INTERNATIONAL SUBCOMMISSION ON JURASSIC STRATIGRAPHY

NEWSLETTER N° 25

Urbino, November 1997

Edited by F. Cecca

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

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Urbino, November 1997

Chairman: Prof. Giulio PAVIA - University of Turin, Italy

Secretary: Dr. Fabrizio CECCA - University of Urbino, Italy

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

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CHAIRMAN'S EDITORIAL

The 25th Newsletter of the ISJS represents the occasion for the new Chairman to contact directly all the people involved in the Subcommission: Members, Convenors, Correspondings and Researchers who actively work in our common interest, the Jurassic.

The chairmanship had been renewed since the Bejing Congress in 1996 with offices to Giulio PAVIA as the Chairman, Dorothy GUY-OHLSON as the Vice-Chairman, and Fabrizio CECCA as the Secretary.

This editing wants to continue the tradition established by the past-chairman in order to communicate news and information to as many workers as possible, directly or by means of the Convenors of the different Working Groups. The committment is both to keep on with Autumn as the expiry date for the editing of the annual Newsletter, and to contact members and coordinators for particular information and for collecting data on contributions, meetings, and any initiative dealing with ISJS interests.

The first official out-going of the Subcommission is the 5th Symposium of the Jurassic System, that will be held in Vancouver, Canada, August 1998, through the organisation by Paul SMITH, Canadian and North-American collaborators (see details in this paper). The congress had been decided during the plenary meeting of the Subcommission held in 1994 at Mendoza, Argentina, where predictable high costs and opportunity to alternate the meetings from Europe and outside have been taken into account. The reasons of such a choice depended upon (1) the opportunity to complete the visit (and study) of the eastern Pacific Jurassic, a part of which we crossed in Patagonia, (2) the availability of Canadian colleagues for the organisation of the Symposium, (3) the impossibility to realize the suggestion of the past-chairman of a Symposium in Italy, because too early. Despite any practical difficulties, I hope that the presence of colleagues will be large and I would like to thank in advance P. SMITH and collaborators for the facilities they are implementing.

The most pressing implication of the ISJS lies on the long-term programme for the definition of the boundary stratotypes (GSSP) of any stage. On this subject the past-chairmanship spent so many words, notices and direct contacts with the WG convenors that it would appear unuseful (and may be boring) to call again your attention on such a commitment that has been excited over and over by the IUGS, through the ICS, particularly after the pubblication of the new Guidelines (see Chapter 3). On the other hand the attention of the IUGS to stratotype ratifications has been recently made more concrete with acts for modelling the permanent bronze markers of GSSPs' loci and to ensure protection and free-access to the selected sections.

In fact, most subcommissions being late in this operation, the situation for the Jurassic is not so bad if we look at the schedule attached in the following pages (1.2. Anticipated work-plan 1998-2000). In particular, we are in a privileged position as the GSSP of the Bajocian Stage had been ratified during the IUGS meeting at Beijng in 1996 (see Chapter 2). This successful conclusion is positive because we are both the only Subcommission of the Mesozoic Erathem to have gone up the first step, and we have the experience to carry out the scheduled programme for GSSPs.

The Working Group convenors of each stage (the right name is actually "Stage boundary W. G.") are therefore warmly invited to pay the best attention to their own goal. Particular efforts have to be devoted to the Triassic-Jurassic GSSP, whose proposal seems to be ripe for being submitted to the Subcommission. The occasion of the North-American Symposium could be decisive, mainly after the field-trip to the New York Canyon in Nevada, whose section is among the potential candidates for the definition of the T-J GSSP. The Symposium should be also the occasion to discuss the proposals for Oxfordian and, perhaps, Aalenian, Bathonian and KimmeridgianGSSPs.

With such perspectives, it is worth to recall the main points of the procedure in submitting the proposals, as already pointed out by the past-chaiman, as far as the selection is concerned:

1) sections without breaks at the boundary and documented by a succession of guide-fossils in the beds below and above the boundary;
2) potential type-areas without too confined paleobiogeographical settings and, as far as possible, diversified faunal content with elements useful for wide correlations;
3) in the same ways, facilities for using non-ammonite fossil groups, especially microfossils, and other scale-correlation tools like magnetochronology, isotope stratigraphy, cyclostratigraphy;
4) opinion of the whole WG, may be through a ballot on the selection of the GSSP candidate with a comparison to other less suitable sections that can be yet regarded as references;
5) voting on the final proposal within the ISJS; for the above mentioned GSSPs it would be possible to collect votes of the members of the Subcommission up to the Vancouver meeting;
6) voting within the ICS;
7) final ratification by the IUGS Committee.

Beside this main goal, the Subcommission may attend other activities. In this respect, I would like to recall what I expressed at the time of my nomination as the ISJS Chairman at Mendoza, in 1994. I am deeply convinced that until now studies on Jurassic have been deeply influenced by, and referred to, ammonite inputs and chronostratigraphical statements; the rightest expansion and implement have to be devoted to as many research fields as possible. Nobody can doubt that ammonites have been and still are the ground reference for any geochronological statements; nevertheless other disciplines are attempting to integrate and it is time that members of the Subcommission pay the most appropriate attention to them. If the reality of the ISJS consists of three successive chairmanships by ammonitologists (ZEISS, ENAY, PAVIA), a first changing signal is offered by the office of Dorothy GUY-OHLSON as the vice-Chairman. Another signal consists in the restoration of the Sequence Stratigraphy WG, recently reactivated by Nicol MORTON.

The need to open a new space within ISJS to interfacing disciplines is highlighted by the next Jurassic Symposium. At Vancouver we will actually join in "unusual" sessions such as "Terrestrial Ecosystems", "Sequence Stratigraphy", "Time Scale". I agree so much with this meeting plan as it offers the opportunity to go off the custom to submit provincial and punctual contributions, most times on ammonites, as well. As far as the paleobiological aspects are concerned, the occasion could be suitable to set up specific working groups (vertebrates, paleobotany) following what has been made by the informal Jurassic Microfossil Group in the last years under the coordination of Donna HULL and Niels POULSEN.

As a logic conclusion, we must keep in mind the need to go on scales and correlation charts among different disciplinary fields like bio- (different groups), magneto-, isotope stratigraphy, and so on. In other words it is not too far the time when we would be authorized to put aside (not away!) the dated programme of GSSPs' definition, that mostly deals with carrying out well-established projects; and we will focus our attention on other targets, somehow methodologically derived from the former, such as the integrate stratigraphy. Notwithstanding, all kinds of reference scales need refinements, starting from an accurate definition of their event boundaries; such a job will join in consuming our future activity.

In any cases, before flying with new perspectives, it is necessary to complete our "istitutional" target, that is the definition of Stage boundary stratotypes. So, I am calling again all the WG convenors to best operate to respect the scheduled plan of GSSP ratification, which actually they knew and tacitly accepted since one year. In this efforts, the chairmanship of the Subcommission feels to be engaged for solving as many technical needs as possible, may be financial too, depending on logics and budget.

Giulio PAVIA
Chairman

1 - CURRENT STATUS

1.1. CURRENT STATUS IN GSSPS' PROPOSITION/PREPARATION

STAGES	PROGRESS REPORT
TITHONIAN	First field trip and meeting will take place on 9-14 November '97 in the SE France basin/Lyon. Next meetings will be organized in the Betic chains and South Germany.
KIMMERIDGIAN	English workers prefer a GSSP section on the Dorset Coast. The secondary reference section for the mediterranean province is selected in the Crussol Mountain. Formal proposal and vote before end '98
OXFORDIAN	A proposal for GSSP is expected to be presented at Vancouver Meeting (August 1998). Proposals must be formalized to be submitted to ISJS and then ICS.
CALLOVIAN	The Convenor of the BWG carried out during 1997 a revision of the Swabian GSSP already proposed in 1990.
BATHONIAN	The Bas Auran section was selected as GSSP. During April 1997 new data have been collected for both ammonites and dinoflagellates. A formal proposal of GSSP is expected by 1998.
BAJOCIAN	The proposal of the Cabo Mondego GSSP was ratified during the Beijing IGC Congress. Published on *Episodes*, vol. 20/1, 1997
AALENIAN	The basal horizon has been voted and fixed by the BWG. A ballot to choose between two GSSP candidates is planned by 1997
TOARCIAN	The BWG meeting was held during September 96 in Spain and Germany.
PLIENSBACHIAN	The new convenor has reorganized the BWG and its activities: workers are selecting potential GSSP candidates.
SINEMURIAN	A GSSP proposal is currently in study in Somerset (Quantock's head near Watchet, U.K.).
HETTANGIAN and T/J BWG	Today there are 4 proposals: Somerset (UK), Utcubamba Valley (Northern Peru), New York canyon (Nevada, USA) and Queen Charlotte Island (CANADA).

1.2. ANTICIPATED WORK PLAN FOR THE PERIOD 1998 -2000

1998 - Preparation of Aalenian, Bathonian, Oxfordian and Kimmeridgian GSSPs' to ISJS for voting.

Preparation of Sinemurian and Callovian GSSPs' proposals to respective BWGs for voting.

Formal proposal for Oxfordian GSSP is expected to be presented at Vancouver Symposium

1999 - Presentation of proposals for Aalenian, Bathonian, Oxfordian and Kimmeridgian GSSPs to ICS.

Preparation of Sinemurian and Callovian GSSPs' proposals to ISJS for voting.

Preparation of T/J, Toarcian and Tithonian GSSPs' to respective BWGs for voting.

2000 - Presentation of T/J, Toarcian and Tithonian GSSPs' proposals to ISJS for voting.

Presentation of Sinemurian and Callovian proposals to ICS.

Preparation of Pliensbachian GSSPs' proposal to its BWG for voting.

2 - Definition of the Aalenian-Bajocian Stage boundary

by
G. Pavia & R. Enay

Reprinted from *Episodes*, 20/1 (1997)

by G. Pavia and R. Enay

Definition of the Aalenian–Bajocian Stage boundary

The Global boundary Stratotype Section and Point (GSSP) for the Bajocian Stage, formally defined at the base of bed AB11 of the Murtinheira section at Cabo Mondego (Portugal), has been ratified by the IUGS. Multidisciplinary biostratigraphical data, mainly based on ammonite and calcareous nannofossil assemblages, assure worldwide correlations; magnetostratigraphic data increase the correlation power. The position of the boundary coincides with the first occurrence of the ammonite assemblage characterized by Hyperlioceras mundum *and related species (*H. furcatum, Braunsina aspera, B. elegantula*). The boundary lies just below the nanno-horizon of the entry of* Watznaueria communis *and* W. fossacincta, *and closely corresponds with an inversion to normal polarity correlated with the up-to-date Jurassic magnetic polarity time scale. An Auxiliary Stratotype Point (ASP) is also selected at the base of bed U10 of the Bearreraig Bay section on the Isle of Skye, Scotland, as the complementary reference for the palaeobiological key of the Bajocian lower boundary, i.e. the evolutionary transition* Graphoceras–Hyperlioceras.

Introduction

Multidisciplinary research on the boundary stratotype, developed over many years by the Bajocian Working Group (BWG), was brought to a conclusion in 1994 with the nomination of the Murtinheira section at Cabo Mondego, Portugal, as the best outcrop for defining the Global boundary Stratotype Section and Point (GSSP) of the Stage. After a positive ballot within the BWG, the resolution was submitted to the Congress of the International Subcommission on Jurassic Stratigraphy (ISJS) in Mendoza, Argentina, in October, 1994. In addition to the GSSP, the selection of the Bearreraig Bay section on the Isle of Skye, Scotland, as the Auxiliary Stratotype Point (ASP) was also suggested as a complementary outcrop where the palaeobiological key (evolutionary transition within the ammonite group *Graphoceras–Hyperlioceras*) for recognizing the Bajocian lower boundary is finely represented. The consensus at the Mendoza meeting encouraged submission of the proposal of both the Bajocian GSSP and the ASP (Pavia and others, 1995) to the ISJS which unanimously accepted the resolution.

This paper gives details on the definition of the Bajocian GSSP recommended by the ICS at the end 1995. The proposal was formally ratified by the IUGS at the meeting of the Executive Committee in January 1996.

The lower boundary of the Bajocian Stage

The original definition of the Bajocian Stage dates back to 1850 (d'Orbigny, 1842–51, p. 606, and 1849–52, pp. 477, 483; see Rioult, 1980 for references) with geographic references to Bayeux and the area around Caen, NW France. In the Jurassic Colloquium held in Luxembourg, Rioult (1964) proposed the section at Sainte-Honorine-des-Pertes, near Bayeux, as the stratotype of the Bajocian Stage. However, Pavia (in Cresta and Pavia, 1994, p. 93) observed that stratigraphic condensation and fossil reworking dictate exclusion of any section in the area of Bayeux as the stratotype of the Stage.

