEETING OF THE INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY MENDOZA, ARGENTINA, Oct. 23,1994
(Enay R.)

## 5 - MEETING OF THE INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY (ENAY R.)

Chairman : Professor R. ENAY, Université Cl. Bernard-Lyon I
Secretary : Professor C. Mangold, idem.

Report of the business meeting, Mendoza, Argentina, October 23, 1994
by the Chairman

The meeting was held during the 4th International Congress on Jurassic Stratigraphy and Geology. Unfortunately, owing to lack of financial support, the secretary was prevented to attend the Congress and the chairman also acted as secretary.

Agenda

1 - Working groups activities
2 - Sequence Stratigraphy and Commitee on Genetic Stratigraphy
3 - Changes concerning membership
4 - Changes concerning the Bureau, present and future
5 - Future Jurassic Congress
6 - Any other questions.

The meeting was declared open at 15.30 and the chairman welcomed those attending. Participants included J. Remane, Chairman of the ICS, members of the ISJS and/or convenors of Boundary WG : Callomon (Callovian BWG), Krishna, Pavia (Bajocian BWG), Pessagno, Riccardi, Volkheimer, Westermann (all voting members), Bloos (Sinemurian BWG), Damborenea, Guy-Ohlson, Gygi, Hall, Herngreen, Morton, Poulsen, Rocha, Thomson (Corresponding members), Warrington (TJ BWG), Elmi (Toarcian BWG), Cresta (Aalenian BWG), Hull (Jurassic Microfossil Group).

Apologies had been received from : Mangold (ISJS Secretary), Cope, Liu, Mouterde, Poulton, Sapunov, Sato, Stevens, Zakharov, Zeiss (Voting members), Atrops, Cecca, Geczy, Grygelis, Gu, Hantzpergue, Khuc, Melendez, Michelsen, Tchoumatchenko, Tipper, (Corresponding members).

### 5.1 - BOUNDARY WORKING GROUPS ACTIVITES

#### 5.1.1. Trias-Jurassic B.W.G.

Dr. Warrington, Secretary, summarized the report he presented the same day in the morning and discussions which ensued during the TJBWG meeting.

#### 5.1.2. Jurassic Stages B.W.G.

The chairman called again the present situation which is lenghtily and clearly exposed in ISJS Newsletter N° 22. Altough we received the last WG convenor answer only by mid-September, we succeeded to achieve the issue just in time for being delivered to the attending members before the ISJS meeting.

The progress by the B.W.G. are quite different. So, the chairman presented the BWG activities according to the advance of studies more than in the normal stratigraphic order. When he was here, situation was exposed by the WG convenor himself. All the WG convenors reports are brought together after the ISJS Meeting report.

5.1.2.1. In situation to present formal proposal soon (Before the 30 th IGC ?) : Bajocian, Callovian, Oxfordian.

- **Bajocian.** G. Pavia summarized the activity of the BBWG and gave the result of the vote concerning the proposal for the Bajocian GSSP, the deadline being the meeting in Mendoza. (See report, p.35). A discussion ensued especially on the suitability of the small group of workers which was finally accepted.

In addition, the formal petition to be adressed to the President of the Portugal Republic, concerning the classification of the Cap Mondego section as a Natural Monument, and adopted by the whole participants, is here enclosed (enclosure 1).

Since the ISJS meeting, the provided calendar has been a few disturbed when the ICS secretary informed chairpersons of all subcommissions " the submission (for ratification of GSSP, prior to the 30 th IGC) need to reach the ICS Chairman not later than September 1, 1995" (letter dated December 15, 1994). The date arranged for the Coimbra meeting cannot be changed. G. Pavia proposed some arrangements which would allow to send the submission of Bajocian GSSP by October 10, 1995. We are waiting the ICS answer.

- **Callovian.** No more informations were given by the BWG convenor J.H. Callomon and no discussion of the item ensued. The ICS deadline was notified January 4, 1995 and we are waiting the poposal for submission.

- **Oxfordian.** The convenor, G. Melendez, was obliged to cancel his attendance to the Mendoza Congress and was unable to present the scheduled communication on the subject. The chairman added some new informations to the report previously published in the ISJS Newsletter n° 22.

By the beginning of October were received two drafts concerning potential Oxfordian GSSPs ; the first, from D. Marchand and D. Fortwengler, is a proposal to select Savournon and Thuoux sections (Serres area), South East France, Hautes-Alpes Department ; the second, from K. Page entitled "a review of the suitability of Redcliff point, near Weymouth, Dorset (Southern England), as a global Stratotype Section and Point (GSSP) for the Callovian-Oxfordian Boundary".

The two proposals have to be completed with other fossil groups and non biological data and formalized following the ICS requirements on the criteria to be fulfilled. G. Melendez has been urgently asked on the progress of the proposals.

5.1.2.2. Progress are made but no formal proposal expected before the 3th IGC : Aalenian, Kimmeridgian, Tithonian.

- **Aalenian.** The report in Newsletter n° 22 was prepared by the new convenor, S. Cresta (Roma, Italy). During the Mendoza meeting he presented some deadlines of the ABWG activity for the next four years. A joint meeting with the Toarcian BWG is scheduled this year in Lyon (see report p. 34 and enclosure 2).

- **Kimmeridgian.** F. Atrops, convenor, did not attend the Congress. In the absence of G. Melendez the scheduled communication on the matter has been suppressed.

The chairman summarized the present situation. Increasing evidences on the correlations with the Boreal/Subboreal sequence prove the Oxfordian/Kimmeridgian boundary in the Tethyan/ Submediterranean province has to be placed earlier. Some more studies are needed to decide the exact level and to select the place of the auxilliary stratotype (ASP), probably in SE France or S. Germany.

In any case the position in Submediterranean province will be still dependent on the correlation with the Subboreal /Boreal one. So, the potential candidate for basal Kimmeridgian boundary stratotype (GSSP) will have to be the most suitable section in the Subboreal/Boreal province, probably in Great-Britain.

No discussion on the matter ensued and no more informations have been received.

- **Tithonian.** Illness prevented the convenor, A. Zeiss, to attend the Congress and F. Cecca, Secretary, was also absent. The chairman summarized the situation from the report in the ISJS Newsletter n° 22. During the Congress, by way of G. Pavia, F. Cecca, communicate to the chairman a joint field trip and meeting with the Jurassic-Cretaceous BWG (depending of the Cretaceous Subcommission) was scheduled for 1995 in SE France or S Germany. But this appears now to be again cancelled ! The TBWG Newsletter N° 6 by the Secretary, here enclose (p. 43) try to revitalize the WG which would have been best placed in the following section.

5.1.2.3. Far to be in situation to elaborate proposals : Sinemurian, Toarcian, Bathonian.

- **Sinemurian** - Report was presented by the convenor, G. Bloos. In his opinion, activities of the SBWG. would be best placed in the preceding section. This did not appear clearly from the report in the ISJS Newsletter n° 22. Nearest proposal(s) of Sinemurian GSSP are expected soon.

- **Toarcian.** Report was presented by the convenor, S. Elmi. A circular letter has been sent to all the possible interested peoples. Three topics are proposed for the future work of the TBWG, priority being given to the definition of a GSSP. A joint meeting and field trip with the Aalenian BWG is scheduled this year in Lyons (see p. 33).

- **Bathonian.** The convenor (and Secretary of the ISJS), C. Mangold, was unable to attend the Congress. The chairman commented on the report in the JSJS Newsletter 22, especially the lack of interest to which the convenor have had to face. The BBWG is currently being renewed and a field meeting is scheduled this year in SE France (Digne). The date will be not in May as previously planned, and probably in September. Te meeting will be maintained whatever would be the number of participants !

5.1.2.4. No progress by no means : Pliensbachian

The convenor, R. Schlatter was returning the commission he received in Lisboa (1987). New convenor is needed.

5.2 - SEQUENCE STRATIGRAPHY AND COMMITTEE ON GENETIC STRATIGRAPHY.

A large place was given to these in ISJS Newsletter 22. In Mendoza two questions were discussed :

5.2.1. ISJSJ participation to the Committee

The bureau wrote to ICS, September 1994, and proposed Dr. O Michelsen, past ISJS Secretary, to be appointed as a member of the Committee on Genetic Stratigraphy. We are still waiting the answer and we asked again for reply, March 1995.

The participants agree and no discussion ensued.

5.2.2. Concerning a WG on Sequence Stratigraphy within the Subcommission ?

The question was discussed some years ago by the past chairman and secretary. So, in connection with the 2.1 item above, two proposals are made :

1) to establish a Working Group on Sequence Stratigraphy

2) to appoint Dr.O. Michelsen as convenor of the WG.

All the participants agree the two proposals.

5.3 - CHANGES/REPLACEMENTS OF WG CONVENORS AND ISJS MEMBERS

5.3.1. - Concerning WG convenors

Aalenian and Bajocian BWG convenors changed by common consent ; respectively A. Goy (Spain) is replaced by S. Cresta (Italia) and A. Galacz (Hungary) will replace G. Pavia (Italia).

The nominations are ratified by the present ISJS members.

S. Cresta was allready active in preparing the report, with G. Pavia, and he played a major part in the printing of the Proceedings of the Aalenian and Bajocian WG Meeting in Marrakech, May 1994. This was presented by the chairman at the opening of the ISJS meeting. S. Cresta received congratulations of all the party and a gift was offered in the name of the participants to the Marrakech meeting.

Callovian WG convenor would to be replaced in the future unless the proposal prepared by J.H. Callomon would to be finally ratified...

Pliensbachian WG. needs new convenor in replacement of R. Schlatter.

5.3.2. - Concerning membership of the ISJS.

The chairman exposed the situation concerning both Voting and Corresponding Members. A large number of the latter (> 50 %) did not answer letters and inquires or did not give any indication for being really active or interested. On the contrary, active Jurassic workers are not members of the Subcommission, many of them acting as WG convenors for several years or recently appointed.

We requested again, first September 1994 and then November 1994, the non-answering Voting (1) and Corresponding (first 23, then 13) and the situation is now as following :

Voting Members. All warranted to be interested and are willing (any "decide") to remain in the Subcommission. I recall again that under the art 8.1. (terms of office) of the Statutes of the ICS : "at the end of each term (e.g. period between two IGC, normally 4 years), one third (1/3) of the Voting Members shall be replaced by new Voting Members". Moreover, the number of Voting Members, including their officers (now 3, see below 4.1), should not excess 20 and we are really 22.

Corresponding Members. Following the last inquiry :

- Concerning present members, a few less than ten did not answer again and will be radiated. Four accepted to be retired and two proposed a colleague to be appointed as Corresponding member.

- We received five other proposals as Corresponding member both directly or presented by present ISJS members.

- Convenors of Trias-Jurassic BWG, Toarcian, Aalenian and Bajocian BWG are not appointed as Corresponding member actually.

Revision of the lists of the members will be made in agreement with the next chairman (see below, 4.1.)

5.4 - CHANGES IN THE BUREAU, PRESENT AND FUTURE

5.4.1. - Vice chair for the end of the term

As chairman said, according to the Revised statutes of the ICS, the Subcommission had to elect a Vice-chairperson for the end of the term (e.g. to the end of 30th ICG, August 4-14 1996).

Prof. G. Pavia accepted the charge and the members of the ISJS attending the IVth Jurassic Congress, in Mendoza, recommanded unanimously prof. G. Pavia.

Voting Members were advised for internal postal vote on the matter, November 15, 1994. The deadline for the vote was December 31, 1994 and 18 answers were received. As non responses are counted as approval votes, the result is : 21 YES, 1 ABSTENTION.

The ICS was requested to confirm the choice by the Subcommission, January 24, 1995.

5.4.2. - Future ISJS Chairman (and officer).

Being in charge of the Subcommission for two terms, the Chairman and the Secretary intend to be retired by the end of the present term. Prof. G. Pavia, Vice-chairman accepted to be appointed as Chairman for the next term (1996 to 2000). The members of the ISJS attending the IVth Jurassic Congress in Mendoza recommanded unanimously Prof. G. pavia.

Candidates for officers of the Subcommission, e.g. Chairperson and Secretary, for the 1996 to 2000 term, will be proposed by the future chairman.

Following the recommandation received from the ICS, dated December 15, 1995 (here enclosed), a postal ballot will be organised within the Voting members in time to provide the ICS Secretary with the candidate for officers of the ISJS not later than July 1, 1995.

5.5 - FUTURE JURASSIC CONGRESS

During the scientific sessions in Mendoza, several possibilities for the place of the next Jurassic Congress were discussed informally.

At last agreement was reached on the one proposal that the next Congress will take place at Calgary or Vancouver, Canada 1997.

5.6 - ANY OTHER QUESTIONS

No other points of additional business were raised.

The chairman thank all the attending peoples for their interest and contributions and declared the ISJS meeting closed at 17.35.

# REPORTS OF THE STAGES BOUNDARY W.Gs

## 6 - REPORTS OF THE STAGES BOUNDARY W.Gs.

### 6.1 - TOARCIAN B.W.G. (ELMI S.)

Dear Colleagues,

The Toarcian Working Group has started lately its work on the Lower Toarcian-Pliensbachian boundary, mainly as most of the interested specialists have been previously engaged in works on the Aalenian and Bajocian lower limits. However, owing to the Stefano CRESTA's kindness, some preliminary discussions have been held during a field meeting on the Italian Toarcian-Bajocian biostratigraphy.

I have received no written answers or remarks on the report that I have distributed before the Mendoza Congress. I hope that it is not an indication of a general lack of interest ! A copy is joined to this letter. I think that the elaboration of biostratigraphical (or zonal) schemes in several countries (or group of countries) has delayed the work on the "golden spike".

However, the following topics can be proposed for our future work.

1) The priority must be given to the definition of a GSSP (= Global Stratotype Section and Point) and locality for the Lower Toarcian boundary.

Three profiles seem to be valuable for the definition :

- in the NW European domain : the *South German* outcrops studied by OHMERT and his colleagues ;

- in the Intermediate Europe-Tethys domain, the *Portuguese* outcrop of Peniche along the coast gives a good reference ; it has been studied in detail since a long time by Portuguese, French and British teams ; it has been visited during the 2d Jurassic Symposium (1987) ;

- in the Tethyan domain, the best outcrop seems to be the *Taksempt* profile along the road crossing the Northern limit of the High Atlas (Midelt Atlas) ; it has been visited during the Marrakesh meeting of the Aalenian and Bajocian Working Groups (June 1994) ;

It must be stressed that the Peniche and Taksempt profiles are perennial outcrops along natural or stabilized slopes.

2) The biostratigraphic and zonal successions has been worked with much attention during the last five years. The British succession has been revised by Howarth (1992). The Iberian Toarcian has given an opportunity to compare Medio-european and Tethyan faunas (GOY *et al.*) and, in the Apennines, a new and enriched survey has been made under the CRESTA's leadership. The French Jurassic Working Group has also made a revision of its 1971 standard and has established comparisons with the Tethyan realm but the definitive papers have not yet been printed and the Poitiers volume is just out of print now (ELMI *et al.*). PAGE is also progressing with the ultimate preparation of a synthetic paper on the Toarcian zones.

It seems that the problem of correlating the different provinces and subprovinces can be at least evoked during the next meeting.

3) A less urgent question concerns the <u>informal subdivisions of the stage into "substages"</u>. There are two main possibilities : three fold (Lower, Middle, Upper) or binary (more or less : Whitbian - Yeovilian).

I must stress that the Working Group is officially only in charge of point n° 1 in the scope of the Subcommission instructions but it seems usefull to take the opportunity of the forthcoming meetings to have an overall discussion on the stratigraphic problems of the Toarcian stage. We must also pay attention to the overseas correlations. The correlations with the Western Americas are of primordial importance for all world-wide reconstructions.

As a conclusion, I can propose a meeting of the TWG. After a consultation with CRESTA, I propose that the first formal meeting will be held in Lyon (10-12 th July 1995). As I have not received any proposal for the goldenspike, the main topic will be to establish a preliminary comparison between the three profiles listed here above. This meeting can be widened to an informal discussion on the Lower Aalenian limit as several participants are concerned with both problems.

Lyon has been selected for the meeting as it is well connected by rail and air, and as it is central (and sligthly cheaper than many capitals). One day excursion will be organized (Beaujolais, Lyonnais, Southern Jura).

A rapid answer to the enclosure 2 will be welcome !

S. ELMI
Convenor of the TWG

* Note of the editors : Lyon meeting has been cancelled and will be replaced by a joint meeting of the Toarcian-Aalenian WGs (13-19 September, 1996) - See p. 33 and enclosure 3.

6.2 - <u>AALENIAN B.W.G. ( CRESTA S.)</u> (see enclosure n°3)

Dear Colleagues,

We are all involved in a work with the following final goals :

- GSSP selection
- chronostratigraphical subdivisions (Substages, Chronozones) ;
- ammonite biostratigraphic scales and their correlations with the Standard scale ;
- integrated stratigraphical scales.

As most of you surely know, a large number of activities have already been started, either within the WG or independently, within national research projects and international cooperation. The results of such activity are described in the Proceedings of Piobbico (1988), Skye (1911), Marrakech (1994) meetings and in those of ISJS (Erlangen, Lisboa, Poitiers, Mendoza).

I find it however necessary to point out some deadlines to our activity :

- 1995 - June, *Aalenews* first issue ;
- 1996 - (July ? September ?), WG meeting ;
- 1997 - ballot on GSSP proposals ;
- 1998 - 5 th ISJS Congress (Vancouver) submission of the results of the GSSP ballot and chronostratigraphical subdivision of the Stage.

At present, two sections have been proposed as GSSP : *Wittnau* (Oberrhein area, South-West Germany, OHMERT & ROLF, 1994 cum bibl.) and *Fuentelsaz* (Iberian range, Spain ; GOY *et alii*, 1994 cum bibl.). Integrated biostratigraphical data (ammonites, forams, ostracods) are available for both sections ; for one of them (Wittnau) we have also geochemical data (MARTIN, 1994), for the other, further biostratigraphical elements (brachiopods, nannofossils) are available. Recently W. OHMERT informed me that the core drilling in the Wittnau section has been started (46 meters already cored !) in order to allow the best study conditions for micro and nannofossils, as well as for magnetostratigraphy.

I think that all this will be enough to wake up your curiosity, at least to return the enclosed application form of "responsibility assumption" for your future involvement in WG activities.

Since our "seats of work" are far from each other, most of the activities will be worked out by mail ; your decision of proposing yourself as a voting member will therefore coincide with your will of answering quickly to the questionnaires I'll send to you (enclosure 4).

With the best wishes for a Happy New Year.

6.3 - BAJOCIAN B.W.G. ( PAVIA G.)

Dear Friends,

This is my last communication as the coordinator of the Bajocian Working Group ; my next activity will concern only the formalisation fo the proposal on the Bajocian GSSP. The nomination of A. Galacz for coordinating the BWG has been approved by the Subcommission in Mendoza and thus any further communication will be from and to :

Andras GALACZ
Department of Paleontology, Eötvös University
Ludvika tér 2
H-1083 BUDAPEST
Fax : 36 1 2101089

Here you can find the summary of the report I presented during the meeting of the Jurassic Subcommission in Mendoza on 23rd October 1994. It will be inserted in the next (n. 23) Newsletter by the Chairman R. Enay

Giulio Pavia

SUMMARY OF THE REPORT

The activity of the Bajocian Working Group in 1994 has been summarized by the retiring coordinator G. PAVIA. An ample report on this activity was published in the Newsletter n° 22 of the International Subcommission on Jurassic Stratigraphy. The main point discussed during the meeting of the ISJS in Mendoza (23 rd october 1994) was concerning the proposal for the Bajocian GSSP.

In July 1994, voting-papers had been mailed to 79 colleagues, both currently working on Bajocian stratigraphy and acting as coordinators of the Jurassic Subcommission working groups. The ballot was regarding the triple choice : (1) selection of the Bearreraig Bay section for fixing the Bajocian GSSP ; (2) selection of the Cap Mondego section for fixing the Bajocian GSSP ; (3) abstention meaning that a different section would have to be examined and proposed. Options (1) and (2) were documented by reports drawn by respectively U.K. and Portugal colleagues.

Up to the meeting in Mendoza (deadline for the ballot), 35 answers have been returned : 7 (20 %) for Bearreraig Bay section; 23 (65,7 %) for Cap Mondego section ; 5 (14,3 %) abstentions.

<u>The Cap Mondego section has been thus elected by a majority as the site where the Bajocian GSSP is to be fixed.</u>

By coincidence, during the meeting, Portuguese colleagues submitted to the President of the ICS and to the President of the ISJS the request, dated on 26 th May 1994, of a formal petition to be addressed to the President of the Portugal Republic. It concerns the classifications of the Cap Mondego section as Natural Monument for "guaranteing its preservation and keeping it free from urbanistic pression".

G. Pavia has undertook to formalize the proposal of the Bajocian GSSP within the early 1996. In such a way it could be rendered for ballot to the voting-members of the ISJS and of the ICS, before the final submitting at the IUGS in China (August 1996).

As far as the plan of operation was concerned, the coordinator pointed out the complementary information to two sections allow. Actually, the Bearreraig Bay section precisely documents the evolutionary lineage of the ammonite genus *Hyperlioceras* which the Bajocian lower boundary is to be fixed on ; the Cap Mondego section is the most suitable one for direct correlation based on ammonite associations. It is then proper to arrange a joint document with two formal proposals :

Cap Mondego section as the Global stratotype (GSSP)
Bearreraig Bay section as the Auxiliary stratotype (ASP)

For this purpose, a small group of workers has been proposed and accepted ; it will act in homogenizing biostratigraphic and mainly taxonomic informations of the two sections. This group is composed by people who actually worked on the sections : S. Fernandez Lopez, M.H. Henriquez, R. Mouterde, R. Rocha, B. Chandler, N. Morton, and G. Pavia as the coordinator ; the collaboration of J. Callomon is also expected. The group will meet in Coimbra on September 1995, so that there is the possibility to complete the work within January 1996.

P.S. Who is interested to receive the Proceeding of the Aalenian and Bajocian WG Meeting (Marrakesh, May 1994), please ask to

dr. Stefano CRESTA
Sevizio Geologico Nazionale
Largo Santa Susanna 13
00187 ROMA (Italy)

The volume is free of charge. Add 5 U.S.$ to the request for mailling cost.

6.4 - BATHONIAN B.W.G. - (MANGOLD C.)

1 - Reorganization of the Bathonien W.G.

The reorganization of the BWG is in progress. The convenor received 42 answers to the Circular letter and inscription form sent directly to about 60 scientist interested by the Bathonian or inserted in Newsletter n° 22 and CFS strati. Info n° 8.

The members of the renewed Bt. W.G. are concerned by following topics

• Specialities

| | |
|---|---|
| Biochronology and biostratigraphy | 32 membres |
| Paleontology | 34 |
| Biogeography | 26 |
| Ecology | 13 |
| Sequence stratigraphy | 12 |
| Sedimentology | 4 |
| Geochemistry | 2 |
| Magnetostratigraphy | (1) ? |

• Palaeontologic groups

| | | |
|---|---|---|
| Ammonoids | | 28 membres |
| Bivalves | | 4 |
| Foraminifers | | 4 |
| Ostracods | | 4 |
| Dinoflagellates | | 2 |
| Brachiopods | | 2 |
| Echinids | | |
| Coleoids | | |
| Acritarchs | } | 1 |
| Eadiolarians | | |
| Traces | | |

• Geographic interests : Europe (28), Tethys (19), World (6), Northern Russia Siberia (3), South and Central America (2), North America (1), SW-Pacific (1).

• Creation of a leading team

Working with the convenor we had to choice 6 members representing each the major specialities and palaeontologic groups : Ammonites and biochronology (G. Dietl), Brachiopods (Y. Alméras), Foraminifers (C. Ruget), Ostracods (A.M. Bodergat), Dinoflagellates (N. Poulsen), taphonomy and sequence stratigraphy (S. Fernandez-Lopez), Geochemistry (M. Renard).

All these people are in agreement with this choice.

2 - Field trip and workshop meeting in Digne (13 th-15 th October, 1995)

This meeting previously planed in May 1995 will be held this autumn, October 13th-15th, 1995 in the Réserve géologique de Haute-Provence, Centre de Géologie Saint-Benoît.

A registration form has been sent to all the registered members of the Bathonian working group (Bt. W.G.)

• The participants will be able to visit the Bathonian outcrops of the Digne region, especially the Bas Auran section which was proposed as a G.S.S.P. candidate section in Lisboa (Innocenti *et al.*, 1988-1989)

• Ammonites collected in Digne sections by C. Sturani, G. Pavia and H.S. Torrens will be exposed for comparison.

• Short contributions on Bathonian stratigraphy, especially on other G.S.S.P. candidate sections are welcome.

The publication is foreseen in *Documents de Lyon*, only if the total number of printed pages is 100 p.

The deadline for definitive manuscript is October 15 th, during the meeting.

The editorial staff needs two copies of the manuscript and a MAC computer diskette (MAC II, LASER II NT, WORKD 4, PAGE MAKER).

### 6.5 - OXFORDIAN B.W.G. - (MELENDEZ G.)

Since the last Oxfordian-Kimmeridgian Working Group joint Meeting (Lyon 1994) efforts continue by the active members of the Group in studying, discussing and selecting an appropriate GSSP candidate for the basal Oxfordian. The aim of this Group is to get the most suitable GSSP candidate selected (by internal voting among the most active members of the Group) by August 1st 1995, in order to be able to submit the definitive proposal by means of the Jurassic Subcommission to the ICS Secretary by September 1st 1995, according to the ICS Secretary requirements (cfr. letter by KH Gohrband, December 15, 1994).

Two main groups of proposals for Oxfordian GSSP have so far been presented, besides the initially submitted section of Osgodby Nab, Scarborough by J.H. Callomon at the Ist. OWG Meeting (CALLOMON, 1990). The first one, by Kevin N. PAGE (Peterborough), first presented at the Lyon Meeting (PAGE, 1994) and then, as a formal report. After revising the formerly proposed sections at NE England, Scarborough, the author stands for the section at Redcliff Point, Weymouth, Dorset (S England) since it shows a more complete and expanded sequence than those of Scarborough coast and hence, "it is considered to be the best available GSSP candidate in Britain".

The second proposal, by Didier MARCHAND and Dominique FORTWENGLER, also presented during the Lyon Meeting during the Field excursion by SE France, includes the double outcrop of Thuoux and Savournon, in the Vocontian basin, near Serres, SE France (FORTWENGLER & MARCHAND, 1994). An extremely expanded sequence through the uppermost Callovian and lowermost Oxfordian makes these sections most suitable for a detailed ammonite succession analysis and biostratigraphy. Main palaeontological and biostratigraphic results are summarized by the authors in their report. A study on the Dinoflagellate successions in both outcrops was carried out by Niels POULSEN and submitted at the Meeting (POULSEN & JUTSON, 1994). It showed the better conditions and appropriateness of the Savournon outcrop for microfossil analysis and the good biostratigraphic results at the Callovian-Oxfordian boundary. Moreover an initial, detailed magnetostratigraphic sampling across the Callovian-Oxfordian boundary in both outcrops has been carried out and is at present under study (OGG *et al.*, in prep.).

Copies of both proposals having already been sent to all active OWG members the next step should be to quickly return the personal vote or opinion to the WG convenor on the most suitable section to be proposed as Oxfordian GSSP. As we are quickly running out of time the convenor urges all members to return their votes **as soon as possible.** It should be noted that this internal voting within the OWG has no official status within the ICS but, as the majoritary opinion of Oxfordian specialists, will be a solid basis for the official votation by the voting members of the ISJS.

According to the ICS Secretary General requirements, all submissions of GSSP proposals should be at the ICS by September 1st 1995. Therefore, the convenor has established an undelayable deadline by **July 20th 1995** to receive opinions and internal voting by OWG members. After this date all documentation will be sent to the ISJS Chairman to carry on with the official process of voting.

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CALLOMON J.H.C. 1990 - On the definition of the basal boundary stratotype of the Jurassic Oxfordian stage. In: Meléndez G. ed: First Oxfordian Meeting. Zaragoza 1988. *Publ. Sem. Pal. Zaragoza*, 2: 119-127.

FORTWENGLER D., MARCHAND D. 1994 - Upper Callovian (Lamberti Zone) to lower Oxfordian (Mariae Zone) under "Terres noires" facies in the Savournon and Thuoux sections. In: Atrops, F. *et al.* (eds.): IV Oxfordian-Kimmeridgian Working Groups Meeting, Lyon and SE France Basin. Guide-Book and Abstracts. Lyon, 1994: 95-99; 103-106.

PAGE K.N. 1994 - A Review of the suitability of Key British Callovian-Oxfordian and Oxfordian-Kimmeridgiant sites as global stratotype sections and points (GSSPs) for stage boundaries. In: Atrops, F. *et al.* (eds.): IV Oxfordian-Kimmeridgian Working Groups Meeting, Lyon and SE France Basin. Lyon, 1994, Abstracts: 15-16.
POULSEN N. JUTSON D. 1994 - Biostratigraphic (micropalaeontological and Palynological) study of a potential candidate for the Upper Jurassic Oxfordian stage basal boundary stratotype (GSSP). IV Oxfordian-Kimmeridgian Working Groups Meeting, Lyon and SE France Basin. Lyon, 1994, Abstracts: 17.

The following members have received the document with the Oxfordian proposals and are urgently encouraged to fill in the questionnaire overleaf and return it as quick as possible (express mail or fax) to the convenor (address below), **no later than July 20th**. The convenor will thank the receivers of this document to send it to other ISJS members non-mentioned in this list, who might be also interested in giving their opinion. It must be kept in mind that the results of this votation have to be sent to the ISJS chairman by August 1st.

ATROPS F. (Lyon); AURELL M. (Zaragoza); BENETTI, A. (Lessinia,Verona); BOULLIER, A. (Besançon); CALLOMON, J.H.C. (London); CARIOU, E. (Poitiers); CHECA A. (Granada); COE, A. (Durham); COURTINAT, B. (Lyon) COX, B. DIETL, G. (Stuttgart); ELMI, S. (Lyon) ENAY R. (Lyon) FORTWENGLER D. (Dieulefit); FÖZY I. (Budapest); GLOWNIAK E. (Warsaw); GYGI R. (Basel); HANTZPERGUE P. (Poitiers); HILLEBRANDT A.v (Berlin); KRISHNA J. (Benares); LOMINADZE T.A. (Tbilisisi); MALINOWSKA L. (Warsaw); MANGOLD Ch. (Lyon); MARCHAND D. (Dijon); MARQUES B. (Lisbon); MARTIRE L.(Torino); MATYJA B. A. (Warsaw); MÖNNIG E. (Coburg); MICHELSEN O. (Ärhus); MYCZYNSKI R. (Warsaw); OGG J. (Purdue); PAVIA G. (Torino); POULSEN N. (Copenhagen); POULTON T. C. (Calgary); RICCARDI A.C. (La Plata); ROCHA, R. B. (Lisbon); SAPUNOV I.G. (Sofia); SARJEANT W.A.S. (Saskatchewan); SEQUEIROS L. (Córdoba); SMELROR M. (Trondheim); TARKOWSKI R. (Krakow); SCHWEIGERT G. (Stuttgart); TCHOUMATCHENKO, P. (Sofia) THIERRY J. (Dijon); TINTANT H. (Dijon) WIERZBOWSKI A. (Warsaw); WESTERMANN G.E.G., (Ontario) WRIGHT J. (London, Egham); ZEISS A. (Erlangen); ZIEGLER B. (Stuttgart).

### 6.6 - KIMMERIDGIAN B.W.G. - (ATROPS F.)

Since the last Working Group Meeting (Lyon 1994) efforts continue by the active members of the Group in studying and discussing an appropriate GSSP candidate for the basal Kimmeridgian stage. The aim of this Group, due to the strong observed ammonite provincialism between the Boreal and Tethyan Realms at the turn of the Oxfordian and Kimmeridgian stages is to select the most suitable GSSP candidate showing the best correlation possibilities between the Boreal and the Tethyan Realm. This process seems to make necessary, besides the selection of a formal stratotype section in either the Boreal or the Tethyan Realm, the proposition of a further, complementay reference section.

Choosing the best candidate section for the lower boundary stratotype in the boreal areas should be supported by a detailed study of the stratigraphic successions of genera *Pictonia* and *Amoeboceras*. On the other hand, the choice of an idoneous section in southern Europe has to be preceeded by the precise study of the *Orthosphinctes* (Ataxioceratinae) succession and the correlative *Amoeboceras* accompanying fauna. In a recent report by Kevin N. Page and Beris M. Cox, the authors select as potential GSSP candidate for the Kimmeridgian stage, in Great Britain, the section of South Ferriby (Lincolnshire, N England) and also, as a secondary reference, Staffin Bay in Scotland rather than the classical locality of Ringstead Bay at Dorset

(Page, 1994). In a separate report, F. Atrops proposes the localities of Crussol and Châteauneuf-d'Oze (SE France) as possible alternative, or secondary reference sections in the Submeditarranean Province.

The proposed successions in SE France, besides supplying a highly detailed biostratigraphic resolution at the Oxfordian-Kimmeridgian boundary, permit a good biostratigraphic correlation with the true Mesogean Province by means of Ataxioceratidae and Oppeliidae. Yet representatives of boreal Perisphinctids or Amoeboceratids are rare to completely absent, which has impedded so far a close correlation with the boreal type-area.

Sections in S Germany (Swabia and Franconia) might also stand as good GSSP candidates because of their rich ammonite succesions, mainly of submediterranean character, across the boundary, and the higher share of Amoeboceratids which would allow a better interprovincial correlation. Yet they are still poorly known, the *Amoeboceras* succession in this area still lacking a detailed study.