On the basis of ammonite fossil assemblages, the European Bajocian presently comprises seven 'Standard Zones' (Figure 1),

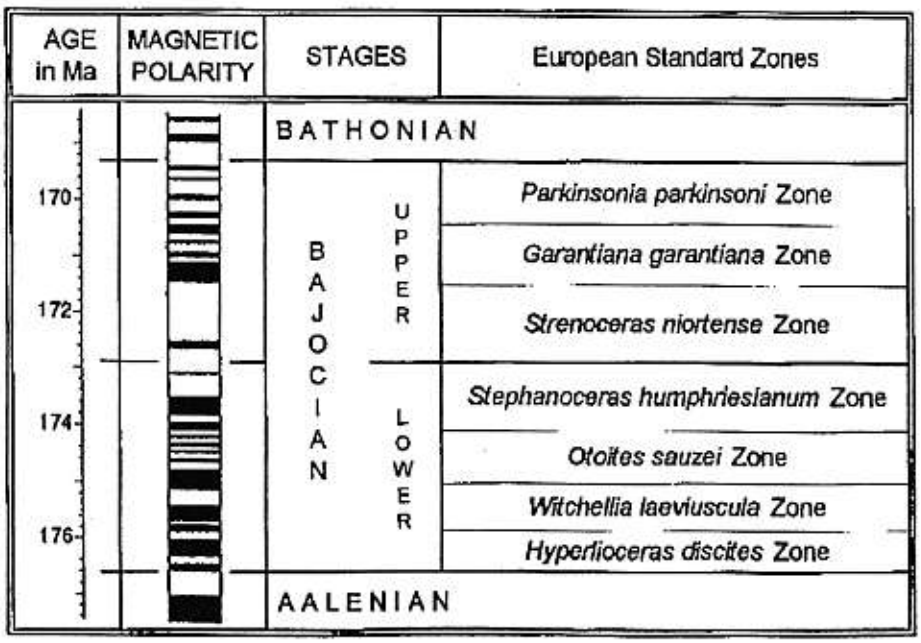

***Figure 1** Bajocian ammonite Standard Zones in Europe correlated with magnetic polarity time scale (modified from Gradstein and others, 1994; Ogg, 1995).*

which have been tentatively correlated with the standard ones proposed for the Pacific Realm (Hillebrandt and others in Westermann, 1992, p. 254). The biochronological correlation power of the European Standard Zones thus would spread out the palaeobiogeographical sectors where they are usually recognized and applied. Other biostratigraphic zonal schemes are in progress, e.g. for calcareous nannofossils, palynomorphs, inoceramid bivalves and others (Cresta and Pavia, 1994).

The Bajocian is divided in two substages (Pavia *in* Michelsen and Zeiss, 1984, p. 65). The European Lower Bajocian encompasses the *Hyperlioceras discites* to the *Stephanoceras humphriesianum* Zones. The base of the *H. discites* Zone is traditionally used to determine the base of the substage. For its recognition, in many Jurassic Colloquia (Erlangen 1984, Lisboa 1987, Poitiers 1991, Mendoza 1994) and related BWG meetings (Cresta and Pavia, 1990; Morton, 1991; Cresta and Pavia, 1994), the evolution of the ammonite family Graphoceratidae has been stated as providing the highest biostratigraphical resolution. In particular the first occurrence of species of the genus *Hyperlioceras*, evolved from *Graphoceras*, has been largely accepted as being the biochronological event which best enables recognition of the basal boundary of the Bajocian Stage, particularly in the Sub-Mediterranean and Sub-Boreal Provinces.

The recent usage means that the *H. discites* Zone is an Assemblage Zone in the sense of the International Stratigraphic Guide (Salvador, 1994). It is mainly characterized by species of the genus *Hyperlioceras*. On the basis of the more recent literature, the lower boundary of the *H. discites* Zone can be assumed to be marked by the first occurrence of the ammonite assemblage with *Hyperlioceras mundum* and related species (*H. furcatum, Braunsina aspera, B. elegantula*). Early forms of the evolutionary transition *Graphoceras–Hyperlioceras* (Callomon and Chandler in Cresta and Pavia, 1990, p. 96; Morton in Cresta and Pavia, 1994, p. 79) are referable to the topmost Aalenian.

Two sections have been demonstrated to be the best for recording such a biostratigraphic datum: Murtinheira at Cabo Mondego in Portugal and Bearreraig Bay on the Isle of Skye in Scotland. Both furnish supplementary biostratigraphic and magnetostratigraphic data. The Scottish section, as far as the ammonite biostratigraphy is concerned, is limited to Graphoceratidae and can be regarded as the reference section for the evolution within this family and for the onset of the genus *Hyperlioceras*. On the contrary, the Murtinheira section contains more diversified ammonite assemblages useful for worldwide correlation.

In conclusion, the lower boundary of the *H. discites* Zone in the Murtinheira section can be used to define the GSSP for the base of the Bajocian Stage. In the same time the section of Bearreraig Bay is formally proposed as the ASP of the Bajocian Stage.

Improving the proposal for the GSSP

Since 1988, BWG members have met in Italy (Cresta and Pavia, 1990), Scotland (Morton, 1991) and Morocco (Cresta and Pavia, 1994) both to discuss the biostratigraphical key for the recognition of the Bajocian basal boundary and to develop a common proposal for defining the Bajocian GSSP according to the Guidelines of the ICS (Cowie and others, 1986).

In 1988 at Piobbico, central Italy, several sections were documented: Digne, south-eastern France, by G. Pavia; Barranco de Agua Larga, southern Spain, by A. Linares and J. Sandoval; Wutach, southern Germany, by G. Dietl; Dorset, southern England, by J. Callomon and R. Chandler; Bearreraig Bay, Isle of Skye, Scotland, by N. Morton; Murtinheira, Cabo Mondego, Portugal, by R. Rocha and collaborators. Discussion for defining the Bajocian lower boundary stratotype centred on the sections of Isle of Skye and Cabo Mondego. The conclusions were brought together in a document supported by most of the participants:

1 The basal boundary of the *H. discites* Zone is marked by an ammonite assemblage which contains the *H. mundum* group, late representatives of *Graphoceras* and *Haplopleuroceras*; other taxa, like *Euhoploceras* and Hammatoceratidae, did not seem so useful for stratotype definition because of wide biostratigraphic range and low frequency in the Sub-Mediterranean sequences.
2 The Murtinheira section was provisionally regarded as the more suitable candidate for GSSP with the Bearreraig Bay section being considered as the auxiliary stratotype.
3 For these two sections, nevertheless, more information on biostratigraphy and magnetostratigraphy was to be done.

During the BWG meetings of Portee in Scotland (1991) and Marrakech in Morocco (1994) no agreement on a single proposal was reached. The dilemma was that:

1 the Bearreraig Bay section is better for documenting the evolutionary lineage within the ammonite family Graphoceratidae and the early development of *Hyperlioceras*;
2 the Murtinheira section is more suitable for direct correlation based on ammonite assemblages;
3 no alternative candidates had been submitted.

In a postal vote within the BWG, a majority of 65.7% favoured Murtinheira. The resolution to define the GSSP of the Bajocian Stage in the Murtinheira section was presented during the meeting of the ISJS (Argentina, 1994); it was also suggested that a joint proposal be made for the Bearreraig Bay section to become the Bajocian ASP.

In order to refine the proposal as much as possible, a group of workers met in Coimbra (Pavia and others, 1995) with the aim of revising the taxonomy of graphoceratid ammonite specimens on which the Bajocian lower boundary had been formerly recognized at Cabo Mondego by Rocha and others (*in* Cresta and Pavia, 1990, p. 49, pls. 1-4) and by Henriques and others (*in* Cresta and Pavia, 1994, p. 79). By availability of Buckman's types and comparative material specially brought by R. Chandler and N. Morton from Great Britain (Dorset and Skye), it was possible to improve and sometimes modify previous determinations of Graphoceratidae listed from Cabo Mondego. Even though rare specimens referable to *Hyperlioceras* had been reported from beds AB9 and AB10 of the Murtinheira section, the most significant biostratigraphical change occurs between beds AB10 and AB11. It records the first occurrence of the ammonite assemblage with *H. mundum* and related species. This assemblage is precisely correlatable with other ammonite successions from Sub-Mediterranean (e.g. Morocco) and Sub-Boreal (e.g. Dorset, Skye) localities. As a result of the revision, it has been proposed to define the Bajocian GSSP at the base of bed AB11 of the Murtinheira section.

The Murtinheira section (west Portugal)

The relevance of the sections of Cabo Mondego was firstly pointed out by Mouterde and others (1972) and all the subsequent works strongly emphasized its importance for correlation with other provinces (e.g. Rocha and others *in* Cresta and Pavia, 1990, p. 49; Henriques, 1992; Henriques and others *in* Cresta and Pavia, 1994, p. 63; Henriques and others, 1996), based on the richness in ammonites which show both north-European and Mediterranean affinities. The main stratigraphic data, useful to define the Bajocian GSSP, are here summarized from Pavia and others (1995).

Recommended stratotype

Cabo Mondego is located on the Portuguese Atlantic coast, 40 km west of Coimbra and 7 km north of Figueira da Foz. The Murtinheira section is at the foot of Cabo Mondego cliff, south-west of the village of Murtinheira (Figure 2). There is exceptional exposure along the cliffs and inland for about 5 km (the northern flank of Serras da Boa Viagem and Alhadas) without significant facies variation or

structural complication. The beds are monoclinal and dip at about 30° S. The precise geographical location of the GSSP is shown on the 1:25 000-scale topographic map of Vais (sheet 238A) by coordinates M = 134.4, P = 359.2.

The succession consists of marine sediments ranging from Upper Toarcian to Middle Callovian with a thickness exceeding 400 m. The Aalenian–Bajocian section corresponds to a more-or-less rythmic alternation of gray limestones and marls (*Calcários e margas do Cabo Mondego* formation), sometimes very fossiliferous (ammonites, brachiopods), with bioturbation marks, coal fragments, disseminated pyrite and rare celestite nodules. Strata are normally thin (0.15 to 0.25 m) and the stratification surfaces are more-or-less regular. At the Lusitanian Basin organization scale, the Aalenian–Bajocian boundary is placed within the Megasequence F (Soares and others, 1993) between discontinuity 6, which marks a generalized absence of the base of mid-Aalenian *L. murchisonae* Zone, and discontinuity 7 placed towards the top of the *H. discites* Zone.

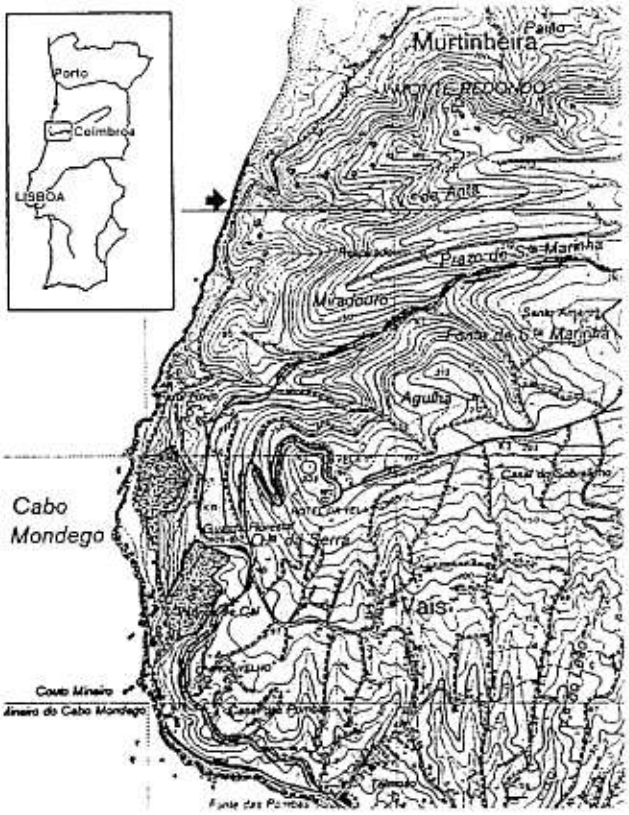

***Figure 2** Location of the Murtinheira section in the northern part of the Cabo Mondego cliff (arrow), 7 km north of Figuera da Foz, west Portugal. 1:25000 topographic map of Vais, sheet 238 A, coordinates M=134.4, P=359.2.*

***Figure 3** The GSSP of the Bajocian Stage (arrow indicates bed A11) in the alternating limestones and marls of the Murtinheira section, foot of the Cabo Mondogo cliff.*

The Aalenian–Bajocian boundary is defined at 77.8 m from the base of the section measured along the coast (Henriques, 1992), at the base of bed AB11 of former works (e.g. Henriques and others *in* Rocha and Soares, 1988, p. 243) or bed M337 of recent works (e.g. Henriques and others *in* Cresta and Pavia, 1994, p. 63) (Figures 3 and 4).

Ammonite record

The ammonite assemblages in the Cabo Mondego sections (Rocha and others in Cresta and Pavia, 1990, p. 49, pls. 1-4) have several biostratigraphic advantages:

1 the material is quite abundant and easy to sample;
2 it is well preserved as internal moulds providing easy identification;
3 in general, it includes individuals representing different ontogenetic stages; this fact is particularly evident for microconchs which are more frequent due to paleoecological and taphonomic reasons;
4 ammonites can be sampled in widespread micritic limestone beds and are contemporaneous with the sediment, as they correspond to resedimented elements in the taphonomic sense of Fernandez Lopez (1991).