The recent identification of a well-defined *Amoeboceras bayi* assemblage at the base of Platynota Zone in SE France and northern Swizerland by Atrops *et al.* (1993) (= Bayi Horizon; Atrops, 1994) allows a close correlation between the base of Platynota Zone and the upper part of Baylei Zone. This would mean that the base of the Baylei Subzone does not correspond to the base of Platynota zone but to a probably much lower level, probably at the base of the Galar Subzone (Atrops & Meléndez, 1994) or even Planula Zone (Wierzbowski, 1991). This point is still the subject of research.

The problem of the precise position of the Oxfordian-Kimmeridgian boundary in the Submediterranean Province and its correlation with the Boreal Realm appears still unresolved. It largely depends on the precise determination of the first *Amoeboceras* recorded in Britain at the base of the Baylei Zone, Densicostata Horizon, in association with the first *Pictonia densicostata* (SALFELD) and its possible equivalent in the Submediterranean Province. It follows, as a conclusion, that the main question to resolve before getting to an agreement on a formal proposal for the basal Kimmeridgian GSSP is a problem of correlation between the base of the Baylei Zone (Densicostata Horizon) in Britain (Boreal Realm) and the equivalent level (within the Planula Zone) in the Submediterranean Province.

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WIERZBOWSKI A. 1991 - Biostratigraphical correlations around the Oxfordian-Kimmeridgian boundary. *Acta Geologica polonica,* Warszawa, 41, (3-4): 149-155.

## NEXT WG MEETING AND ACTIVITIES

The next Oxfordian-Kimmeridgian Working Group joint Meeting is intended to take place in 1996 or 1997 either in England or in Germany, in order to bring the WG members an opportunity to visit some of the most relevant boundary sections in the Subboreal/Submediterranean Province. Initial contacts with our colleagues in England and Germany are on. However, the WG members are requested to give their personal opinions on the details of the Meeting by quickly filling in and returning the questionnaire below (enclosure 5).

Copies of both groups of proposals, in Britain and SE France, have been sent to all active KWG members. The convenor of the Group will also acknowledge any opinion on both problems: (1) The biostratigraphic correlation between the base of Baylei Zone and its equivalent level in the submediterranean Planula Zone, and (2) the selection of the most suitable section for GSSP candidate and/or reference section. Comments may be also added in the same questionnaire.

The following members have received the document with the Kimmeridgian proposals and are encouraged to send a quick answer to the convenor of he Group (address below). The convenor will thank the receivers of this document to send it to other ISJS members non-mentioned in this list, who might be also interested in giving their opinion.

AURELL M. (Zaragoza); BENETTI, A. (Lessinia,Verona); BOULLIER, A. (Besançon); CALLOMON, J.H.C. (London); CARIOU, E. (Poitiers); CECCA F. (Rome); CHECA A. (Granada); COE, A. (Durham); COPE J.C.W. (Cardiff); COURTINAT, B. (Lyon); COX, B. (Keyworth); DIETL, G. (Stuttgart); ENAY R. (Lyon); FÖZY I. (Budapest); GEYSSANT J. (Paris); GEYER O.F. (Stuttgart); GYGI R. (Basel); HANTZPERGUE P. (Poitiers); KRISHNA J. (Benares); KUTEK J. (Warsaw); MALINOWSKA L. (Warsaw); MARQUES B. (Lisbon); MARTIRE L.(Torino); MELENDEZ G. (Zaragoza); MICHELSEN O. (Århus); MYCZYNSKI R. (Warsaw); OGG J. (Purdue); OLORIZ F. (Granada); PAVIA G. (Torino); POULSEN N. (Copenhagen); RICCARDI A.C. (La Plata); ROCHA, R. B. (Lisbon); SAPUNOV I.G. (Sofia); SARJEANT W.A.S. (Saskatchewan); SARTI C. (Bologna); SCHAIRER G. (München); SCHWEIGERT G. (Stuttgart); SEQUEIROS L. (Córdoba); SMELROR M. (Trondheim); TCHOUMATCHENKO, P. (Sofia) TINTANT H. (Dijon); WIERZBOWSKI A. (Warsaw); WRIGHT J. (London, Egham); ZEISS A. (Erlangen); ZIEGLER B. (Stuttgart).

6.7 - TITHONIAN B.W.G. - (CECCA F.)

NEWSLETTER N° 6

A - Report and news

1 - About the Field trip in Southern France...

In the Newsletter n° 5 we gave information about the possiblitity to visit possible candidate sections for the stratotype of the Kimmeridigian/Tithonian boundary in Southern-East France. Since 1991, in the occasion of the Poitiers Symposium, it was decided to organize a field-trip of all the Upper Jurassic Working Groups in South-East France. Finally, the field trip has been organized June 1994 for the Oxfordian and Kimmeridgian Working Groups only because of logistic problems.

On the other hand in the Newsletter n° 5 we wrote : "... ZEISS, ATROPS and ENAY are now studying a solution for a field trip in 1995. The decision will be advertised in the next Newsletter."

Our french colleagues still have problems to organize the excusion for 1995. Thus, we can only hope to visit these french candidates sections in 1996. ZEISS and SCHWEIGERT are studying the possibility ot organize a field meeting in Southern Germany in 1997.

We ask all colleagues who have possible candidate sections for the Kimmeridgian/Tithonian boundary to contact us in order to discuss the possibility to organize a field-trip.

2 - Re-Organization of the ISJS Working Groups

As exposed by the President of the ISJS in different letters sent this year to the WG convenors and finally in the Newsletter n° 22, the conclusions of the International Commission on Stratigraphy (ICS) about the activity of the different Subcommission show that only a few proposals for GSSP have been presented so far for approval. Concerning Jurassic, only two stage boundary sections will be proposed to ICS for discussion in Bejing International Congress (1997).

The activity of a Working Group is to carry on research on a special topic, in our case the Kimmeridgian-Tithonian boundary. The scope is to reach an agreement to propose a GSSP to the ICS.

Concerning our Working Group, we know where we want to draw the boundary, i.e. at the base of the Hybonotum Zone but, as exposed in the Newsletter 5, we are still unable to propose a continuous boundary stratotype section with sufficient faunal content !!!

The successful experience of the Bajocian Working Group, which proposes now the Cabo Mondego section, shows that the participants' suggestions on possible stratotype section and then the excursions on them is the best way to proceed.

Thus, we have to concentrate our effort on this problem and to be able to propose a GSSP in the next five years. Obviously, it means that we have actually to do something for that. However, sometimes it happens that we do not have the possibility to carry out this kind of research because of other professional projects or duties, changes in research field etc.

Most of the participants of our Working Group were totally inactive since the beginning of our histoiry. It is hard to compile the "K/T Library" because almost everybody forgets to send any communications on his papers on topics related to the Kimmeridgian/Tithonian boundary or simply to the Tithonian.

We intend to re-build the Working Group and to limit it to the active members only. To be sure and in order to avoid an authoritarian behaviour, we ask you to fill the enclosed form and to send it back to the Secretary, F. CECCA, by May 1995 (form not include, the dead-line being fulfilled).

Nevertheless, we will cancel from the Directory of our WG the colleagues who do not answer.

The colleagues who will give a positive answer are requested to give us suggestions for possible stratotype of auxiliary sections and ideas about the potential organization of WG excursion to visit them.

B - Participants contributions

We present the second contribution from our participants since the beginning of our activities. We hope that this report will stimulate you to communicate news and results to the Working Group. See scientific contributions (p. 000).

NEWSLETTER N° 7

A - ABOUT THE FIELD MEETING IN SOUTHERN FRANCE

Francois ATROPS is re-sampling the sections of Canjuers and Crussol which could be good candidates for the stratotype-sections of the Kimmeridigan/Tithonian boundary. He also sampled these sections together with Jim OGG for magnetostratigraphic purposes. The ammonite palaeontologic and biostratigraphic study is in progress and ATROPS hopes to publish something before the end of this year .We can visit these section next year. There will be also time for oral contributions, discussions on the boundary as well as visits of the collections. The period will be the end of september. All the Working Group members who are interest to this field meeting must contact Francois Atrops directly. His phone, fax and address are indicated below. A first circular will be send out by F. Atrops by September 1995.

B - OTHER FILED MEETINGS.

Frederigo OLORIZ can organize a field meeting for our Working Group in Southern Spain (Subbetic Zone), in september-october 1997. ZEISS and SCHWEIGERT will then try to organize a field meeting in Southern Germany in 1998 (possibly in coincidence with a meeting of the Working Group on the Oxfordian/Kimmeridgian Boundary). We will have more details next year.

C - THE NEW DIRECTORY OF OUR WORKING GROUP

Following the indication exposed in the ISJS Newsletter n° 22 and resumed in our Newsletter n° 6 we sent a form to reduce our Working Group to the active members only. We received 25 answers. The new directory is listed below.

Dr. ASCOLI P.
Atlantic Geoscience Centre
Bedford Institute of Oceanography
P.O. Box 1006 - Dartmouth
Nova Scotia B2Y 4A2 - CANADA
Phone: 1-(902) - 4262736
Fax: 1- (902) - 4264465
**Fields of interest:** Foraminifera and Ostracoda, Late Jurassic and Early Cretaceous (Canadian Atlantic Shelf).
**Suggested sections:** none

Dr. ATROPS F
Université Claude Bernard -Lyon I
Centre des Sciences de la Terre
27-43 bd du 11 novembre
F-69622 Villeurbanne Cedex - FRANCE
Phone: (33) 72431341
Fax: (33) 72448382
**Fields of interest:** Ammonites, Biostratigraphy, SE France, Morocco (Rif).
**Suggested sections:** Boundary stratotype in Crussol (Ardèche) or Canjuers (Provence) both in SE France.

Dr. BORZA V.
Geologicky ustav
Dionyza Stura - Mlynska dolina 1
81704 Bratislava - SLOVACK REPUBLIC
Phone: (42) - 7 - 3705322
Fax: (42) - 7 - 371940
**Fields of interest:** Microfacies and microfossils (Upper Jurassic-Lower Cretaceous).
**Suggested sections:** none

Dr. CARACUEL MARTIN J. E.
Dpt. Estratigrafia y Paleontologia
Facultad de Ciencias - University of Granada
Av. Fuentenueva S/N
18002 Granada - SPAIN
Phone: (34) - 58 - 243345
Fax: same
**Fields of interest:** Paleontology, sedimentology (carbonates), Ecostratigraphy
**Suggested sections:** none.

Dr. CECCA F.
Servizio Geologico Nazionale
Largo S. Susanna 13
I-00187 Roma - ITALY
Phone: (39) - 6 - 4874751
Fax: (39) - 6 - 4827338
E-mail: F.Cecca@agora.stm.it
**Fields of interest:** Ammonites, Biostratigraphy, Palaeobiogeography.
**Suggested sections:** Boundary stratotype in Canjuers (Provence) or Crussol (Ardèche) both in SE France.

Dr. COBIANCHI M.
Dip. Scienze della Terra
via Abbiategrasso 217
27100 Pavia - ITALY
Phone: (39) - 382 - 505897
Fax: (39) - 382 - 505890
**Fields of interest:** Calcareous nannofossil biostratigraphy
**Suggested sections:** none

Dr. Coe A. L.
Unbiversity of Durham
Dept. Geological Sciences
South Road Durham DHI 3LE - UNITED KINGDOM
Phone: (44) - 191 - 3742535
Fax: (44) - 191 - 3742510
**Fields of interest:** Sedimentology, Geochemistry, Sequence stratigraphy, Upper Jurassic of Europe and Argentina.
**Suggested sections:** probably auxiliary section(s) in the Kimmeridge Clay, Dorset Coast UK, *autissiodorensis-elegans* zonal boundary.

Dr. Cox B. M.
British Geological Survey
Nicker Hill, Keyworth
Nottingham NGI2 5GG - UNITED KINGDOM
Phone: 44 - 115 - 9363100
Fax: 44 - 115 - 9363200
**Fields of interest:** Biostratigraphy and Macropalaeontology.
**Suggested sections:** Kimmeridge Bay, Dorset, UK.

Prof. Enay R.
Université Claude Bernard -Lyon I
Centre des Sciences de la Terre
27-43 bd du 11 novembre
F-69622 Villeurbanne Cedex - FRANCE
Phone: (33) 72431341
Fax: (33) 72448382
**Fields of interest:** Stratigraphy, Palaeobiogeography, Ammonites, Upper Jurassique.
**Suggested sections:** SE France: Crussol or Canjuers or other suitable localities in the same area.

Dr. Fozy I.
Természettudomanyi Muzeum
Fold-és Oslénytar
Pf.330 - Budapest V
H-1370- HUNGARY
Phone: (36) - 1 - 1383905
Fax: (36) - 1 - 1138820
**Fields of interest:** Upper Jurassic - Lower Cretaceous ammonites.
**Suggested sections:** none.

Dr. Geyssant J.R.
Université P. et M. Curie-Paris VI
Dépt. Géologie Sédimentaire (T 15-E 4)-Case 117
4, place Jussieu
F-75252 Paris Cedex 05 - FRANCE
Phone: (33) - 1 - 44274905
Fax: (33) - 1 - 44273831
**Fields of interest:** Kimmeridgian-Tithonian ammonites.
**Suggested sections:** SE France.

Dr. Herngreen G. F. W.
Rijks Geologische Dienst
P. O. Box 157
NL-2000 AD Haarlem - THE NETHERLANDS
Phone: (31) - 23 - 300359
Fax: (31) - 23 - 401754
**Fields of interest:** Palynology, (interregional) correlation NW Europe - Tethyan Realm, biostratigraphy.
**Suggested sections:** Hen Cliff, Kimmeridge, Dorset (U. K.)

Dr. Krobicki M.
Univ. Mining and Metallurgy
Dept. Stratigraphy and Regional Geology
al. Mickiewicza 30
30-059 Krakow - POLAND
Phone: (48) - 12 - 339100 (24-09)
Fax: (48) - 12 - 332936
E-mail: krobicki@geol.agh.edu.pl
**Fields of interest:** biostratigraphy, brachiopods, paleoecology.
**Suggested sections:** none.

Prof. Kutek J.
Warszaw University - Institute of Geology
Al. Zwirki i Wigury 93
O2-089 Warszawa - POLAND
Phone: (48) - 22 - 223051
Fax: (48) - 22 - 220248
**Fields of interest:** Stratigraphy (chiefly Upper Jurassic and Lower Cretaceous), tectonics.
**Suggested sections:** Auxiliary section for the Kimmeridgian-Volgian boundary to be selected in central Poland as for the classical Volgian (that of cratonic Poland and Russian platform, not that of Arctic Russia).

Dr. Leanza H.
Servicio Geologico Nacional - CONICET
Avda. Julio A. Roca 651 - Piso 10
1067 Buenos Aires - ARGENTINA
Phone: (54-1) 349 3146
Fax: (54-1) 349 3160
**Fields of interest:** Ammonite biostratigraphy.
**Suggested sections:** none.

Prof. MATSUOKA A.
Dpt. Earth Sciences
Faculty of Gen. Education Niigata University
Niigata 950-21 - JAPAN
Phone: (81)-25-2626376
Fax: (81)-25-2627278
E-mail: matsuoka@geobio.ge.niigata-u.ac.jp
**Fields of interest:** Radiolarian biostratigraphy.
**Suggested sections:** none.

Dr. OLORIZ SAEZ F.
Dpt. Estratigrafia y Paleontologia
Facultad de Ciencias - University of Granada
Av. Fuentenueva s/n
18002 Granada - SPAIN
Phone: (34) - 58 - 243345
Fax: same
**Fields of interest:** Ammonite palaeontology and biostratigraphy; Ecostratigraphy and facies analysis; tintinnids.
**Suggested sections:** Southern Spain (Subbetic Zone). Excursion in 1997.

Dr. PATHAK D. B.
Dpt. Geology - Banaras Hindu University
P3/11 Ravindra Puri
221005 Varanasi - INDIA
Phone: (91)-542-310291(99)
Fax: (91)-542-312059
**Fields of interest:** Ammonoid palaeontology, biostratigraphy/biochronology and Palaeogeography.
**Suggested sections:** auxiliary 1) Spiti Shale formation, Spiti valley, Tethyan Himalaya, India; 2) Katrol Formation, Ler-Katrol area, Kachchh, India.

Dr. PROSOROVSKAYA E.L.
VSEGEI
Sredny pr., 74
199026, St.Petersburg - RUSSIA
Phone: 7(812) 2189258
Fax: 7(812) 2135738
**Fields of interest:** Jurassic stratigraphy, particularly Aalenian-Tithonian (Volgian). Jurassic brachiopods.
**Suggested sections:** auxiliary section of Kimmeridgian/Volgian boundary in the type area of the Volgian stage at Gorodishche section (Russian platform).

Dr. REHANEK J.
Moravian Oil Company
MND - GCHS Uprkova 5
695 30 Hodonin - TCHEC REPUBLIC
Phone: (42) - 628 - 523418
Fax: (42) - 628 - 21455
**Fields of interest:** Biostratigraphy, Microfacies.
**Suggested sections:** none.

Dr. SARTI C.
Dip. Scienze Geologiche
Università di Bologna
via Zamboni 67
I-40127 Bologna
ITALY
Phone: (39) - 51 - 354556
Fax: (39) - 051 - 354522
**Fields of interest:** Ammonites.
**Suggested sections:** none.

Dr. SCHWEIGERT G.
Staatliches Museum für Naturkunde
Rosenstein 1
D-70191 Stuttgart - GERMANY
Phone: (49) - 711 - 8936170
Fax: (49) - 711 - 8936100
**Fields of interest:** Ammonite biostratigraphy, Beckeri and Hybonotum zones, Southern Germany, mainly Swabia.
**Suggested sections:** none.

Dr. STEVENS R.G.
Institute of Geological and Nuclear Sciences
P.O. Box 30368
Lower Hutt - NEW ZEALAND
Phone: (04) 5697543
**Fields of interest:** Ecolgy and Biogeography of Late Jurassic Belemnite and Ammonite biostratigraphy.
**Suggested sections:** no suitable sections in the SW Pacific

Prof. WIERZBOWSKI A.
Warszaw University
Institute of Geology
Al.Zwirki i Wigury 93
02-089 Warszawa - POLAND
Phone: (48)-22-223051
Fax: (48)-22-220248
**Fields of interest:** Ammonites, Biostratigraphy.
**Suggested sections:** none.

Prof. ZEISS A.
Institut fur Palaontologie
Universitat Erlangen-Nurnberg
Loewenichstr. 28
D-91054 Erlangen - GERMANY
Phone: (49) 9131 852701
Fax: (49) 9131 852690
**Fields of interest:** Biostratigraphy and systematics of Upper Jurassic Ammonites.
**Suggested sections:** none.

## D - RESEARCH ACTIVITIES

Françsois ATROPS (SEE ABOVE, SECTION A).

Federigo OLORIZ is working on itneresting Kimmeridgian-Tithonian sections both in Southern Spain (Mallorca) and in Mexico. The results have been presented in the occasion of the X "Journadas de Paléontologia", in Madrid, and during the 4th ISJS in Argentina.

Graeme Stevens is publishing a monograph on palaeontology and biostratigraphy of Kimmeridgian-Tithonian ammonites from New Zealand. He has been able to correlate his faunas with the Mediterranean zonation and the sea-level curve.

## K/T BOUNDARY LIBRARY

The references of new papers concerning K/T boundary, Early Tithonian stratigraphy or also containing information on these topics are listed below.

COPE J. C. W., DODONA E., KANANI J., NICOSIA U., & TONIELLI R. (1995) - The ophiolite sedimentary cover of the inner Albanids and the age of Late Jurassic ocean floor spreading. **Palaeopelagos, 4** (1994): 3-12, Roma.

HERBIN J.-P., FERNANDEZ-MARTINEZ J.-L., GEYSSANT J.-R., EL ALBANI A., DECONINCK J.-F., PROUST J.-N., COLBEAUX J.-P. & VIDIER J.-P. (1995) - Sequence stratigraphy of source rocks applied to the study of the Kimmeridgian/Tithonian in the north-west European shelf (Dorset/UK, Yorkshire/UK and Boulonnais/France). **Marine and Petroleum Geology, 12**: 177-194, Amsterdam.

HERBIN J.-P. & GEYSSANT J.-R. (1993) - "Ceintures organiques" au Kimméridgien/Tithonien en Angleterre (Yorkshire, Dorset) et en France (Boulonnais). **C. R. Acad. Sci. Paris**, 317, sér. II: 1309-1316.

HERBIN J.-P., MÜLLER C., GEYSSANT J.-R., MELIERES F., PENN I. E. & Y. GROUP (1993) - Variation of the distribution of organic matter within a transgressive system tract: Kimmeridge Clay (Jurassic), England. *In* KATZ B. J. & PRATT L. M. "Source rocks in a sequence stratigraphic framework". **A. A. P. G., Studies in Geology, 37**: 67-100, Tulsa.

KUTEK J. (1994) - The Scythicus Zone (Middle Volgian) in Poland: its ammonite and biostratigraphic subdivision. **Acta Geol. Pol., 44 (1-2)**: 1-33, Warszawa.

GEYSSANT J.-R., VIDIER J.-P., HERBIN J.-P., PROUST J.-N. & DECONINCK J.-F. (1993) - Biostratigraphie et paléoenvironnement des couches de passage Kimméridgien/Tithonien du Boulonnais (Pas-de-Calais): nouvelles données paléontologiques (ammonites), organisation séquentielle et contenu en matière organique. **Géologie de la France, 4**: 11-24.

LANDMAN N. H. & GEYSSANT J.-R. (1994) - Heterochrony and Ecology in Jurassic and Cretaceous ammonites. **Geobios, mém. spéc. 15**: 247-255.

SCHWEIGERT G. & SCHERZINGER A. (1995) - Erstnachweis heteromorpher Ammoniten im Schwäbischen Oberjura. **Jber. Mitt. oberrhein geol. Ver., N. F., 77**: 307-319.

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The volume CARIOU E. & HANTZPERGUE P. (eds.) "3rd International Symposium on Jurassic Stratigraphy", Poitiers 1991. **Geobios, mém. spéc. 17** has been printed finally. We indicate here the papers which concerns our Working Group.

ADATTE T., STINNESBECK W. & REMANE J. (1994) - The Jurassic-Cretaceous boundary in Northeastern Mexico, confrontation and correlation by microfacies, clay minerals mineralogy, calpionellids and ammonites. *In* CARIOU E. & HANTZPERGUE P. (eds.) "3rd International Symposium on Jurassic Stratigraphy", Poitiers 1991. **Geobios, mém. spéc. 17**: 37-56, Lyon.

ATROPS F. & BENEST M. (1994) - Les formations à ammonites du Malm dans le bassin tellien, au Nord de Tiaret: leur importance pour les corrélations avec les séries de l'avant-pays de l'Ouest algérien. **Geobios, m. sp. 17**: 79-91, Lyon.

FATMI A. N. & ZEISS A. (1994) - New Upper Jurassic and Lower Cretaceous (Berriasian) ammonite faunas from the Sembar Formation ("Belemnite shales")of Southern Baluchistan, Pakistan. **Geobios, m. sp. 17**: 175-185, Lyon.

GEYSSANT J.-R. (1994) - Colonisation par des ammonites méridionales, des mers subboréales kimméridgiennes du Yorkshire (Angleterre). **Geobios, m. sp. 17**: 245-254, Lyon.

KRISHNA J., PATHAK D. B. & PANDEY B. (1994) - New ammonoid evidence for the Jurassic/Cretaceous boundary in Kachchh, Western India, and long distance correlation with southern Europe. **Geobios, m. sp. 17**: 327-335, Lyon.

KUTEK J. & ZEISS A. (1994) - Biostratigraphy of the highest Kimmeridgian and Lower Volgian in Poland. **Geobios, m. sp. 17**: 337-341, Lyon.

PESSAGNO E. A., HULL D. & PUJANA I. (1994) - Correlation of circum-pacific Upper Tithonian boreal and tethyan strata: synthesis of radiolarian and ammonite biostratigraphic and chronostratigraphic data. **Geobios, m. sp. 17**: 395-399, Lyon.

POULSEN N. E. (1994) - Dinoflagellate cyst biostratigraphy of the Late Jurassic of Poland. **Geobios, m. sp. 17**: 401-407, Lyon.

TAVERA J. M., AGUADO R., COMPANY M. & OLORIZ F. (1994) - Integrated biostratigraphy of the Durangites and Jacobi Zones (J/K boundary) at the Puerto Escano section in Southern Spain (Province of Cordoba). **Geobios, m. sp. 17**: 469-476, Lyon.

OGG J. G., HASSENYAGER II R. W. & WIMBLEDON W. A. (1994) - Jurassic-Cretaceous boundary: Portland-Purbeck magnetostratigraphy and possible correlation to the Tethyan faunal realm. **Geobios, m. sp. 17**: 519-527, Lyon.

SRIVASTAVA A. P., KRISHNA J., RAJAGOPALAN G., PATHAK D. B. & OJHA J. R. (1994) - The first ever absolute age determination from the Jurassic of Kachchh, Western India. **Geobios, m. sp. 17**: 529-533, Lyon.

# OTHER REPORTS AND INFORMATIONS

# 7 - OTHER REPORTS AND INFORMATIONS

## 7.1 - JURASSIC MICROFOSSIL GROUP MEETING MENDOZA, ARGENTINA OCTOBER 1994 - (HULL D).

The Jurassic Microfossil Group met together during the ISJS meeting this past October in Mendoza, Argentina. The meeting included approximately 20-25 members plus several new Jurassic workers. During the meeting, the following major points were discussed :

(1) Content of future newsletters ;
(2) Establishing fees for covering the costs of JMG mailings ;
(3) Establishing a publications directory of the JMG ;
(4) New Officers.

Members at the meeting have suggested the inclusion of more discussions and replies in the newsletters, as well as earlier announcement of meeting while meetings are still in the planning stages, so that they might have more input on when and where meetings take place and thus be able to attend. Future newsletters may also include abstracts of the members once publications are in press.

The largest difficulty in newsletter mainlings has been finding the funding for postal costs. The JMG now has 172 members and mailing of a 12 page newsletter in the past three years has cost approximately U.S. $350-$400 per newsletter. To cover these costs in the future, members agreed that a fee of $30 will be collected from each member at the time of every ISJS meeting (i.e., every 3-4 years) to cover postage and printing of the newsletter.

A copy of the JMG membership directory is available at this time. A new update of the directory will be available at each subcommission meeting. Further, it was suggested and approved that a publications directory of the JMG be established which will include all publications of the JMG members which pertain directly to Jurassic micropaleontology and biostratigraphy.

The new officers who have agreed to take on the future of the JMG are :

Co-Secretaries and Newsletter Editors : Niels Poulsen and Karen Dybkjfr
Adress for both Niels and Karen : Geological Survey of Denmark
Thoravej 8, Dk-2400 Copenhagen NV Denmark
Email : NEP@MMDGU.DGU.MIN.DK

Research Directory Chair : Patricia Whalen
Address : Dept. of Geological Sciences, Southern Methodist University, Dallas, TX 75275 USA

Publications Directory Chair : David Cole and the Southampton Group
Address : Department of Geology, University of Southampton
Highfield, Southampton, Hampshire, United Kingdom
email : DCC1@SOTON. AC.UK

In the future, all information to be included in JMG Newsletters should be sent to Niels Poulsen and Karen Dybkjfr. New member forms should be directed to Patricia Whalen who is managing the JMG database. David Cole is actively soliciting journal references to publications on Jurassic micropaleontology (not including " in press" papers), each reference with up to 10 keywords for cross-referencing. He can accept files in plain ASCII text for those who can download their information via internet communication.

7.2 - CREATION OF THE WORKING GROUP ON SEQUENCE STRATIGRAPHY, W.G.S.S. (MICHELSEN O.)

International Subcommission on Jurassic Stratigraphy (ISJS)

Convenor : Professor Olaf Michelsen, Department of Earth Sciences, Aarhus University, DK 8000 Århus C, Denmark. - Phone +45 89 422522, Fax +45 86 139248, E-mail geolom@aau.dk
Secretary : Dr. Lars Henrik NIELSEN, Geological Survey of Denmark, Thoravej 8, DK-2400 København NV, Denmark.-Phone+45 31 106600, Fax +45 31 196868, Email LHN@mmdgu.dgu.dk

Århus, 7th April 1995

Dear Colleague,

During the ISJS meeting in Mendoza (1994), the Subcommission decided to establish a working group on sequence stratigraphy, and I was appointed as the convenor. I have asked Lars Henrik Nielsen (Geological Survey of Denmark) to assist me initiating the work and to serve as a secretary. You are invited to join the working group or to appoint a member of your group.

We suggest the following items to be the primary goals, at least in an initial phase of the work.

Goals :

1) Sequence stratigraphic interpretation of stratotypes or candidates for stratotypes of stage boundaries, selected by the stage boundary working groups. The sequence stratigraphic analysis may add to the understanding of the processes that formed the section and how local factors have influenced it and hence how complete or condensed the section is. The analysis may identify potential hiati below resolution of the current biostratigraphic methods.

2) Sequence stratigraphic schemes of the Jurassic section in individual basins should be established. Intra - and inter-basinal correlation of such schemes may indicate which stratigraphic surfaces have a superior character, being useful for correlation in a regional sense.

Remarks :

Sequences are bounded by unconformities and they are of chronostratigraphic signficance alone by the concept, but this fact does not make these units equal to chronostratigraphic units (s.s.) the geological age of a sequence stratigraphic unit has to be determined by other stratigraphic methods, e.g. biostratigraphy. Eustatic sea-level changes are often believed to be the controlling factor of the sequence development. Many papers published in these years are based on a well-performed sequence stratigraphic analysis leading to a sequence stratigraphic scheme, which subsequently are correlated with the published (Haq *et al.)* eustatic sea level curve. The sequence boundaries are subsequently numbered with numerical ages, which is very dangerous for any stratigraphic conclusion and often without the adequate control. A detailed documentation of the chronostratigraphic validity of this chronostratigraphic correlation is often missing. This means that arguing in a circle may be the case instead of presenting a scientifically valid discussion and conclusion. Our comments concerning the future work of the working group are as follows :

A) The sequence stratigraphic analysis within one basin makes it possible to establish a stratigraphic scheme, often with a higher resolution than that of the controlling biostratigraphy. Correlation of such schemes between basins may therefore be difficult. The dominance of eustatic sea-level changes in relation to local factors (subsidence, climate, sediment influx etc.) has to be carefully evaluated. However, creation of a "global" sequence stratigraphic scheme will probably be hampered by the fact that the resolution of sequence stratigraphy often is higher than that of biostratigraphy. A thorough inter-plate correlation should, therefore, be carried out, but we suggest this matter to be postponed to a later phase.

B) At least four different surfaces within the depositional cycle are suggested as sequence boundary in the currently used models : top of the highstand system tract, top of the forced regressive systems tract, top of the lowstand prograding wedge, and top of the transgressive systems tract. Since different models may be adequate for different types of deposits, different basinal settings, we face a problem of precise communication of the achieved stratigraphic results. It is, therefore, important to describe clearly the character of the boundary, its sedimentological significance and its position within the depositional cycle.

### 7.3 - THE IMPORTANCE OF TEACHING STRATIGRAPHY - (Remane J.)

Chairman of the International Commission on Stratigraphy (ICS)

In December 1991, Amos Salvador, then Chairman of the International Subcommission on Stratigraphic Classification (ISSC), sent out questionnaires to 100 North American universities in order to get a picture of their teaching of stratigraphy. The result of this personal initiative was published in Newsletter 86 of ISSC ; it was rather alarming. A world-wide poll of this kind would very probably lead to similar results.

Understandably, ICS is highly concerned with this situation, and we think that something should be done in order to make stratigraphy more attractive for teaching. It would of course be desirable to have world-wide data comparable to those collected by Amos Salvador, but we should also tell geologists now why an appropriate teaching of stratigraphy is vital for the future of geology (and not only of stratigraphy !).