The definition of the Aalenian—Bajocian boundary at bed AB11 is based on ammonite biostratigraphy (Figure 5). In particular, it marks the first occurrence of the assemblage with *Hyperlioceras mundum* and related species (*H. furcatum, Braunsina aspera, B. elegantula*), even though the genus *Hyperlioceras* makes early appearance in the underlying beds AB9 and AB10, according to Fernandez Lopez and others (*in* Rocha and Soares, 1988, p. 301). The *H. mundum* assemblage also contains other *Hyperlioceras* taxa and late representatives of *Graphoceras* and *Haplopleuroceras*, as well as species of *Zurcheria*, *Parazurcheria* and *Fontannesia*. Less frequent ammonites of the basal Bajocian refer to genera *Euhoploceras*, *Son-*

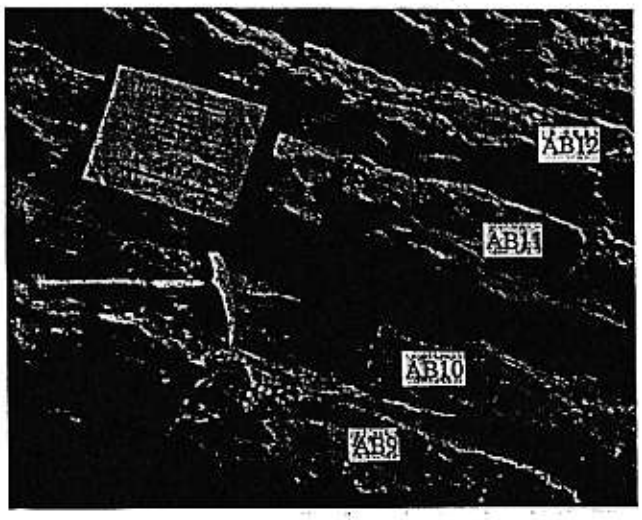

***Figure 4** The position of the GSSP of the Bajocian Stage at the base of bed A11 (arrow) in the Murtinheira section.*

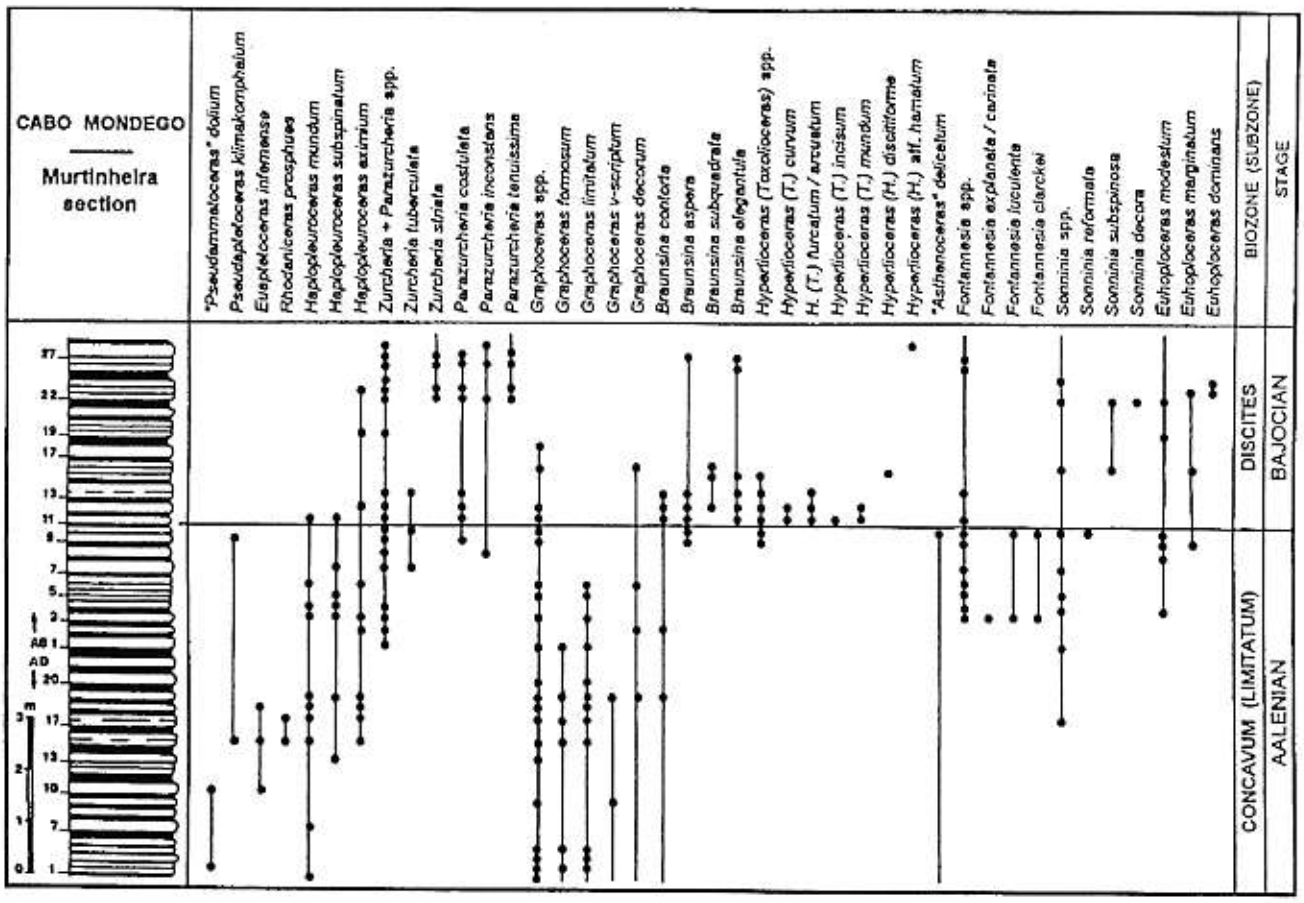

Figure 5 Distribution of the most significant ammonites through the Aalenian—Bajocian boundary in the Murtinheira section.

ninia, 'Docidoceras', Pelekodites, Nannoceras, Praestrigites, Bradfordia, 'Asthenoceras', Protoecotraustes and *Trilobiticeras.*

Calcareous nannofossil record

Detailed studies across the Aalenian–Bajocian boundary have been published recently by Henriques and others (*in* Cresta and Pavia, 1994, p. 63). The nannofossil assemblages are dominated by specimens of *Schizosphaerella punctulata, Lotharingius contractus, L. velatus, Triscutum tiziense, Biscutum depravatum* and *Discorhabdus criotus.* The genera *Crepidolithus* and *Carinolithus*, which dominate the early Jurassic assemblages, are rare. The results point to a gradual turnover across the Aalenian–Bajocian boundary with change in nannofossil dominance rather than abrupt appearences and/or disappearences of taxa. This change is initiated by the Watznaueriacea in the upper *G. concavum* Zone, from where the genus *Lotharingius* is more and more replaced by *Watznaueria* and *Cyclagelosphaera.*

Several nanno-horizons have been detected at the Aalenian–Bajocian transition, based on the onset of different species of *Watznaueria* (Figure 6). Two nanno-horizons are observed in the *G. concavum* Zone, defined by the appearence of *W. ovata* (AB1) and *W.* aff. *communis* (AB3). Six nanno-horizons characterize the *H. discites* Zone. Some data can be pointed out: *W. fossacincta* and *W.* aff. *manivitae* are observed from sample AB13; the entry of *W. communis* is recorded in sample AB14; the first occurrence of *W. britannica* is observed in sample AB17; *W. manivitae* appears in sample AB34.

The presence of forms such as *W.* aff. *communis* and *W.* aff. *manivitae*, precursory of the nominate species, and the gradual change in the nannofloral assemblages suggest continuous sedimentation across the boundary, as confirmed also by sedimentology.

Magnetostratigraphy

The succession of the Aalenian–Bajocian boundary has been sampled in a total thickness of 16 m. The intensity of rock magnetization in the Murtinheira section is generally weak (between 6.7×10^{-5} and 2.2×10^{-4} A/m), but it is measurable using a triaxial high-sensivity cryogenic magnetometer (CCL-GM400). The magnetic stability of the samples has been investigated by incremental thermal demagnetisation. The majority of samples carry two principal components of magnetisation. The lower stability component is progressivelly removed during demagnetisation in average up to 250°C and appears to represent a normal polarity overprint near the local present geomagnetic field. The high stability component direction results to be similar to the Dogger direction indicated for the Iberian Peninsula (Schott and others, 1981) after applying the bedding-tilt correction (average 40° towards 130°). Then it is clear that this component represents the record of the geomagnetic field polarity at the time of sedimentation. The values of the natural remanent magnetisation have positive inclinations; but during demagnetisation about 30% of the samples changes polarity and finally there are two groups of clear opposite polarity.

The final results of the palaeomagnetic field polarity record of the Aalenian–Bajocian boundary at Cabo Mondego are shown in Figure 7. The Bajocian lower boundary, at the base of bed AB11 of the Murtinheira section, coincides with an inversion from reversed to normal polarity, which can be correlated with the Jurassic magnetic

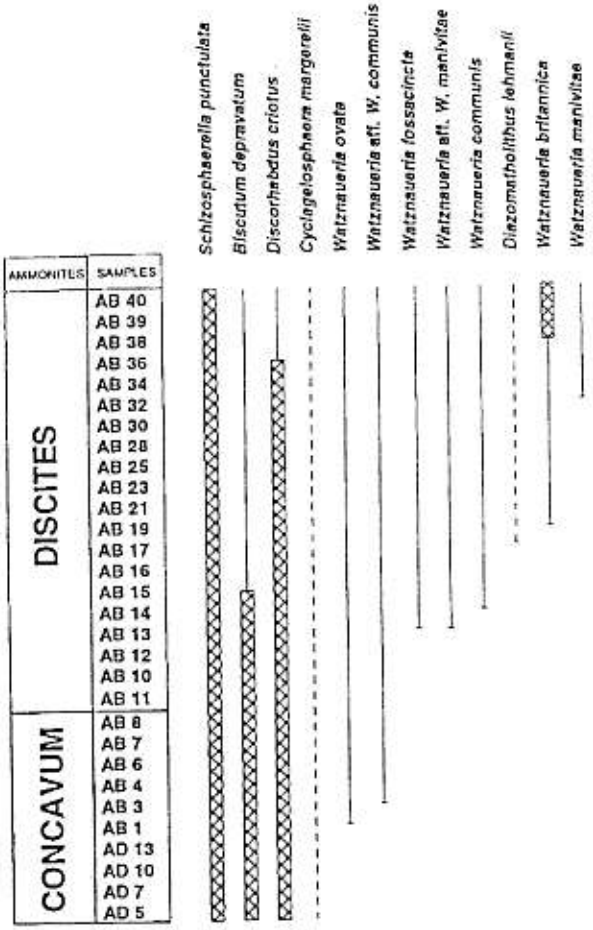

Figure 6 Selected calcareous nannofossil FO at the Aalenian–Bajocian boundary in the Murtinheira section (modified from Henriques and others in *Cresta and Pavia, 1994).*

polarity time scale (Ogg, 1995). Between beds AB11 and AB23, in the lower *H. discites* Zone, an interval of normal polarity is recorded, also in agreement with Steiner and others (1987).

The Bajocian ASP in the Bearreraig Bay section (Scotland)

Name and geographical location of the ASP

Bearreraig Bay, west Scotland, eastern coast of the Isle of Skye some 10 km north of Portree. Topographic map 1:25000, sheet NG45/55 (Trotternish); National Grid reference: NG51705271.

Position of the ASP

The uppermost Aalenian (*G. concavum* Zone) and lowermost Bajocian (*H. discites* Zone) occur in a thick sequence of silty shales, the Udairn Shale Member of the Bearreraig Sandstone Formation. The outcrops and succession have been described in the proceedings of previous BWG meetings (Morton *in* Cresta and Pavia, 1990, p. 23, and 1994, p. 79). The Auxiliary stratotype Section and Point is located at the base of bed U10 in the lower Udairn Shale Member, 12.4 m above the base of the section recently revised by Morton (*in* Pavia and others, 1995). Fossils are preserved in scattered calcareous nodules.

Major character

The first occurrence of the ammonite assemblage with *Hyperlioceras mundum* and related species is well documented. This overlies an assemblage with *H. incisum* which marks the first step in the evolutionary lineage *Graphoceras* to *Hyperlioceras* at the topomost Aalenian. In particular, the following biostratigraphical markers are registered: (1) top bed U9 (1 m below the ASP): first occurrence of *H. incisum* (M)—*rotabilis* (m) and *H. micca*; (2) bed U10: first occurrence of *H. mundum, H. furcatum, B. aspera*; (3) middle bed U16 (9 m above the ASP): transition from *H. mundum* to *H. walkeri*; (4) middle bed U18 (11 m above the ASP): last representatives of *G. limitatum* (M)—*carbatinum* (m).