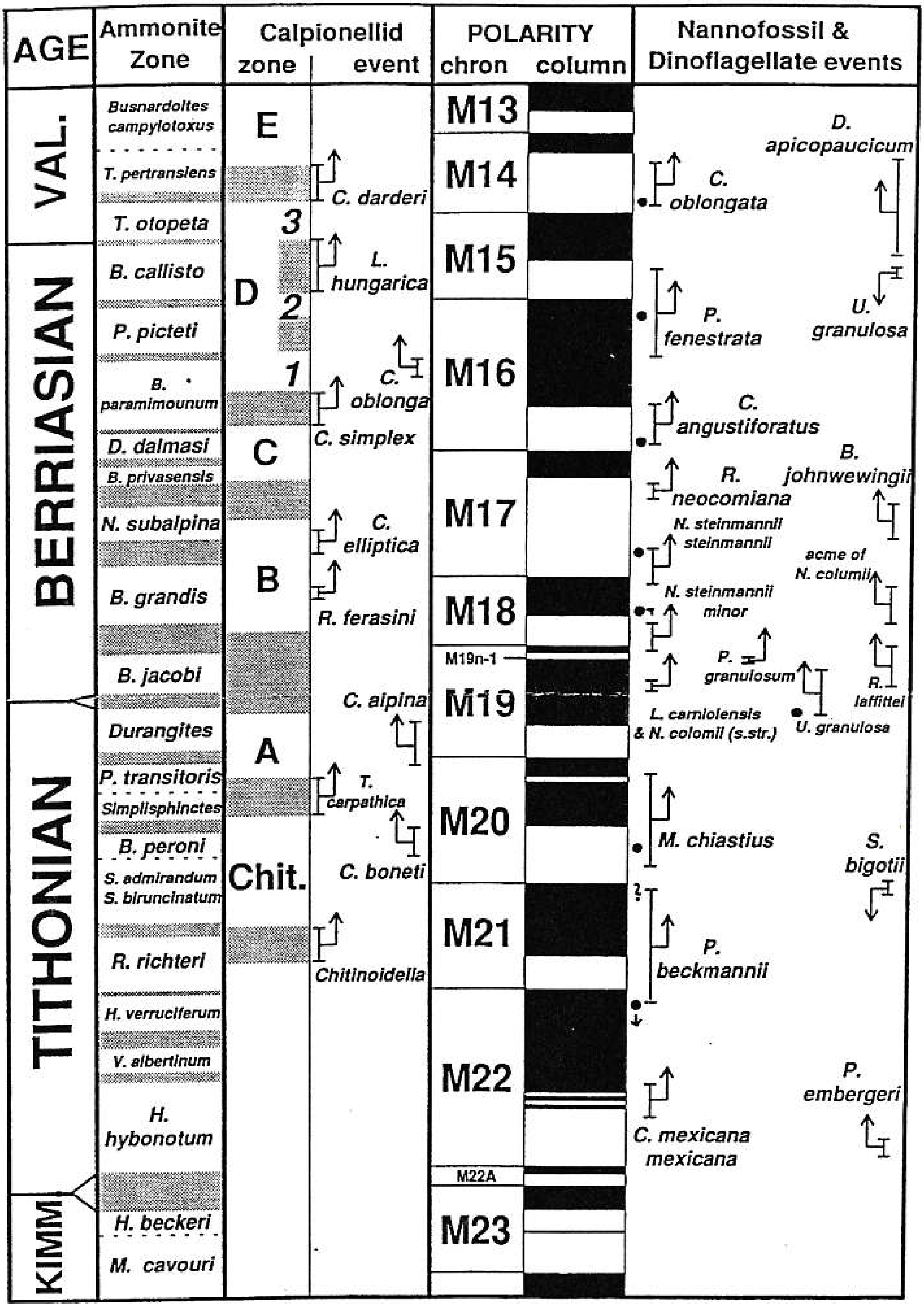
There is of course the point that stratigraphy really is a basic discipline without which geology cannot survive. This is not only because geology is a historical science. Reliable structural analyses are simply unthinkable without a proper knowledge of the original-the stratigraphic (!) order of strata. But others have already made this point and therefore I would like to draw your attention to another field which seems equally important to me : the general didactic interest in teaching stratigraphy.

Just one example : the *geomagnetic polarity time scale* (GPTS), which is now well established back to Late Jurassic (Oxfordian) times. In one way magnetic reversals are ideal chronostratigraphic markers : they are world-wide and practically instantaneous events. But they are not time specific, as there are only two kinds of reversals occurring repeatedly many, many times. As a matter of fact, it was known since the beginning of our century that reversals of the Earth's magnetic field had occurred. But the construction of a GPTS was not possible before additional methods of dating were available. Only in the 1960s a precise GPTS emerged thanks to the radiometric dating of volcanic rocks. This was, however, limited to the last 5 million years, as for older rocks radiometric datings are not precise enough to separate closely spaced reversals. It becomes also more and more difficult to ascertain a continuous documentation of the Earth's magnetic history through volcanic rocks. The latter problem was eventually overcome through the utilization of the marine magnetic anomalies. As there are no abrupt changes of ocean floor spreading rates, the pattern of oceanic anomalies gives a fair picture of their relative duration. Moreover, the pattern is comparable to that observable in continuous sedimentary succession with a reasonably constant sedimentation rate. DSDP and ODP cores as well as suitable land sections thus allowed to calibrate the oceanic standard by radiometric and above all biochronologic methods. This example demonstrates well the importance of multidisciplinary approaches in stratigraphy.

The application of the GPTS demonstrates another interesting case of interdisciplinarity. The "fingerprint" of oceanic anomalies is difficult to identifiy in sedimentary successions with minor gaps and variable rates of sedimentation. But with a rough dating by fossils the choice can be narrowed down thus allowing a correct identification of magnetic chrons. Now magnetic reversals may be used in return to test the isochrony of biostratigraphic boundaries !

These examples illustrate well the importance of multidisciplinary thinking in stratigraphy, and everbody will agree that the training of multidisciplinary reasoning is one of the most important goals in teaching. One condition has, however, to be fulfilled : all aspects of stratigraphy have to be dealt with in one and the same course, otherwise the understanding of multidisciplinary interactions will not be achieved.

Still other examples could be given, but I hope that the example of magnetostratigraphy has sufficiently illustrated the importance of teaching stratigraphy also to non-stratigraphers.




selon OGG et al. (1991), Cretaceous Research 12/5

# INTERRAD VII CONFERENCE REPORT FROM THE ORGANIZING COMMITEE - (Takemura A. and Yao A.)

## 8 - INTERRAD VII Conference Report from the Organizing Commitee - (TAKEMURA A. and YAO A.)

The INTERRAD VII Conference was held at the Inter-University Seminar House of Kansai, about 30 km northwest of Osaka City, Japan, during October 20-24, 1994. The number of participants was 96, those are 52 Japanese and 44 non-Japanese. The list of participants of the meeting is on page 4 of this report. The total number of presentations was 108 including oral and posters. Abstract Volume including 139 abstracts, Guidebook for Field Excursions and Bibliography of recent Japanese radiolarian studies were presented for all the participants as well as souvenirs. The conference program is shown in attached sheets.

OPENING SESSION

The Conference started with the Opening Session. Following to Dr. ICHIKAWA, Koichiro's Congratulatory Address, Dr. NAKASEKO, Kojiro, the Honorary Chairperson of this meeting had presented the special talk entitled "The study of Radiolaria in Japan."

SYMPOSIA

In this INTERRAD meeting, we had scheduled three specific symposia listed in the program. Each symposium was a morning session of Oct. 21 to 23. The followings are the reports of each symposium by their convenors.

The symposium A entitled "Radiolarian survival, extinction and recovery across the major geologic boundaries" was held on October 23. BLOME and EICHER presented paleoceanographical and paleoclimatological impacts on mid-Cretaceous radiolarian biostratigraphy. HORI indicated significance of geochemical investigation to evaluate sedimentary environments in Middle Triassic-Lower Jurassic bedded cherts of the Katsuyama section from the Inuyama area, Japan. KOZUR presented the stratigraphic importance of the Ladinian radiolarian zonation. NISHIZONO *et al.* were pointed to Jurassic radiolarian zonation in the Southern Chichibu Belt in Western Kyushu, Southwest Japan. SUZUKI presented difference of patterns on occurence of the *Canoptum* Assemblage from Southwest Japan. RUDENKO and PANASENKO indicated the Upper Permian and Lower Triassic radiolarians in cherty deposits of Primorye. Finally, KAKUWA talked of bedded chert as a witness of shallow-sea environmental deterioration across the Permo-Triassic boundary, in which "Ishiga-diagram" a sedimentary rhythmicity diagram was introduced to indicate valuable usefulness and its correlation to carbon isotope excursion (by ISHIGA, H.).

The symposium B was entitled" Radiolarians and Orogenic Belts" and focused on the Circum-Pacific Orogenic Belt. Seven papers on Mesozoic radiolarian researches were presented form New Zealand, Indonesia, Japan, Russian Far East and Canada. A single paper co-authored by all contributors of the symposium is in preparation for a proceeding volume of the INTERRAD VII. After the symposium, a working group of more than 30 radiolarian researchers, was organized. The group will arrange a symposium or workshop in the next INTERRAD conference. The title and authors(s) of the papers reported in the symposium are indicated in the attached program (by MATSUOKA, A).

The symposium C entitled " Radiolarians as Environmental and Paleoenvironmental Proxy and their Ecology" was held on October 21. SANFILIPPO and CAULET gave an intriguing synthesis on Theoperids phylogenies and paleoenvironmental implications. BAUMGARTNER *et al.* talked about Mesozoic faunal change and paleoceanography. CAULET *et al.* discussed on Neogene paleoceanographic changes based on fertility signals. ERBACHER presented his comprehensive view of mid-Cretaceous paleoceanographic conditions involving carbon isotopic signal and black shales. MOLIN-CRUZ discussed paleoceanographic changes and tectonics around the mouth of the gulf of California. ITAKI *et al.* talked about modern fluxes in the Bering Sea and Subarctic Pacific. Due to stimulative and well prepared presentations we had wealth of in-depth discussions and exchange of pertinent information. It can be readily said " the Proxy Session was a success" (by TAKAHASHI, K).

GENERAL AND POSTER SESSIONS

Most oral presentations were arranged in the program based on their contents of their study. Twenty-six oral presentations were made in the General Session during the conference. Poster Sessions were held in the afternoon of Oct. 22 and 23. The total number of poster presentation was 61, covering all the geologic period from Cambrian through Recent.

SIGHTSEEING AND PARTY

On the afternoon of Oct. 23, we went to Osaka Casle and the South downtown of Osaka City for sightseeing. Each sightseeing group had one large INTERRAD flag and the attendants marched through the crowded street of the South downtown. All the participants had a traditional Japanese-style party at the downtown.

FIELD EXCURSION

Prior to the conference, two courses of field excursions were organized. Paleozoic excursion was led by Dr. ISHIGA, Hiroaki (Shimane University), and held in the Sasayama Area and near Kyoto in the Tanba Belt on Oct. 18-20. Eighteen researchers had attended this excursion, which was focused on Upper Paleozoic radiolarian biostratigraphy and paleoenvironmental study within bedded chert sequence.

Mesozoic excursion was organized by Dr. MATSUOKA, Atsushi (Niigata University) at the Inuyama Area in the Mino Belt on Oct. 19-20. The 20 participants of this excursion had discussed the Triassic to Jurassic radiolarian biostratigraphy, sedimentology and paleoceanography within the chert and siliceous rock sequences.

After the disperse of the conference, Cenozoic field excursion was organized by Drs. SAKAI, TOYOSABURO and AITA, YOSHIAKI (Utsunomiya University), on Oct. 25-27 with 14 participants. This excursion was focused on Neogene mid-latitude radiolarian biostratigraphy and paleoceanography. Following the excursion, some attendants had optional Nikko Tour.

## BUSINESS MEETING

The Business Meeting was held in the night of Oct. 22, which was attended by all participants of the INTERRAD VII meeting. The following summary was reported by BAUMGARTNER, P. O. (Chairman of the business meeting).

(1) Proceedings : K. Takahashi reported on the state of the proceedings of INTERRAD VII. About 30 papers are announced to be included with a special issue of *Marine Micropaleontology*, and about 15 papers with the special issue of *Island Arc*. All papers should be submitted by the end of November 1994 in 4 copies to the editors (K. Takahashi for *Marine Micropal.*, and A. Yao for *Island Arc)*.

(2) Host of next INTERRAD VIII, 1997 : P. O. Baumgartner reported that initially there were 4 propositions for hosting the upcoming meeting : Lausanne (P. O. Baumgartner), Cadiz (Spain, L. O'Dogherty), London (J. Thurow), and Paris (P. De Wever). In a preliminary meeting of the Board of INTERRAD, a consensus was reached to have the meeting in France, but to share the organization of it between various European countries. P. De Wever was asked by the chairman to briefly exposed his project of the meeting place for 1997.

(3) Budget of INTERRAD and New fees based on frequency of "Radiolaria" newsletter : The secretary, P. O. Baumgartner apologized for the long delay of the appearance of the last newsletter. J. P. Caulet, the treasurer, exposed the financial situation of the organization and stated that the annual fee of US $ 15.- covers, in theory, the production and distribution of the newsletter. In past years, however, important subsidies were obtained from the institutions hosting the secretary (for instance, over half of the cost of RADIOLARIA 14, was funded by the University of Lausanne, Switzerland). Thanks to these subsidies, the actual balance of INTERRAD amounts to US $ 1000.- J. P. Caulet opened the discussion on whether members of former eastern countries and from developing countries were still to receive the newsletter without payment. Several members stated that the situation in Russia and some other eastern countries is still precarious and that they would suggest to continue the pratice of supplying the newsletter at the charge of the members from the economically better- countries. It was decided to follow these suggestions, with the following restriction : A advertisement will be sent out to all members before the appearance of the newsletter, announcing its contents and date of appearance. Those members unable to pay will then have to send back the attached form and request the newsletter. The newsletter will then be sent out to all who requested it or previously paid it. In order to reduce the cost of bank transfers, it was decided to collect the annual fees at the INTERRAD meetings. Payments for the upcoming year going to be accepted in cash at the meeting. For the next meeting, payment of the fees will be made possible in conjunction with the registration fee. I was decided to try to issue one newsletter per year. The future secretary, L. O' Dogherty, stated that he was willing to try to meet this schedule.

(4) Reports of Working Groups : P. Noble reported for the Paleozoic Working Group, who met the day before. This group decided to have an internal newsletter that would also be forwarded to the secretary for inclusion with " Radiolaria". P. O. Baumgartner reported of the activity concerning the Atlas of Jurassic-Cretaceous Radiolaria of Tethys, carried out in the frame of the Mesozoic Working Group. A. Sanfilippo reported of the activities of the Cenozoic Working Group and announced the electronic bulletin board (radfolks) that had recently been put in function. The absence of the representative of the Recent, D. Boltovskoy was much regretted.

(5) Vote on new INTERRAD Board : The chairman expose that the statutes of INTERRAD required that the host country should propose the president of the association. The necessity of the Working Groups and their Chairpersons was put in doubt by some attendees of the meeting. Especially for the Mesozoic, which is a very large groug of people, it was suggested to have project-oriented groups rather than one big WG. The chairman and other members insisted on the communication as principal task of the chairpersons. It was then suggested that the Mesozoic Groups needed another person that would coordinate communication in Asian countries. Rie Hori was proposed. The Board members were proposed as follows, and were accepted.

| | |
|---|---|
| President | CAULET, Jean-Pierre (Paris, France) |
| Past-President | YAO, Akira (Osaka, Japan) |
| Secretary | O'DOGHERTY, Luis (Cadiz, Spain) |
| Treasurer | ULQUHART, Elspeth (London, UK) |
| Working Group Chairpersons | |
| Paleozoic | NOBLE, Paula (Sacramento, CA, USA) |
| Mesozoic | BAUMGARTNER, P. O. (Lausanne, Switzerland) |
| | HORI, Rie (Matsuyama, Japan) |
| Cenozoic | SANFILIPPO, Annika (La Jolla, CA, USA) |
| Recent/Living | BOLTOVSKOY, Demetrio (Buenos Aires, Argentina) |

(6) Propositions for INTERRAD IX, 2000 : H. Kozur reported that he and Prof. Mostler would be able to host the meeting in Salzburg (Austria). A Sanfilippo suggested that a group of Institutions located in California could probably host the meeting in 2000. The chairman mentioned a proposition by J. Aitchison, for a possible meeting in Hong Kong.

The organizing committee of INTERRAD VII still have some copies of Abstract Volume. If you need one, please contact the following address.

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TAKEMURA, Atsushi, Secretary : Geoscience Institute, Hyogo University of Teacher Education, Yashiro-cho, Kato-gun, Hyogo 673-14, JAPAN, Phone : 81-795-44-2206, Fax : 81-795-44-2189.

We, the organizing committee, express our special thanks to the following colleagues for their kind and helpful assistance for the conference.
FURUTANI, Hiroshi, HORI , Rie, ISHIDA, Keisuke, KAWABATA, Kiyoshi, KOJIMA, Satoru, KUMON, Fujio, KURIMOTO, Chikao, KUWAHARA, Kiyoko, MUSASHINO, Makoto, NAKAE, Satoshi,YAMAUCHI, Moriyoshi.

List of participants of INTERRAD VII. OSAKA 1994

| | |
|---|---|
| AJTA, Yoshiaki | [Japan] |
| AITCHISON, Jonathan | [Australia] |
| AKIMOTO, Mizuho | [Japan] |
| ARAKAWA, Ryuichi | [Japan] |
| BAUMGARTNER, Peter O. | [Switzerland] |
| BERNAL-RAMIREZ, Rocio | [Mexico] |
| BLOME, Charles D. | [USA] |
| BLUEFORD, Joyce R. | [USA] |
| BRAGIN, Nikita Yu | [Russia] |
| BRAUN, Andreas | [Germany] |
| CARIDROIT, Martial | [France] |
| CAULET, J. P. | [France] |
| CLOWES, Emma | [UK] |
| CORDEY, Fabrice | [Canada] |
| DANELIAN, Taniel | [UK] |
| DE WEVER, Patrick | [France] |
| DOUZEN, Kaori | [Japan] |
| DUMITRICA, Paulian | [Switzerland] |
| ERBACHER, Jochen | [Germany] |
| EZAKI, Yoichi | [Japan] |
| FIFOOT, Annette | [Australia] |
| FUNAKAWA, Satoshi | [Japan] |
| FURUTANI, Hiroshi | [Japan] |
| GORICAN, Spela | [Slovenia] |
| GUPTA, Shyam M. | [India] |
| HASHIMOTO, Hisao | [Japan] |
| HATTORI, Isamu | [Japan] |
| HIRAISHI, Mikiko | [Japan] |
| HORI, S., Rie | [Japan] |
| ICHIKAWA, Koichiro | [Japan] |
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| IMOTO, Nobuhiro | [Japan] |
| ISHIDA, Keisuke | [Japan] |
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| ITAKI, Takuya | [Japan] |
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| KAIHO, Kunio | [Japan] |
| KAKUWA, Yoshitaka | [Japan] |
| KAMATA, Yoshihito | [Japan] |
| KAWABATA, Kiyoshi | [Japan] |
| KEMKIN, Igor V. | [Russia] |
| KHOKHLOVA, Irena E. | [Russia] |
| KITO, Norio | [Japan] |
| KOJIMA, Satoru | [Japan] |
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| KUMON, Fujio | [Japan] |
| KURIMOTO, Chikao | [Japan] |
| KUWAHARA, Kiyoko | [Japan] |
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| LING, Hsin Yi | [USA] |
| MARCUCCI , Marta | [Italy] |
| MATSUOKA, Atsushi | [Japan] |
| McCLELLAN, Wendy | [USA] |
| MOLINA-CRUZ, Adolfo | [Mexico] |
| MOTOYAMA, Isao | [Japan] |
| MUNASRI | [Indonesia] |
| MURATA, Masafumi | [Japan] |
| MURCHEY, Bonita | [USA] |
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| NAKAE, Satoshi | [Japan] |
| NAKASEKO, Kojiro | [Japan] |
| NIGRINI, Catherine | [USA] |
| NISHIMURA, Akiko | [Japan] |
| NISHIZONO, Yukihisa | [Japan] |
| NOBLE, Paula | [USA] |
| O'DOGHERTY, Luis | [Spain] |
| RUDENKO, Valeriya | [Russia] |
| SAKAI, Toyosaburo | [Japan] |
| SANFILIPPO, Annika | [USA] |
| SASHIDA, Katsuo | [Japan] |
| SHEN, Gaoping | [China] |
| SIMES; John | [New Zealand] |
| SPILLER, Frances C. P. | [Australia] |
| STRATFORD, James M. C. | [Australia] |
| SUGANO, Kozo | [Japan] |
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| SUZUKI, Shigeyuki | [Japan] |
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| TAKAHASHI, Osamu | [Japan] |
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| TAKETANI, Yojiro | [Japan] |
| THUROW, Jurgen | [UK] |
| TUMANDA, Fe | [Philippines] |
| UMEDA, Masaki | [Japan] |
| URQUHART, Elspeth | [UK] |
| VISHNEVSKAYA, Valentina | [Russia] |
| WAKITA, Koji | [Japan] |
| YAGI, Nobuyuki | [Japan] |
| YAMAUCHI, Moriyoshi | [Japan] |
| YANG, Qun | [China] |
| YAO, Akira | [Japan] |
| YONEMITSU, Isao | [Japan] |
| ZSUZSANNA, Tompe | [Hungary] |
| ZYABREV, Sergei | [Russia] |

# PROGRAM OF INTERRAD VII, OSAKA, 20-24 OCTOBER, 1994
at the Inter-University Seminar House of Kansai, Kobe City, JAPAN

## 20 October 1994

**REGISTRATION** 14:00 - 21:00
**RECEPTION** 19:00 - 21:00

## 21 October 1994

**OPENING SESSION** 8:30 - 9:00
**SPECIAL LECTURE**
Nakaseko K.: *The Study of Radiolaria in Japan*

**SYMPOSIUM C**: *Radiolarians as Environmental and Paleo-environmental Proxy and Their Ecology.* 9:00 - 12:00
[Convener: Takahashi, K.]
Sanfilippo, A. and Caulet, J. P.: *Cenozoic radiolarian phylogenies: paleo-environmental and paleogeographic implications.*
Baumgartner, P. O., O'Dogherty, L., and Bartolini, A.: *Mesozoic radiolarian faunal change and its correlation with plaeooceanography and paleo-climate.*
Caulet, J. P. , Nigrini, C. A., Venec-Peyre, M. T., and Vergnaud Grazzini, C.: *Radiolarians as markers of fertility processes.*
Erbacher, J.: *Paleooceanographical and paleoclimatological impacts on mid-Cretaceous radiolarian bio-stratigraphy.*
Molina-Cruz, A.: *Biostratigraphy and paleoceanographycal significance of the radiolarians from the "proto-mouth" of the Gulf of California.*
Itaki, T., Takahashi, K. and Maita, Y.: *Radiolarian fluxes in the northern North Pacific and Bering Sea.*

**GENERAL SESSION** 13:00 - 18:00
[Chairperson: Nigrini, C.]
De Wever, P.: *Radiolarians and radiolarites, primary produc-tion, deposition.*
Thurow, J. and Erbacher, J.: *Perturbations of the Mid-Cretaceous marine biosphere by sea level changes - evidence from radiolarian occurrence, geochemistry and black shale deposition.*
Blueford, J. and Amon, E.: *Cretaceous/Cenozoic siliceous rocks of West Siberia: interpreting the flora and fauna.*
Blueford, J. and White, L.: *Cenozoic siliceous rocks of North Sakhalin.*

[Chairperson: Ling, H.-Y.]
De Wever, P., Azema, J. and Fourcade, E.: *Radiolarians and tethyan radiolarites, their Paleogeography.*
Nigrini, C., Caulet, J.-P. and Sanfilippo, A.: *High resolution radiolarian stratigraphy: tricks, traps and triumphs.*
Khokhlova, I. E.: *Paleocene-Eocene Radiolaria of Russian Platform and adjacent regions and their application or direct correlation with north Atlantic (Site 400A, Biscay Bay).*
Iijima, K., Takahashi, K., Ittekkot, V., and Nair, R. R.: *Radiolarian fluxes in the monsoon environ-ment in the Arabian Sea.*
Yamauchi, M.: *The seasonal changes of radiolarian fluxes of the Northwestern Pacific.*

[Chairperson: Kozur, H.]
Li, H.-S.: *A great (an extraordinary) variety of well-preserved radiolaria assemblage in the Early Middle Ordovician from the Baijingsi, Qilian Mountains, China.*
Noble, P. J. and Ketner, K. B.: *Early Silurian (early Llandoverian) Radiolaria from the Northern Adobe Range, North-eastern Nevada, U.S.A.*
Aitchison, J. C. and Stratford, J. M. C.: *Early to Middle Devonian radiolarian bio-stratigraphy of the Gamilaroi Terrane, NSW Australia.*
Stratford, J. M. C. and Aitchison, J. C.: *Middle Devonian radiolarians from the Gamilaroi Terrane, Glenrock Station. NSW, Australia.*

[Chairperson: Broun, A.]
Caridroit, M.: *Taxonomy, classification and phylogeny of latentifistulidae, Upper Paleozoic Radiolaria.*
Spiller, F. C. P.: *Late Palaeozoic radiolarians from the Bentong-Raub Suture, Peninsular Malaysia.*
Kozur, H.: *Permian radiolarians from Sicily (Italy) and Texas.*
Kuwahara, K.: *Morphologic change of Late Permian Radio-laria Albaillella.*

## 22 October 1994

**SYMPOSIUM B**: *Radiolarians and Orogenic Belts.* 9:00 - 12:00

[Convener: Matsuoka, A.]

Matsuoka, A.: *Late Jurassic tropical radiolarians: Vallupus and its related forms.*

Aita, Y.: *Triassic radiolaria and their faunal affinities in New Zealand.*

Munasri and Wakita, K.: *Cretaceous radiolarians from the Bantimala and Barru Complexes, South Sulawesi, Indonesia.*

Shen, G., Ujiié, H. and Sashida, K.: *Off-scraped Permo-Jurassic bedded chert thrust on Permo-early Cretaceous accretionary prism: evidence from Ie Island, Central Ryukyu Island Arc.*

Vishnevskaya, V. S.: *Mesozoic radiolarian assemblages of the northwestern Pacific continental framing (Russia).*

Bragin, N. Yu.: *Boreal Triassic radiolarian succession of Omolon Massif (Northeast Siberia).*

Cordey, F.: *Carboniferous to Late Jurassic radiolarian chert in Western Canada: new discoveries, biostratigraphy, faunal comparisons with East Asia: similar record of long-lived paleo-Pacific deposition?*

**GENERAL SESSION** 12:00 - 14:40

[Chairperson: Vishnevskaya, V.]

Danelian, T. and Robertson, A. H. F.: *Biostratigraphy and tectonic significance of Jurassic-Cretaceous radiolarian cherts of the North Indian passive margin (Indus Suture Zone, Ladakh Himalaya).*

Taketani, Y.: *Cretaceous radiolarian stratigraphy of the Sorachi Group and the Yezo Supergroup, Central Hokkaido, Japan.*

Ling, H. Y., Chandra, R., Karkare, S. G., Srinivasan, M. S. and Tripathi, S. A.: *Cretaceous and Eocene Radiolaria from South Andaman Island, Northeastern Indian Ocean and their tectonic significance.*

Funakawa, S.: *Internal skeletal structure of Family Plagiacanthidae (Nassellaria) as a means for classification.*

Dumitrica, P. and Dumitrica-Jud, R.: *Aurisaturnalis carinatus (Foreman), an example of phyletic gradualism among Satur-nalid-type radiolarians.*

**POSTER SESSION** 15:00 - 18:00

Iwata, K., Kungrutsev, L. V. and Obut, O. T.: *Lower Cambrian Radiolaria from South-western Siberia and Eastern Australia.*

Aitchison, J. C. and Flood, P. G.: *Early Ordovician radiolarians from the Lower Port Complex, Western Newfoundland, Canada.*

Aitchison, J. C. and Krynen, J.: *Developments in the study of Ordovician and Silurian radiolarians from the Lachlan Fold Belt, Southeastern Australia.*

Amon, E. and Braun, A.: *Silurian radiolarians from the Southern Urals and Germany.*

Suzuki, N.: *Diversity and composition of Devonian radiolarian faunas from phosphatic nodules from the Woodford Formation (Famennian), Southeast Oklahoma.*

Furutani, H.: *Evolution of Devonian lattice-shelled Palaeo-scenidiidae.*

Umeda, M.: *Late Devonian radiolarian assemblages from the Yokokurayama Formation, Central Kochi, Southwest Japan.*

Iwata, K., Watanabe, T., and Dobretsov, N. L.: *Radiolarian biostratigraphic study of the Chara Belt, East Kazakhstan.*

Amon, E. and Braun, A.: *Upper Carboniferous radiolaria: state and progress of research.*

Sashida, K., Adachi, S., Igo, H., Nakornsri, N. and Ampornmaha, A.: *Small Radiolaria from Permian bedded chert in Thailand.*

Caridroit, M.: *Some Upper Permian radiolarian assemblages from NW Thailand. Comparisons with assemblages from Japan and paleogeographic potential.*

Takemura, A., Kurumida, K. and Yamakita, S.: *Permian radiolarians from a phosphate nodule in the Chichibu Belt, Shikoku, Southwest Japan.*

Rudenko, V. S.: *Permian radiolarian of Primorye.*

Takemura, S. and Suzuki, S.: *The Maizuru and the Ultra-Tamba Zones; are they really accretionary complexes? -structural development of the inner zone of Southwest Japan-.*

Kuwahara, K. and Ezaki, Y.: *Permian/Triassic boundary and siliceous clay-stone in the Mino Belt.*

Kamata, Y.: *Discovery of the Permian/Triassic boundary in bedded chert sequence in the Ashio Mountains, Central Japan.*

Ishiga, H.: *Change of oceanic condition across the Permian/Triassic boundary.*

Simes, J.: *Radiolarian ages from the Wellington greywacke, New Zealand.*

Amodeo, F. and Baumgartner, P. O.: *Upper Triassic Radiolaria from the Scisti Silicei Formation, Lagonegro Domain, Italy.*

Bragin, N.Yu and Tekin, U. K.: *Upper Triassic Radiolaria from Ankara Ophiolitic Melange (Ankara, Turkey).*

Hiraishi, M.: *Spectral analysis of bed thickness of Triassic-Early Jurassic bedded cherts in the Inuyama area, central Japan.*

Yang, Q. and Mizutani, S.: *Triassic and Jurassic radiolarian zones of the Nadanhada Terrane, Northeast China.*

Douzen, K. and Ishiga, H.: *Change of oceanic condition at the Triassic/ Jurassic boundary from sedimentologic examination of bedded cherts of Southwest Japan.*

Hori, R. S. and Goto, H.: *Two type faunas of lowest Jurassic (Hettangian?) radiolarians from bedded cherts in SW Japan.*

Hori, R. S., Aita, Y. and Grant-Mackie, J. A.: *Preliminary report of Lower Jurassic Radiolaria from Murihiku strata of Gondwana origin on the Kawhia Coast, New Zealand.*

Yao, A.: *Faunal change of Early-Middle Jurassic radiolarians: part 2.*

Arakawa, R.: *Middle Jurassic Radiolaria from Manganese dioxide nodule, Kuzuu Area of Ashio Belt, central Japan.*

Amodeo, F. and Baumgartner, P. O.: *Jurassic Radiolaria from the Scisti Silicei Formation, Lagonegro Domain, Italy.*

Gorican, S. and Baumgartner, P. O.: *Jurassic and Cretaceous sedimentary evolu-tion of the Budva Zone (Dinarides, Monte-negro) based on radiolarian biostratigraphy.*

Kemkin, I. V.: *Role of Radiolaria in Sikhote-Alin geology.*

Tumanda, F. P., Banda, R. M., Ahai, T. and Jau, J. Jok: *Jurassic and Cretaceous Radiolarian Assem-blages from Lundu-Sematan Area and Lupar Valley, Sarawak, Malaysia.*

Tumanda, F. P.: *Some Occurrences of Cretaceous Radiolaria in the Philippines.*

Zyabrev, S.: *Kiselyovsky Subterrane as the youngest accretionary complex of the Sikhote-Alin Fold System (Russian Far East): radiolarian biostratigraphy and microfossils recycling phenomena.*

Ishida, K.: *Radiolarians from the shallow-marine Lower Cretaceous of the Kurosegawa Terrane, East Shikoku: a distinctive key marker for the paleoenvironmental changes.*

Kumon, F. and Matsuyama, H.: *Chert olistoliths in the Cretaceous Miyama Formation of the Shimanto Belt in Kii Peninsula, Southwest Japan.*

Dalla Piazza - Mallan, P.: Application of Unitary Associations Method to Faunal Turnover Study of Three Fossil Groups During Cenozoic.

O'Dogherty, L. and Baumgartner, P. O.: *Biochronology and Paleontology of middle Cretaceous radiolarians from Umbria-Marche Apennines (Italy) and Betic Cordillera (Spain).*

Urquhart, E. and Robertson, A. H. F.P.*Radiolaria and the Structural Evolution of Cyprus in the Late Cretaceous.*

Aitchison, J. C., Meffre, S., Clarke, G. L., Cluzel, D. and Stratford, J. M. C.: *Late Cretaceous radiolarians from the Poya Nappe (Formation de Basalt) New Caledonia: age constraints on ocean floor sedimentation.*

Hashimoto, H.: *Comparison of radiolarian faunae in the deposits of Late Cretaceous fore-arc basins and oceanic basin in SW Japan.*

Iwata, K. and Tajika, J.: *Radiolarian biostratigraphic study of the northern Hidaka Belt, Hokkaido.*

Sanfilippo, A. and Nigrini, C.: *Biostratigraphic review and recalibration of Paleogene radiolarian zones in all tropical DSDP/ODP sediment sequences (Legs 1-135).*

Hollis, C. and O'Connor, B.: *Studies of Paleogene Radiolaria in New Zealand.*

Takemura, A. and Ling, H. Y.: *Biostratigraphy of Middle Eocene to Oligocene radiolarians from ODP Leg 114, Subantarctic South Atlantic Ocean.*

Kruglikova, S. B. and Barash, M. S.: *On the sediments and age of manganese nodules of the Clarion Clipperton Area in the Equatorial Pacific.*

Funakawa, S.: *Change of internal structure and its significance – a case of Corythomelissa, Plagiacanthidae –.*

Sakai, T., Sugie, H. and Aita, Y.: *Paleoecology of Cyrtocapsella japonica (Nakeseko) – significance of stratigraphic changes in abundance–.*

Motoyama, I.: *Late Neogene radiolarian biostratigraphy in the Subarctic Northwest Pacific.*

Nishimura, A.: *Cenozoic spumellarians with pylome from the Antarctic bottom sediments.*

Nishimura, A., Nakaseko, K. and Okuda, Y.: *A new radiolarian assemblage from the Antarctic Quaternary bottom sediments.*

Bernal-Ramírez, R., G. and Molina-Cruz, A.: *Radiolaria biogeography and its relation to the oceanography of the Western Nordic Seas.*

Matsuoka, A.: *Biology of a radiolarian species Dictyocoryne truncatum.*

Dumitrica, P.: *Family Centrocubidae (Radiolaria), a new approach based on the structure of the initial skeleton.*

De Wever, P. and Blanc, P.: *Mounting techniques for Scanning Electron Microscopy.*

Lazarus, D., Beckmann, J. P., Biolzi, M., Hilbrecht, H., von Salis, K., Spencer-Cervato, C., Störrlein, U., Thierstein, H. R. and Sancetta, C.: *A global database of Neogene DSDP/ODP marine microfossil plankton and its use in geographic, stratigraphic and evolutionary syntheses.*

Marcucci, M., Chiari, M., Cortese, G. and Nozzoli, N.: *New data on the radiolarian assemblages in the Jurassic cherts of the western and southern Tuscany, Italy.*

Gupta, S. M. and Fernandez, A. A.: *Coarser taxonomy based radiolarian transfer functions for estimating paleoceanographic changes since Late Miocene in the Tropical Indian Ocean.*

Rudenko, V. S., Kemkin, I. V. and Prokopyev, A. V.: The First Finding of Early Carboniferous Radiolarians from Cherty Deposits of North-East Yakutia, Russia

Bragina, L. G.: Maastrichtian Radiolaria from the Shikotan Island

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**BUSINESS MEETING** 20:00 - 22:00

[Chairperson: Baumgartner, P. O.]