Correlation

In summary, the main biostratigraphical features of the ASP are:

1 **Ammonites**—Representatives of Hammatoceratidae and Sonninidae, although rare, improve correlations with the GSSP.
2 **Bivalves**—Fossil assemblages found in the lower part of the Udairn Shale Member show a significant change in the bivalve composition from the *G. concavum* Zone into the *H. discites* Zone. In particular, *Mytiloceramus polyplocus* first appears near the base of the Bajocian (top of bed U9). The species is also present at the base of the Bajocian in north Germany (Metz, 1994, pers. comm.), confirming its biostratigraphical potential in Europe. Inoceramids are widely used for Middle Jurassic biostratigraphy in eastern Russia and the circum-Pacific (Damborenea and others in Westermann, 1992), where *M. polyplocus* is recorded from the Upper Aalenian *P. tugurense* Zone.
3 **Microfossils**—Good results have been obtained with foraminifera, dinoflagellates, spores/pollen and calcareous nannofossils. For example, the base of the Bajocian is marked by radiation of gonyaulacacean cysts, and the boundary lies within the NJ8b nannofossil Subzone.
4 **Sequence stratigraphy**—The Aalenian–Bajocian boundary is placed within the genetic sequence D of the Hebrides Basin (Morton and others, 1987).

Conclusions

The GSSP of the Bajocian Stage, ratified by the Executive Committee of the IUGS in January 1996, has been defined at the base of bed AB11, at the point located 77.8 m from the base of the Murtinheira section at Cabo Mondego (western Portugal). The section fulfills most of the requirements indicated in the Guidelines of the ICS:

1 Succession of more than a hundred meters of rhythmic alternation 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.
2 Absence of unconformities in the interval from uppermost Aalenian to lowermost Bajocian with continuous exposure from Upper Toarcian (Lower Jurassic) to Callovian (Middle Jurassic).
3 Correlation by means of ammonite and calcareous nannofossil assemblages which show significant turnovers at the boundary, correlatable within Tethyan and Pacific Realms. In particular: bed AB11 is marked by the first occurrence of the ammonite assemblage with *Hyperlioceras mundum* and related species (*H. furcatum, Braunsina aspera, B. elegantula*); at about 0.30 m

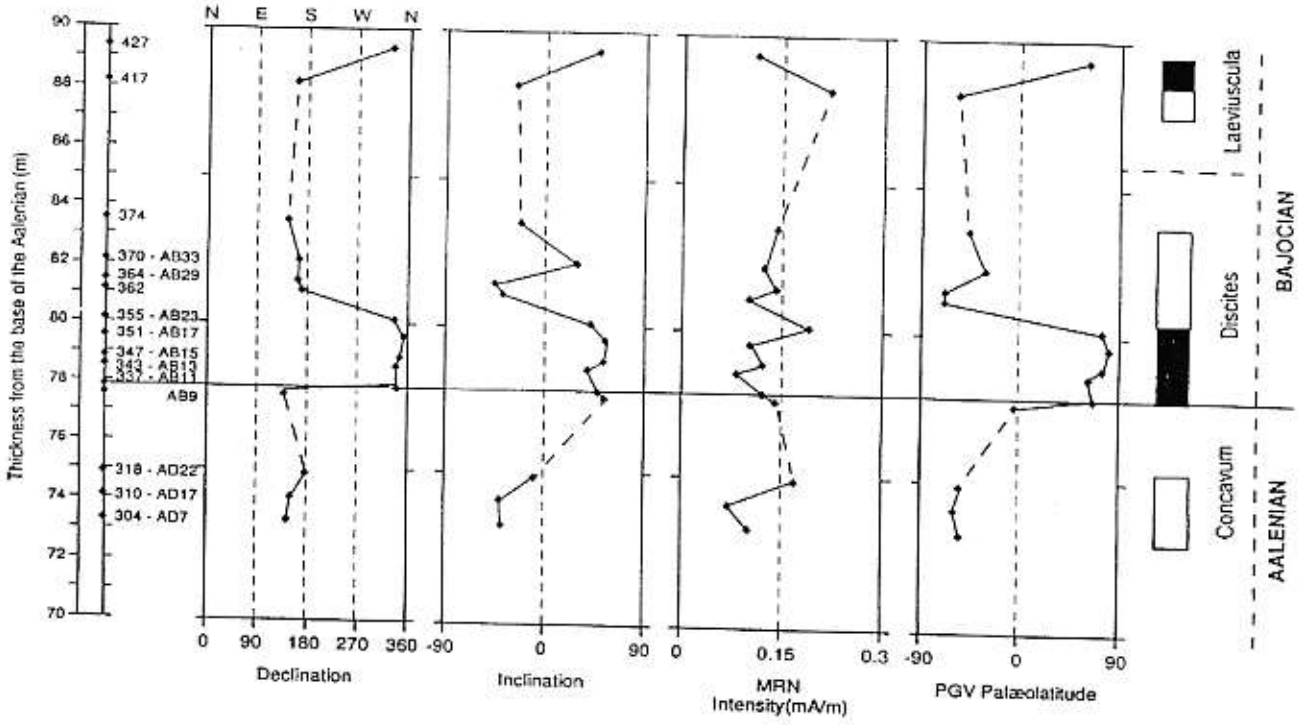

Figure 7 Magnetostratigraphic sequence across the Aalenian–Bajocian boundary in the Murtinheira section (modified from Henriques and others in Cresta and Pavia, 1994).

above the boundary, bed AB13 registers the first occurrence of nannofossils *Watznaueria fossacincta* and *W.* aff. *manivitae*.

4 Well correlatable palaeomagnetic results with an inversion from reversed to normal polarity exactly at the lower boundary of the Bajocian Stage.

5 Easy accessibility of the section well exposed on the cliff at Cabo Mondego, which is subject to marine erosion.

6 Classification of the Cabo Mondego area as a Natural Monument is in progress. A formal petition was submitted to the President of the Portuguese Republic in 1994.

The Bearreraig Bay section (Isle of Skye, west Scotland) has been accepted as the Bajocian ASP within the same GSSP proposal. It provides fine documentation of the ammonite lineage *Graphoceras-Hyperlioceras*, and complementary biostratigraphical data mainly related to the onset of the bivalve *Mytiloceramus polyplocus* near the boundary.

Acknowledgements

The present report is the result of hard work by many members of the Bajocian Working Group including R. Chandler, S. Fernandez Lopez, M.H. Henriques, N. Morton, R. Mouterde and R. Rocha, who together wrote the GSSP proposal submitted for ratification by the ICS. This proposal will be published in extended form in the very near future.

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3 - Revised guidelines for the establishment of global chronostratigraphic standards by the International Commission on Stratigraphy (ICS)

by
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with the cooperation of members of ICS

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by Jürgen Remane, Michael G Bassett, John W Cowie, Klaus H Gohrbandt, H Richard Lane, Olaf Michelsen and Wang Naiwen, with the cooperation of members of ICS

Revised guidelines for the establishment of global chronostratigraphic standards by the International Commission on Stratigraphy (ICS)

Background

These Revised Guidelines are the result of close cooperation between the Bureau and Subcommissions of ICS. A first provisional draft was prepared by J Remane, Chairman of ICS, taking into account proposals made by K H Gohrbandt, then Secretary General of ICS. A more formal draft was established on this basis by the Bureau of ICS at its meeting at Neuchâtel (Switzerland) in March 1994. This was circulated to all Subcommissions for comments. That draft was also discussed at the International Symposium on Permian Stratigraphy at Guiyang (China) in September 1994, the 4th International Symposium on Jurassic Stratigraphy at Mendoza (Argentina) in October 1994, and at the 2nd International Symposium on Cretaceous Stratigraphy at Brussels (Belgium) in September 1995. The final version, incorporating as far as possible oral and written comments from members of ICS bodies, was worked out at the meeting of the Bureau of ICS at Neuchâtel in April 1996, attended by J Remane (Chairman), M G Bassett (1st Vice-chairman), O Michelsen (Secretary General), and H R Lane (1st Vice-chairman elect), and was then submitted for vote to the full Commission of ICS (consisting of the five members of the Bureau of ICS and the 16 Chairpersons of ICS Subcommissions).

In this vote, the Revised Guidelines were approved by the full Commission with an overwhelming majority, with only one opposing vote. The Revised Guidelines are thus a formal and mandatory document regulating the procedure to be followed in the definition of chronostratigraphic boundaries. The particular importance of this text lies also in the fact that this is the first document on stratigraphic procedure issued by ICS which represents a voted formal agreement.

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1 Introduction

The Silurian–Devonian Boundary Committee was the first to put into practice (in 1960) the principle to define chronostratigraphic units by their lower boundary only, which thus becomes automatically the upper boundary of the underlying unit. The Silurian–Devonian boundary-stratotype at Klonk in the Czech Republic was ratified at the 24th International Geological Congress (IGC) at Montreal, 1972. During this process, the committee developed the principles of chronostratigraphic boundary definition. These 'lessons learned' (McLaren, 1977:23) constituted the basis of the first Guidelines of ICS, where the concept of the Global Standard Stratotype-section and Point (GSSP) was introduced:

> *This Boundary Stratotype Section and Point is the designated type of a stratigraphic boundary identified in published form and marked in the section as a specific point in a specific sequence of rock strata and constituting the standard for the definition and recognition of the stratigraphic boundary between two named global stratigraphic (chronostratigraphic) units* (Cowie and others, 1986:5).

This definition is still valid for the Phanerozoic. A GSSP voted by the Full Commission of ICS (the Bureau of ICS and Chairpersons of all ICS Subcommissions, see also Bassett, 1990) and confirmed by the Executive of the International Union of Geological Sciences (IUGS) represents a ratified boundary definition.

The necessity for a precise global chronostratigraphic scale is obvious. Research on global events means comparison of stratigraphic documents from distant regions—but how can we be sure to deal with the same event throughout, without having a precise and reliable chronostratigraphic scale? The same is true for the establishment of eustatic sea-level curves or the reconstitution of global climatic changes in the past. Progress in these and many other fields of geological research is only possible if progress is also made in the definition of chronostratigraphic units.

2 Aims and principles

2.1 Aims of the revision

The original Guidelines were issued by the Bureau of ICS (Cowie and others, 1986) and summarised by Cowie (1986) in *Episodes*, the official publication of IUGS, and by Cowie (1990, 1991). They have guided uniformity of definition for 20 chronostratigraphic boundaries during ten years of successful application. The experience gained in this process has confirmed the basic principles of the original Guidelines. Nevertheless, a cautious revision of the Guidelines appears useful for different reasons:

1 The Precambrian Subcommission of ICS has proposed a global stratigraphic subdivision for the Proterozoic where boundaries are defined in terms of absolute ages (see section 2.2), with entirely new names for the nine Proterozoic systems created on

this basis. The resultant new subdivision of the Proterozoic was voted by ICS and ratified by IUGS at the 28th IGC in Washington, 1989; it is thus formalised (and should therefore not have been omitted in the 2nd edition of the ISG).

2 During the last years, great progress has been made in the field of non-biostratigraphic methods of correlation (see section 3.1). These should therefore be given more weight in the choice of boundary levels and type-sections.

3 Certain problems concerning the philosophy of boundary definition came up repeatedly in recent discussions of GSSP candidates, such as the necessity to respect priority, to have natural boundaries (see section 2.4), the role of fossils in boundary definition (see section 3.1), and the degree to which global correlation has to be exact before defining a boundary (see section 2.3).

4 Since the publication of the original Guidelines (Cowie et al., 1986), important publications on the principles of stratigraphy have appeared, especially the 2nd edition of the International Stratigraphic Guide (ISG) (Salvador, 1994), or Harland (1992). The position of the Guidelines in this new context had to be clarified.

The role of the Guidelines remains, however, unchanged. They regulate the procedures of boundary definition, the selection of an appropriate boundary level, and the corresponding voting procedures (also partly dealt with in articles 3 and 7.1 of the statutes of ICS). They further define the requirements to be fulfilled by the stratotype-section housing the boundary point.

2.2 The Precambrian Standard

The new boundary-type definition, first introduced for the Proterozoic in 1989, was necessitated by the lack of adequate fossils in most of the Precambrian. It is termed herein the **Global Standard Stratigraphic Age (GSSA)**. Defining boundaries in terms of absolute ages means that the numerical value of the boundary age is a theoretical postulate, independent of the method applied to obtain numerical ages. But, as in the case of boundaries defined by a GSSP, an explicit motivation for the choice of the proposed numerical value should be given, clarifying, at the same time, its relation to traditional boundary definitions. GSSAs have the same status for boundary definition in the Precambrian as GSSPs have in the Phanerozoic.

2.3 Correlation precedes definition

Except for the Precambrian, this principle is still valid. To define a boundary first and then evaluate its potential for long-range correlation (as has been proposed in some cases) will mostly lead to boundary definitions of limited practical value. On the other hand, it would be unrealistic to demand that a given boundary be recognisable all over the world before it can be formally defined. In each case we must find the best possible compromise, otherwise the search for the Holy Grail of the perfect GSSP will never end.

2.4 Priority and natural boundaries

Our main task for a number of years will be to develop precise boundary definitions for traditional chronostratigraphic units. Most of them were defined in the last century by their characteristic fossil contents, and their boundaries coincided with spectacular biostratigraphic and lithologic changes. These were 'natural' boundaries, in perfect agreement with the catastrophist philosophy of that time. In reality, rapid faunal turnovers are to a certain extent artefacts due to stratigraphic gaps or condensation. Most of the classic type-localities are thus unsuitable for a precise boundary definition: we have to look for new sections where sedimentation is continuous across the boundary interval; but then boundaries will rarely correspond to a lithologic change.

The idea that chronostratigraphic boundaries should always correspond to something 'visible' has also led to conflicting regional 'definitions' of international chronostratigraphic boundaries, which were adapted to regional lithostratigraphic boundaries of different ages.

There is no formal priority regulation in stratigraphy. Therefore, in redefining boundaries, priority can be given to the level with the best correlation potential. The redefinition will give us the opportunity to use fossil groups (such as conodonts) and methods of chronocorrelation (such as magnetostratigraphy) which were unknown or poorly developed at the time of the original definition. This does not mean that priority should be totally neglected. Practical considerations will incite us to limit changes to the necessary minimum. If, however, the interregional correlation potential of a traditional boundary does not correspond to the needs of modern stratigraphy, its position has to be changed.

Chronostratigraphic boundaries are conventional boundaries. They are a matter of normative science and can be decided by a majority vote (Cowie and others, 1986). To a certain degree, this principle can be reconciled with the demand for natural boundaries. As stated above, most of the classical boundaries are not clear-cut but correspond to critical biotic and/or climatic transitions. Placing a boundary within such an interval will preserve the advantage of having successive units which are distinguished by their contents. But where exactly the boundary is to be placed, are matters of convention and practical considerations.

Once a boundary is (re)defined by a GSSP or a GSSA, it should be used in all published figures and tables. Such an obligation will not hinder any authors from expressing their personal opinions.

2.5 Boundary-stratotypes instead of unit-stratotypes

If chronostratigraphic units were defined by unit-stratotypes, the boundary between two adjacent units would be defined by two separate GSSPs: as the upper boundary of the lower unit in one unit-stratotype and as the lower boundary of the succeeding unit in the other. The Global Chronostratigraphic Scale must, however, comprise strictly contiguous units, without overlaps and with no gaps between them. But there is no method of correlation which would guarantee a perfect isochrony of two separate boundary points, even at a short distance apart (Harland, 1992).

This problem was already recognised in the first edition of the ISG (Hedberg, 1976), but unit-stratotypes for chronostratigraphic units were still admitted as an alternative possibility. In the second edition (Salvador, 1994), boundary-stratotypes are given a stronger preference, but as a whole, the position remains ambiguous: 'Since the only record of geologic time . . . lies in the rocks themselves, the best standard for a chronostratigraphic unit is a body of rocks formed between two designated instants of geologic time.' (Salvador, 1994: 88).

The Guidelines of ICS are unambiguous: **Chronostratigraphic units of the Phanerozoic Global Standard can only be defined through boundary stratotypes.** Even should the situation arise (e.g. as in the Silurian stratotypes in Britain) that the GSSPs defining the lower and upper boundaries of one-and-the-same unit are located in the same section, this does not imply that the stratigraphic interval and its biota between the the two GSSPs represent a unit stratotype.

For several systems, upper and lower boundaries are now defined by GSSPs. Following the choice of the best type-section these are located in distant regions: the base of the Silurian in Scotland, UK; that of the Devonian in the Czech Republic; that of the Carboniferous in the Montagne Noire, France; of the Permian in Kazakhstan; and the base of the Quaternary in Italy.

The lower boundaries of chronostratigraphic units of higher rank (series, systems etc.) are automatically defined by the base of their lowermost stage. In other words: the lower boundary of a system is always also a series and a stage boundary.

A GSSP cannot be compared to the holotype of Zoological Nomenclature; it corresponds rather to a standard of measure in physics (Harland, 1992). The use of terms like holostratotype, parastratotype etc. should therefore be avoided (Cowie and others, 1986). If reference sections and points seem necessary in order to give a better understanding of the boundary in another facies or paleobiogeographic context, an auxiliary stratotype point may be defined. Such auxiliary points are subordinate to a GSSP.

3 The choice of the best boundary level

3.1 Some general considerations about chronostratigraphic methods

Chronostratigraphy and chronocorrelation have been discussed at length in the ISG (Salvador, 1994). We may thus limit the following discussion to selected topics which are of particular importance for the choice of the boundary level.

Considerable progress has been made in the last few years in developing and improving methods of non-biostratigraphic chronocorrelation. Some of them are based on geochemical signals, like the famous Ir-spike used as guidance for the definition of the Cretaceous–Paleogene boundary, or on shifts of stable isotopes which should be helpful in the definition of the Permian–Triassic boundary (Baud and others, 1989).

Reversals of the Earth's magnetic field are important, because they are a worldwide phenomenon and practically instantaneous, thus providing a precise and reliable means of chronocorrelation. Late Jurassic to Recent reversals have been calibrated to the Magnetic Polarity Time Scale based on oceanic anomalies (Hailwood, 1989).

Geophysical and geochemical events are, however, repetitive and do not allow an unequivocal determination of the age. They need calibration through radioisotopic or biostratigraphic dating. Unfortunately, radioactive isotopes are rarely available where needed so that stratigraphic routine work depends mostly on other methods. But radioisotopic datings are very important for the quantitative calibration of relative ages.

Biostratigraphic boundaries, i.e. the boundaries of the material stratigraphic occurrence of species, are diachronous (ISG). This fact has, however, been overstated. A species exists for a finite span of time and is therefore characteristic of a certain geologic interval. In rapidly evolving lineages this may be less than one million years, so that most biostratigraphic datings attain a higher degree of resolution than the use of radioisotopes.

The use of fossils for calibrating chronostratigraphic units does not only involve tracing of biostratigraphic boundaries. It is indeed less a matter of correlation than of determining relative ages within a biochronologic standard of reference. Biochronology is the reconstruction of the succession of species in time through the synthesis of local and regional biostratigraphic data (for a recent overview, *see* Remane, 1991). The chronostratigraphic reliability of biostratigraphic boundaries can thus be tested by comparing data from different species. In this process, mathematical approaches (Quantitative Stratigraphy) play an increasingly important role (Gradstein and others, 1985; Guex, 1991; Mann and Lane, 1995).

Fossil species depend on the environment and are biogeographically limited. An appropriate choice of widespread species may diminish but never totally eliminate these shortcomings. Radioactive isotopes do not suffer from these geographical restrictions; but their resolution diminishes with increasing age. Therefore, non-biostratigraphic markers like magnetic reversals and stable isotopes have gained increasing importance in long-range lateral correlation.

3.2 The best boundary level

With the above considerations in mind, the correlation potential of any boundary level should be tested through a detailed study of several continuous successions covering the critical interval, if possible on different continents. The most suitable of these sections can then be selected for definition of the GSSP. If two boundary levels of equal correlation potential are available, the better candidate (see chapter 4) will decide the choice of the boundary level.

This implies the integration of data from different facies and paleogeographic provinces in a global synthesis. The perfect GSSP, where all elements of such a synthesis are well represented, will often not be available. Flexibility is therefore necessary in order to make a timely decision.

The boundary definition will normally start from the identification of a level which can be characterised by a marker event of optimal correlation potential. This marker event may be a magnetic reversal, some kind of geochemical or isotopic signal, or the first appearance or last occurrence of a fossil species. However, only the boundary point in the section, the GSSP (Cowie et al., 1986) formally defines the boundary. This means that an occurrence of the primary marker does not automatically determine the boundary. Other markers should therefore be available near the critical level, in order to support chronostratigraphic correlation in sections other than the GSSP. If the primary marker is a fossil species, first appearances are generally more reliable than extinction events, especially if the gradual transition between the marker and its ancestor can be observed.

4 The requirements for a GSSP

The danger of eternalising the search for the best type-section has already been addressed in section 2.2. **The stratotype-section should contain the best possible record of the relevant marker events**. In this sense, the requirements listed below characterise the ideal section. Not all of them can be fulfilled in every case, but the fact that all GSSPs are voted by ICS in accordance with the present Guidelines insures that flexibility will not degenerate to arbitrariness.

4.1 Geological requirements

- **Exposure over an adequate thickness** of sediments is one requirement to guarantee that a sufficient time interval is represented by the section, so that the boundary can also be determined by interpolation, using auxiliary markers close to the boundary.
- **Continuous sedimentation**: no gaps, no condensation in proximity of the boundary level.
- The **rate of sedimentation** should be sufficient that successive events can be easily separated.
- **Absence of synsedimentary and tectonic disturbances.**
- **Absence of metamorphism and strong diagenetic alteration** (identification of magnetic and geochemical signals).

4.2 Biostratigraphic requirements

- **Abundance and diversity of well-preserved fossils** throughout the critical interval. Diversified biotas will offer the best possibility of precise correlations.
- **Absence of vertical facies changes** at or near the boundary. A change of litho- or biofacies reflects a change of ecologic conditions which may have controlled the appearance of a given species at the boundary level. A sharp lithofacial change may also correspond to a hiatus. 'An obvious boundary should be suspect' (Cowie and others, 1986).
- **Favourable facies for long-range biostratigraphic correlations**; this will normally correspond to an open marine environment where species with a wide geographic range will be more common than in coastal and continental settings. The latter should therefore be avoided.

4.3 Other methods

Magnetostratigraphy, sequence stratigraphy, cyclostratigraphy, analysis of stable isotopes should be given due weight in the selection of a GSSP. If a choice has to be made between candidates having more or less the same biostratigraphic qualities, the one offering the better applications of non-biostratigraphic methods should be preferred.

- **Radioisotopic dating.** Whenever possible, it is important to achieve direct quantitative calibration (numerical age) of a chronostratigraphic boundary at the GSSP.
- **Magnetostratigraphy.** A reproducible magnetic reversal stratigraphy is a desirable requirement in order to know where in the magnetostratigraphic sequence the GSSP is located.

- **Chemostratigraphy**, including the study of vertical changes of the proportions of stable isotopes, which may be indicative of global events.
- The regional paleogeographical context and the facies relationships of the stratotype-section should be clarified. Knowledge of the sequence stratigraphy will contribute to an understanding of these relations.

4.4 Other requirements

- The GSSP should be indicated by a permanently fixed marker.
- Accessibility: candidate sections in remote regions which can only be visited by organising costly expeditions should normally be excluded from the selection.
- Free access for research to the type-section for all stratigraphers regardless of their nationality.
- When making a formal submission to ICS, the concerned Subcommission should try to obtain guarantees from the respective authority concerning free access for research and permanent protection of the site.

5 Procedure for the submission of a GSSP

5.1 Editing of the submission

Submissions must be in English. In order to provide a clear picture of the qualities of the proposed GSSP candidate, the formal submission to ICS or to the concerned Subcommission should give the following information:

1 name of the boundary;
2 indication of the exact location (coordinates) of the stratotype-section on a detailed topographic map or aerial photograph, if possible at a scale not less than 1 : 50.000;
3 location on a detailed geologic map;
4 detailed description of the stratotype-section including a litholog and photos of the section, indicating the bed in which the boundary-point is defined and the key-levels for all physical and biostratigraphic markers;
5 motivation for the choice of the boundary level and the stratotype-section, with a discussion of failed candidates and their ease of intercontinental correlation;
6 any comparison with former usage should be discussed fully;
7 discussion of all markers used in the determination of the boundary level;
8 illustration of important fossils;
9 results of radioisotopic dating, indicating clearly what method has been used;
10 results of all votes within the Working Group and the Subcommission.

Note: Within these procedures, only items 1, 6, 7, 9, 10, and the motivation for the choice of the boundary-level are relevant to the establishment of a GSSA.

Following acceptance of the submission within these Guidelines, the Chairperson or the Secretary of ICS will arrange a vote by the full Commission within a period of no more than 60 days.

5.2 Voting procedure

In accordance with the ICS statutes, all formal voting must be conducted by post, giving a deadline of 60 days for the receipt of votes. Voting members (of the Working Group, Subcommission or full Commission) may vote 'YES', 'NO', or 'ABSTAIN'. The last step in the selection of a final candidate for a boundary level and/or a GSSP should always be a vote on one single candidate (Cowie et al., 1986).

In outline, this procedure includes the following steps:

1 Successive voting by members of the concerned Working Group leading to the choice of a boundary level and the final selection of a single GSSP or GSSA candidate.
2 If this obtains the statutory working majority in the Working Group, members of the respective Subcommission will vote on whether or not the candidate be approved.
3 In the case of a statutory majority being in favour, formal submission of the candidate to ICS for approval.
4 Again, in the case of a statutory majority, submission of the GSSP or GSSA candidate to the IUGS Executive Committee for ratification, together with an abstract of the submission, prepared by the responsible ICS body.

ICS should attempt to finalise, within three years after IUGS ratification, any remaining official steps for the protection of the site with the authorities of the country in which the GSSP is located.

6 Revision of a GSSP

A GSSP or GSSA can be changed if a strong demand arises out of research subsequent to its establishment. But in the meantime it will give a stable point of reference. Normally, this stability should be maintained and the practical value of the boundary definition tested for a minimum period of ten years. Revisions for other reasons should be made only in exceptional circumstances, such as:

1 The permanent destruction or inaccessibility of an established GSSP,
2 a violation of accepted stratigraphic principles discovered only after the ratification of a GSSP.