**WORKSHOP** 22:00 - 23:00

[Convener: Hori, R.] Radiolarian biostratigraphy across the Triassic/Jurassic boundary.

[Convener: Baumgartner, Peter O.] Mesozoic-Cenozoic Paleoenvironment.

## 23 October 1994

**SYMPOSIUM A:** *Radiolarian Survival, Extinction and Recovery across Major Geologic Boundaries.* 9:00 - 12:00

[Convener: Ishiga, H.]

Blome, C. D. and Eicher, D. L.: *Radiolarian paleoceanography of the mid-Cretaceous western interior seaway.*

Kozur, H.: *The stratigraphic importance of the Ladinian radiolarian zonation.*

Hori, R. S.: *Radiolarian biostratigraphy and geochemical change recorded in Middle Triassic - Lower Jurassic bedded cherts of the Katsuyama Section from the Inuyama Area, Japan.*

Nishizono, Y., Sato, T. and Murata, M.: *Jurassic radiolarian zonation in the South Belt of Chichibu Terrane in Western Kyushu, Southwest Japan.*

Suzuki, H.: *Pattern on occurrence of the Canoptum Assemblage from Southwest Japan.*

Rudenko, V. S. and Panasenko, E. S.: *Upper Permian and Lower Triassic radiolarian in cherty deposits of Primorye.*

Kakuwa, Y.: *Extinction and recovery of radiolarians across the Permo-Triassic boundary in bedded chert formations of Southwest Japan.*

**POSTER SESSION** 13;00 - 14:00

**SIGHTSEEING** (Osaka Castle and Dotonbori) 14:00 - 18:00

**PARTY** (at Shinsai-bashi) 18:00 - 20:00

## 24 October 1994

**GENERAL SESSION** 9:30 - 11:30

[Chairperson: De Wever, P.]

Aitchison, J. C., Hada, S., and Yoshikura, S.: *Silurian radiolarians of the Kurosegawa Terrane and Hida Gaien, Japan: a contribution to development of a global biostratigraphy.*

Kito, N. and Nagai, H.: *Jurassic Hagiastrid-like Radiolaria.*

Interrad Jurassic-Cretaceous Working Group: *A new Middle Jurassic to Lower Cretaceous radiolarian zonation and worldwide correlation of low-latitude radiolarian associations.*

Takahashi, K.: *Environmental proxy and radiolarian fluxes: a review.*

Dumitrica, P.: *On the presence of capsular membranes of radiolaria in fossil state.*

# SCIENTIFIC CONTRIBUTIONS

## 9 - SCIENTIFIC CONTRIBUTIONS

### 9.1 - ABOUT THE KIMMERIDGIAN-TITHONIAN (VOLGIAN) BOUNDARY ON THE TERRITORY OF THE FORMER SOVIET UNION (extract from the Tithonian W.G., Newsletter n° 6)

PROSOROVSKAYA E., SEY I. & KALACHEVA E.
Russian Geological Research Institute (VSEGEI) st. Petersburg, 199026, Srendny pr. 74 Russia.

INTRODUCTION

The Kimmeridgian-Tithonian (Volgian) boundary on the territory of the former Soviet Union (FSU) is one of the difficult question in the Jurassic stratigraphy.

As for the southern regions of FSU (The Crimea, Caucasus, Transcaucasus, Central Asia), where the Tithonian is the terminal stage of the Jurassic system, Kimmeridgian and Tithonian stages are mainly represented in a regressive cycle and often can be determined only by their position between Oxfordian and Cretaceous deposits. There are different formations with different facies ; the regressive lagoon deposits, without faunas, are the most widespread. The lack of faunas and the fast lateral variation make the correlations very difficult.

In the Boreal regions, where the Volgian is the terminal Jurassic Stage, Kimmeridgian and Volgian stages are represented by normal marine deposits in many districts (Russian platform, Northern Urals, Siberia, Eastern Russia). But there are only isolated sections with a continuous uninterrupted stratigraphic succession and abundance of both Kimmeridgian and Volgian fossils. Although the Volgian was the time of the most extensive Mesozoic transgression (MESEZHNIKOV, 1989), the limited occurrence of Kimmeridgian and lowermost Volgian deposits is due to the erosion caused by the short but geographically wide Early Volgian regression.

KIMMERIDGIAN - TITHONIAN (K/T) BOUNDARY

CRIMEA - Kimmeridigan deposits in Crimea are preserved from the erosion only in limited, scanty areas. The best sections here are in the SW and W parts of the peninsula but the presence of Kimmeridgian deposits is not always clear, or the Upper Kimmeridgian is absent and in this case the Tithonian directly overlies the Lower Kimmeridgian. The Lower Tithonian is here established by *Richterella richteri* (OPPEL), *Haploceras cristifer* ZITTEL, *H. woehleri* (OPPEL), *Virgatosphinctes saheraensis* SPATH (Stratigraphy of the USSR, Jurassic system, 1972).

NORTHERN CAUCASUS - In this area the Kimmeridgian - Tithonian deposits are exposed in lithologically heterogeneous sections representing different facies (calcareous and volcanic rocks, flysch, evaporites). The places where the Kimmeridgian and Tithonian stages are represented in continuous successions and characterized by ammonites are rare. In the central part of the Northern Caucasus (Baksan - Assa interfluve) the Kimmeridgian is composed by limestones with thin sandstones, dolomites and gritstones (SACHAROV & KHIMSHIASHVILI, 1967 ; SACHAROV, 1984 ; SACHAROV *et al.*, 1987 : The Jurassic Ammonite Zones, 1988). One can only suppose the uppermost Kimmeridgian here, because the ammonites indicate the Lower Kimmeridgian and the base of the Upper Kimmeridgian (beds with *Aspidoceras* and *Idoceras*). The Early Tithonian *Lithacoceras ulmense* (OPPEL) was recorded from the thick overlying dolomites. In general the Lower Tithonian is represented in this area by evaporites and what is called the Kimmeridgian - Lower Tithonian of Northern Caucasus is represented by saline deposits. According to all the above mentioned facts it is clear that there is no possibility to identify the K/T boundary here (BEZNOSOV, 1973).

TRANSCAUCASUS - As for the former area, there is no possibility to identify this boundary here. In the Transcaucasus region the Kimmeridgian is mostly represented by lagoon deposits (Georgia) or volcanic rocks (Armenia, Azerbaidjan). In some districts there is a marine Kimmeridgian but without ammonites in its upper part. At the same time in Azerbaidjan (Konachgermaz Formation) there are findings of the Late Kimmeridgian species *Hybonoticeras beckeri* (NEUMAYR) while in the overlying Martuni Formation beds with "*Subplanites*" *contiguus* (CATULLO), *Haploceras carachtheis* (ZEUSCHNER), "*Perisphinctes*" *zitteli* SIEM. have been recognized (ROSTOVTSEV, 1992). However, the identification of the K/T boundary remains impossible. The uppermost Jurassic is composed by limestones, dolomites and volcanic rocks. Ammonites are extremely rare and only some findings are reported.

As for the other fossil groups in the Kimmeridgian and Tithonian stages, there are some attempts to establish zones based on Foraminifera (MAKAR'EVA & SACHAROV, 1982 ; TODRIA, 1977), there are also beds with Brachiopoda (PROSOROVSKAYA, 1993 a, b) but until now these groups cannot be used to identify the K/T boundary.

CENTRAL ASIA - As it has been mentioned above, K/T deposits are formed during a large regressive cycle (which lasted from the top of the Callovian - base of the Oxfordian up to the Mid-Berriasian) and lagoon facies is widespread here. There are only solitary isolated finding of ammonites in this interval in Balkhan, Kopet Dag and Gissar.

KIMMERIDGIAN - VOLGIAN (K/V) BOUNDARY

These stages are mainly represented in Boreal and Sub-Boreal regions by terrigenous deposits and, besides, by volcanic and siliceous rocks in Eastern Russia. The Kimmeridgian is mostly represented by finegrained rocks (clays and aleurolithes , cabonates often, sometimes by sands and sandstones).The Volgian has more various lithological composition (from conglomerates to fine aleurolithes and clays).

The best continuous K/V sections are exposed in the central part of the Russian platform (Gorodishche) and its southeastern surrounding (Berdyanka River Basin) as well as in the eastern slopes of the Northern Urals. As for the other regions of the FSU where Kimmeridigian and Volgian deposits occur, the boundary beds are eroded or they do not contain significant faunas for its identification.

The best studied ammonite succession is in the Volgian lectostratotype (Gorodishche). The uppermost Kimmeridgian is here composed by clay - marls (7 m) of the Autissiodorensis Zone ; two Subzones, Subeumela at the base and Fallax on top are represented. An abundant ammonite assemblage is known from here : *Aulacostephanus (Aulacostephanoides) autissiodorensis* (COTTEAU), *A. (A.) volgensis* (VISCHN.), *A. (A.) kirghisensis* (ORB.), *A. (A.) undorae* (PAVL.), *Amoeboceras (Nannocardioceras) subtilicostatum* (PAVL.), *Virgataxioceras fallax* (ILOV. & FLOR.), *Sutneria subeumela* (SCHNEID), *Haploceras* cf. *subelimatum* (FONT.), *Subdichotomoceras (S.) sublacertosum* (ILOV. & FLOR.), *Glochiceras* spp. These clay-marls conformably pass to the base of the Volgian and in particular to the clay - marls (5 m) of the Klimovi Zone, which contain *Ilowaiskya klimovi* (ILOV. & FLOR.), *Sutneria cf. subeumela* (SCHNEID), *Neochetoceras* cf. *steraspis* (OPPEL), *Gravesia* cf. *gigas* (ORB.) , *G. sp.* and *Glochiceras spp.* (GERASIMOV & MIKHAILOV, 1966 ; MESEZHNIKOV *et al.*, 1977 : The Jurassic Ammonite Zones, 1988).

A rather similar section is exposed along the Berdyanka River : Upper Kimmeridgian sandstones with *Virgataxioceras fallax* (ILOV. & FLOR.) *Aulacostephanus jasonoides* (PAVL.), conformably pass to sandstones with *Ilowaiskya klimovi* (ILOV. & FLOR). Thus, the K/V here coincides with the boundary between the beds with *Virgataxioceras fallax* and *Ilowaiskya klimovi* (GERASIMOV & MILHAILOV, 1966).

The second region where it is possible to observe the continuous succession of Upper Kimmeridgian and Lower Volgian beds is the eastern slope of the Northern Urals. The best section here is located along the Lopsia River. The uppermost Kimmeridgian clays with *Aulacostephanus (Aulacostephanoides) volgensis* (VISCH.), *A. (A.) undorae* (PAVL.), *Virgataxioceras dividuum* MESEZH. gradually pass to the lowermost Volgian aleurithe with *Eosphinctes gracilecostatum* MESZEH., *E.* cf. *magnum* MESEZH., *Gravesia polypleura* HAHN. In the headstream of the Tolja River the clays with *Virgataxioceras dividuum* also pass to aleurithe with *Eosphinctes magnum* MESEZH., *E.* cf. *gracilecostatum* MESEZH. and *Gravesia* sp. M.S. MESEZHNIKOV (1984) recognized here the Autissiodorensis Zone, with the Virgataxioceras dividuum Subzone in its upper part, and the Eosphinctes magnum Zone. The K/V boundary coincides with the boundary between these two zones.

In other regions of Northern Europe and Siberia the K/V boundary coincides with a sedimentary gap. In the basin of the Pechora River (Pishma River) the beds with *Aulacostephanus (Aulacostephanoides) undorae* (PAVL.), *A. (A.) volgensis* (VISCH.) *A. (A.) kirghisensis* (ORB.), *A. (A.) autisssiodorensis* (COTTEAU) *A. (Pararasenia)* cf. *quenstedti* (DURAND), *A. (P.) pishmae* (KHUD.) are overlain, with an angular unconformity, by deposits with *Pectinatites* (upper part of the Lower Volgian).

In Northern Siberia (Left Bojarka River) also the uppermost Kimmeridgian with *Oxydiscites taimyrensis* MESEZH., *Amoeboceras (Nannocardioceras) sp., A. (Euprionoceras) sokolovi* (BODYL.) of the Oxydiscites taimyrensis Zone is overlain by the Pectinatus Zone (MESEZHNIKOV, 1984).

Thus, according to the ammonite scale of the central and northern parts of FSU, the K/V boundary is the top of the Autissiodorensis Zone and the base of the Klimovi Zone (Russian platform) or Magnum Zone (Northern Urals). Their zonal assemblages include *Gravesia spp.* with the other ammonites.

Also the Bivalvia *Buchia* characterizes the K/V boundary. The whole Upper Kimmeridgian is characterized by the maximum development of *Buchia tenuistriata* (LAH.), sometimes, together with *B. rugosa* (FISCH.) and *B. mosquensis* (BUCH) : B. tenuistriata Zone in Siberia (ZAKHAROV, 1981) and B. tenuistriata - B. rugosa Zone in the Far East (SEY & KALACHEVA, 1993). The Lower Volgian is characterized by the maximum development of *B. rugosa* and *B. mosquensis*. The mosquensis-rugosa Zone (lower part of the Middle Volgian) is established in the Russian platform, Far East and, apparently, in Siberia (ZAKHAROV, 1987). However, because of the hiatus occuring mostly everywhere at the base of the Volgian, it is impossible to recognize with certainty the K/V boundary by the means of *Buchia*.

According to foraminifera, the K/V boundary is represented on the Russian platform (Gorodishche section) between Pseudolamarkina pseudorjasanensis - Haplophragnium monstratus Zone and the P. bieleckae - Verneuilinoides Kirillae Zone. The former corresponds to the Upper Kimmeridgian (= Acanthicum, Eudoxus and Autissiodorensis ammonite Zones) while the latter to the Lower Volgian (= Klimovi and Sokolovi Zones) (AZBEL *et al.* 1986).

For the same section there is the attempt (NIKIFOROVA, 1986) to establish the K/V boundary according to the nannoplankton : coccolith assemblage from the Upper Kimmeridgian (= Eudoxus and Autissiodorensis Zones) has the greatest resemblance with the association of the Vekshinella stranderi Zone of S England and N France. The Lower Volgian assemblage has been correlated by E. V. Nikiforova with the association of the Watznaueria communis Zone in England and France.

Thus, it is possible to propose the stratotype of the K/V boundary in the type-area of the Volgian stage at the Gorodishche section (Russian platform, FSU) where the stratigraphic succession is continuous and the possibility to establish the K/V boundary both by ammonites and foraminifera exists.

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9.2 - MESOZOIC MAGNETIC POLARITY TIME SCALE - Compiled by OGG J.G.*

## Introduction And Nomenclature

The Mesozoic portion of the magnetic polarity time scale was compiled from selected publications and represents the status of investigations through early 1994. Many of these sources incorporate numerous studies by other paleomagnetists. This version of the magnetic polarity scale was incorporated into the Mesozoic time scale of Gradstein *et al.* (1994) and the chronostratigraphy synthesis of European Basins (Hardenbol *et al.*, in press). The following review includes some additional magnetostratigraphy studies of late 1994 and earliest 1995.

Reversals of the polarity of the main geomagnetic dipole field are geologically rapid events, typically less than 5000 years in duration, which occur at random intervals. These geologically rapid events are recorded by iron oxides within volcanic and sedimentary rocks. The magnetic polarity time scale is constructed from paleomagnetic analyses of various sedimentary sections having detailed biostratigraphy and by correlations to marine magnetic anomaly patterns. The pattern of polarity reversals commonly provides a unique "fingerprint" for correlating rock strata among diverse depositional and faunal realms and the assignment of geologic ages to marine magnetic anomalies.

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"Polarity chrons" are intervals of geological time having a constant magnetic field polarity delimited by reversals (International Subcommission on Stratigraphic Classification, 1979). A "polarity zone" is the corresponding interval in a stratigraphic section deposited during the polarity chron. Magnetic polarity is called "normal" if the geomagnetic field orientation is similar to the present dipole polarity, and "reversed" if it is opposite in orientation.

Nomenclature for Cenozoic and late Mesozoic and Cenozoic polarity chrons is derived from the numbering from youngest to oldest of the corresponding "C" and "M" marine magnetic anomaly series. Each numbered polarity chron consists of a pair of a younger normal-polarity chron, denoted with the suffix "n", and an older reversed-polarity chron, denoted with "r". When a major numbered polarity chron is further subdivided, the resulting subchrons are denoted by a suffix of a corresponding numbered polarity chron. For example, "M22n.2n" is the second-oldest normal-polarity subchron which comprises normal-polarity chron M22n. In some cases, further subdivisions have been made to previously published polarity subchrons, and are denoted by an additional suffix.

The relative stratigraphic timing of an event with a polarity chron or zone can be indicated by appending a decimal fraction to the polarity chron name (Hallam *et al.*, 1985; Ogg *et al.*, 1991). For example, the relative age of the Berriasian/Valanginian boundary is at polarity chron M15n.4, indicating that 40% of normal-polarity chron M15n preceded the event. [The systematic numbering from most recent to oldest for the Cenozoic and late Mesozoic magnetic polarity chrons is more consistent with an inverted system (Cande and Kent, 1992), where the relative timing of this boundary is denoted as "M15n.6", implying that 60% of polarity chron M15n is younger than the boundary. However, the stratigraphic system is used in this compilation.]

Pre-Late Jurassic portions of the magnetic polarity time scale are derived entirely from paleomagnetic analysis of stratigraphic sections; therefore the polarity chrons do not have a corresponding marine magnetic anomaly sequence to provide an independent nomenclature system. Some published magnetostratigraphic sections have designated the individual polarity zones by stratigraphic numbering or lettering (upward or downward). Until the completeness and relative pattern of these various polarity zone series have been verified from coeval stratigraphic successions, it is premature to attempt any systematic nomenclature. When the magnetic polarity pattern in a stage or ammonite zone is documented and verified in additional sections, then a numbering of the major events from oldest to youngest within each individual stage could be proposed. Therefore, "polarity chron Toarcian-3n" would indicate the 3rd major normal polarity chron from the base of the Toarcian stage.

The pre-"M-sequence" magnetic polarity time scale in this paper summarizes polarity chron patterns according to composite sections (e.g., Toarcian from France, Spain and Switzerland) or as recorded in a "biostratigraphically complete" section (e.g., Aalenian stage in Breggia Gorge, Switzerland). These polarity zones are scaled in the stratigraphic charts according to the durations of ammonite zones or subzones in the Mesozoic time scale of Gradstein *et al.* (1994). In cases where the ammonite-zonal control is inadequate (e.g., Sinemurian), then the observed pattern is scaled within the stage.

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9.2 - MESOZOIC MAGNETIC POLARITY TIME SCALE - Compiled by OGG J.G.*

## Introduction And Nomenclature

The Mesozoic portion of the magnetic polarity time scale was compiled from selected publications and represents the status of investigations through early 1994. Many of these sources incorporate numerous studies by other paleomagnetists. This version of the magnetic polarity scale was incorporated into the Mesozoic time scale of Gradstein *et al.* (1994) and the chronostratigraphy synthesis of European Basins (Hardenbol *et al.*, in press). The following review includes some additional magnetostratigraphy studies of late 1994 and earliest 1995.

Reversals of the polarity of the main geomagnetic dipole field are geologically rapid events, typically less than 5000 years in duration, which occur at random intervals. These geologically rapid events are recorded by iron oxides within volcanic and sedimentary rocks. The magnetic polarity time scale is constructed from paleomagnetic analyses of various sedimentary sections having detailed biostratigraphy and by correlations to marine magnetic anomaly patterns. The pattern of polarity reversals commonly provides a unique "fingerprint" for correlating rock strata among diverse depositional and faunal realms and the assignment of geologic ages to marine magnetic anomalies.

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## Cretaceous

### *Upper Cretaceous*

The Cretaceous/Paleogene boundary occurs in polarity chron C29r (approximately C29r.7), according to an average of 5 magnetostratigraphic sections (Cande and Kent, 1992). Hicks (1993) correlated magnetic polarity zones C29n through C33r to ammonite zones in the U.S. Western Interior and interpolated ages for the magnetic reversals from the dated bentonite horizons (Obradovich, 1988, 1993). I combined these ages on the magnetic polarity chrons and associated error limits derived by Hicks (1993) with the spacing of magnetic anomalies (Cande and Kent, 1992) to obtain a best-fit smoothed seafloor spreading curve and associated ages of the magnetic polarity chron boundaries. This polarity scale is similar to the results from a spline fit on South Atlantic spreading rates using a second control of 74.5 Ma for a level in the upper part of polarity chron C33n (Cande and Kent, in press). After this scale was prepared, additional radiometric and ammonite observations near the C32r/C33n boundary indicated that the age may be closer to 73.5 Ma (M. Steiner and J. Hicks, pers. commun., Oct., 1994). The base of polarity chron C33r is at or near the Santonian/Campanian boundary (reviewed in Cande and Kent, 1992).

### *Middle Cretaceous* (Aptian through Santonian)

An extended interval of normal polarity, the "Cretaceous Long Normal-Polarity Chron" or polarity chron C34n, extends from the early Aptian to the Santonian/Campanian boundary.

Within this anomalous interval, brief reversed-polarity zones have been reported, especially within the Aptian and Albian in drilling cores of deep-sea sediments. Ryan *et al.* (1978) proposed three reversed-polarity events or clusters of events and suggested a "negative" nomenclature continuation of the older M-sequence : (1) M"-1r" in late Aptian (Pechersky and Khramov, 1973 ; Jarrard, 1974; VandenBerg *et al.*, 1978; Keating and Helsley, 1978a,b,c; Hailwood, 1979, VandenBerg and Wonders, 1980; Lowrie *et al.*, 1980 ; Tarduno *et al.*, 1989; Ogg *et al.*, 1992), which has a documented age near the base of the *Globigerinelliodes algerianus* planktonic foraminifer zone, an alternate designation as the "Isea" event (Tarduno *et al.*, 1989), and an estimated duration less than 100,000 years (Tarduno, 1990); (2) M"-2r" set of Middle Albian events near the boundary of the *Biticinella breggiensis* and *Ticinella primula* planktonic foraminifer zones (Keating and Helsley, 1978a; Jarrard, 1974 ; VandenBerg and Wonders, 1980; Tarduno et al., 1992); and (3) M"-3r" set in Late Albian (Green and Brecher, 1974; Jarrard, 1974; Hailwood, 1979), which may occur at the end of the *Praediscosphaera cretacea* or within the *Eiffellithus turriseiffeli* nannoplankton zones (Tarduno *et al.*, 1992). Neither M"-2r" nor M"-3r" have been verified in outcrop sections.

### *Lower Cretaceous*

The M-sequence polarity scale for polarity chrons M0r through M25r is derived from a block model of the Hawaiian lineations by Larson and Hilde (1975) with minor later additions (Tamaki and Larson, 1988). The M-sequence nomenclature and separation of additional major polarity chrons (e.g., polarity chron "M11A") follows Cox (*in* Harland *et al.*, 1982).

The M-sequence polarity chrons have been correlated to ammonite, calcareous nannofossil, dinoflagellate and calpionellid zones and datums (reviews in Ogg, 1988, 1995; Bralower *et al.*, 1989 ; Ogg *et al.*, 1991a ; Channell and Erba, 1992; Channell *et al.*, 1994). The Barremian/Aptian boundary is correlated to the base of polarity chron M0r, and this association has been proposed as a key factor in defining the base of the Aptian Stage (E. Erba, pers. commun., 1993). The Hauterivian/Barremian stage boundary occurs approximately two-thirds from the base of polarity chron M5n (M5n.66) (Cecca *et al.*, 1994); this ammonite-zonal calibration is younger than the previous estimates of near polarity chron M7 from microfossil datums (Channell and Erba, 1992). There have not been any precise ammonite or nannofossil markers for the Valanginian/Hauterivian boundary in magnetostratigraphic sections, and the observed variability in a dinoflagellate marker for the boundary (last appearance datum of *Scriniodinium dictyotum*) brackets polarity zone M10Nr. However, Channell *et al.* (1994) have reported a possible occurrence of *Acanthodiscus radiatus* in an Italian section that would place the ammonite-defined Valanginian/Hauterivian boundary near the base of polarity zone M11n. The base of the *Thurmanniceras otopeta* ammonite zone in southern Spain occurs just below the middle of polarity chron M15n, and the corresponding Berriasian/Valanginian stage boundary is placed at M15n.4 (Ogg *et al.*, 1988).

Berriasian ammonite zones in the Tethyan realm have been directly correlated to magnetic polarity chrons M14r through M18n (Galbrun, 1984; Ogg *et al.*, 1984), although these assignments may have been influenced by sequence boundaries and associated hiatuses within the reference sections (e.g., Jan du Chêne *et al.*, 1993). The regional Purbeck stage of southern England has yielded a magnetostratigraphy consistent with an age assignment to polarity chrons M19r through M14r, indicating correlation to latest Tithonian through earliest Valanginian stages of the Tethyan realm (Ogg *et al.*, in press, *Geobios*; Algeo and Ogg, in prep.). The underlying Portland appears to span only polarity zones M21r through M19n, implying a middle and late Tithonian age correlation (Ogg *et al.*, in press, *Geobios*).

## Jurassic

### *Upper Jurassic*

The base of the *Berriasella jacobi* Zone, which is a common working definition for the Tithonian/Berriasian stage boundary, is in the upper portion of polarity chron M19n (approximately M19n.2n.5) (Galbrun, 1984; Ogg *et al.*, 1984, 1991a). Magnetostratigraphic correlations have been determined for a suite of other nannofossil, calpionellid, dinoflagellate datums near the Jurassic/Cretaceous boundary interval (compiled in Bralower *et al.*, 1989; Ogg *et al.*, 1991a).

Kimmeridgian and Tithonian ammonite zones of the Tethyan realm have been directly correlated to magnetic polarity chrons M19n through M25n (Ogg *et al.*, 1984). The Kimmeridgian/Tithonian boundary (base of the *Hybonoticeras hybonotum* ammonite zone) occurs in southern Spain within polarity chrons M23n to M22An, and is provisionally assigned to the top of polarity chron M23n. The Oxfordian/Kimmeridgian boundary (base of the *Sutneria platynota* ammonite zone) appears to occur within polarity chron M25r or M24Br within southern Spain (Ogg *et al.*, 1984), and was provisionally assigned to the top of polarity chron M25n in the time scale of Gradstein *et al.* (1994), although later studies suggest an assignment at the base of polarity chron M25n (Ogg and Gutowski, in press).

Close-spaced magnetic anomalies M26 through M39 are observed in Pacific crust of Early Callovian-Oxfordian age (Cande *et al.*, 1978; Handschumacher *et al.*, 1988; Larson *et al.*, 1992). Ages of this older portion of the M-sequence of marine magnetic anomalies can be estimated by assuming a constant spreading rate for the detailed Japanese set modeled by Handschumacher *et al.* (1988). Ocean Drilling Program (ODP) Site 765, drilled on marine magnetic anomaly M26r in the Argo Abyssal Plain, has an Ar-Ar age on the basement basalts of 155.3 ± 3.4 Ma (Ludden, 1992); and ODP Site 801, drilled into Pacific crust older than magnetic anomaly M39, has basement basalts interbedded with radiolarian assemblages of latest Bathonian or earliest Callovian (Larson *et al.*, 1992) and an Ar-Ar age of 166.8 ± 4.5 Ma (Pringle, 1992). I have retained the anomaly numbering of Handschumacher *et al.* (1988) for this new scale, but their polarity chron and subchron nomenclature was revised to be consistent with the younger portion of the M-sequence. For example, their normal-polarity chron "35a" is renamed as subchron "M35r.1n" because it occurs within their reversed-polarity chron M35r. There may be a duplication of one chron within their marine magnetic anomaly pattern due to a spreading ridge jump (R. Larson, pers. commun., 1991).

The portions of the Oxfordian have yielded a reproduceable magnetic polarity pattern (e.g., Steiner *et al.*, 1986; Ogg *et al.*, 1991b; Juárez *et al.*, 1994), but the continuous intervals were too limited to allow unambiguous correlations to the marine magnetic anomaly pattern. A compilation of multiple Oxfordian magnetostratigraphic sections in Poland and Spain (Ogg and Gutowski, in press) has suggested a correlation of Oxfordian ammonite zones to the main features of the magnetic anomaly model of Handschumacher *et al.* (1988) and projects an assignment of the Callovian/Oxfordian boundary to polarity chron M35r. However, these correlations require additional verification.

### *Middle Jurassic*

Magnetic anomalies M36r through M39n of Handschumacher *et al.* (1988) are constrained to have a late Callovian age by the early Callovian age of ODP Site 801 (Larson *et al.*, 1992). Pre-M39 oceanic crust in the Pacific is called the "Jurassic Quiet Zone", and the indistinct nature of the oceanic crust magnetization of this region may indicate the blurring effect caused by a high frequency of magnetic reversals. Deep-tow magnetometer surveys within this region also indicate close-spaced, low-amplitude magnetic anomalies (P. Johnson, pers. commun., Dec., 1994). However, magnetostratigraphic polarity successions for the Late Bathonian or for the entire Callovian Stage have not yet been verified, and this interval represents one of the longest gaps in our knowledge of the Mesozoic magnetic polarity time scale.

This magnetic anomaly model for the oldest Pacific oceanic crust is consistent with the observed very high frequency of magnetic reversals in the Bajocian through Middle Bathonian ammonite-zoned sediments of southern Spain (Steiner *et al.*, 1987). The Bajocian through Middle Bathonian polarity pattern in the chart is a correlation of the main magnetostratigraphic features within the component ammonite zones; there may be additional short-duration polarity zones. The Aalenian polarity pattern is from an ammonite-zoned pelagic sediment section in southern Switzerland (Horner and Heller, 1983).

### *Lower Jurassic*

Toarcian stage has yielded a magnetostratigraphy in several ammonite-zoned sections in Switzerland, France and Spain (Horner and Heller, 1983 ; Galbrun *et al.*, 1988, 1990), but correlations were inhibited by regional differences in ammonite zonation and distortions introduced by discontinuities in sedimentation. I derived a consistent magnetic polarity time scale for the Toarcian by plotting the polarity patterns of these individual studies on a common ammonite-correlation standard (Groupe Français d'Etudes du Jurassique, 1991; Thierry *et al.* in Hardenbol *et al.*, in press) with allowances for reported hiatuses or condensations in the lithostratigraphy.

The Pliensbachian sequence is from an ammonite-zoned section in northern Italy (Horner and Heller, 1983).

The Hettangian and Sinemurian stages have not yet yielded a verified magnetostratigraphy. Sections in Italy (Channell *et al.*, 1982) and in Austria (Steiner and Ogg, 1988; shown in the chart) have yielded magnetostratigraphy sequences dominated by reversed polarity, but these sections lack detailed biostratigraphic zonation. Preliminary results from a borehole in the Paris Basin also indicate that the uppermost Hettangian and Sinemurian may be dominated by reversed polarity, but with a high frequency of normal-polarity zones (Yang *et al.*, 1994).

Magnetostratigraphic results from eastern United States (McIntosh *et al.*, 1985; Kent *et al.*, in press), a borehole in the Paris Basin (Yang *et al.*, 1994), and from southern Germany (Ogg and Steiner, unpublished) suggest that the Hettangian may be dominated by normal polarity.

## Triassic

### *Upper Triassic*

Two independent magnetic polarity scales are shown for the Upper Triassic. The first column is derived from continental sediments in North America and is scaled according to the placement of stage boundaries in the published stratigraphic studies. The second column is derived from marine sediments in southwestern Turkey and has been rescaled to correspond to individual ammonite zones within each stage.

The Newark Basin of eastern U.S. is a thick succession dominated by lacustrine deposits exhibiting Milankovitch climatic cycles. The Norian and upper Carnian magnetic polarity pattern is from a composite of Newark Basin sections (Olsen and Kent, 1990; Witte *et al.*, 1991), and the potential for scaling to regular Milankovitch cycles implies that these sections can provide an approximation to the actual relative durations of polarity zones. The calibration of the magnetostratigraphy to geologic stages is partially constrained by palynology, but the exact assignments of the Rhaetian-Norian and Jurassic-Triassic boundaries are uncertain. Brief normal-polarity zones are observed within reversed-polarity marine sediments of lower Rhaetian on the northwestern Australian margin (Galbrun, 1992), and may correlate to features in the Chinle Formation of New Mexico (Molina-Garza *et al.*, 1991). These two normal-polarity zones have been tentatively inserted into the reversed-polarity lower Rhaetian portion of the Newark pattern. Magnetostratigraphy of marine sediments of Carnian through middle Norian age on the northwest Australian margin (Galbrun, 1992) and in Turkey (Gallet *et al.*, 1992) indicate that the Carnian-Norian boundary is within or near the base of a normal-polarity zone, which is similar to the placement of this boundary in the Newark Basin. These studies also suggest that the published Newark Basin pattern did not resolve some brief polarity zones. High-resolution magnetostratigraphy on drill cores of the Newark succession has indicated additional polarity intervals within the main pattern (Kent *et al.*, in press), however the details were not yet published for inclusion in our compilation. A composite Carnian and Middle Triassic magnetic polarity pattern was compiled by Molina-Garza *et al.* (1991) from various studies of North American continental sediments.