7 Selected references

The 2nd edition of the ISG (Salvador, 1994) contains a comprehensive list of publications dealing with the principles and techniques of stratigraphy. The present list of references is therefore limited to papers providing further information on the principles underlying these Guidelines, adding some titles not mentioned in the ISG.

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Klaus H Gohrbandt, *originally a Paleogene stratigrapher has long experience as petroleum geologist in several companies. He was Secretary General of ICS from 1992 to 1995, while working as a senior research geologist with Chevron Overseas Petroleum.*

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H Richard Lane *is a graduate of the University of Illinois and a postgraduate of the University of Iowa. For most of his career he has been a palaeontologist/stratigrapher with Amoco, at the Research Center in Tulsa, Oklahoma, and with the Worldwide Exploration Business and Exploration and Production Technology Groups in Houston, Texas. Currently, he is the Director of the Biostratigraphic Support and Development Section.*

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Olaf Michelsen *has long experience in Mesozoic stratigraphy, from his work in the Danish Geological Survey. Since 1989, he has taught stratigraphy as a professor at the University of Aarhus, with a special interest in sequence stratigraphy of the Cenozoic succession in the North Sea. He was Secretary of the Jurassic Subcommission of ICS for ten years and, since 1995, has been Secretary General of ICS.*

John W Cowie *is a retired professor of the University of Bristol, UK. He is mainly a Cambrian stratigrapher and has done much work on the Precambrian—Cambrian boundary. He was Chairman of the Precambrian–Cambrian Boundary Working Group of ICS for several years. From 1984 to 1992 he was Chairman of ICS and since then, has actively participated in the activities of ICS Bureau.*

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achieved, with the cooperation of those who have advanced the proposals, the TJBWG will be in a position to carry out the selection of a preferred candidate GSSP as soon as the voting membership has been determined.

6. Membership

The TJBWG membership list in this newsletter includes those who responded to a circular from the Secretary requesting confirmation of contact details and of interest or activity in Triassic-Jurassic boundary successions; those who did not respond have not been included. The contact details given are the latest notified to the Secretary.

Members are asked to advise the Secretary promptly of any errors in the details given and of any future changes in their contact information (i.e. full postal address, telephone number, FAX number, e-mail address) or field of interest. Please print or type information clearly; accurate records will ensure that members receive TJBWG documents satisfactorily and will help to keep postage and related costs to the minimum.

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TJBWG Members: June 1997

The list has been compiled by the Secretary on the basis of responses to a circular requesting confirmation of contact details and of interest and activity in Triassic-Jurassic boundary successions; those who did not respond have not been included. Please advise the Secretary (G. Warrington; contact details in the list below) promptly of any errors in the details given and of any future changes in the contact information or field of interest; please print or type information (e.g. full postal address, telephone number, FAX number, e-mail address) clearly. Members who are aware of workers who are active in the study of Triassic-Jurassic boundary successions but are not in the following list are asked to contact the Secretary.

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4.2. NEW OBSERVATIONS ON THE AMMONITE FAUNAS NEAR THE BASE OF THE JURASSIC IN BRITAIN - A PRELIMINARY NOTE

by

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Work in progress on the ammonite faunas near the base of the Jurassic in NW Europe, and the search for a GSSP for the base of the system, has revealed new and important information in England. It is planned to fully describe and discuss these observations elsewhere, prior to the ISJS Congress in Vancouver in 1998; the following account is, therefore, a summary.

In 1992, P. Hodges (then at the National Museum of Wales, Cardiff) noted the rare occurrence of very poorly preserved *Psiloceras*-like ammonites on the west Somerset coast (south-west England) at a level below the previously recorded first appearance of *Psiloceras planorbis* (J. Sowerby) in that area. The specimens were found at St Audrie's Bay, in beds 8 and 9 of Whittaker & Green (1983, pp.64, 65) and about 0.9m below the previous lowest record of ammonites (Warrington *et al.* 1994), in bed 14 (Hodges 1994).

In April 1994, one of us (KNP) discovered further specimens in the top of bed 8 at Doniford Bay, about 2.5km west of St Audrie's Bay; these specimens were strongly abraded by the sea. In association with J. Radley (City of Bristol Museum) and H. C. Ivimey-Cook (formerly of the British Geological Survey) we succeeded in extracting three small specimens from the interior of the limestone bed where ammonites are rather rare. These specimens were crushed but not totally flattened. Preparation was very difficult and a satisfactory result was obtained only on the outer whorls. Strikingly, two of these specimens display blunt ribbing; the third is smooth. The three specimens, 30-35 mm in diameter, show a wide coiling; one shows suture line of the same simple type as in *Psiloceras psilonotum.*

In April 1997, a further effort was made to obtain more and better material and to sample beds 9-13 in Doniford Bay and, farther west, near Blue Anchor. This time, larger bedding planes had been washed clean by the sea and collecting was especially good in beds 9 and 13. In the few hours of low tide more than 30 specimens were found. All are crushed; the relatively narrow umbilicus of specimens in bed 13 indicates *Psiloceras planorbis*. At least one specimen from the lowest part of bed 9 shows a longitudinal striation typical of some *Neophyllites* (see below). From bed 8 two further specimens were obtained, partly abraded by the sea. In one of these relics of nodes can be recognized on the innermost whorls indicating *Psiloceras erugatum* (Phillips) (see below); this species typically has blunt ribs on the inner whorls, as do specimens obtained previously from this bed.

H.C. Ivimey-Cook drew our attention to a further occurrence of ribbed *Psiloceras* below smooth *Psiloceras planorbis* in the Wilkesley borehole in Cheshire, north-west England (Poole & Whiteman, 1966: 118-119). This ribbed form had been determined by Donovan (in Poole & Whiteman, 1966: 50, 140) as *Psiloceras planorbis erugatum* (Phillips). Another occurrence of *Psiloceras* aff. *erugatum* reported in Kent (1937) from a quarry west of Barnstone Church, south Nottinghamshire, cannot be confirmed as the whereabouts of the specimen in unknown.

A restudy of the ammonites from the Wilkesley borehole, kindly arranged by S. Tunnicliff and G. Warrington (British Geological Survey, Keyworth) revealed the following, in a grey mudrock sequence:

Depth	Thickness	Ammonites present
134.6m		First *Caloceras* (base of the Johnstoni Subzone)
136.8m	2.2m	*Psiloceras sampsoni* + *Psiloceras plicatulum*
137.5m	0.7m	*Psiloceras sampsoni*
138.2m	0.7m	*Psiloceras planorbis*
145.2m	7.0m	Psiloceratids, with indication of *Neophyllites*
145.9m	0.7m	Psiloceratids as above, and a specimen of *Psiloceras erugatum*
147.9m	2.0m	No ammonites
148.4m	0.5m	*Psiloceras erugatum* (10 specimens; base of Planorbis Subzone)
157.9m	9.5m	"Pre-planorbis beds"

The thickness of the Planorbis Subzone in this borehole (13.8 m) is one of the highest known in NW Europe, and the sequence of ammonites is the most complete, containing forms which have never been found before in their proper stratigraphic position. In spite of the thickness, the subzone is rich in ammonites almost throughout; 68 specimens have been extracted from 56 different levels. All specimens are preserved in shale and therefore crushed; limestone beds are lacking in the sequence. Three body chambers were uncrushed. Suture lines are not preserved. *Neophyllites* is indicated by a wide umbilicus, a steep umbilical wall and, sometimes, by longitudinal striae corresponding, for example, to *Neophyllites sulcifer* Lange. The lack of visible suture lines, however, may leave some degree of uncertainty. There are no indications of the early *"Schlotheimia"* described by Guerin-Franiatte & Muller (1979, 1987) from Belgium below ammmonites compared to *Psiloceras psilonotum.*

In the Watchet area, the sequence is as follows (observed mainly at Doniford Bay (Page *et al.* 1994); bed numbers of Whittaker & Green, 1983: 64, 65):

Bed 25		First *Caloceras* (base of the Johnstoni Subzone)
Bed 24	1.5m	*Psiloceras plicatulum*
	0.7m	*Psiloceras sampsoni*, with *Psil. plicatulum* in the middle of the unit
	0,6m	*Psiloceras planorbis*

Beds 23 - 9 (upper part): *Psiloceras planorbis*; from the limestone beds (nos. 22, 20, 16, 12, 10) no determinable ammonites are known so far; the traditional "first appearance" of the species is in bed 14

Bed 9 (lower part): psiloceratids, with indication of *Neophyllites*

Bed 8 *Psiloceras*, ribbed and smooth forms, wide-whorled, most probably *Psiloceras erugatum* (base of the Planorbis Subzone?)

The thickness of the Planorbis Subzone here is about 5m. The sequence of ammonites is essentially the same as in the Wilkesley borehole, but the lower part is much thinner and incomplete. The former questions on the stratigraphic relations between *Psiloceras planorbis*, *Psiloceras sampsoni / psilonotum* and *Neophyllites* now appear to be of minor importance for discussions of the base of the Jurassic and are therefore not treated in more detail here.

The crushed ammonites at the base of the ammonite sequence of the Wilkesley Borehole have been identified with *Ammonites erugatus* Phillips by Donovan (1966: 50) who characterized them in the following way: "The earliest specimens have blunt, bead-like ribs on the innermost whorls and are identical with the holotype of *Ammonites erugatus* Phillips which is regarded as a chronological subspecies of *Psiloceras planorbis*...". The species had been previously known only from loose blocks found in Robin Hood's Bay, Yorkshire, NE England and its stratigraphic occurrence remained unknown. The excellently preserved Yorkshire specimens show a close similarity to *Psiloceras sampsoni / psilonotum* in habitus and suture line and may appear as a variety of this group. The main difference is the existence of well developed small nodes on the innermost whorls in *Psiloceras erugatum*, well seen in Buckman's figure of a supposed holotype (1921, pl. 223). Howarth, however, figured a second specimen as the true holotype and stated that Buckman was mistaken (Howarth 1962: p.99, Pl. 14, fig.2). Howarth's specimen also shows the typical noded nucleus.The nodes are mostly followed by an ontogenetic stage of blunt ribbing which is regular at first and later becomes irregular and indistinct. The duration of the stage of ribbing is very variable. A limestone block in the Sedgwick Museum crowded with specimens shows the whole variability. All prepared specimens show the tubercles on the innermost whorls. No other species could be traced in this accumulation. As far as known this limestone has never been found in boreholes or *in situ*.

The crushed state and the lack of suture lines prevent close comparison of specimens from the Wilkesley Borehole and from Yorkshire but the ornament of the inner whorls seems rare enough in NW European *Psiloceras* species that Donovan's identification appears reasonable. Moreover, with regard to the special ornament the rank of a full species seems to be justified for *erugatum*.

Comparison with other regions

In NW Europe, the Jurassic sequence of ammonites begins with different psiloceratid forms in different regions. The age relations between these forms have not been known before because of their isolated occurrences. Striking accumulations of monospecific character have been found in regions remote from one another, suggesting that the forms represent separate stratigraphical levels and did not appear contemporaneously.

Donovan (1966: 50) found that *Psiloceras planorbis* and *Psiloceras sampsoni / psilonotum* could not be separated statistically; this has also been noted in material from southern Germany (unpublished): it is not possible to allocate specimens with intermediate coiling to the one or the other species. Nevertheless, accumulations of *Psiloceras sampsoni / psilonotum* (occurring frequently throughout NW Europe) and of *Psiloceras planorbis* in the Watchet area can be readily distinguished. In the Watchet area, as well as in the Wilkesley Borehole, the two forms occur in stratigraphic sequence, with the narrow-whorled *Psiloceras planorbis* being earlier. The wide umbilicus form occurs in scattered specimens together with the narrow-whorled. The latter disappears abruptly whereas the former persists higher, into the range of *Psiloceras plicatulum*.

Mass occurrences of *Neophyllites* are also known. An accumulation of well preserved specimens was first found in Great Britain, in loose blocks from the Holderness Drift in Yorkshire (Thompson, 1913: 170; identified as *Neophyllites* by Lange (1941a: 58, 60)). A further accumulation was described by Lange (1941a, b) from loose blocks at Drove, 30 km

east of Aachen (NW Germany). A third mass occurrence identified near Tubingen in SW Germany (unpublished) includes all the forms described by Lange from Drove. These widely separated *Neophyllites* concentrations indicate that a separate *Neophyllites* horizon must exist. Thompson and Lange both suggested that this horizon occurred below the earliest *Psiloceras*; the Wilkesley Borehole material reveals that their suggestion was essentially correct.

The rarest type of accumulation is that of *Psiloceras erugatum* which had been known only from loose blocks from the North Yorkshire coast, including Robin Hood's Bay (Thompson 1913: 171). In the Wilkesley Borehole this species shows overlap with other forms only at the top of its stratigraphic range. Donovan (1966) therefore noted that the species has a special stratigraphic position.

For a representative profile, well preserved ammonites are desirable. In this regard, Yorkshire and the adjoining North Sea would be the most important region for the lower part of the Planorbis Subzone. In the Wilkesley Borehole, the crushed preservation is not optimal but recognition of the stratigraphical relationship of the different groups is possible.

A similar situation has been described from South America by v. Hillebrandt (1988, 1990, 1994, 1997) where there is also a sequence of psiloceratids of different age, and where the sequence does not begin everywhere with the same forms. Such age differences in the beginning of ammonite sequences must be expected if one tries to correlate different faunal provinces.

NW Europe was a marginal sea area, and *Psiloceras erugatum* obviously migrated from another province. The migrants have brought with them the tuberculation of the innermost whorls, a character which is frequent in Tethyan forms (*Psiloceras calliphyllum* and its relatives) as well as in forms occurring in South and North America (the *Psiloceras tilmanni / pacificum* group, *Psiloceras primocostatum* and others). In other characters most of these forms are too different to be directly connected with *Psiloceras erugatum*.

So far, correlations with South America (v. Hillebrandt, 1994: 306; 1997) were based on similarities which do not appear to be the closest possible. *Psiloceras plicatulum* and the correlated *Psiloceras primocostatum* differ in the presence or absence of tubercles on the innermost whorls and in the persistence of ribbing to the end of the shell or ending earlier. Similar comments are true for *Psiloceras planorbis* and the correlated *Psiloceras tilmanni*; in this case there are, additionally, differences in cross section.

In NW Europe, *Psiloceras* with ribbing restricted to the inner whorls (but without tubercles) are rarely found with *Psiloceras planorbis*, and the co-occurrence of *Psiloceras calliphyllum* - with tubercles and early ribbing - and *Psiloceras psilonotum* (and even *Neophyllites*) in the Alps (Wahner, 1886; Lange 1952) indicates that the Primocostatum Zone could include the NW European Planorbis Subzone. An additional indication could be NW European *Psiloceras erugatum* in the Planorbis Subzone and its similarity to forms in the Primacostatum Zone of South America (v. Hillebrandt, 1988, 1990, 1994, 1997). This would mean that the conspicuously thick whorled forms of the *tilmanni/pacificum* group would have no stratigraphic equivalents in Europe and would be one of the earliest psiloceratids after the end of *Choristoceras*. The difference between this group and the crushed, obviously totally smooth ammonites below in the New York Canyon section (Guex 1982, 1995; Guex *et al.* 1997) seems to be conspicuous enough to provide a suitable lower boundary of the Jurassic.

The ammonites of the early Lias in Siberia (Dagys, 1996) are too different, morphologically, from other psiloceratids to be closely compared. *Psiloceras suberugatum* displays such a strange ornament that it is certainly not closely related to *Psiloceras erugatum*. The question of correlations with Siberia remains therefore open.

Preliminary Conclusions

There are several levels of first appearance of psiloceratids in different regions during the earliest Lias. Thus, the interval between the last *Choristoceras* and the first *Psiloceras* has a different duration in different regions. Whatever level one selects for the base of the Jurassic there are, in all cases, difficulties of correlation. In most regions the position of the Triassic/Jurassic boundary will not be exactly known as it will lie in ammonite-barren "Pre-planorbis beds". At higher levels, correlations are hampered by differences caused by

provincialism. Moreover, in the many cases of crushed preservation the position of the base of the Jurassic would be difficult to determine as separating the different smooth forms can be very difficult . A GSSP will rarely meet all desirable requirements. It is therefore necessary to decide what requirements must have priority. A GSSP should be that point in the world which shows the boundary between two systems or stages most clearly and where a time interval around the boundary is represented as completely as possible by appropriate guide fossils. For the base of the Jurassic, it presently seems unlikely that a continuous sequence of ammonoids, from the last Triassic *Choristoceras* to the first recorded psiloceratids, will be found in Europe. Whether these earliest psiloceratids, below the level of the first Jurassic subzonal index, *Psiloceras planorbis*, are considered Jurassic rather than Triassic in age, is a matter for debate.

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5 - JURASSIC STAGE BOUNDARY WGS

5.1. REPORT OF HETTANGIAN - SINEMURIAN BOUNDARY WORKING GROUP

by
Gerd BLOOS
Convenor

The working group has organized also in 1997 (April) a field trip to the candidate GSSP at Quantock's Head near Watchet (Somerset, SW England) to increase the knowledge on the ammonite fauna around the stage boundary. Further collection has been made, this time from limestone beds in the boundary region, whereas in April 1996 collecting had been concentrated on the shale horizons. The material has not yet been prepared. A documentation on the boundary is in work; it is planned to appear in 1998 by the congress in Vancouver.

The basal ammonite assemblage at Quantock's Head - compared with *Vermiceras solaroides* and *V. rougemonti* in IVIMEY-COOK & DONOVAN, 1983 - shows some similarity with the assemblage of "*Paracaloceras*" cf. *coregonense* and "*P.*" *multicostatum* in the Taseko Lakes area of Canada (FREBOLD, 1967). A more detailed comparison has not been made thus far. It may be that the Canadian forms are fore-runners of the Watchet form. There are first indications that similar forms occur also in South America (pers. comm. v. HILLEBRANDT).

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5.2. REPORT OF THE SINEMURIAN - PLIENSBACHIAN BOUNDARY WORKING GROUP

by
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Convenor

The Pliensbachian Working Group is now organized and can start its work on the Lower Carixian - Sinemurian boundary. In comparison with other stages we started very lately but we want to follow the work plan establish by the new Bureau of the I.S.J.S.

- The priority must be given to the choice of a locality with a good continuous profile without gap or any unconformity for the Lower Pliensbachian Boundary .

A first attempt of DOMMERGUES & MEISTER (1992) used as a basis for discussion and the comments of the Members of the Working Group induced the selection of four areas which are potentially good candidates for the Lower Pliensbachian Boundary GSSP. At the present time these regions are investigated or have to be investigated. All belong to the Euroboreal Realm:

SW Germany

In this historical and well studied area, the transition between the uppermost Sinemurian and the lowermost Carixian is usually characterized by the lack of sediments, condensation and/or beds without ammonites. Meanwhile during the last meeting of the German Subcommission for Jurassic Stratigraphy in May 1997, a very accessible profile appeared to be a good candidate. The profile of Aselfingen is not very thick, but complete (probably the only one in this historical area) at the Sinemurian- Pliensbachien boundary and all the classic succession of ammonites is present (SCHLATTER, 1991). During the mentioned meeting we have sampled for complementary studies (microfauna, microflora and geochemistry).

NW Germany

In this area the transition between the uppermost Sinemurian and the lowermost Carixian is poorly documented. It seems that the Late Sinemurian fauna and the Early Carixian fauna are always separated by beds (usually several meters thick) lacking ammonites. One profile in Bünde (*Paltechioceras* level to *Platypleuroceras capriarium* level) area is in study for microfauna, macrofauna (ammonites) and geochemistry. For ammonite biostratigraphy we can already state that the sedimentary column between the *Paltechioceras* level and the *Platypleuroceras capriarium* level lack ammonite faunas. (BLAU, EBEL, MEISTER, SCHLATTER).

The microfaunal and microfloral content of 16 samples from the Bünde section were analyzed by K. DYBKJÆR and D. JUTSON. They report the following results: <"The investigations are part of a multidisciplinary study with the purpose to clarify wether this locality is suitable as stratotype for the Pliensbachian. The palynological samples were prepared using the method described by Poulsen et al. (1980); microfaunal and nannofossil samples were prepared using conventional techniques>.

Palynological Analysis - The investigated samples, contained homogenous, poor and very heat-influenced palynoassemblages. Only a very few spores and pollen were recorded , while dark brown to black wood particles totally dominated the assemblage. No other palynomorph-categories (dinoflagellate cysts, freshwater algaes ....) were recorded.

The few recorded spores and pollen were difficult to identify due to a very poor preservation state. The grains were severely heat-influenced; dark-brown to black (the thermal alteration index (TAI) for the recorded specimens are about 4- on the scale developed by D.L. Pearson, Phillips Petroleum Company ,1984), and partly to strongly degraded.

Microfaunal Analysis - All samples were barren of microfauna.

Nannofossil Analysis - All samples were barren of nannofossils.

On the basis of the present study it must be recommended to try to find a stratotype which is less thermally influenced and present more diverse microfossil assemblages".

Yorkshire

The famous area of Robin Hood's Bay is known since the early 19 th century. Recently the transition between the Raricostatum and Jamesoni Zones has been studied acutely for ammonites (DOMMERGUES & MEISTER, 1992) and re-measured, integrating existing lithostratigraphical and biostratigraphical schemes by HESSELBO & JENKYNS (1995). The boundary Sinemurian-Pliensbachian is most evident at Wine Haven profile. The data deserve special attention. Indeed, deposition and faunal information (ammonites) appear to be more continuous in this area than in other countries. It also seems to be a good candidate.

A discrete fauna (*Bifericeras donovani* DOMMERGUES & MEISTER and nucleus of *Apoderoceras* sp.) overlies the last Upper Sinemurian Echiocertatidae and precedes the first unambiguous Carixian *Apoderoceras* and *Phricodoceras taylori* (SOWERBY).

For the microfauna and other studies we have no information until now. We fear that the encountered problems with the microfauna in NW Germany will be the same in the Yorkshire area (?).

Hebrides (Raasay, Pabbay, North shore of Loch Eishort)

This area is re-investigated by HESSELBO et al.. In brief, according to S. HESSELBO, the sections comprising the boundary are highly faulted at Raasey, therefore it seems not possible to compile a complete sequence. The section in Pabay island is difficult to access, the island is small and privately owned; only the East coast has been studied, nobody has worked on the West coast . At Loch Eishort only few work on the Sinemurian - Pliensbachian boundary has been done.

For **Intermediate Euroboreal - Tethyan** domains like Austrian Upper Austroalpine no good sections are available for the moment.

For **Tethyan Realm** this boundary seems to be not very clear, perhaps new works of FARAONI, PALLINI, MARINI, VENTURI in Central Apennines will provide some precisions.

In **Pacific regions** the boundary is poorly represented in North America... (SMITH in letter) and in South America (HILLEBRANDT, RICCARDI...) a detailled and clear profile has not been published until now.

A major problem will be the precise position of the Sinemurian - Pliensbachian boundary in the Tethyan (Mediterranean - Pacific) realm and its correlation with The Euroboreal realm; it appears still unresolved.

- To find a good definition of this boundary.

It is necessary to mention briefly how the Sinemurian-Pliensbachian boundary is defined in the literature and to note that the biochronological subdivisions of the Jurassic are primarily based on ammonites. The boundary between two stages must be based on the unambiguous definition of the base of the overlying stage (see CALLOMON & DONOVAN, 1971, CALLOMON, 1994...). In the present case, the base of the first Pliensbachian subzone (Taylori subzone) was defined by SPATH (1923) in the Dorset Coast and later discussed by DEAN et al. (1961) and other authors. In the Dorset Coast, SPATH (1923) and then LANG (1928) indicated the association of Phricodoceras taylori with Apoderoceras in bed 105 which is considered as the first bed of the Taylori subzone. This definition allows us to recognize the Taylori subzone in the major part of the NW Europeean areas. But this association remains ambiguous, usually it is the presence of *Apoderoceras* (sometimes associated with *Tetraspidoceras*) which indicates the first Pliensbachian level, especially since *Phricodoceras* gr. *taylori* (SOWERBY) is already known by rare specimens from the Upper Sinemurian. So the *Phricodoceras taylori* (SOWERBY) record is inadequate to define the Taylori subzone (see DOMMERGUES &

MEISTER, 1992) and only Apoderoceras seems to provide a good indication for the Early Pliensbachian.

So we are involved in a work with the following final goals
- GSSP selection
- ammonite biostratigraphic scales and the correlations with the Standard scale
- integrated stratigraphical scales

These proposals are not exhaustive and all other suggestions are welcome especially on other G.S.S.P. candidate sections. Moreover all informations on other fossil groups (e.g. bivalvia, brachiopoda...) or investigation methods (magnetostratigraphy...) to precise the Sinemurian - Pliensbachian boundary are needed.

All these points will be discussed during the 5th International Symposium on the Jurassic System in Vancouver, 1998.

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5.3. REPORT OF THE TOARCIAN - AALENIAN BOUNDARY WORKING GROUP

by
Stefano CRESTA,
Convenor

RESULT OF THE POSTAL BALLOT ON SELECTION OF THE LOWER AALENIAN BOUNDARY INDEX SPECIES

AALENIAN WG DIRECTORY (in bold the answers to the ballot)

Almeras Y., Baldanza A., Benedetti L., Boutakiout M., Bucefalo Palliani R., Callomon J., Canales M.L., Carter E., Cecca F., Chandler R., Christ H., Cobianchi M., Cox B., Damborenea S., De Kaenel E., Dietl G., Elmi S., Fernandez-Lopez S., Galbrun B., Garcia-Joral F., Goy A., Guy-Ohlson D., Hall R., Henriques M.H., Herrero C., Von Hillebrandt A., Mancenido M., Martin M., Martinez G., Mattioli E., Myczynski R., Morton N., Mouterde R., Ohmert W., Pavia G., Perilli N., Riccardi A., Rieber H., Rolf C., Ruget C., Rulleau L., Sadki D., Sato T., Seyed-Emami K., Sandoval J., Sarjeant W., Schmidt-Effing R., Ureta S., Venturi F., Westermann G., Wonik T.