A suite of condensed ammonite- and conodont-bearing marine sections in southwestern Turkey yielded a composite magnetic polarity time scale that can be directly correlated to Norian and Carnian ammonite biochronozones (Gallet *et al.*, 1992, 1993; Marcoux, 1993).

At first glance, the Newark Basin and southwest Turkey columns appear to contradict each other. However, the mismatch is probably caused by the different methods of scaling (relative sediment thickness within a geologic stage vs. equal ammonite subzone) and the uncertainty in assigning stage boundaries to the Newark Basin succession (Kent *et al.*, in press). For example, a potential correlation is to assign the the normal-polarity zone of longest duration in the Newark Group (at 216-218 Ma in the chart) to the longest-duration zone in Turkey (lower half of Alaunian substage of upper Norian), thereby requiring either that the Rhaetian-Norian boundary in the Newark group should be relocated downward or that the relative duration of the Sevatian substage of upper Norian should be greatly expanded (Kent *et al.*, in press). The Newark Basin polarity pattern with its scaling to Milankovitch cyclicity provides a reference standard for actual time durations of each magnetic polarity zone for the Upper Triassic. Correlation of this pattern to the magnetostratigraphy of the southwestern Turkey sections will enable assignments of relative time durations for individual biostratigraphic zones and a precise biostratigraphic framework for the Newark Basin. At present, such correlations between the Newark Basin and Turkey patterns are poorly constrained.

A composite Carnian magnetic polarity pattern was compiled by Molina-Garza *et al.* (1991) from various studies of North American continental sediments. The lower Carnian portion of the magnetostratigraphy from Turkey (Gallet *et al.*, 1992; Marcoux, 1993) indicates that the western U.S. composite is oversimplified.

### *Middle Triassic*

Ladinian through upper Anisian ammonite-bearing pelagic sediments at Hydra, Greece, provide the current standard for the magnetic polarity time scale (Muttoni *et al.*, 1994). The main features in the Hydra study were consistent with a composite Middle Triassic magnetic polarity pattern derived from continental sediments in the western United States (Molina-Garza *et al.*, 1991). The lower Anisian portion of the western U.S. scale has not yet been calibrated to ammonite zones.

### *Early Triassic*

There have been several magnetostratigraphic studies on Lower Triassic continental and marginal-marine sediments (e.g., Helsley and Steiner, 1974; Shive *et al.*, 1984; Heller *et al.* 1988; Steiner *et al.*, 1989), but biostratigraphy on most of these sections does not allow recognition of individual geological stages. The polarity pattern from ammonite-zoned Griesbachian through Spathian substages in the Canadian Arctic (the former stratotype region) yielded a reproduceable polarity pattern (Ogg and Steiner, 1991). The magnetostratigraphy of the Werfen Formation of marginal-marine deposits in the Dolomites of Italy can be correlated to this Arctic magnetic polarity scale using constraints from biostratigraphy and sequence-stratigraphy (Graziano and Ogg, 1994).

## Summary

The magnetic polarity time scale for the Mesozoic is well-documented in the Cretaceous and latest Jurassic where the seafloor magnetic anomaly pattern provides a guide for scaling the polarity sequence. The polarity pattern is known in partial detail for two-thirds of the Triassic and Jurassic ammonite zones. The major stages with ill-defined or unknown magnetic polarity patterns are the Carnian, Rhaetian-Hettangian-Sinemurian, and late Bathonian-Callovian-early Oxfordian. This magnetic polarity time scale will continue to evolve with further high-resolution magnetostratigraphy research.

### *Acknowledgments*

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*Handbook of Physical Constants* (to be eventually published by the American Geophysical Union). Major portions of the magnetostratigraphy research and development of associated composite scales have been in association with Maureen Steiner. The current (early 1995) version has greatly benefited from preprints and discussions from James Channell, Jason Hicks, and Dennis Kent.

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## 9.3 - COMMENT ON MESOZOIC TIME-SCALE

From : Committee for Quantitative Stratigraphy, Newsletter n° 6, January, 1995, p. 15-18.

A new numerical Mesozoic time-scale was recently published by F.M. Gradstein, F.P. Agterberg, J.G. Ogg, J. Hardenbol, P. van Veen, J. Thierry, and Z. Huang (*Journal of Geophysical Research*, vol. 99, n° B12, pp. 24,051-24,074, December 10, 1994à) (also see article on this topic by same authors in W.A. Berggren, ed., *SEPM Special Volume*, in press ; publication date : July 1995). Figures 1 to 3 from the JGR article are reproduced on the next pages. These figures differ from those shown in the last CQS Newsletter (April, 1992), because of use of more recent data and improved methodology for data integration. Our new scale (MTS) is relatively close to Harland *et al.'s* (1989) scale (PTS). Figure 4 shows differences between PTS and MTS with the (±2s) error bars of MTS plotted against the stage boundary age estimates (data from Table 1 in "Estimation of the Mesozoic Time Scale" by F.P. Agterberg, *Jour. Mathematical Geology*, vol. 26, n° 6, p. 857-876). If the error bar of a stage boundary in Figure 4 includes O (for equality of age), the corresponding difference between scales is not statistically significant.

# Mesozoic Magnetic Polarity Time Scale

| STAGE / Main Polarity Chron | Subchron | Polarity Chron Age (in Ma) Top | Bottom | Duration | Comments |
|---|---|---|---|---|---|
| **Latest Mesozoic "C-Sequence"** | | | | | |
| **"C-Sequence"** | | | | | |
| **Early Paleocene** | | | | | |
| C29 | C29n | 63.976 | 64.945 | 0.97 | |
| | C29r | 64.945 | 65.578 | 0.63 | |
| **CRETACEOUS** | | | | | |
| **MAASTRICHTIAN** | | 65.000 | | | The Cretaceous/Paleogene boundary is at C29r.7. |
| C30 | C30n | 65.578 | 67.519 | 1.94 | |
| | C30r | 67.519 | 67.640 | 0.12 | |
| C31 | C31n | 67.640 | 68.657 | 1.02 | |
| | C31r | 68.657 | 70.969 | 2.31 | |
| C32 | C32n.1n | 70.969 | 71.314 | 0.34 | |
| **CAMPANIAN** | | 71.300 | | | The Campanian/Maastrichtian boundary is within polarity chron C32n.1n. |
| | C32n.1r | 71.314 | 71.643 | 0.33 | |
| | C32n.2n | 71.643 | 73.635 | 1.99 | |
| | C32r.1r | 73.635 | 74.021 | 0.39 | |
| | C32r.1n | 74.021 | 74.133 | 0.11 | |
| | C32r.2r | 74.133 | 74.470 | 0.34 | |
| C33 | C33n | 74.470 | 79.650 | 5.18 | |
| | C33r | 79.650 | 83.500 | 3.85 | |
| **SANTONIAN** | | 83.500 | | | Santonian/Campanian boundary is provisionally near base of polarity chron C33r. |
| C34 | C34n | 83.500 | 100.187 | 16.69 | |
| **CONIACIAN** | | 85.800 | | | |
| **TURONIAN** | | 89.000 | | | |
| **CENOMANIAN** | | 93.500 | | | |
| **ALBIAN** | | 98.900 | | | |
| | M"-3"r set | 100.187 | 102.761 | 2.57 | The existence of reversed-polarity zones within this interval has not yet been verified. |
| | (C34n) | 102.761 | 105.335 | 2.57 | |
| | M"-2"r set | 105.335 | 107.910 | 2.57 | The existence of reversed-polarity zones within this interval has not yet been verified. |
| | (C34n) | 107.910 | 115.333 | 7.42 | |
| **APTIAN** | | 112.200 | | | |
| | M"-1"r | 115.333 | 115.483 | 0.15 | |
| | (C34n) | 115.483 | 119.533 | 4.05 | |
| **Early Cretaceous-Late Jurassic "M-sequence"** | | | | | |
| | M0r | 120.398 | 121.000 | 0.60 | |
| **BARREMIAN** | | 121.000 | | | Barremian/Aptian boundary is provisionally assigned to base of polarity chron M0r |
| M1 | M1n | 121.000 | 123.673 | 2.67 | |
| | M1r | 123.673 | 124.051 | 0.38 | |
| M3 | M3n | 124.051 | 124.721 | 0.67 | also called "M2" |
| | M3r | 124.721 | 126.723 | 2.00 | |
| M5 | M5n | 126.723 | 127.669 | 0.95 | also called "M4" |
| **HAUTERIVIAN** | | 127.000 | | | Hauterivian/Barremian boundary is within upper M5n ("M4"), but precise placement is uncertain (Cecca et al., Cret.Research, 1994). |
| | M5r | 127.669 | 128.176 | 0.51 | |
| M6 | M6n | 128.176 | 128.313 | 0.14 | |
| | M6r | 128.313 | 128.425 | 0.11 | |
| M7 | M7n | 128.425 | 128.580 | 0.15 | |
| | M7r | 128.580 | 128.966 | 0.39 | |
| M8 | M8n | 128.966 | 129.276 | 0.31 | |
| | M8r | 129.276 | 129.508 | 0.23 | |
| M9 | M9n | 129.508 | 129.774 | 0.27 | |
| | M9r | 129.774 | 130.221 | 0.45 | |
| M10 | M10n | 130.221 | 130.556 | 0.34 | |
| | M10r | 130.556 | 130.874 | 0.32 | |
| M10N | M10Nn.1n | 130.874 | 131.201 | 0.33 | |
| | M10Nn.1r | 131.201 | 131.252 | 0.05 | |
| | M10Nn.2n | 131.252 | 131.570 | 0.32 | |
| | M10Nn.2r | 131.570 | 131.588 | 0.02 | |
| | M10Nn.3n | 131.588 | 131.880 | 0.29 | |
| | M10Nr | 131.880 | 132.069 | 0.19 | |
| **VALANGINIAN** | | 132.000 | | | Valanginian/Hauterivian boundary is tentatively assigned to polarity chron M10Nr. |
| M11 | M11n | 132.069 | 132.679 | 0.61 | |
| | M11r.1r | 132.679 | 133.025 | 0.35 | |

| STAGE<br>Main Polarity Chron | Subchron | Polarity Chron Age (in Ma)<br>Top | <br>Bottom | <br>Duration | Comments |
|---|---|---|---|---|---|
| | M11r.1n | 133.025 | 133.060 | 0.03 | |
| | M11r.2r | 133.060 | 133.350 | 0.29 | |
| M11A | M11An.1n | 133.350 | 133.627 | 0.28 | |
| | M11An.1r | 133.627 | 133.641 | 0.01 | |
| | M11An.2n | 133.641 | 133.911 | 0.27 | |
| | M11Ar | 133.911 | 133.988 | 0.08 | |
| M12 | M12n | 133.988 | 134.216 | 0.23 | |
| | M12r.1r | 134.216 | 134.777 | 0.56 | |
| | M12r.1n | 134.777 | 134.846 | 0.07 | |
| | M12r.2r | 134.846 | 134.999 | 0.15 | |
| M12A | M12An | 134.999 | 135.248 | 0.25 | |
| | M12Ar | 135.248 | 135.338 | 0.09 | |
| M13 | M13n | 135.338 | 135.525 | 0.19 | |
| | M13r | 135.525 | 135.843 | 0.32 | |
| M14 | M14n | 135.843 | 136.044 | 0.20 | |
| | M14r | 136.044 | 136.675 | 0.63 | |
| M15 | M15n | 136.675 | 137.222 | 0.55 | |
| **BERRIASIAN** | | **137.000** | | | Valanginian/Berriasian) boundary (base of Th. otopeta zone) is at approximately M15n.4. |
| | M15r | 137.222 | 137.877 | 0.66 | |
| M16 | M16n | 137.877 | 139.631 | 1.75 | |
| | M16r | 139.631 | 140.335 | 0.70 | |
| M17 | M17n | 140.335 | 140.790 | 0.45 | |
| | M17r | 140.790 | 142.404 | 1.61 | |
| M18 | M18n | 142.404 | 143.021 | 0.62 | |
| | M18r | 143.021 | 143.476 | 0.45 | |
| M19 | M19n.1n | 143.476 | 143.616 | 0.14 | |
| | M19n.1r | 143.616 | 143.703 | 0.09 | |
| | M19n.2n | 143.703 | 144.691 | 0.99 | |
| **JURASSIC** | | | | | |
| **TITHONIAN** | | **144.200** | | | Jurassic/Cretaceous boundary definition used here is top of Duranites zone, and occurs within polarity chron M19n.2n. |
| | M19r | 144.691 | 145.094 | 0.40 | |
| M20 | M20n.1n | 145.094 | 145.366 | 0.27 | |
| | M20n.1r | 145.366 | 145.418 | 0.05 | |
| | M20n.2n | 145.418 | 145.996 | 0.58 | |
| | M20r | 145.996 | 146.750 | 0.75 | |
| M21 | M21n | 146.750 | 147.704 | 0.95 | |
| | M21r | 147.704 | 148.116 | 0.41 | |
| M22 | M22n.1n | 148.116 | 149.491 | 1.38 | |
| | M22n.1r | 149.491 | 149.535 | 0.04 | |
| | M22n.2n | 149.535 | 149.579 | 0.04 | |
| | M22n.2r | 149.579 | 149.623 | 0.04 | |
| | M22n.3n | 149.623 | 149.693 | 0.07 | |
| | M22r | 149.693 | 150.428 | 0.74 | |
| M22A | M22An | 150.428 | 150.542 | 0.11 | |
| | M22Ar | 150.542 | 150.700 | 0.16 | |
| **KIMMERIDGIAN** | | **150.700** | | | Kimmeridgian/Tithonian boundary is near top of polarity chron M23n. |
| M23 | M23n | 150.700 | 151.098 | 0.40 | |
| | M23r.1r | 151.098 | 151.399 | 0.30 | |
| | M23r.1n | 151.399 | 151.432 | 0.03 | |
| | M23r.2r | 151.432 | 152.109 | 0.68 | |
| M24 | M24n | 152.109 | 152.465 | 0.36 | |
| | M24r.1r | 152.465 | 152.863 | 0.40 | |
| | M24r.1n | 152.863 | 152.895 | 0.03 | |
| | M24r.2r | 152.895 | 153.110 | 0.22 | |
| M24A | M24An | 153.110 | 153.250 | 0.14 | |
| | M24Ar | 153.250 | 153.541 | 0.29 | |
| M24B | M24Bn | 153.541 | 153.928 | 0.39 | |
| | M24Br | 153.928 | 154.100 | 0.17 | |
| **OXFORDIAN** | | **154.100** | | | Oxfordian/Kimmeridgian boundary is near top of polarity chron M25n. |
| M25 | M25n | 154.100 | 154.305 | 0.21 | |
| | M25r | 154.305 | 154.489 | 0.18 | |
| **Pre-M25 Magnetic Anomaly Series** | | | | | |
| M25A | M25An.1n | 154.489 | 154.612 | 0.12 | |
| | M25An.1r | 154.612 | 154.670 | 0.06 | |
| | M25An.2n | 154.670 | 154.752 | 0.08 | |
| | M25An.2r | 154.752 | 154.811 | 0.06 | |
| | M25An.3n | 154.811 | 154.922 | 0.11 | |
| | M25Ar | 154.922 | 155.003 | 0.08 | |
| M26 | M26n.1n | 155.003 | 155.085 | 0.08 | |
| | M26n.1r | 155.085 | 155.144 | 0.06 | |
| | M26n.2n | 155.144 | 155.202 | 0.06 | |

| STAGE | Subchron | Polarity Chron Age (in Ma) | | | Comments |
|---|---|---|---|---|---|
| Main Polarity Chron | | Top | Bottom | Duration | |
| | M26n.2r | 155.202 | 155.260 | 0.06 | |
| | M26n.3n | 155.260 | 155.319 | 0.06 | |
| | M26n.3r | 155.319 | 155.360 | 0.04 | |
| | M26n.4n | 155.360 | 155.506 | 0.15 | |
| | M26r | 155.506 | 155.681 | 0.18 | |
| M27 | M27n | 155.681 | 155.827 | 0.15 | |
| | M27r | 155.827 | 155.991 | 0.16 | |
| M28 | M28n | 155.991 | 156.137 | 0.15 | |
| | M28r | 156.137 | 156.283 | 0.15 | |
| M29 | M29n.1n | 156.283 | 156.423 | 0.14 | |
| | M29n.1r | 156.423 | 156.470 | 0.05 | |
| | M29n.2n | 156.470 | 156.633 | 0.16 | |
| | M29n.2r | 156.633 | 156.657 | 0.02 | |
| | M29n.3n | 156.657 | 156.762 | 0.11 | |
| | M29r | 156.762 | 156.838 | 0.08 | |
| M30 | M30n | 156.838 | 157.165 | 0.33 | |
| | M20r.1r | 157.165 | 157.363 | 0.20 | |
| | M30r.1n | 157.363 | 157.393 | 0.03 | |
| | M30r.2r | 157.393 | 157.445 | 0.05 | |
| M31 | M31n | 157.445 | 157.550 | 0.11 | |
| | M31r | 157.550 | 157.656 | 0.11 | |
| M32 | M32n | 157.656 | 157.918 | 0.26 | |
| | M32r.1r | 157.918 | 158.041 | 0.12 | |
| | M32r.1n | 158.041 | 158.076 | 0.04 | |
| | M32r.2r | 158.076 | 158.117 | 0.04 | |
| M33 | M33n | 158.117 | 158.281 | 0.16 | |
| | M33r | 158.281 | 158.415 | 0.13 | |
| M34 | M34n | 158.415 | 158.608 | 0.19 | |
| | M34r.1r | 158.608 | 158.713 | 0.11 | |
| | M34r.1n | 158.713 | 158.765 | 0.05 | |
| | M34r.2r | 158.765 | 158.836 | 0.07 | |
| | M34r.2n | 158.836 | 158.871 | 0.04 | |
| | M34r.3r | 158.871 | 158.958 | 0.09 | |
| M35 | M35n.1n | 158.958 | 159.174 | 0.22 | |
| | M35n.1r | 159.174 | 159.250 | 0.08 | |
| | M35n.2n | 159.250 | 159.373 | 0.12 | |
| | M35r.1r | 159.373 | 159.484 | 0.11 | |
| | M35r.1n | 159.484 | 159.525 | 0.04 | |
| | M35r.2r | 159.525 | 159.577 | 0.05 | |
| M36 | M36n.1n | 159.577 | 159.753 | 0.18 | |
| | M36n.1r | 159.753 | 159.788 | 0.04 | |
| | M36n.2n | 159.788 | 159.893 | 0.11 | |
| | M36r | 159.893 | 160.027 | 0.13 | |
| M37 | M37n | 160.027 | 160.226 | 0.20 | |
| | M37r.1r | 160.226 | 160.296 | 0.07 | |
| | M37r.1n | 160.296 | 160.331 | 0.04 | |
| | M37r.2r | 160.331 | 160.407 | 0.08 | |
| | M37r.2n | 160.407 | 160.454 | 0.05 | |
| | M37r.3r | 160.454 | 160.518 | 0.06 | |
| M38 | M38n.1n | 160.518 | 160.664 | 0.15 | |
| | M38n.1r | 160.664 | 160.676 | 0.01 | |
| | M38n.2n | 160.676 | 160.810 | 0.13 | |
| | M38r | 160.810 | 161.225 | 0.41 | |
| M39 | M39n | 161.225 | | | The age of M39n is constrained to be late Callovian. |
| Callovian | | **159.400** | | | |

## Pre-M25 Magnetostratigraphy from Outcrop Sections

| | | Top | Bottom | Duration | Placement relative to ammonite zones |
|---|---|---|---|---|---|
| OXFORDIAN | | **154.100** | | | |
| N. Spain series | AG-N8 | 154.928 | 155.028 | 0.10 | base = middle of E.bimammatum s.z. |
| | AG-R8 | 155.028 | 155.319 | 0.29 | base = 0.7 of A. hypselum s.z. |
| | AG-N7 | 155.319 | 155.425 | 0.11 | base = 0.5 of A. hypselum s.z. |
| | AG-R7 | 155.425 | 155.770 | 0.34 | base = 0.7 of P. grossouvrei s.z. |
| | AG-N6 | 155.770 | 155.823 | 0.05 | base = 0.6 of P. grossouvrei s.z. |
| | AG-R6 | 155.823 | 155.955 | 0.13 | base = base of P. grossouvrei s.z. |
| | AG-N5 | 155.955 | 156.194 | 0.24 | base = 0.1 P. stenocycloides s.z. |
| | AG-R5 (upper) | 156.194 | 156.220 | 0.03 | base = base of P. stenocycloides s.z. |
| | Hiatus? | 156.220 | 156.485 | 0.27 | base = base of "rotoides" s.z. |
| | AG-R5 (lower) | 156.485 | 156.644 | 0.16 | base = 0.4 of L. schilli s.z. |
| | AG-N4 | 156.644 | 156.750 | 0.11 | base = base of L. schilli s.z. |
| | AG-R4 | 156.750 | 156.790 | 0.04 | base = 0.85 of P. wartae s.z. |
| | AG-N3 | 156.790 | 156.856 | 0.07 | base = 0.6 of P. wartae s.z. |
| | AG-R3 | 156.856 | 156.922 | 0.07 | base = 0.35 of P. wartae s.z. |
| | AG-N2 | 156.922 | 156.936 | 0.01 | base = 0.3 of P. wartae s.z. |
| | AG-R2 | 156.936 | 156.975 | 0.04 | base = 0.15 of P. wartae s.z. |
| | AG-N1 | 156.975 | 156.983 | 0.01 | base = 0.12 of P. wartae s.z. |

| STAGE<br>Main Polarity Chron | Subchron | Polarity Chron Age (in Ma) Top | Bottom | Duration | Comments |
|---|---|---|---|---|---|
| | AG-R1 | 156.983 | 157.121 | 0.14 | base = 0.6 of P. parandieri s.z. |
| S. Poland series | [no data] | 157.121 | 157.227 | 0.11 | base = 0.2 of P. parandieri s.z. |
| | par.-N | 157.227 | 157.280 | 0.05 | base = base of P. parandieri s.z. |
| | [no data] | 157.280 | 157.439 | 0.16 | base = 0.7 of P. antecedens s.z. |
| | ant.-R | 157.439 | 157.492 | 0.05 | base = 0.6 of P. antecedens s.z. |
| | ant.-N | 157.492 | 157.704 | 0.21 | base = 0.2 of P. antecedens s.z. |
| | [no data] | 157.704 | 157.890 | 0.19 | base = 0.7 of C. vertebrale s.z. |
| | ten.-R | 157.890 | 157.996 | 0.11 | base = 0.3 of C. vertebrale s.z. |
| | cord.-N | 157.996 | 158.393 | 0.40 | base = 0.6 of C. cordatum z. |
| | cord./mar.-R | 158.393 | 159.082 | 0.69 | base = 0.6 of Q. mariae z. |
| | mar.-N | 159.082 | 159.135 | 0.05 | base = 0.5 of Q. mariae z. |
| | mar./lamb.-R | 159.135 | 159.622 | 0.49 | base = 0.6 of Q. lamberti z. |
| CALLOVIAN | | **159.400** | | | |
| | lamb.-N | 159.622 | 159.733 | 0.11 | base = 0.4 of Q. lamberti z. |
| | lamb.-R | 159.733 | 159.844 | 0.11 | base = 0.2 of Q. lamberti z. |
| | [no data] | 159.844 | 160.122 | 0.28 | base = 0.8 of P. athleta z. |
| | ath.-R | 160.122 | 160.706 | 0.58 | base = 0.1 of P. athleta z. |
| | [no data] | 160.706 | 160.956 | 0.25 | base = 0.7 of E. coronatum z. |
| | cor.-R | 160.956 | 161.122 | 0.17 | base = 0.4 of E. coronatum z. |
| | cor.-N | 161.122 | 161.344 | 0.22 | base = base of E. coronatum z. |
| | jas.-R | 161.344 | 161.567 | 0.22 | base = 0.6 of K. jason z. |
| | jas.-N | 161.567 | 161.733 | 0.17 | base = 0.3 of K. jason z. |
| | [no data] | 161.733 | 162.011 | 0.28 | base = 0.8 of S. calloviense z. |
| | call.-R2 | 162.011 | 162.122 | 0.11 | base = 0.6 of S. calloviense z. |
| | call.-N | 162.122 | 162.206 | 0.08 | base = 0.45 of S. calloviense z. |
| | call.-R1 | 162.206 | 162.344 | 0.14 | base = 0.2 of S. calloviense z. |
| | [no data] | 162.344 | 165.270 | 2.93 | base = mid-Late Bathonian (est. 0.7 of retrocostatum zone) |
| BATHONIAN | | **164.400** | | | |
| S. Spain series | R | 165.270 | 165.360 | 0.09 | base estimated as 0.6 of retrocostatum zone |
| | asp.-N | 165.360 | 165.630 | 0.27 | base estimated as 0.3 of retrocostatum zone |
| | [no data] | 165.630 | 166.020 | 0.39 | base estimated as 0.9 of costatus zone; estimated as 0.8 of bremeri zone |
| | R | 166.020 | 166.260 | 0.24 | base = 0.7 of costatus zone; estimated as 0.4 of bremeri s.z. |
| | cost.-N | 166.260 | 166.800 | 0.54 | base = base of costatus zone; estimated as base of morrisi zone. |
| | R | 166.800 | 167.010 | 0.21 | base = 0.7 of sofanus zone; estimated as 0.3 of subcontractus zone |
| | sof.-N | 167.010 | 167.280 | 0.27 | base = 0.3 of sofanus zone; estimated as 0.7 of progracilis zone |
| | R | 167.280 | 168.120 | 0.84 | base = 0.65 of combined zigzag zone of Spain |
| | zig.-N1 | 168.120 | 168.300 | 0.18 | base = 0.5 of combined zigzag |
| | R | 168.300 | 168.480 | 0.18 | base = 0.35 of combined zigzag |
| | zig.-N2 | 168.480 | 168.540 | 0.06 | base = 0.3 of combined zigzag |
| | R | 168.540 | 168.780 | 0.24 | base = 0.1 of combined zigzag |
| | zig.-N3 | 168.780 | 168.900 | 0.12 | base = base zigzag |
| BAJOCIAN | | **169.200** | | | |
| | R | 168.900 | 169.310 | 0.41 | base = 0.9 of parkinsoni |
| | park.-N1 | 169.310 | 169.419 | 0.11 | base = 0.8 of parkinsoni |
| | R | 169.419 | 169.518 | 0.10 | base = 0.71 of parkinsoni |
| | park.-N2 | 169.518 | 169.583 | 0.07 | base = 0.65 of parkinsoni |
| | R | 169.583 | 169.802 | 0.22 | base = 0.45 of parkinsoni |
| | park.-N3 | 169.802 | 169.912 | 0.11 | base = 0.35 of parkinsoni |
| | R | 169.912 | 170.131 | 0.22 | base = 0.15 of parkinsoni |
| | park.-N4 | 170.131 | 170.229 | 0.10 | base = 0.06 of parkinsoni |
| | R | 170.229 | 170.317 | 0.09 | base = 0.98 of garantiana |
| | gar.-N1 | 170.317 | 170.514 | 0.20 | base = 0.8 of garantiana |
| | R | 170.514 | 170.624 | 0.11 | base = 0.7 of garantiana |
| | gar.-N2 | 170.624 | 170.678 | 0.05 | base = 0.65 of garantiana |
| | R | 170.678 | 170.843 | 0.16 | base = 0.5 of garantiana |
| | gar.-N3 | 170.843 | 170.952 | 0.11 | base = 0.4 of garantiana |
| | R | 170.952 | 171.007 | 0.05 | base = 0.35 of garantiana |
| | gar.-N4 | 171.007 | 171.390 | 0.38 | base = base of garantiana |
| | R | 171.390 | 172.412 | 1.02 | base = 0.3 of subfurcatum |
| | subf.-N | 172.412 | 172.558 | 0.15 | base = 0.2 of subfurcatum |
| | R | 172.558 | 172.978 | 0.42 | base = 0.93 of humpriesianum |
| | humph.-N1 | 172.978 | 173.069 | 0.09 | base = 0.8 of humpriesianum |
| | R | 173.069 | 173.398 | 0.33 | base = 0.5 of humpriesianum |
| | humph.-N2 | 173.398 | 173.726 | 0.33 | base = 0.2 of humpriesianum |
| | R | 173.726 | 173.836 | 0.11 | base = 0.1 of humpriesianum |
| | suaz.-N1 | 173.836 | 173.996 | 0.16 | base = 0.93 of sauzei |
| | R | 173.996 | 174.055 | 0.06 | base = 0.85 of sauzei |
| | suaz.-N2 | 174.055 | 174.113 | 0.06 | base = 0.77 of sauzei |
| | R | 174.113 | 174.201 | 0.09 | base = 0.65 of sauzei |
| | suaz.-N3 | 174.201 | 174.288 | 0.09 | base = 0.53 of sauzei |
| | R | 174.288 | 174.310 | 0.02 | base = 0.5 of sauzei |
| | suaz.-N4 | 174.310 | 174.383 | 0.07 | base = 0.4 of sauzei |
| | R | 174.383 | 174.493 | 0.11 | base = 0.25 of sauzei |
| | suaz.-N5 | 174.493 | 174.566 | 0.07 | base = 0.15 of sauzei |
| | R | 174.566 | 174.639 | 0.07 | base = 0.05 of sauzei |

| STAGE | Subchron | Polarity Chron Age (in Ma) | | | Comments |
|---|---|---|---|---|---|
| Main Polarity Chron | | Top | Bottom | Duration | |
| | | | | | |
| | sow.-N1 | 174.639 | 175.040 | 0.40 | base = 0.8 of sowerbyi |
| | R | 175.040 | 175.314 | 0.27 | base = 0.65 of sowerbyi |
| | sow.-N2 | 175.314 | 175.588 | 0.27 | base = 0.5 of sowerbyi |
| | R | 175.588 | 175.642 | 0.05 | base = 0.47 of sowerbyi |
| | sow.-N3 | 175.642 | 175.770 | 0.13 | base = 0.4 of sowerbyi |
| | R | 175.770 | 175.898 | 0.13 | base = 0.33 of sowerbyi |
| | sow.-N4 | 175.898 | 176.208 | 0.31 | base = 0.16 of sowerbyi |
| S. Switzerland series | R | 176.208 | 176.354 | 0.15 | base = 0.08 of sowerbyi |
| | sow.-N5 | 176.354 | 176.500 | 0.15 | base = base of sowerbyi |
| **AALENIAN** | | **176.500** | | | |
| | R | 176.500 | 176.900 | 0.40 | base = 0.5 of concavum |
| | concav.-N | 176.900 | 177.800 | 0.90 | base = 0.75 of murchisonae |
| | R | 177.800 | 177.900 | 0.10 | base = 0.7 of murchisonae |
| | murch.-N1 | 177.900 | 178.300 | 0.40 | base = 0.5 of murchisonae |
| | R | 178.300 | 179.200 | 0.90 | base = 0.05 of murchisonae |
| | murch.-N2 | 179.200 | 179.340 | 0.14 | base = 0.95 of opalinum |
| | R | 179.340 | 179.420 | 0.08 | base = 0.85 of opalinum |
| | opal.-N1 | 179.420 | 179.700 | 0.28 | base = 0.5 of opalinum |
| | R | 179.700 | 179.820 | 0.12 | base = 0.35 of opalinum |
| | opal.-N2 | 179.820 | 180.496 | 0.68 | base = base of P.aalensis s.z. (Toarc.) |
| **TOARCIAN** | | **180.100** | | | |
| Toarcian composite series | R | 180.496 | 180.971 | 0.47 | base = 0.8 of D. pseudoradiosa s.z. |
| | pseu.-N | 180.971 | 181.683 | 0.71 | base = base of D. levesquei s.z. |
| | R | 181.683 | 182.277 | 0.59 | base = 0.5 of E. insigne s.z. |
| | insig.-N | 182.277 | 182.515 | 0.24 | base = 0.9 of P. fallaciosum s.z. |
| | R | 182.515 | 182.950 | 0.44 | base = 0.8 of fascigerum s.z. |
| | thou.-N | 182.950 | 183.306 | 0.36 | base = 0.9 of G. thouarsense s.z. |
| | R | 183.306 | 184.969 | 1.66 | base = 0.7 of H. variabilis s.z. |
| | vari.-N | 184.969 | 185.365 | 0.40 | base = 0.7 of H. semipolitum s.z. |
| | R | 185.365 | 186.275 | 0.91 | base = 0.7 of (H. sublevisoni+lusitanicum) s.z. |
| | bif.-N | 186.275 | 186.948 | 0.67 | base = 0.7 of H. falciferum s.z. |
| | R | 186.948 | 187.185 | 0.24 | base = 0.7 of falciferum Zone |
| | fal.-N1 | 187.185 | 187.423 | 0.24 | base = 0.5 of falciferum Zone |
| | R | 187.423 | 187.601 | 0.18 | base = 0.35 of falciferum Zone |
| | fal.-N2 | 187.601 | 187.779 | 0.18 | base = 0.2 of falciferum Zone |
| | R | 187.779 | 187.898 | 0.12 | base = 0.1 of falciferum Zone |
| | tenui.-N | 187.898 | 188.808 | 0.91 | base = 0.5 of D. tenuicostatum Zone |
| | R | 188.808 | 190.010 | 1.20 | base = 0.92 of P. apyrenum s.z. (P. spinatum Zone) |
| **PLIENSBACHIAN** | | **189.600** | | | |
| ***Late (Domerian)*** | | | | | |
| S. Switzerland series | spin.-N1 | 190.010 | 190.033 | 0.02 | base = 0.86 of apyrenum s.z. (spinatum z.) |
| | R | 190.033 | 190.056 | 0.02 | base = 0.8 of apyrenum s.z. (spinatum z.) |
| | spin.-N2 | 190.056 | 190.170 | 0.11 | base = 0.5 of apyrenum s.z. (spinatum z.) |
| | R | 190.170 | 190.189 | 0.02 | base = 0.45 of apyrenum s.z. (spinatum z.) |
| | spin.-N3 | 190.189 | 190.208 | 0.02 | base = 0.4 of apyrenum s.z. (spinatum z.) |
| | R | 190.208 | 190.246 | 0.04 | base = 0.3 of apyrenum s.z. (spinatum z.) |
| | spin.-N4 | 190.246 | 190.455 | 0.21 | base = 0.75 of gibbosus s.z. (margaritatus z.) |
| | R | 190.455 | 190.550 | 0.10 | base = 0.5 of gibbosus s.z. (margaritatus z.) |
| | marg.-N1 | 190.550 | 190.740 | 0.19 | base = base of gibbosus s.z. (margaritatus z.) |
| | R | 190.740 | 190.759 | 0.02 | base = 0.95 of subnodosus s.z. (margaritatus z.) |
| | marg.-N2 | 190.759 | 190.854 | 0.09 | base = 0.7 of subnodosus s.z. (margaritatus z.) |
| | R | 190.854 | 190.873 | 0.02 | base = 0.65 of subnodosus s.z. (margaritatus z.) |
| | marg.-N3 | 190.873 | 190.968 | 0.09 | base = 0.4 of subnodosus s.z. (margaritatus z.) |
| | R | 190.968 | 191.063 | 0.09 | base = 0.15 of subnodosus s.z. (margaritatus z.) |
| | marg.-N4 | 191.063 | 191.101 | 0.04 | base = 0.05 of subnodosus s.z. (margaritatus z.) |
| | R | 191.101 | 191.215 | 0.11 | base = 0.75 of stokesi s.z. (margaritatus z.) |
| | marg.-N5 | 191.215 | 191.272 | 0.06 | base = 0.6 of stokesi s.z. (margaritatus z.) |
| | R | 191.272 | 192.127 | 0.85 | base = 0.45 of davoei |
| ***Early (Carixian)*** | | *191.500* | | | Uppermost zone of Early Pliensbachian is Prodactylioceras davoei. |
| | dav.-N | 192.127 | 192.412 | 0.28 | base = 0.2 of davoei |
| | R | 192.412 | 192.674 | 0.26 | base = 0.97 of ibex |
| | ibex-N1 | 192.674 | 192.731 | 0.06 | base = 0.92 of ibex |
| | R | 192.731 | 192.743 | 0.01 | base = 0.91 of ibex |
| | ibex-N2 | 192.743 | 192.822 | 0.08 | base = 0.84 of ibex |
| | R | 192.822 | 192.845 | 0.02 | base = 0.82 of ibex |
| | ibex-N3 | 192.845 | 193.096 | 0.25 | base = 0.6 of ibex |
| | R | 193.096 | 193.267 | 0.17 | base = 0.45 of ibex |
| | ibex-N4 | 193.267 | 193.290 | 0.02 | base = 0.43 of ibex |
| | R | 193.290 | 193.438 | 0.15 | base = 0.30 of ibex |
| | ibex-N5 | 193.438 | 193.461 | 0.02 | base = 0.28 of ibex |
| | R | 193.461 | 193.506 | 0.05 | base = 0.24 of ibex |
| | ibex-N6 | 193.506 | 193.541 | 0.03 | base = 0.21 of ibex |
| | R | 193.541 | 193.552 | 0.01 | base = 0.20 of ibex |
| | ibex-N7 | 193.552 | 193.598 | 0.05 | base = 0.16 of ibex |
| | R | 193.598 | 193.666 | 0.07 | base = 0.10 of ibex |
| | ibex-N8 | 193.666 | 193.757 | 0.09 | base = 0.02 of ibex |
| | R | 193.757 | 193.810 | 0.05 | base = 0.98 of jamesoni |

| STAGE / Main Polarity Chron | Subchron | Polarity Chron Age (in Ma) Top | Bottom | Duration | Comments |
|---|---|---|---|---|---|
| | jam.-N1 | 193.810 | 193.886 | 0.08 | base = 0.93 of jamesoni |
| | R | 193.886 | 193.993 | 0.11 | base = 0.86 of jamesoni |
| | jam.-N2 | 193.993 | 194.540 | 0.55 | base = 0.50 of jamesoni |
| | No Data | 194.540 | 195.960 | 1.42 | base = .9 of Sinemurian |
| **SINEMURIAN** | | **195.300** | | | Sinemurian magnetic polarity intervals are not correlated to ammonite zones. Pattern is schematic only. |
| Austrian series | N (top KH) | 195.960 | 196.290 | 0.33 | base = .85 of Sinemurian |
| | R | 196.290 | 196.620 | 0.33 | base = .8 of Sinemurian |
| | N (upper KH) | 196.620 | 196.752 | 0.13 | base = .78 of Sinemurian |
| | R | 196.752 | 196.884 | 0.13 | base = .76 of Sinemurian |
| | N (upper KH) | 196.884 | 197.016 | 0.13 | base = .74 of Sinemurian |
| | R | 197.016 | 199.260 | 2.24 | base = .4 of Sinemurian |
| | N (mid-KH) | 199.260 | 199.392 | 0.13 | base = .38 of Sinemurian |
| | R | 199.392 | 199.788 | 0.40 | base = .32 of Sinemurian |
| | N (lower mid-KH | 199.788 | 200.184 | 0.40 | base = .26 of Sinemurian |
| | R | 200.184 | 200.316 | 0.13 | base = .24 of Sinemurian |
| | N (lower mid-KH | 200.316 | 200.778 | 0.46 | base = .17 of Sinemurian |
| | R | 200.778 | 202.280 | 1.50 | base = .9 of Hettangian |
| **HETTANGIAN** | | **201.900** | | | Hettangian magnetic polarity intervals are not correlated to ammonite zones. Pattern is schematic only. |
| | N (mid-HSA) | 202.280 | 202.470 | 0.19 | base = .85 of Hettangian |
| | R (lower HSA) | 202.470 | 204.180 | 1.71 | base = .4 of Hettangian |
| | N (base HSA) | 204.180 | 204.370 | 0.19 | base = .35 of Hettangian |
| | R (base HSA) | 204.370 | 204.560 | 0.19 | base = .3 of Hettangian |
| | No Data | 204.560 | 205.700 | 1.14 | base = base of Hettangian |
| **TRIASSIC** | | | | | |
| **RHAETIAN** | | **205.700** | | | |
| Newark Basin series | l+ | 205.700 | 206.660 | 0.96 | |
| | k- | 206.660 | 207.838 | 1.18 | |
| | N (Leg 122) | 207.838 | 207.882 | 0.04 | |
| | (k-) | 207.882 | 208.062 | 0.18 | |
| | N (Leg 122) | 208.062 | 208.101 | 0.04 | |
| | (k-) | 208.101 | 209.800 | 1.70 | |
| **NORIAN** | | **209.600** | | | Top of Norian not located with respect to magnetics. |
| SW Turkey series | quin-N1 | 209.739 | 209.808 | 0.07 | |
| | quin-R1 | 209.808 | 210.363 | 0.56 | |
| | quin-N2 | 210.363 | 210.571 | 0.21 | |
| | quin-R2 | 210.571 | 210.779 | 0.21 | |
| | mac-N | 210.779 | 211.820 | 1.04 | |
| | mac-R | 211.820 | 212.653 | 0.83 | |
| | hog-N | 212.653 | 215.081 | 2.43 | |
| | bic-R | 215.081 | 215.289 | 0.21 | |
| | bic-N | 215.289 | 215.358 | 0.07 | |
| | mag-R | 215.358 | 217.648 | 2.29 | |
| | mal-N | 217.648 | 218.896 | 1.25 | |
| | mal-R | 218.896 | 219.451 | 0.55 | |
| | jan-N1 | 219.451 | 219.590 | 0.14 | |
| | jan-R1 | 219.590 | 219.659 | 0.07 | |
| | jan-N2 | 219.659 | 219.729 | 0.07 | |
| | jan-R2 | 219.729 | 220.214 | 0.49 | |
| | jan-N3 | 220.214 | 220.700 | 0.49 | |
| Newark Basin series | N (Leg 122) | 209.800 | 209.912 | 0.11 | |
| | (k-) | 209.912 | 210.361 | 0.45 | |
| | N (Leg 122) | 210.361 | 210.473 | 0.11 | |
| | (k-) | 210.473 | 212.660 | 2.19 | |
| | j+ | 212.660 | 213.500 | 0.84 | |
| | i- | 213.500 | 215.852 | 2.35 | |
| | h+ | 215.852 | 218.348 | 2.50 | |
| | g- | 218.348 | 219.668 | 1.32 | |
| | f+ | 219.668 | 220.820 | 1.15 | |
| **CARNIAN** | | **220.700** | | | |
| SW Turkey (upper Carnian) | ana-R1 | 220.700 | 221.102 | 0.40 | |
| | ana-N1 | 221.102 | 221.370 | 0.27 | |
| | ana-R2 | 221.370 | 221.504 | 0.13 | |
| | ana-N2 | 221.504 | 221.638 | 0.13 | |
| Newark Basin series | e- | 220.882 | 221.445 | 0.56 | |
| | d+ | 221.445 | 222.229 | 0.78 | |
| | c- | 222.229 | 222.542 | 0.31 | |
| | b+ | 222.542 | 222.855 | 0.31 | |
| | a- | 222.855 | 223.858 | 1.00 | |
| Western U.S. composite | N (Carn-3) | 223.858 | 223.889 | 0.03 | |
| | R | 223.889 | 224.688 | 0.80 | |
| | N (Carn-4) | 224.688 | 225.268 | 0.58 | |
| | Carn-N? | 225.268 | 226.145 | 0.88 | |

| STAGE | Subchron | Polarity Chron Age (in Ma) | | | Comments |
|---|---|---|---|---|---|
| Main Polarity Chron | | Top | Bottom | Duration | |
| | | | | | |
| | N (Carn-5) | 226.145 | 227.785 | 1.64 | |
| SW Turkey (lower Carnian) | austro-N1 | 224.787 | 225.122 | 0.34 | |
| | austro-R1 | 225.122 | 225.658 | 0.54 | |
| | austro-N2 | 225.658 | 225.926 | 0.27 | |
| | trachy-R1 | 225.926 | 226.261 | 0.34 | |
| | trachy-N1 | 226.261 | 226.328 | 0.07 | |
| | trachy-R2 | 226.328 | 226.395 | 0.07 | |
| | trachy-N2 | 226.395 | 226.797 | 0.40 | |
| | trachy-R3 | 226.797 | 226.864 | 0.07 | |
| | trachy-N3 | 226.864 | 227.065 | 0.20 | |
| | trachy-R4 | 227.065 | 227.266 | 0.20 | |
| **LADINIAN** | | **227.400** | | | |
| Hydra, Greece series | longobard-R1 (F | 227.785 | 228.838 | 1.05 | |
| | longobard-N1 (E | 228.838 | 229.183 | 0.34 | |
| | longobard-R2 (D | 229.183 | 231.080 | 1.90 | |
| | fassan-N1 (C+) | 231.080 | 231.713 | 0.63 | |
| | fassan-R1 | 231.713 | 232.000 | 0.29 | |
| | fassan-N2 (C+) | 232.000 | 233.438 | 1.44 | |
| | fassan-R2 | 233.438 | 233.725 | 0.29 | |
| | fassan-N3 (C+) | 233.725 | 235.225 | 1.50 | |
| **ANISIAN** | | **234.300** | | | |
| Hydra, Greece series | illyrian-R (B-) | 235.225 | 235.965 | 0.74 | |
| | illyrian-N (A+) | 235.965 | 237.025 | 1.06 | |
| Western U.S. series | Anis-R2 | 237.025 | 239.413 | 2.39 | |
| | Anis-N2 | 239.413 | 241.820 | 2.41 | |
| **OLENEKIAN (Spathian)** | | **241.700** | | | |
| Arctic Stratotypes of Early Triassic Stages | No Data | 241.823 | 241.875 | 0.05 | |
| | N? | 241.875 | 241.906 | 0.03 | |
| | SpR2 | 241.906 | 242.165 | 0.26 | |
| | SpN1 | 242.165 | 242.690 | 0.53 | |
| | R | 242.690 | 242.827 | 0.14 | |
| | N? | 242.827 | 242.858 | 0.03 | |
| | R | 242.858 | 243.003 | 0.14 | |
| | N? | 243.003 | 243.033 | 0.03 | |
| | SpR1 | 243.033 | 243.376 | 0.34 | |
| ***(Smithian)*** | | *243.250* | | | Age from proportional scaling of ammonite zonal units. |
| | SmN3? | 243.376 | 243.490 | 0.11 | |
| | SmR2 | 243.490 | 243.688 | 0.20 | |
| | SmN2 | 243.688 | 244.328 | 0.64 | |
| | SmR1? | 244.328 | 244.457 | 0.13 | |
| | SmN1 | 244.457 | 244.800 | 0.34 | |
| **INDUAN (Dienerian)** | | **244.800** | | | Age from proportional scaling of ammonite zonal units. |
| | DR2 | 244.800 | 245.101 | 0.30 | |
| | DN2 | 245.101 | 245.277 | 0.18 | |
| | DR1 | 245.277 | 245.718 | 0.44 | |
| | DN1 | 245.718 | 246.019 | 0.30 | |
| | GR2 | 246.019 | 246.386 | 0.37 | |
| ***(Griesbachian)*** | | *246.311* | | | Age from proportional scaling of ammonite zonal units. |
| | GN2 | 246.386 | 246.668 | 0.28 | |
| | GR1 | 246.695 | 247.430 | 0.74 | |
| | GN1 | 247.444 | 248.051 | 0.61 | |
| | [no data] | 248.053 | 249.105 | 1.05 | |
| | | **248.200** | | | |
| | | | | | |
| **Late PERMIAN** | | | | | |
| **TATARIAN** | | **248.200** | | | |
| Pakistan series | N | 249.105 | 249.230 | 0.13 | |
| | | 249.230 | 249.557 | 0.33 | |
| | N | 249.557 | 251.532 | 1.98 | |
| | | 251.532 | 251.582 | 0.05 | |
| | N | 251.582 | 252.035 | 0.45 | |
| | | 252.035 | 253.700 | 1.67 | |
| **Ufimian-Kasanian** | | **252.100** | | | |
| | N | 253.700 | 253.781 | 0.08 | |
| | | 253.781 | 255.124 | 1.34 | |
| | N | 255.124 | 256.000 | 0.88 | |
| **Kungurian** | | **256.000** | | | |
| | N | 256.000 | 256.363 | 0.36 | |
| | | 256.363 | 258.384 | 2.02 | |
| **Artinskian** | | **260.000** | | | |
| | | | | | |

| STAGE / Main Polarity Chron | Subchron | Polarity Chron Age (in Ma) Top | Bottom | Duration | Comments |
|---|---|---|---|---|---|
| | jam.-N1 | 193.810 | 193.886 | 0.08 | base = 0.93 of jamesoni |
| | R | 193.886 | 193.993 | 0.11 | base = 0.86 of jamesoni |
| | jam.-N2 | 193.993 | 194.540 | 0.55 | base = 0.50 of jamesoni |
| | No Data | 194.540 | 195.960 | 1.42 | base = .9 of Sinemurian |
| **SINEMURIAN** | | **195.300** | | | Sinemurian magnetic polarity intervals are not correlated to ammonite zones. Pattern is schematic only. |
| Austrian series | N (top KH) | 195.960 | 196.290 | 0.33 | base = .85 of Sinemurian |
| | R | 196.290 | 196.620 | 0.33 | base = .8 of Sinemurian |
| | N (upper KH) | 196.620 | 196.752 | 0.13 | base = .78 of Sinemurian |
| | R | 196.752 | 196.884 | 0.13 | base = .76 of Sinemurian |
| | N (upper KH) | 196.884 | 197.016 | 0.13 | base = .74 of Sinemurian |
| | R | 197.016 | 199.260 | 2.24 | base = .4 of Sinemurian |
| | N (mid-KH) | 199.260 | 199.392 | 0.13 | base = .38 of Sinemurian |
| | R | 199.392 | 199.788 | 0.40 | base = .32 of Sinemurian |
| | N (lower mid-KH | 199.788 | 200.184 | 0.40 | base = .26 of Sinemurian |
| | R | 200.184 | 200.316 | 0.13 | base = .24 of Sinemurian |
| | N (lower mid-KH | 200.316 | 200.778 | 0.46 | base = .17 of Sinemurian |
| | R | 200.778 | 202.280 | 1.50 | base = .9 of Hettangian |
| **HETTANGIAN** | | **201.900** | | | Hettangian magnetic polarity intervals are not correlated to ammonite zones. Pattern is schematic only. |
| | N (mid-HSA) | 202.280 | 202.470 | 0.19 | base = .85 of Hettangian |
| | R (lower HSA) | 202.470 | 204.180 | 1.71 | base = .4 of Hettangian |
| | N (base HSA) | 204.180 | 204.370 | 0.19 | base = .35 of Hettangian |
| | R (base HSA) | 204.370 | 204.560 | 0.19 | base = .3 of Hettangian |
| | No Data | 204.560 | 205.700 | 1.14 | base = base of Hettangian |
| | | | | | |
| **TRIASSIC** | | | | | |
| | | **205.700** | | | |
| **RHAETIAN** | | | | | |
| Newark Basin series | l+ | 205.700 | 206.660 | 0.96 | |
| | k- | 206.660 | 207.838 | 1.18 | |
| | N (Leg 122) | 207.838 | 207.882 | 0.04 | |
| | (k-) | 207.882 | 208.062 | 0.18 | |
| | N (Leg 122) | 208.062 | 208.101 | 0.04 | |
| | (k-) | 208.101 | 209.800 | 1.70 | Top of Norian not located with respect to magnetics. |
| **NORIAN** | | **209.600** | | | |
| SW Turkey series | quin-N1 | 209.739 | 209.808 | 0.07 | |
| | quin-R1 | 209.808 | 210.363 | 0.56 | |
| | quin-N2 | 210.363 | 210.571 | 0.21 | |
| | quin-R2 | 210.571 | 210.779 | 0.21 | |
| | mac-N | 210.779 | 211.820 | 1.04 | |
| | mac-R | 211.820 | 212.653 | 0.83 | |
| | hog-N | 212.653 | 215.081 | 2.43 | |
| | bic-R | 215.081 | 215.289 | 0.21 | |
| | bic-N | 215.289 | 215.358 | 0.07 | |
| | mag-R | 215.358 | 217.648 | 2.29 | |
| | mal-N | 217.648 | 218.896 | 1.25 | |
| | mal-R | 218.896 | 219.451 | 0.55 | |
| | jan-N1 | 219.451 | 219.590 | 0.14 | |
| | jan-R1 | 219.590 | 219.659 | 0.07 | |
| | jan-N2 | 219.659 | 219.729 | 0.07 | |
| | jan-R2 | 219.729 | 220.214 | 0.49 | |
| | jan-N3 | 220.214 | 220.700 | 0.49 | |
| Newark Basin series | N (Leg 122) | 209.800 | 209.912 | 0.11 | |
| | (k-) | 209.912 | 210.361 | 0.45 | |
| | N (Leg 122) | 210.361 | 210.473 | 0.11 | |
| | (k-) | 210.473 | 212.660 | 2.19 | |
| | j+ | 212.660 | 213.500 | 0.84 | |
| | i- | 213.500 | 215.852 | 2.35 | |
| | h+ | 215.852 | 218.348 | 2.50 | |
| | g- | 218.348 | 219.668 | 1.32 | |
| | f+ | 219.668 | 220.820 | 1.15 | |
| **CARNIAN** | | **220.700** | | | |
| SW Turkey (upper Carnian) | ana-R1 | 220.700 | 221.102 | 0.40 | |
| | ana-N1 | 221.102 | 221.370 | 0.27 | |
| | ana-R2 | 221.370 | 221.504 | 0.13 | |
| | ana-N2 | 221.504 | 221.638 | 0.13 | |
| Newark Basin series | e- | 220.882 | 221.445 | 0.56 | |
| | d+ | 221.445 | 222.229 | 0.78 | |
| | c- | 222.229 | 222.542 | 0.31 | |
| | b+ | 222.542 | 222.855 | 0.31 | |
| | a- | 222.855 | 223.858 | 1.00 | |
| Western U.S. composite | N (Carn-3) | 223.858 | 223.889 | 0.03 | |
| | R | 223.889 | 224.688 | 0.80 | |
| | N (Carn-4) | 224.688 | 225.268 | 0.58 | |
| | Carn-N? | 225.268 | 226.145 | 0.88 | |

**Note:** This Mesozoic Magnetic Polarity Time Scale is the scaling used in Gradstein et al. (1994, J. Geophys. Res.) and in the forthcoming suite of Mesozoic-Cenozoic Chronostratigraphy Charts (J. Hardenbol et al., compilers; SEPM Special Publication).

Scaling within the Oxfordian-earliest Kimmeridgian, Sinemurian-Hettangian, Norian-Rhaetian, and Early Triassic has not incorporated new results (e.g., Ogg and Gutowski, in press; Kent et al., in press; Graziano and Ogg, 1994 and in prep.).

**Note:** M"-1"r (also called ISEA reversal) is probably slightly older than the base of P. nutfieldiensis ammonite zone (Elisabetta Erba, pers. commun.). It has been arbitrarily set as 0.2 Ma older than the base of P. nutfieldiensis, with a duration of 0.15 Ma.

**Note:** M0r is scaled as extension of Barrem+Haut relative duration compared to DNAG scale, rather than expanded with the enlarged Aptian.

**Note:** The "preferred" definition for the top of the Tithonian stage is the top of Durangites (=base of B. jacobi) ammonite zone; but a higher definiton (top of B. jacobi zone) is an alternative assignment.

**Note:** Composite Aguilon section from Steiner et al. (1986)

**Note:** Magnetic zone "AG-N8" is at top of investigated succession. An arbitrary duration of 0.1 m.y. was assigned to it.

**Note:** Upper subzones of G. transversarium zone ("rotoides" and "schilli") were only a "schilli" subzone (condensed) in Melendez's original Spanish zonation (1987) used for the magnetostratigraphy scale. It is possible that "rotoides" was absent in the Aguilon sections; so the magnetics have a "unknown" interval inserted for this subzone.

**Note:** Oxfordian and earliest Kimmeridgian magnetic polarity zones (e.g., Poland, N. Spain) does not include the new results and calibrations of Ogg and Gutowski (in press, 4th Jurassic Congress).

**Note:** Polarity pattern for each ammonite zone from Steiner et al.'s composite (with minor modification) from Subbetic region in S.Spain. There are probably more polarity intervals than indicated -- most sections had several additional one-sample "polarity zones".

**Note:** Polarity pattern for each ammonite zone from Felix J. Horner's thesis (ETH, 1983) on the Breggia section in S. Switzerland.

**Note:** Basal Aalenian polarity chron "opal.-N2" is assumed to extend to the mid-P. aalensis zone of latest Toarcian based on the S. Switzerland magnetics, which corresponds to an "no data" interval in the Thouars-Airvault section. However, the Switzerland polarity zonation did not resolve the "R" that comprises the Late Toarcian P. macta s.z.

**Note:** Toarcian polarity pattern is based on my correlations of the magnetostratigraphy of Thouars and Airvault sections in France (Galbrun), the Iznalloz section in Bettic Cordiller of S. Spain (Galbrun), and Breccia Gorge section of S. Switzerland (Felix J. Horner's thesis, ETH, 1983). The Thouars-Airvault section is used as the main standard, but the placement of polarity zone boundaries is shifted slightly to agree with the other less condensed (but less ammonite subzone-controlled) sections.

**Note:** Late Toarcian polarity zone "insig.-N" comprises the lower half of the E. insigne s.z. and the topmost P. fallaciosum s.z. (Thouars-Airvault, and possibly Iznalloz sections), and is equivalent to the lower normal zone in the Switzerland "meneghinii" zone (the overlying reversed polarity zone in Switzerland is compacted relative to France due to its marl lithology).

**Note:** Toarcian polarity chron "thou.-N" spans the majority of the "fascigerum" s.z. of the G. thouarsense zone in the Thouars-Airvault composite. This zone is probably equivalent to the normal polarity zone in the middle of the "erbaense" zone of S. Switzerland (the relative position is shifted downward in S. Switzerland owing to the change from underlying nodular marl to overlying nodular limestone).

**Note:** Middle Toarcian "vari.-N" polarity zone spans the majority of the H. variabilis s.z., but according to Switzerland and Iznalloz sections, it begins in the upper part of the underlying H. semipolitum s.z.

**Note:** Middle Toarcian "bif.-N" polarity zone recorded in France-Switzerland-Spain spans the lower third of the H. bifrons Zone (most of the H. sublevisoni s.z. = H.sublevisoni+'lusitanicum s.z. on Exxon chart, according to Thouars-Airvault composite). The base is not defined in the French sections due to condensed Fe-oolite lithology, but seems to begin in the uppermost H. falciferum Zone in Switzerland.

**Note:** Early Toarcian polarity pattern for H. falciferum Zone is based on Switzerland, because it is condensed facies or unstable magnetization in the Thouars-Airvault composite.

**Note:** Early Toarcian "tenui.-N" polarity zone is defined according to Iznalloz (Spain) section of Galbrun, where it seems to encompass the upper half of the D. tenuicostatum Zone. This ammonite zone is very condensed in Switzerland and absent in France

**Note:** Polarity pattern for each ammonite zone from Felix J. Horner's thesis (ETH, 1983) on the Breggia section in S. Switzerland.

**Note:** Composite from Kendelbach graben region in Austria (Steiner and Ogg, 1988). Pattern has not been verified or tied to ammonite zones.

**Note:** The Newark Basin series for Rhaetian-Norian-Carnian is from Kent and Olsen (1991, Eos) with stage assignments from pollen. Later drilling has added some detail to the main lettered zones in this column (not yet published as of Jan, 1994). This scale is approximately linear with time, because it is controlled by cyclic sediments.

**Note:** The short normal-polarity events within the early Rhaetian and latest Norian are from Galbrun (ODP Leg 122).

**Note:** Ammonite- and conodont-dated Norian strata in SW Turkey (Kavur Tepe and Bolücektasi Tepe sections) have yielded a magnetostratigraphy (Gallet et al., 1993; EPSL, 117: 443-456). I have converted the Krystyn numbered zones to Paul van Veen's nomenclature, e.g., "Lacian 1" -> "G. jandianus", etc. The magnetic scale shown here has omitted the "single-sample" events. I labled the magnetic zones according to the dominant ammonite zone, and have assigned boundaries as a proportion of the ammonite zones as shown in Gallet's Fig. 8. However, a "summary" version (Marcoux, p.67 in Albertiana 12, Nov 1993) has a slightly different positioning of ammonite zones vs. magnetics.

**Note:** "Sevantian" substage of Norian of Turkey has two divisions in Krystyn's scheme; but only one division in Paul van Veen's. Therefore, the Sevantian portion of the polarity scale of Gallet et al. is compacted in our scale, relative to their Fig.8. Norian polarity zone "quin-N1" of

Turkey is probably same as uppermost "N (Leg 122)" that I have inserted into "Newark Basin series".

**Note:** Top of Norian polarity zone quin-N1 is younger than age shown (top of section).

**Note:** Norian polarity zone "quin-R1" of Turkey may contain a brief normal-polarity zone; which may then correspond to the second older "N (Leg 122)" of the upper Norian portion of the "Newark Basin series"

**Note:** Norian/Carnian boundary is assigned to the base of polarity zone "jan-N3" of the Turkish sections, as is shown in Marcoux's (1993) summary of the Gallet..Marcoux magnetics.

**Note:** The Newark Basin series for Rhaetian-Norian-Carnian is from Kent and Olsen (1991, Eos) with stage assignments from pollen. Later drilling has added some detail to the main lettered zones in this column (not yet published as of Jan, 1994). This scale is approximately linear with time, because it is controlled by cyclic sediments.

**Note:** Uppermost Carnian magnetostratigraphy for most of the Anatropites ammonite zone is from the Bolücektasi Tepe section of Gallet et al. (1992; Phys. Earth & Planet. Interiors, 73: 85-108), but as summarized by the co-author Marcoux (Nov. 1993, p.67 in Albertiana 12). I have named polarity zones after the corresponding ammonite zone.

**Note:** Lower Carnian magnetostratigraphy (Julian substage) is from the Bolücektasi Tepe section of Gallet et al. (1992; Phys. Earth & Planet. Interiors, 73: 85-108), but as summarized by the co-author Marcoux (Nov. 1993, p.67 in Albertiana 12). I have named polarity zones after the corresponding ammonite zone.

**Note:** Ladinian and upper Anisian (Illyrian substage) magnetostratigraphy is from Muttoni, Channell, Nicora and Retton (1994, Palaeo-Palaeo-Palaeo, in press) with age control from conodonts. The magnetostratigraphy is very similar to the composite from Western U.S. by Garcia et al.

**Note:** Ladinian polarity zone "longobard-R1 (F-)" is assigned from 0.75"Longbardian to base of N(Cam-5) of Western U.S. composite.

**Note:** Ladinian polarity zone "longobard-R2 (D-) is assigned as 0.1"Longobardian to 0.65"Long.

**Note:** Ladinian polarity zone "fassan-R1" is a brief interval assigned as 0.8" to 0.9"Fassanian.

**Note:** Ladinian polarity zone "fassan-R2" is a brief interval assigned as 0.2" to 0.3"Fassanian.

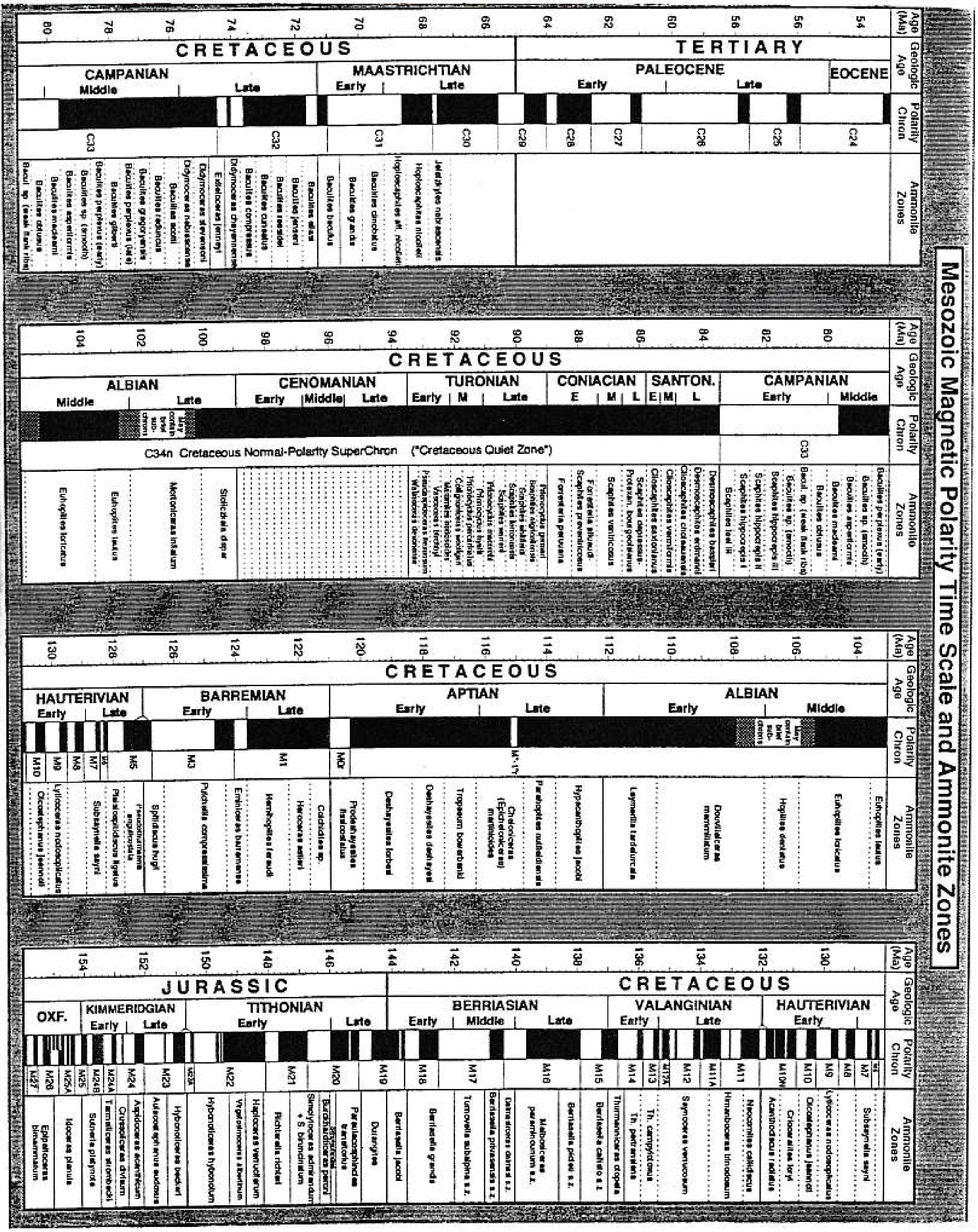
**Note:** Anisian polarity zone "illyrian-R (B-)" is assigned as 0.1" to 0.5"Illyrian.

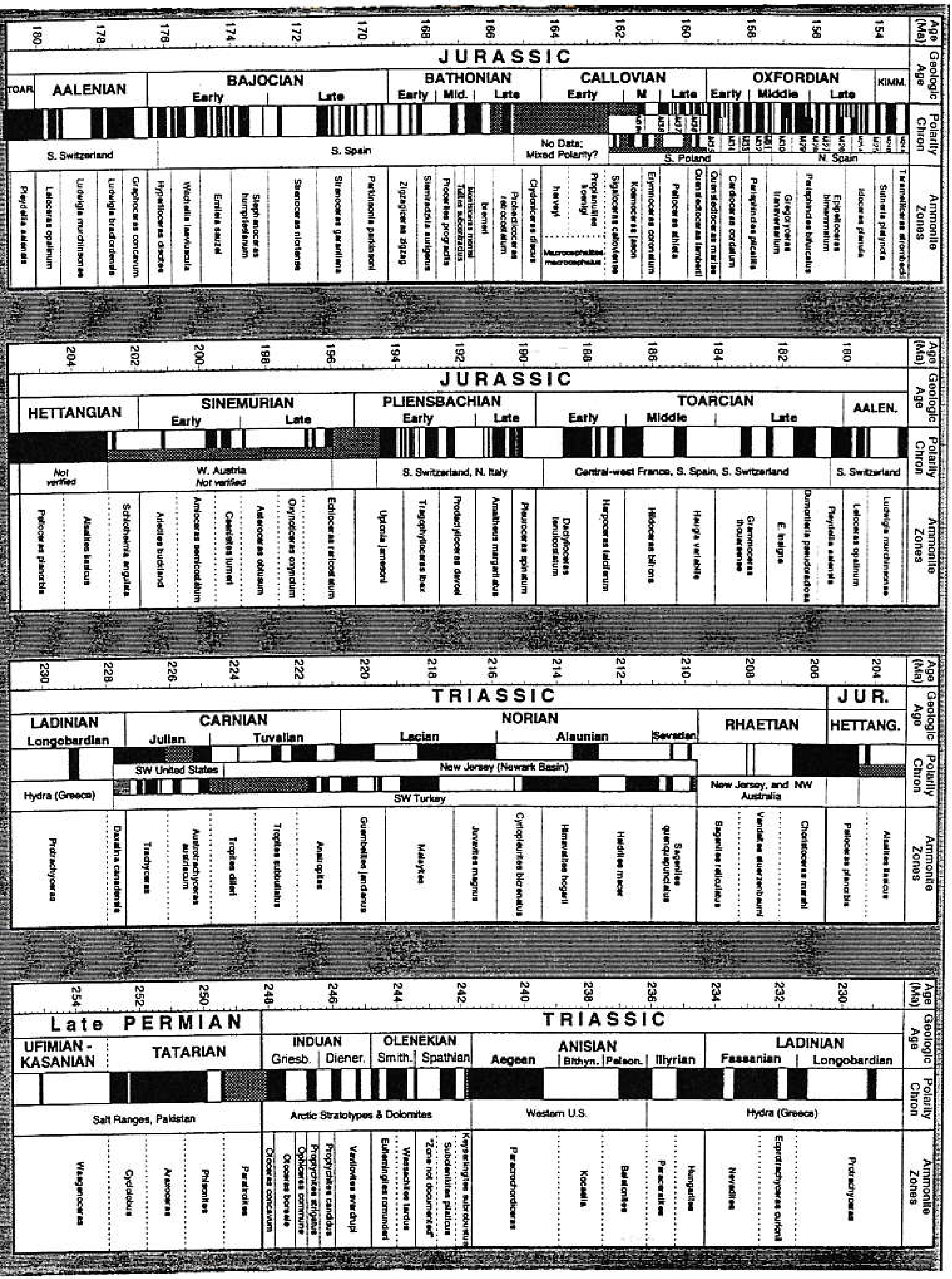
**Note:** Anisian polarity zone "illyrian-N (A+)" is assumed to extend from the base of "Illyrian-R (B-)" to the top of Anis-R2, in turn taken from Garcia et al. composite of western U.S.

**Note:** Lower and Middle Anisian magnetostratigraphy from the western U.S. composite of Garcia et al. also agrees with unpublished data from Anisian near Predazzo, Italy (Muttoni, pers. commun.).

**Note:** Arctic stratotypes of Spathian through Griesbachian stages have partial ammonite biostratigraphy using zonation of Tozer (1965). Magnetics (Ogg and Steiner, 1991) are also correlated to sea-level changes (scale of Haq et al., 1988). Ages of polarity chrons are simple scaling of the composite outcrop pattern (in meters) to the durations of the Olenekian and Induan stages, respectively; direct ammonite zone boundaries could not be established. It is assumed that sedimentation was continuous, although there may be hiatuses or significant condensation at transgressive to maximu-flooding surfaces.

# Mesozoic Magnetic Polarity Time Scale and Ammonite Zones






Compiled from various sources. Modified from Gradstein et al. ("A Mesozoic Time Scale", 1994, J.Geophys.Res.) and Ogg ("Phanerozoic Magnetic Polarity Time Scale", in press, AGU Handbook of Physical Constants)

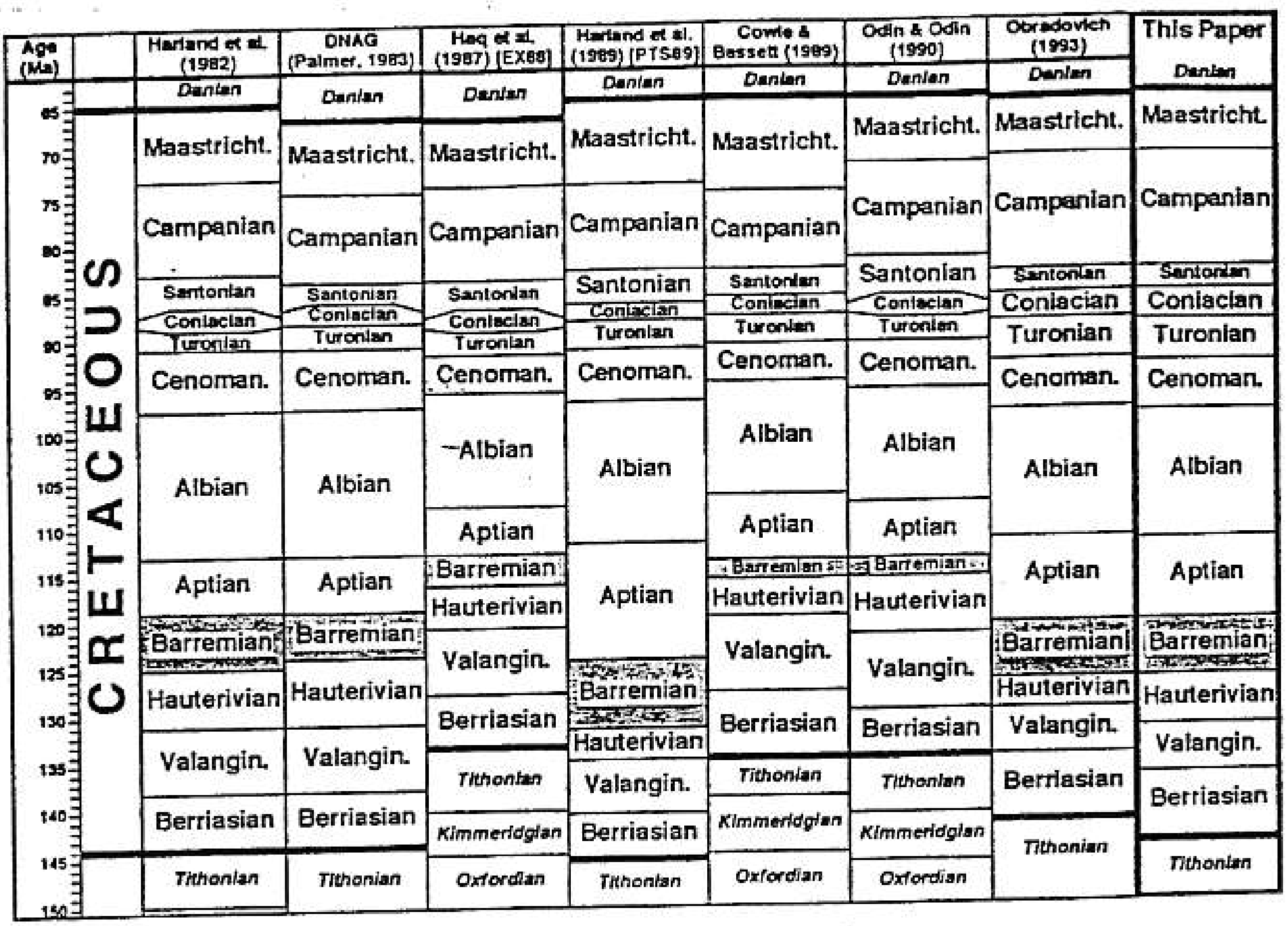



Figure 1. Comparison of Cretaceous time scales.

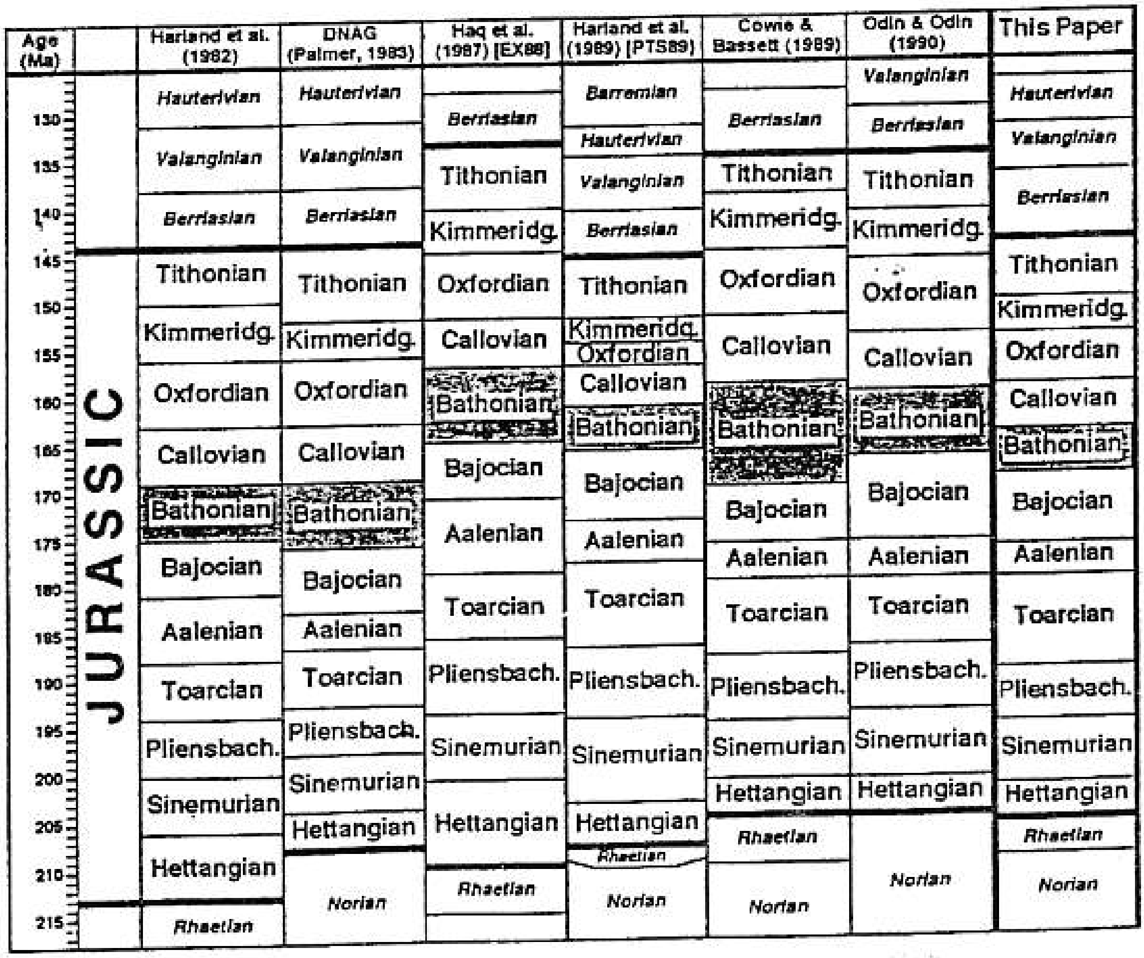



Figure 2. Comparison of Jurassic time scales.

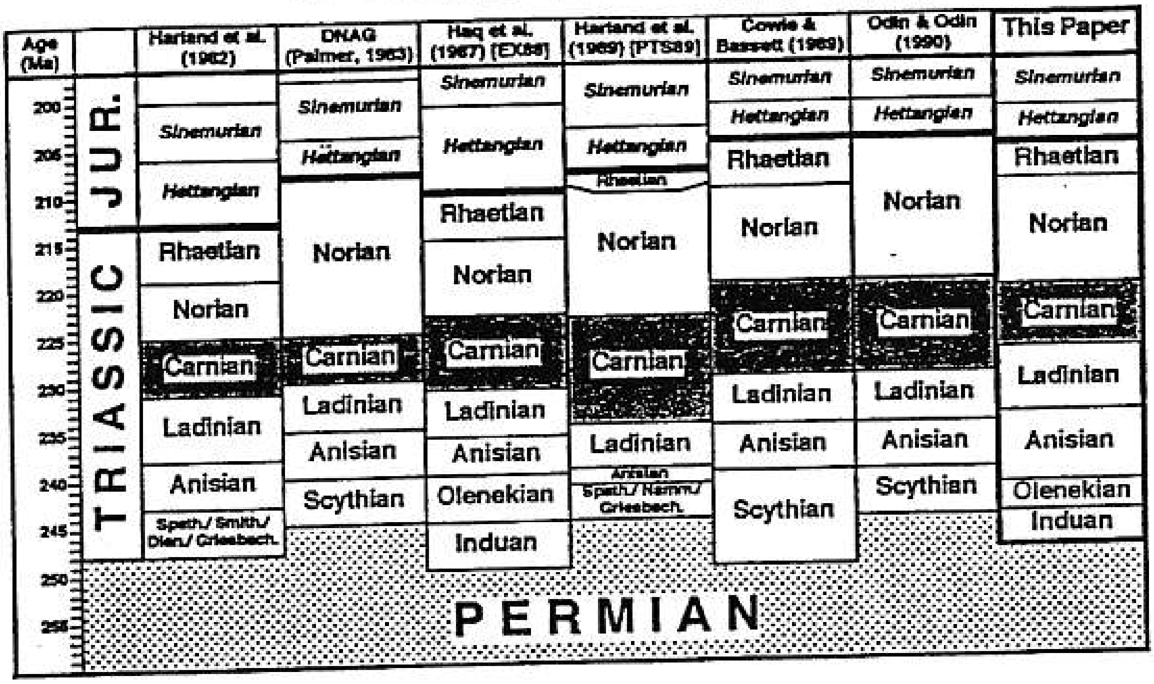



**Figure 3.** Comparison of Triassic time scales.

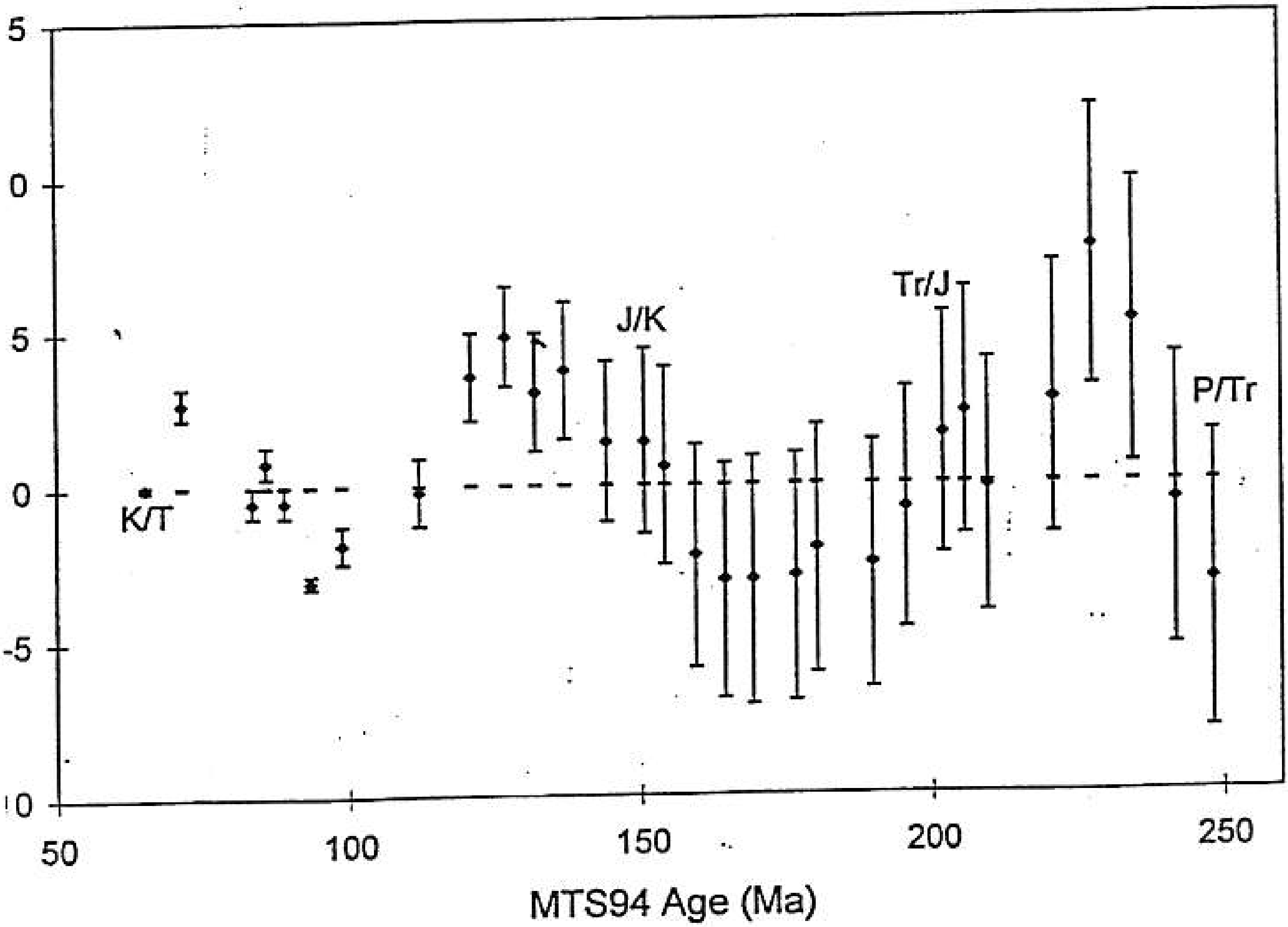



**Figure 4.** Comparison of two time-scales (see text for further explanation).

# LAST NEWS !

## 10 - LAST NEWS !

Completion of Newsletter 23 has been delayed through the shortage and insuitability of the support we receive from our Institute.

Since the text was ready for type-writing long before summer holidays, new informations and progress appeared concerning the activities of some working groups. They are added or summarized below.

### 10.1 - BAJOCIAN BOUNDARY W.G. (B.B.W.G.)

From the final version of the proposal :

COIMBRA, PORTUGAL, SEPTEMBER 1995 - R. Chandler, S. Fernandez Lopez M.H. Henriques N. Morton, R. Mouterde, G. Pavia and R. Rocha participated in a meeting organized by A. Soares at Coimbra University. The aim of the group was to revise the taxomony of graphoceratid ammonite specimens on which the Bajocian lower boundary had been formerly proposed at Cabo Mondego by HENRIQUES *et al.*, (*in* CRESTA & PAVIA, 1994, p. 79). The revision was facilitated by availability of Buckman's types and plaster casts of Graphoceratidae and comparative material from Dorset and Skye specially brought by R. Chandler and N. Morton. Taking into account mainly the morphological variability of graphoceratid species, it was possible to improve and sometimes modify previous determinations of Hyperlioceras taxa listed from Cabo Mondego. After the revision the group collected new samples from the Aalenian-Bajocian boundary beds in the section ; these confirmed the results established from the old collections.

Even though rare specimens referable to Hyperlioceras had been reported from beds AB9 and AB10, the most significant biostratigraphical change accurs between beds AB10 and AB11 of the Murtinheira section at Cabo Mondego. It records the first occurrence of the ammonite assemblage with Hyperlioceras *mundum* and related species (*H. furcatum*, *Braunsina aspera*, *B. elegantula*). This assemblage is precisely correlatable with other ammonite successions from Sub-Mediterranean (e.g. Morocco) and Sub-Boreal (e.g. Dorset, Skye) localities.

In conclusion, the evolution of the genus *Hyperlioceras* was confirmed as the best key for defining the Bajocian GSSP. By tradition in the literature of the last thirty years, the first record of a specimen of *Hyperlioceras* at Cabo Mondego (bed AB9) had been used to define the Bajocian lower boundary. As a result of the revision made in Coimbra and recognizing the correlation power of the *H. mundum* assemblage, it is proposed to place the Bajocian GSSP at the base of bed AB11 (= M337) of the section.

CONCLUSIONS

The Murtinheira section at Cabo Mondego (Portugal) is proposed as the GSSP of the Bajocian Stage as it fulfills the following requirements :

(1) Global-scale correlation by means of ammonite and calcareous-nannofossil assemblages ; in particular, with the first occurrence of *Hyperlioceras mundum* and associated species which assure good correlation to Tethyan and Pacific Realms.
(2) Absence of unconformities in the interval from uppermost Aalenian to lowermost Bajocian in a section with continuous exposure from Upper Toarcian (Lower Jurassic) to Callovian (Middle Jurassic).
(3) Section composed of more than a hundred meters of rhythmic alternations of gray limestones and marls corresponding to an outer zone of sedimentation, beyond the platform, in the most subsiding part of Northern Lusitanian Sub-basin. The Aalenian-Bajocian boundary is placed within the Megasequence F of the Lusitanian Basin.
(4) High abundance and diversity of well preserved fossils. Ammonite, foraminifera and calcareous nannofossils studies have been completed ; study of brachiopod assemblages is in progress.
(5) No structural complexities or metamorphism.
(6) Well correlatable palaeomagnetic results with an inversion from reversed to normal polarity exactly at the lower boundary of the Stage.
(7) Easy accessibility of the section well exposed on the cliff at Cabo Mondego which is subject to marine erosion.
(8) Classification of the site as a Natural Monument in a Protected Area is in progress. A formal petition was presented to the President of the Portuguese Republic in 1994.

The Bearreraig Bay section (Scotland) is proposed as the Bajocian ASP because of the fine documentation of the ammontie lineage *Graphoceras* - *Hyperlioceras* and complementary biostratigraphical data.

In Appendix 1 a summary of data for the Cabo Mondego GSSP and description of the section with significant references are reported. In the same way, summary of data and description of the Bearreraig Bay ASP are reported in Appendix 2. Both descriptions are updated from the communications presented at the Marrakech meeting (HENRIQUES *et al.* and MORTON *in* CRESTA & PAVIA, 1994, pp. 63 and 79 respectively) and internal reports submitted for the ballot by Portuguese and British colleagues.

Consequently the first draft sent to the ICS chairman at the begining of September has been revised and the final version presented by the beginning of October for ratification by the ICS.

In the same time a ballot was urgently organized withing the ISJS. With agreement of the ICS chairman, answers were accepted until the end of November and the results are as just below :

Number of voting members : 22

| | |
|---|---|
| Yes.................... | 18 |
| No...................... | none |
| Abstentions............ | none |
| Non responses........ | 4 |

The proposal received 18 full approvals, so 81 % clearly beyond the requested 60 %. Officially non responses are counted as approvals, so 100 %.

10.2 - BATHONIAN BOUNDARY W.G. (Bt.B.W.G.) (C. MANGOLD)

Bathonian BWG Digne field meeting and workshop (Oct. 14-15th, 1995)

For medical reasons the Convenor was absent and then replaced by R.H. ENAY (Chairman of the ISJS) and by G. Pavia (Torino, next chaimran) during discussion and i nthe field.

**• Saturday Oct. 14 th, morning**

Presentation of the Bas-Auran, Ravin du Bès section as Bathonian GSSP.

G. DIETL (Suttgart) directly poses the problem with two questions which have given matter to discussion.

1st question : If the Lowermost Bathonian Convergens Subzone appears very well documented by ammonite fauna, the Uppermost Bajocian Bomfordi Subzone seems not prooved enough from which ones conclude to the possibility of a discontinuity or a minor gap. This Subzone is better identified in the Chaudon section. But there is an impossibility to define a GSSP based on two sections.

As a conclusion the participants agree with the necessity of new and complementary sampling at Bas Auran. An another workshop is to be planed during springtime 1996.

2nd question : Should the Lower Bathonian boundary be defined by a formal faunistic Horizon ?

G. DIETL thinks that a basal horizon exists in Swabia with *Cadomites exstinctus/deslongchampsi*, *Morphoceras parvum* and *Parkinsonia subgaleata* (m). - *P. convergens* (m). It seems possible to specify this horizon between bed 14 and 23 in the Bas Auran section.

**• Saturday Oct. 14th, afternoon**

Devoted to the visit of the Ravin du Bès section. Attendants collect microfossils and magnetometric samples or prefer examine taphonomic or sequential aspects.

**• Sunday Oct. 15th, morning**

Was devoted to regional Bathonian biostratigraphy, G. DIETL demonstrate the Exstinctus-Horizon of the basal Convergens Subzone in Swabia.

Other short talks were presented on Moroccan-Algerian frontier, Spain, Hungary, Poland. It should be enhanced the discussion about the Bathonian genus *Epistrenoceras* (A. GALACZ, G. MENLENDEZ & K. PAGE, S. FERNANDEZ-LOPEZ & MELENDEZ, S. ELMI) concerning its range, biogeographic distribution, correlation possibilities, origin and evolution.

**• Final resolutions**

- Necessity of new and complementary collectings at Bas-Auran ;
- Formal definition of a basal Early Bathonian horizon ;
- Chaudon will be proposed as an auxiliary stratotype section (G. Pavia).

Finally G. DIETL has adressed compliments and thanks to the organizers and to the permanent people of the St. Benoît Center (Réserve géologique Digne).

10.3 - OXFORDIAN BOUNDARY W.G. (O.B.W.G.) - (G. MELENDEZ)

**• Proceeding of the Voting Process for the most idoneous section for Oxfordian GSSP.**

Introduction

The selection of an appropriate candidate for Oxfordian GSSP has been the matter of intense discussions among the members of this working group in the recent years since the celebration of the 3rd Oxfordian Meeting in Warsaw (1992). In subsequent meetings (Great Britain, 1993 ; Lyon-SE France, 1994) some of the Group members visited several candidate sections in Yorkshire (Osgodby Nab, Scarborough) ; Dorset (Ringstead Bay) and SE France (Thuoux-Savournon, near Serres). A quick work followed on preparation of first documents on these favourable outcrops for selection as stratotype of the Callovian-Oxfordian boundary. Documents were mainly prepared by Kevin Page (British outcrops) and by Didier Marchand and Dominique Fortwengler (Thuoux-Savournon sections). These documents were sent to all members of the Group by the Convenor and a voting form was enclosed.

Results and Decisions

A whole of 28 answers were received in the following weeks which can be regarded as a good score. Answers were clearly directed towards the french sections as the most appropriate candidates for GSSP. However, opinions received by some of the Group members left an impression that many of the members were not completely sure that the french sections were the best, or at least that the knowledge on any of the candidate sections was deep enough to allow a definitive decision on that point. This is why a decision was taken, by subsequent and mutual agreement between the Chairman of the ISJS and the convenor of the Oxfordian Group, not to submit these results as a formal proposition for Oxfordian GSSP to the ICS this year, and the proposal of Oxfordian stratotype will probably wait to the next International Geological Congress. In the mean time, authors of the reports have been encouraged to progress as much as possible with the publication of the stratigraphic results and the main, determinative ammonite species around the Callovian-Oxfordian boundary. A similar request has been addressed to the microfossil specialists and magnetostratigraphers to publish as soon as possible the results on these points in order to support a final decision on one section or the other. These points were discussed during informal talks with some of the OWG members during the Bathonian Working Group meeting at Digne, October 14-15 th 1995.

Votation and Comments

The following colleagues sent an answer to the OWG convenor : A. Benetti, A. Boullier ; J. Cope ; D. Fortwengler ; E. Glowniak ; R.A. Gygi ; J. Krishna, T. Lominadze ; L. Malinowska ; D. Marchand ; B. Marques ; G. Melendez ; R. Myczynski ; E. Mönnig ; K. Page ; G. Pavia ; T.P. Poulton ; A. Riccardi ; R. B. Rocha ; I.G. Sapunov ; W.A.S. Sarjeant; G. Schweigert ; L. Sequeiros ; R. Tarkowski ; J. Thierry ; G.E.G. Westermann ; A. Wierzbowski ; J.K. Wright ; A. Zeiss. We should add my own response and, those of the chairman and secretary.

Final results are including votes of the chairman and secretary of the ISJS :

| | VOTES |
|---|---|
| 1 - THUOUX-SAVOURNON.......................... | 24 |
| 2 - REDCLIFF POINT.................................... | 5 |
| 3 - ANOTHER POINT (must be searched)............ | 1 |

Special comments :

(J.C.W. Cope) : "More information is needed. At Thuoux the only species to appear at the proposed boundary is a new species, at present a manuscript name and invalid. In Dorset there is good potential but would prefer further work".

(K.N. Page) : "There is no doubt that the French sections are the best documented".

(T.P. Poulton) : "Vote based *strictly* on information sent with ballot. Potential for micro ; palyn ; Geochem ; Geomag ; perhaps about equal because of similar shale facies. French sections with more varied ammonites".

(G. Schweigert) "In my opinion both candidates have to be studied in detail, and only in the moment it seems that Thuoux is better examinated. The faunas around the boundary are not figured, so that it is difficult to interpret faunal lists without any picture which are necessary for identification".

(G.E.G. Westermann) : "Peltoceratids are also present in Indonesia (*Parawedekindia*, etc.)".

(A. Zeiss) : Redcliff point : "The documentation of fossils is too poor. The Woodhamense horizon lies below the Scarburgense, just the contrary in France".

Thuoux-Savournon : "Before presented officially, the documentation should be better".

General comments : "See above, the documentation for the Thuoux section is rather poor ; There is no publication list, the situation map is too locally ; seems that the Peltoceratids have not been published as announced in Lyon. Of course there are some other disadvantages (missing of other fossil groups), but I have doubts if one can find better localities at all.

As we can see there are some colleagues who are not too convinced with the "state of the question". Even the Group Convenor would possibly be among them. I wonder whether we should wait for the results to come up more in detail, with species lists published, specimens figured, etc. Only one colleague voted for "another point". This is in some way success but quite a few say things are still not clear.

Hereafter are abstracts of two papers in press by .D Marchand and coll. which reply to some comments quoted above.

**• Les Peltoceratinae (Ammonitina, Aspidoceratidae) au passage Callovo-Oxfordien dans les "Terres Noires" du Sud-Est de la France : ontogenèse, dimorphisme, systématique.**

par BONNOT A., FORTWENGLER D. & MARCHAND D.

Abstract

Numerous Peltoceratinae have been collected from the Callovian-Oxfordian boundary of the Terres Noires Formation (black shales) of South East France. One or more specimens of Peltoceratinae, each considered representative of a paleopopulation, have been analyzed from each biostratigraphic horizon recognized. For all samples, two forms of different size and ornament are found to co-exist and are interpreted as sexual dimorphs (non tuberculate microconchs, tuberculate macroconchs).

Biometric analysis (size and ornament) and the study of ontogenetic stages allow changes in several characters can be traced through a serie of four consecutive samples from levels 6B (Paucicostatum horizon), 7 (Thuouxensis horizon), 8A and 8B (Scarburgense horizon), viz. : (1) rapid but reversible variation in adult size of microconchs ; (2) duplication of latero-ventral tubercles in macroconchs ; (3) lowering of the rib forking point.

It seems that character 2 marks the Callovian-Oxfordian boundary (between level 6B and 7) while feature 3 characterizes the base od the Scarburgense horizon (8A/8B boundary). The systematics of these seldom depicted forms is under revision.

Mot-clés : Peltoceratinae, Ammonites, Dimorphisme sexuel, Evolution morphologique, Terre noires, Callovien, Oxfordien.

Key-Words : Peltoceratinae, Ammonites, Sexual dimorphism, Morphological evolution, Terres noires, Callovian, Oxfordian.

**• Ammonites and Callovian-Oxfordian boundary in the "Terres Noires" from Diois (Southeastern basin, France) ; examples of Thuoux and Savournon sections**

par Fortwengler D., Marchand D. & Bonnot A.

Abstract

Sedimentary deposits at the Dogger - Malm boundary in the South-East France Basin are thick and continuous (Terres Noires). This is exceptional in Western Europe. The ammonite faunal succession exhibits a biochronological resolution that is finer than or equal to the ammonite horizon, i.e. approximately 150000 years.

The Callovian-Oxfordian boundary is clearly visible in the Thuoux and Savournon (Diois area) reference sections. Ammonite faunas are abundant and detailed analysis of the various lineages enables us to identify a very precise demarcation line in both sections on the basis of Boreal ammonites, known only on the North-West European platform, and more widespread Tethyan ammonites. This double zonation means the Callovian-Oxfordian boundary is recognizable at the global scale. Variations in the quantittative distributions of faunas enhance the subdivisions obtained by synevolutionary analysis of the various ammonite lineages.

This paper describes and portrays index species by recognized biostratigraphic units.

Keys-Words : Ammonites, Biochronology, Callovian, Oxfordian, Terres Noires, France.

10.4 - JURASSIC-CRETACEOUS BOUNDARY W.G. (J.C.B.W.G., DEPENDING OF THE INTERNATIONAL SUBCOMMISSION ON CRETACEOUS STRATIGRAPHY)

You will find below 1) The abstracts of two papers concerning the Boreal Berriasian by V. A. Sakharov and 2) the proposal on the Jurassic-Cretaceous boundary he presented as the chairman of the J/K Boundary working group. The copies were sent : "To all members of Jurassic/Cretaceous Working Group, 3 June, 1995".

## THE BOUNDARIES OF THE BOREAL BERRIASIAN

Victor A. Zakharov, Institute of Geology, Siberian Branch of Russian Academy of Science
University Av., 3, Novosibirsk, 90 Russia 630090

1. The Boreal Berriasian (BB) is characterized by the following ammonite genera: *Praetollia, Hectoroceras, Surites, Borealites, Bojarkia, Tollia, (?)Lynnia, Peregrinoceras.* The BB deposits cover a huge territories upwards 50 northern latitude.

2. The stratigraphical range of BB has been changed throughout the last century. The boundaries of the modern BB not correspond to Ryazanian sensu N.Bogoslovskii (1895) and N.Sasonov (1951).

3. The lower boundary of BB is defined at the base of ammonite Zones that is by the first appearence of species from the genus *Praetollia.* This is *P. maincy* Zone in North Siberia, Subpolar Ural, Pechora River basin, East Greenland, (?)Svalbard, Arctic Canada. *P. runctoni* Zone - in England. The *Praetollia maincy* Zone base is placed in the middle of *Buchia unschensis* of BB's Hypostatotype at the North of Siberia (see Zakharov's poster abstract).

4. There is no common opinion about the Boreal - Tethyan correlation of the Jurassic/Cretaceous boundary Zones. Two approaches are dominating. Most of Boreal paleontologists assume that the boreal *Praetollia* genozone base coincides with Mediterranian *Berriasella grandis* one. But some Tethyan paleontologists believe that the bottom of BB should coincide with *Fauriella boissieri* Zone base.

5. The upper boundary of BB is placed at the base of Boreal Valanginian. The position of the upper BB boundary is less defined than the lower one. The BB is terminated with *Bojarkia* spp. Zones in North Siberia, Subpolar Ural, in Canada; with *Peregrinoceras* spp. Zones in England, on Russian plain and East Greenland. There is a reliable Boreal - Tethyan correlative level at the base of Boreal Valanginian owing to jont finds of *Platyleuticeras* and *Propolyptychites* genera in the lowermost Lower Valanginian in the North-West Germany (Lower Saxonian Basin). *Propolyptychites quadrifidus* Zone of the Northern Siberia correlates with *Turmanniceras pertransiens* standart Zone. The basal Boreal Valanginian *Neotollia klimovskiensis* Zone is correlate with *Turmanniceras otopeta* standart Zone by stratigraphical position.

6. BB Hypostratotype's *Buchia*-Zones directly correlate with *Buchia* zonation of Northern California Berrisian section (Grindstone Creek, Paskenta area, Glenn district). The best correlative level is the base of *Buchia okensis* Zone at the lowermost part of Berriasian and BB stages.

# THE RANK AND ZONATION OF THE BOREAL BERRIASIAN

Victor A. Zakharov, Institute of Geology, Siberian Branch of Russian Academy of Science
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1. As demonstrated by V.Sachs and N.Shulgina (1964, 1972) the range of "Ryazanian stage" not coincides with that of Boreal Berriasian (BB). There is no continuous sections of the Ryazanian on the Russian plain. Everywhere, including Oka River Basin Ryazanian horizon occurs on underlying rocks with stratigraphical and sedimentological break. The sedimentological hiatus occurs also within the roof of "Ryazanian stage". The stratigraphical hiatus is very likely to be present within Ryazanian horizon (sensu N.A.Bogoslovskii, 1895). There are no BB sections in Europe to meet the requirements of stratotype standard.

2. The BB ammonites are as specific as Volgian ones. It is practically impossible to correlate directly the Berriasian and BB ammonite sequences. It is necessary to have the standard for BB as the instrument of effective Panboreal correlation. The only continuous BB section occurs along Laptev sea beach, on Nordvik Peninsula, Urdyuk-Khaya Cape. Upper Volgian substage, BB and Boreal Lower Valanginian are composed of offshore black shale facies. The lower and upper BB boundaries are recognized within clays and enriched by organic argillites monotonous succession. The complete successions of the Ammonite, Buchia, Forams and Dinocyst Zones have been established. This section is proposed as the standard of the BB.

3. The following ammonite zones are in Upper Volgian substage: *Craspedites okensis* (thickness is 4,7m.), *C. taimyrensis* (4,2 m.), *Chetaites chetae* (1,2 m.),; BB include following zones: *Praetollia maincy* (0,5 m.), *Chetaites sibiricus* (3,5 m.), *Hectoroceras kochi* (8,7 m.), *Surites analogus* (4,7 m.), *Bojarkia mesezhnikowi* (18,5m.); Boreal Lower Valanginian: *Neotollia klimovskiensis* (14,1 m.), *Propolyptychites* quadrifidus (37,8 m.) (Zakharov et al., 1983; Bogomolov, 1989). *Hectoroceras kochi* and *Surites analogus* Zones in Kheta River section have been subdivided into 3 and 2 subzones respectively (Alekseev,1984). The ammonite zones are widespread in North Eurasia from Anabar River Basin in North Siberia to Greenland in the Western Hemisphere (Zakharov, 1981; Surlyk,Zakharov,1982).

4. The complete *Buchia* - Zone succession is established in the same section as for ammonite one: *Buchia unschensis* (Jurassic/Cretaceous boundary beds), *B.okensis, B.jasikovi, B. tolmatschowi, B. inflata* (BB/Boreal Valanginian transitional beds). The same or almost the same succession of *Buchia* - Zones is defined within Boreal realm and in some Pery - Tethyan regions (for example,in Northern California, USA). This is a good chance to correlate directly Boreal and Tethyan sections.

## WG ON BERRIASIAN: TITHONIAN/BERRIASIAN = J/K BOUNDARY + SUBSTAGE BOUNDARIES

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1. It's proposed to consider ammonite zonation of the Mediterranean region, that is prepared within the framework of IGCP project 262 and coordinated by Lower Cretaceous cephalopod team in Digne, as the basis for discussion of J/K boundary and substage boundaries on the sessions of Working Group (Hoedemaeker, Bulot, 1990)

2. It's necessary to discuss the potentialities of this scale for correlation of Tethyan Berriasian deposits of the Caribbean Basin in America with the east Tethyan deposits of Asia. When discussing Pantethyan correlation it is necessary to analyze not only ammonite scale, but also parallel scales based on calpionellida, nannofossils, foraminifera, dinocysts, and the data on paleomagnitostratigraphy, geochronology, isotope stratigraphy, chemo - & sequence stratigraphy.

3. The main insoluble problem is infrazonal Boreal - Tethyan correlation of Berriasian stage and Boreal Berriasian (BB). 14 Zones and Subzones are distinquished in BB by ammonites (see drawing). Among these zones there is no a single zone to be joint Boreal - Tethian one. We have no a single level, which can permit us to correlate Mediterranean and Boreal deposits using ammonite zonation (*Riasanites* and *Euthymiceras* are not effective for infrazonal correlation).

4. Only *Buchia* allow direct correlation of Boreal and Subtethyan deposits. The only continuous Berriasian sequence without stratigraphycal and sedimentological hiatus, which contains tethyan ammonites of Latinoamerician habit, nannofossils and full sequence of boreal *Buchia*- Zones occurs in North California (Grindstone, Paskenta village). Based on *Buchia*, this section is ready correlated with the most full section of BB of North Siberia. It needs repeated detailed research of this section under the financial support of International Scientific Funds.

5. It's possible that the roof of Upper Tithonian is isochronous to that of Middle Volgian substage. But it does not mean that the base of Berriasian and Upper Volgian substage is also isochronous. Should we accept the level of J/K boundary at the base of *Jacobi* Zone in the Mediterranean sections before we receive direct evidence of the place of this level in Boreal sections?

## Non-approved zonal correlation of the Berriasian, Boreal Berriasian and Upper Volgian on ammonites

| Stages | Substages | Mediterranean region | | Zone's No. | Northern Siberia | | Zone's No. | Substages | Stages |
|---|---|---|---|---|---|---|---|---|---|
| Berriasian | Upper | Fauriella boissieri | ? ? | | Tollia tolli | | 14 | Upper | Boreal Berriasian |
| | | | Berriasella picteti | 7 | Bojarkia mesezhnikowi | | 13 | | |
| | | | Malbosiceras paramimounum | 6 | Surites analogus | Surites analogus | 12 | | |
| | | | | | | Surites subquadratus | 11 | | |
| | Middle | Tirnovella occitanica | Dalmasiceras dalmasi | 5 | Hectoroceras kochi | Surites praeanalogus | 10 | Lower | |
| | | | | | | Borealites constans | 9 | | |
| | | | Berriasella privasensis | 4 | | Hectoroceras kochi | 8 | | |
| | | | | | Chetaites sibiricus | Chetaites sibiricus | 7 | | |
| | | | Tirnovella subalpina | 3 | | Praetollia maimci | 6 | | |
| | Lower | Berrisella jacobi | Pseudosubplanites grandis (?) | 2 | Chetaites chetae | | 5 | Upper | Volgian |
| | | | | | Craspedites taimyrensis | | 4 | | |
| | | | Berriasella jacobi | 1 | Craspedites okensis | C. originalis | 3 | | |
| | | | | | | C. okensis | 2 | | |
| | | | | | | C. exoticus | 1 | | |
| Tithon. | Upper | | Durangites spp. | | Epivirgatites variabilis | | | Mid. | |

# 11 - ENCLOSURES

INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY (ISJS)

INTERNATIONAL COMMISSION ON STRATIGRAPHY (ICS)

A COMMISSION OF THE INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

*Chairman* : Professor Dr. Raymond Enay, Centre des Sciences de la Terre, Université Claude-Bernard - Lyon I,
43 bd du 11 Novembre 1918 - F 69622 Villeurbanne Cedex -
Phone : (33) 72 44 82 23. Telex : UCBL 330 208 F. Telecopy : (33) 72 44 83 82
*Secretary*: Professor Dr. Charles Mangold, [redacted]., same adresses - Phone : 72 44 83 76

One of the best sites to study the Middle and Upper Jurassic succession in Europe is the Cabo Mondego outcrop, in Portugal. Its relevance results from the completeness of the record as well as from the excepcional exposition of the Jurassic sediments ranging from Upper Toarcian to the Tithonian. This has been confirmed particullarly on an excursion during the 2nd International Symposium on Jurassic Stratigraphy (Lisbon, 1987).

The preservation of this important geological site must be guaranteed and those who best know its value are therefore the most responsable for its safety.

The Chairman of the International Commission on Stratigraphy, the Chairman of the International Subcommission on Jurassic Sratigraphy, the President of the Organizing Commitee and the participants of the 4th International Congress on Jurassic Stratigraphy and Geology (Mendoza, Argentina) representing thirty countries of five continents, declare:

1. to appreciate the formal support of His Excellence the President of the Portuguese Republic to the classification of Cabo Mondego as a Natural Monument according to the Portuguese law;

2. to support the efforts delivered by the portuguese colleages in order to preserve this important geological site.

Approved at Mendoza, the 23rd October, 1994.

A. RICCARDI
President Organizing Commitee 4th ICJSG

J. REMANE
Chaiman ICS

R. ENAY
Chairman ISJS

# TOARCIAN WORKING GROUP

***

Please return this form to the Convenor :

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SURNAME and FIRST NAME

ADRESS

PHONE, FAX, Σ MAIL

ACTIVE VOTING MEMBER

ASSOCIATE MEMBER

MAIN INTEREST IN TOARCIAN STRATIGRAPHY

- biochronology and biostratigraphy..................................................
- sedimentology...........................................................................
- sequence and genetic stratigraphy..................................................
- magnetostratigraphy.....................................................................
- paleogeography..........................................................................

PALEONTOLOGY

- group(s)......................................................................................
- paleobiogeography.......................................................................
- paleobiology................................................................................

GEOGRAPHIC AREA.

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PARTICIPATION TO THE JOIN MEETING OF THE TOARCIAN-AALENIAN WG (13-19 SEPTEMBRE 1996)

# AALENEWS

**n. 1 - July 1995**

*International Subcommission on Jurassic Stratigraphy - Aalenian Working Group*

**Convenor**: *Stefano Cresta - Servizio Geologico Nazionale, Largo S. Susanna 13 00187 ROMA*


Dear Colleagues,

I wish to thank all of you who have replied to the first WG Circular (40 out of 70). The main purpose was defining a directory for the future WG activities and testing its effectiveness as to the stated tasks. Such tasks regard, as a primary step, the choice of a GSSP for Aalenian stage and, since no other section has been proposed so far, I think our choice must be turned to those presented up to now.

Just in order to freshen up your memory, the central pages are "wasted" for a summary of the two sections and a short comment, updated according to the news received after the Marrakesh Meeting (May 1994).

And now to the programmed meeting of the next September 1996: both the "section managers" (*W. Ohmert* and *S. Ureta*) gave their availability to host it. I think a direct vision of the two candidated sections is quite important; I shall therefore try to organize the WG meeting in one of the two mentioned localities, giving the chance to visit as a pre-meeting field trip the other section. I'll forward the first circular on the subject within October 1995, including railway and plane time-tables for connections.

Wishing you all what you wish to be wished, I send you my best ... wishes!

## Aalenian Working Group Directory

Yves ALMERAS
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Université Claude-Bernard Lyon 1

27-43, bd du 11 Novembre
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**Brachiopods** European platforms and Western Tethys - biochronology, biostratigraphy paleontology, ecology, biogeography

Angela BALDANZA
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Piazza Università
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**Calcareous nannofossils** Apennines and Western Tethys - biochronology, biostratigraphy, ecology, biogeography

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**Ammonites** Apennines, biochronology, biostratigraphy, biogeography. *Sedimentology*

Mohamed BOUTAKIOUT
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**Foraminifera** North Africa and Western Tethys, biostratigraphy, ecology *Sedimentology*

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**Dinoflagellates** Apennines and western Tethys, biostratigraphy, ecology, biogeography

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**Ammonites** biochronology, biostratigraphy, paleontology, biogeography

Maria Luisa CANALES
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Facultad de Ciencias geologicas
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**Foraminifera** Iberian range, Cantabrian basin and
Betic range, biostratigraphy, biochronology,

paleontology, ecology, biogeography.
*Sedimentology*

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**Radiolaria** Queen Charlotte Islands biochronology
paleontology, biogeography

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**Ammonites** Dorset, biostratigraphy, biochronology
paleontology

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**Calcareous nannofossils** Southern Alps, Apennines, biochronology, biostratigraphy, ecology, biogeography.

Beris COX
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**Macropaleontology (Invertebrate)** UK, biochronology, biostratigraphy, paleontology

Susana DAMBORENEA
Dep. Paleontologia Invertebrados
Museo de Ciencias Naturales
Paseo del Bosque

1900 LA PLATA (Argentina)

**Bivalves** Southern South America, biochronology, biostratigraphy, paleontology ecology, biogeography

Erik DE KAENEL
Department of Geology
Florida State University
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**Calcareous nannofossils** Western Europe biochronology, biostratigraphy, paleontology, biogeography

Gerd DIETL
Staatl. Museum für Naturkunde

Rosenstein 1
70191 STUTTGART (Germany)

**Ammonites** biostatigraphy, biochronology

Serge ELMI

Centre des Sciences de la terre
Université Claude-Bernard Lyon 1

27-43, bd du 11 Novembre
69622 VILLEURBANNE (France)

**Ammonites** Western Europe, North Africa, South America, biochronology, biostratigraphy, ecology, paleontology, biogeography.
*Sedimentology, Sequence stratigraphy*

---

Sixto FERNANDEZ-LOPEZ

Departamento de Paleontologia

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**Ammonites** Iberian and Catalan ranges

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Soledad URETA

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Facultad de Ciencias geologicas
Univ. Complutense 28040 MADRID
**Ammonites** Iberian and Cantabrian ranges
paleontology, biochronology, biostratigraphy

*Sequence stratigraphy*

---

Federico VENTURI

Dipartimento di Scienze della terra

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**Ammonites** Apennines, paleontology, biogeography, biochronology, biostratigraphy

---

Dorothy GUY-OHLSON

Swedish Museum Natural History
P.O. Box 50007

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**All organic-walled microfossils** Global, ecology biogeography, paleontology, biochronology, biostratigraphy. *Sedimentology*

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Russel HALL

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*Sequence stratigraphy.*

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biochronology, biostratigraphy, paleontology, biogeography. *Sedimentology.*

---

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**Magnetostratigraphy** Germany

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**Ammonites** Haut-Atlas Central
paleontology
biochronology, biostratigraphy,
biogeography
ecology. *Sedimentology. Sequence stratigr.*

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paleontology, biogeography.

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**Ammonites** Tethys, paleontology, biochronology, biostratigraphy.

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**Ammonites** Global, paleontology, ecology biochronology, biostratigraphy, biogeography

# The Wittnau candidate

A resolution of the first International "Colloque du Jurassique" at Luxembourg accepted the *P. aalensis* Zone as the uppermost Zone of the Toarcian stage and the *L. opalinum* Zone as the basal Zone of the Aalenian stage (1964: 78). But nothing there was told about the base of the *L. opalinum* Zone. So another agreement is necessary to settle the lower boundary of this Zone.

The type of the index species of the *L. opalinum* Zone was not known up to now but by the original drawing and description by REINECKE (1818). Also no section is available in its type area near Altenbanz (Franconia). Recently the holotype of *Leioceras opalinum* was recovered by E. MÖNNIG in the Naturkundemuseum Coburg and presented to the German Subcommission on Jurassic stratigraphy in 1993. The type is differing in several details from what is taken generally for *L. opalinum* in the literature.

On the other hand MAYER (1864) used *Pachylytoceras torulosum* (ZIETEN) as index for the basal Aalenian when he established the Aalenian stage according to OPPELs definition of the base of the Middle Jurassic. The first appearence of *torulosum* and *opalinum* coincides in many European sections.

In the thick continuous boundary sections of the Oberrhein area in Southwest Germany both species were proved, but *torulosum* considerably below *opalinum*. So the *P. torulosum* biozone was proposed here as the basal biozone of the Opalinum Chronozone (OHMERT *et al.* 1991).

The only permanent outcrop of the Toarcian/Aalenian boundary in the Oberrhein area is the disused clay pit near Wittnau, 6 km to the South from Freiburg i. Br. (R 34 10 560, H 53 12 660 on sheet 8012 Freiburg SW 1:25 000). The boundary there is encompassed within a sequence of 40 m marls and clays of the Jurensismergel and Opalinuston formations. The succession was described by KLÖCKER (1966, 1967) for the first time, including studies of the ammonites, bivalves and gastropods. Also foraminifera (OHM 1967: 106, fig. 1) and sporomorpha (WEISS 1989) were studied and figured from this locality. The Wittnau section is well correlatable with another temporary outcrop from Badenweiler (distance 18 km to the Soutwest), from where the ostracod fauna was figured by KNITTER & OHMERT (1983).

Three major changes of the ammonite fauna were recognized in the transitional succession across the Toarcian/Aalenian boundary at Wittnau.

The first one is characterized by the incoming of *P. torulosum* in the basal *subcandida* horizon. This is the traditional central European basal boundary of the Aalenian. *P. torulosum* of course is not usable for world wide correlation but the accompanying *Cotteswoldia* assemblage is known with similar species as in Europe also in South America (HILLEBRANDT 1987) and Iran (SEYED-EMAMI 1985). The development of the Grammoceratinae-Leioceratinae lineage provides at present the most detailed informations for correlation at the Toarcian/Aalenian boundary.

In many regions, particularly in the mediterranean realm the incoming of *Bredyia subinsignis* (OPPEL) little before *P. buckmani* can be used as additional marker of the *torulosum* (respectively *buckmani*) range (GOY *et al.* 1988, fig. 4; LINARES *et al.* 1988: fig. 3). But at Wittnau the genus *Bredyia* is very rare.

*Tmetoceras scissum* (BENECKE) which marks the Aalenian base in Canada (POULTON & TIPPER 1988) was also observed to come in before the first *L. opalinum* in the Iberian Cordillera (LINARES *et al.* 1988: 200). The genus *Tmetoceras* was proved even before the first appearance of *P. torulosum* in northern Switzerland (ETTER 1990: 66, 68) but appears to be absent in the lowermost Aalenian of our region. [OHMERT 23.5.95...*The most exciting fossil in the core was a small* Tmetoceras *in the Aalensis Zone as described by ETTER (1990) from northern Switzerland.*].

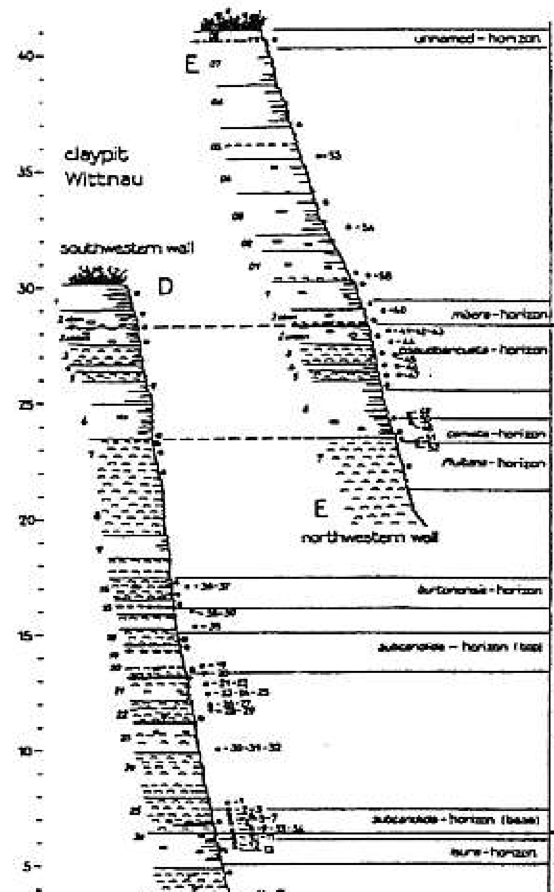
This boundary defined by the incoming of *P. torulosum* at Wittnau is also substantiated by changing microfaunas little before or after the boundary level (fig. 3, OHMERT *et al.* 1991: figs. 6, 7).

Another easily recognizable change in the ammonite fauna is characterized by the sudden and almost complete replacement of the genus *Cotteswoldia* by radiating oxycone *Pleydellia* species in the *comata* horizon. But this event is neither supported by any other new ammonites nor by any change in the microfauna. The geochemical investigations (see MARTIN in this volume) indicate gradually shifting environmental conditions since this level.

The third major boundary revealed by ammonites between the *pseudoarcuata* and the *misera* horizons at Wittnau corresponds to the first incoming of *L. opalinum*, what is often used in the literature for documentation of the Aalenian base. But many of the ammonites assigned to *opalinum* probably do not correspond exactly with the very special form of the holotype, which is represented at Wittnau only scarcely in the *misera* horizon amidst a lot of densely ribbed *Pleydellia* specimens. Also *opalinum* is not distributed world wide and the associated *Pleydellia* fauna is known only from Europe.

The microfauna at Wittnau is reflecting this boundary mainly by the disappearance of several species and by the spreading of arenaceous foraminifera and radiolaria. Only one subspecies is new.

Therefore the traditional boundary at the base of the *P. torulosum* biozone (range zone) appears to be the most appropriate one for world wide correlation.




*Comments*: Palaeomagnetic measurements are in progress [OHMERT 23.5.95:*The core drilling Wittnau reached finally the Upper Toarcian Thouarsense Zone at 109,8 metres. In the open borehole were measured 2 Gamma-ray logs, for corrections a caliber log, and a FEL ... After a preliminary study of the cores (from outside) these were send by railway to Dr. ROLF from the NLfB Hannover for geomagnetic investigations (excepted some metres being to much destroyed by the boring process). 2 measurements were done (every cm and every 2 cm for control) with a new long cor magnetometer...*] Calcareous nannofossils studies are in progress.

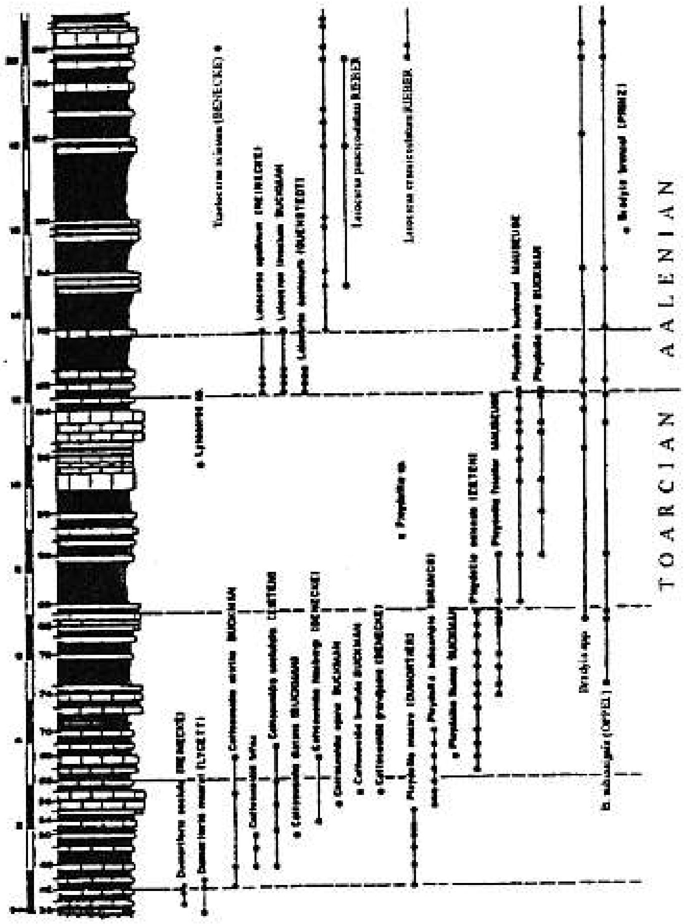
# The Fuentelsaz candidate

In the Fuentelsaz section the Toarcian-Aalenian transition is represented by a rhythmic alternation of marls and limestones, reaching a considerable thickness at this point. The limit between both stages lies immediately above level FZ106, a layer where there is no evidence of premature cementation or consolidation. This boundary is marked by the appearance of the genus *Leioceras*, the first representative of the filetic line of the Graphoceratidae, at the base of FZ107 level. *Pleydellia* coexists with the former genus in this section, and is the last representative of the filetic line of the Grammoceratinae.

The behaviour of the different fossil groups studied shows a marked biological stability during this interval. The assemblages of the organisms, whether bentonic, planktonic or nectonic, show no major modifications, since the faunal events observed generally take place before this boundary. As far as the ammonites are concerned, the main event takes place at the base of the Mactra Subzone, and corresponds to an abrupt morphological expansion of the genus *Cotteswoldia* in this subzone. From the Aalensis Subzone upwards, only the genus *Pleydellia* persists, its species form a filetic line that link with the filetic line of the Leioceratinae at the base of the Aalenian. The Hammatoceratinae, although relatively scarce, appear with constancy and show no important changes up to the upper part of the Comptum Subzone.

As for the brachiopods, the most conspicuous event roughly coincides with the base of the Buckmani Subzone at the time of sedimentation of layers FZ86 and FZ88. Among the terebratulids, this event - which means the definitive disappearance of the *S. stephanoides* morphotypes - is not very evident, due to the gradual nature of the *S. stephanoides*-*S. pisolithica* replacement, but among the rhynchonellids, this episode gives rise to a notable reduction in size that affects both *H. cynocephala* and *P. distercica* (cf. LAURIN & GARCIA JORAL, 1990, GARCIA JORAL & GOY *in litt.*).

The most relevant species of foraminifers do not show major changes throughout the interval studied. Representative of the suborder Lagenina predominate in these assemblages, and it is only occasionally that an increase in the frequency of the Spirillinina (base of the Buckmani Subzone) and Textulariina (Comptum Subzone) can be detected. In the Mactra Subzone and at the base of the Aalensis Subzone, the predominant taxon is *Lenticulina toarcense*, and from that point onwards *Lenticulina subalata* turns dominant. The only changes observed are both a reduction in the number of specimens and an increase in the degree of their recrystalization from level FZ89 onwards.




Neither do the ostracod assemblages show major changes in the taxonomic composition during the Toarcian-Aalenian transition. Such a low resolution shown by the ostracods for detecting this boundary has also been observed in other areas of Western Europe (APOSTOLESCU, 1959; APOSTOLESCU *et al.*, 1961; CHAMPEAU, 1961; FISCHER, 1961; PLUMHOFF, 1967; STOERMER & WIENHOLZ, 1967; KNITTER & RIEGRAF, 1984; BODERGAT *et al.*, 1985; BODERGAT & DONZE, 1988 and TRÖSTER, 1987). Only the species *Aphelocythere kuhni* has been considered useful from a biostratigraphic point of view, since its first appearance was repeatedly described at the top of the Aalensis Subzone (KNITTER , 1983, 1984a, b; OHMERT *et al.*, 1991). However, KNITTER (1987) points out that this is not always the case, and he questions its value as a biostratigraphic marker. In general, most of the species of ostracods show wide stratigraphic distributions which go beyond the lower limit of the Aalenian, showing a faunal renewal which occurs at a later date.

Many samples, especially from the lower part of the Aalensis Zone, display quite a rich, relatively diversified and well-preserved calcareous nannofossil assemblages. The abundance of the species as well as of specimen decreases from the Mactra Subzone to the upper part of the Comptum Subzone, even if the assemblage composition and the relative abundance show a fluctuation whithin the studied interval (eg. level FZ121). The total abundance generally ranges from rare to common and the preservation frequently ranges from medium to good, while the samples from the upper part of the section are badly preserved due to the overgrowth.

***Comments***: In comparison with the other candidate section, no data are available on chemiostratigraphy and magnetostratigraphic studies are not yet started.

INTERNATIONAL SUBCOMMISSION
ON JURASSIC STRATIGRAPHY
*Aalenian Working Group*

Convenor: Stefano Cresta
*Servizio Geologico Nazionale*
*Largo Santa Susanna 13, I-00187 Roma*
Phone (6) 4744645 - Fax (6) 4827338

**Please fill up and return this form to the Convenor**

SURNAME and FIRST NAME ..............................................................................................

ADDRESS ..............................................................................................

PHONE and FAX ..............................................................................................

I am interested in Aalenian Stratigraphy

- *mainly in:*
    - biochronology and biostatigraphy ........................
    - sedimentology ........................
    - sequence statigraphy ........................
    - magnetostratigraphy ........................
    - paleontology ........................

*group(s)* ..............................................................................................

- ecology ........................
- biogeography ........................

- *geographic area(s)* ..............................................................................................

I want to be a member of the Working Group

- as an active member (voting) ........................
- as an ordinary member ........................

*Signature:*

## Indicative programme of the Toarcian-Aalenian joint field meeting 1996

**Friday 13 september** : Departure at 1.00 pm from Madrid airport to La Almunia-Ricla, arrival at 4 pm and visit of the section till 7 pm. Toarcian WG meeting opiening dinner and Hotel at Nuevalos.

**Saturday 14 september** - morning : visit of the Sierra Palomera section. Afternoon Toarcian WG meeting.

**Sunday 15 september** - morning : visit of the Fuentelsaz section. 1.30 pm lunch at the Monasterio Piedra. Return to Madrid.

**Monday 16 september** - morning : departure to Freiburg via Zurich and arrival in the afternoon. 7.30 pm Aalenina WG opening dinner and Hotel at Freiburg.

**Tuesday 17 september** - all the day : visit of the southern Swabian Albs and Wittnan section, return to Freiburg.

**Wednesday 18 september** : Aalenian WG meeting and closure of the joint WG meeting.

**Tursday 19 september** : post meeting excursion (to be decided).

# INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY

## KIMMERIDGIAN WORKING GROUP

**Please return this part by July 31st 1995 to:**

Dr. François ATROPS. Centre Sciences de la Terre et URA 11 CNRS; Université Claude Bernard, 27-43 Bd. 11 Novembre; 69622 Villeurbanne cedex. (FRANCE).
**Fax Nr: (33) 72 448382**

## I. 5th OXFORDIAN-KIMMERIDGIAN WORKING GROUP MEETING.

NAME:

ADDRESS:

| | | |
|---|---|---|
| 1. PREFERRED PLACE FOR CELEBRATION: | GREAT BRITAIN | GERMANY |
| 2. PREFERRED DATES FOR THE MEETING: | 1996 | |
| (at either place) | 1997 | |
| 3. I SHALL ATTEND THE MEETING: | PROBABLE | UNPROBABLE |
| 4. I WILL PRESENT A PAPER: | PROBABLE | UNPROBABLE |

## II. COMMENTS ON THE MAIN PROBLEMS FOR THE SELECTION OF A GSSP CANDIDATE

The convenor of the Group will acknowledge your opinions on the following matters:

(1) BIOSTRATIGRAPHIC CORRELATION BETWEEN THE BASE OF BAYLEI ZONE AND ITS EQUIVALENT LEVEL IN THE SUBMEDITERRANEAN PLANULA ZONE

(2) SELECTION OF THE MOST SUITABLE SECTION FOR GSSP CANDIDATE AND/OR REFERENCE SECTION.