And should it not, in principle, on historical grounds, have become the Torulosus Zone? Clearly, now too late to change it back. And perhaps this evolution has already been described: but I do not have the time to search further. It should however be summarized in a proposal to define the Aalenian Stage formally].

(2) Choice of index species to label the lowest faunal horizon characterized in a boundary type section.
I was pleased to see the ammonite biostratigraphy of Wittnau cast into the form of successive distinguishable faunal assemblages. The implication is that the discovery of isolated specimens of the constituent members of the assemblages at other localities would not permit closer correlation than any of the horizons in which it occurs: e.g., *Pleydellia pseudoarcuata* by itself could not distinguish between *pseudoarcuata* and *misera* horizons, the former in the Torulosum Subzone of Ohmert & Rolf, the latter in the Opalinum Subzone. But in this formulation, *L. opalinum* was not offered as a choice: the lowest horizon il the *Pleydellia misera* horizon.

(3) Choice of a biozone (local range-zone, at the boundary stratotype section) of a single species whose First Appearance (FA) is taken to define the time-plane marking the Stage boundary.

As I have also repeatedly pointed out, this is a lousy way to define standard chronostratigraphical units, for such biostratigraphical units are ephemeral and subjective. FA's keep on evolving as more material is discovered, and depend on the "correct" identification of the species concerned. And how often do two "experts" agree on that? Why, for instance, on the voting-paper sent to us, does it say "*L. opalinum* REINECKE non QUENSTEDT" (recte "(REINECKE non QUENSTEDT)")? If the difference matters, how do we know that *L. opalinum* (REINECKE) occurs at Wittnau at all? We have only OHMERT & ROLF word for it: the specimens they illustrate under this name differ significantly from the figure of the rediscovered holotype [?: REINECKE says "sehr selten", very rare, which could suggest that he had more than one specimen in the type-series; in which case, the re-discovered type, which does match REINECKE's figure tolerably well, should become lectotype]. The type horizon of *L. opalinum* is in fact unknown: it may be higher than the first bed with *L. opalinum* Ohmert non Reinecke at Wittnau. And so on.

As for the alternative offered, *Pachylytoceras torulosum*: as a guide-fossil it is almost useless anywhere outside Germany. Its only function could remain as a Subzonal index, (1) above.

So, what should/could be done?
(1) Choice of the lowest Zone of the Aalenian Stage: Opalinum Zone. Any Subzones: there appear to be two possibilities:
(a) Torulosus Subzone, as suggested by Ohmert at Wittnau: beds with *Pleydellia* but without *Leioceras*;
(b) Buckmani Subzone (of an Aalensis Zone), as suggested by Goy et alii, at Fuentelsaz: again, beds with *Pleydellia* but without *Leioceras*. This Subzone has been used elsewhere in the past, usually at the highest Subzone of the Toarcian. (Note also an immediate conflict: according to Ohmert, the main occurrence of *Pl. buckmani* at Wittnau is in fact in the Opalinum Subzone. Genuine differences in ranges, or differences in identifications? See (3) above!).

For purposes of wider correlation and historical stability, I would press to retain the/an Opalinum Subzone as the basal Subzone of the Aalenian Stage.
(2) Choice of the lowest distinguishable, correlatable faunal horizon:
(a) At Wittnau: Ohmert's *misera* horizon, with allegedly both *Leioceras opalinum* and *Pl. misera, buckmani*: bed "2ob".
(b) At Fuentelsaz: an *opalinum* horizon, not so far expressly described as such: bed 105.
(3) basal boundary horizon of the Aalenian Stage: either at Wittnau, in bed "2", base of "ob", or at Fuentelsaz, base of bed 105 - in both cases, where Ohmert and Goy have drawn the lines. Which of these two sections is preferable I leave to others to decide: I would be happy with either. For all practical purposes, they are equally good.

End of problem. No mention of a "boundary index species", whatever that might be.

Problems remaining to be resolved: harmonization of Subzonal nomenclature, both between Wurttemberg and Iberia and with the current NW European Standard, in Dean, Donovan & Howarth 1961.

I am sorry this is so long, but we went through all these arguments with the Bajocian Golden Spike, arguments based largely on the same misunderstandings and confusion in the minds of the members of the ICS and the "Guides to procedure" they produce is regrettable but no reason for us in the Jurassic to follow them mindlessly.

G. DIETL (16 january 1997) - Thank you very much for your recent circular including a voting-paper about "selection of boundary index species". In this context I do not understand your question about a "boundary index species". Really I had aspected a question about the choice of a candidate for a stratotype section between Wittnau and Fuentelsaz. Also I had aspected a proposal about the definition of the time-plane-marking of the Opalinum Zone. For me there is no question wether Opalinum Zone or Torulosum Zone. Since a long time and at least since the last Colloque de Luxembourg it is very clear that the lowermost Zone of the Aalenian is the Opalinum Zone. The main question now is where we let begin the Opalinum Zone. Here I can see two possibilities: Opalinum Zone including at the base a Torulosum Subzone (very well developed in S-Germany, but the distribution of *Pachylytoceras torulosum* seem to be restricted to Middle-Europe) or a Opalinum Zone excluding the Torulosum Subzone. I prefer the first solution in which the Opalinum Zone should begin with the *subcandida* horizon. Correlation can be made with the faunal association of the different species of *Cotteswoldia* and *Pleydellia*. The base of the *subcandida* horizon should be fixed with the Golden Spike in the section of Wittnau at the base of the layer n.25. For this procedure it is not important in which level the real *Leioceras opalinum* is occurring. At the moment we know nearly nothing about the type horizon of the REINECKE type specimen.

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5.4. REPORT OF THE BAJOCIAN - BATHONIAN BOUNDARY WORKING GROUP

by
Charles MANGOLD
Convenor

At the 3d International Symposium on Jurassic Stratigraphy (Lisboa, 1987-1988, p. 333) a GSSP proposal for the Bajocian - Bathonian boundary in the Digne (F) area located in the ravin du Bas Auran section was presented.

FIRST DIGNE MEETING (13 to 15 October 1995)

After the reorganization of the Bt.B.WG during 1994-1995 a Bathonian workshop and field meeting were held in Digne. Nineteen people attended the meeting, thirteen coming from foreign countries: N. & M. POULSEN (Denmark); G. DIETL (Germany); A. GALACZ (Hungary); S. CRESTA, R. LANZA, G. PAVIA (Italy); B. MATYJA, A. WIERSZBOWSKI (Poland); S. FERNANDEZ-LOPEZ, G. MELENDEZ (Spain); K. PAGE (United Kingdom) and A.M. BODERGAT, S. ELMI, L. EMMANUEL, R. ENAY, D. MARCHAND, F. THIERRY (France).The convenor was left alone in Lyon with his broken foot.

During this meeting, G. DIETL emphasized the following points:

1° The Bomfordi Subzone, the latest Subzone of the Upper Bajocian Parkinsoni Zone seems insufficiently ensured in the section. Consequently a gap may be invoked below the bed 23, the marker bed proposed for the base of the Convergens or Parvum Subzone of the Early Bathonian Zigzag Zone.

2° G. DIETL put forward that in Swabia exists a Cadomites exstinctus biohorizon at the bottom of the Convergens Subzone. He thinks that this biohorizon will be present in the Bas Auran section too and will represent a good reference tool for correlation.

After discussion four items were drawn during the final session:

1° Need of complementary ammonite collecting below the bed 23 in the Bomfordi Subzone.

2° Reexamination of the previously recorded ammonite material (Sturani, Pavia, Italian Ph.D. students etc.)

3° Definition of a formal biohorizon for the lowermost Bathonian.

4° Possibility to propose auxiliary or complementary sections in the same Digne area (Chaudon, La Palud).

Since the first Digne meeting, a restricted team is currently busying with these items.

SECOND DIGNE MEETING (25-30 April 1997)

The second field meeting was held in Digne in. Its aim was further ammonite collecting below the bed 23 in the Bomfordi Subzone. The participants were: G. PAVIA with the help of three Italian ammonite lovers and collectors G. BORTOLOTTI, B. CAVALLO, A. DEFAVERI. They were accompanied during the five days by A. GALACZ, the convenor, and during three days by A.M. BODERGAT and D. MARCHAND.

New ammonites were collected firstly in the ravin du Bès section, secondly in the ravin du Bas Auran section and thirdly more upstream in the ravin des Robines.

During July, the ammonites collected should be studied and, if we have enough time, a comparison with previously collected ones should be undertaken this summer.

GATHERING OF RESULTS: dead line 15th October 1997

The convenor is waiting for new results and data and ask people investigating microfauna (N. POULSEN and A.M. BODERGAT) to send their data not later than the dead line mentioned above. If any other people, participants of the 1st or / and 2nd meetings, have new results (palaeomagnetism, palaeoecology, sedimentology, sequence stratigraphy, taphonomy etc.), please return these informations to the convenor too.

When the maximum number of data will be gathered together, the convenor would be able to prepare a provisional document sent for correction to the different authors and stratigraphers involved with the Bajocian - Bathonian boundary.

DEFINITIVE PROPOSAL

+ First step : after correction and complements, the convenor would be able to prepare the final proposal. This document will be submitted to the members of the Bt.B.WG for approval by a postal ballot.

Voting members of the Bt.B.WG are people directly interested by GSSP and having expressed their desire of active participation in 1995.

- Argentina: A.C. RICCARDI
- Bulgaria: I. SAPUNOV
- Canada: G.E.G. WESTERMANN
- Denmark: N. POULSEN
- France: A.M. BODERGAT, S. ELMI, E. ENAY, C. MANGOLD, D. MARCHAND, J. THIERRY
- Germany: G. DIETL, M. GRÖSCHKE, A. von HILLEBRANDT,.E. MÖNNIG
- Hungary: A. GALACZ
- Italy: F. CECCA, S. CRESTA, G. PAVIA, R. LANZA
- Poland: B. MATYJA, A. WIERSZBOWSKI
- Russia: N. BESNOSOV, G. KRIMGOLTS, S. MELEDINA
- Spain: S. FERNANDEZ-LOPEZ, G. MELENDEZ, J. SANDOVAL
- United Kingdom: J.H. CALLOMON, K. PAGE, H.S. TORRENS.

+ Second and third steps are the submission of the final GSSP proposal to the I.S.J.S. and the I.C.S.

5.5. REPORT OF THE CALLOVIAN - OXFORDIAN BOUNDARY WORKING GROUP

by
Guillermo MELENDEZ
Convenor

Activities of the Oxfordian Working Group in the last few years since the IV Oxfordian and Kimmeridgian Meeting (Lyon, 1994) have been intense in the efforts made by the members of the group to reach a deffinitive decission on the GSSP for the Callovian-Oxfordian boundary.

The IV meeting of the group, superbly organised by F.Atrops and leaded in the field by himself and by D. Marchand and D. Fortwengler, allowed the Oxfordian group to revise the expanded Callovian-Oxfordian successions at the localities of Thuoux and Savournon near Serres (SE France). Ammonite successions were supplemented by the fine study of the Dinoflagellate successions carried out by Niels Poulsen. Diverse paleontological evidence clearly pointed towards these sections being the most appropriate candidate for the Callovian-Oxfordian boundary GSSP. A quick votation among the members of the group showed the unanimous accordance on this point. Subsequent considerations on the still incomplete state of other macro, and micropaleontological, magnetostratigraphical, mineralogical etc, studies refrained the chairmen of the Jurassic Subcommission and the ISC to give way to this positive result as a new formal proposal for a Jurassic stage boundary stratotype in the subsequent ISJS Meeting (Mendoza, Argentina), and IGC, Beijing.

Studies have been, therefore in progress since that point both in the effort to carry on a detailed sampling of this expanded marly interval for magnetostratigraphy and for other paleontological studies (see report by F. Atrops in the former newsletter of the ISJS). At the same time, work in progress by the members of the group in these years has dealt mainly with the refining of

Oxfordian ammonite biostratigraphy in different regions of Europe. A part of it was exposed and presented for discussions in the Oxfordian Meeting recently organised by our dear colleagues from Poland, B.A. Matyja; A. Wierzbowski and coll. and from Denmark, Niels Poulsen and coll. (see report below). The presented contributions as poster were noteworthy as they provided a good view on the current status of the state-of-work of Oxfordian ammonite successions in some areas so far still poorly known: Middle Oxfordian Plicatilis to Parandieri subzone in Britain, Upware quarry (J.Wright and K. Page), upper Oxfordian in S Germany (G. Schweigert), in eastern Iberia (I. Pérez-Urresti and G. Meléndez); Middle Oxfordian of the Polish Jura (E. Glowniak) and upper Oxfordian-lower Kimmeridgian around Polish Jura and the Wielun Upland (Wierzbowski *et al.*), to show the good potential of polish ammonite successions for correlation with the boreal realm, and to enter the spinous question of the future position of the Oxfordian-Kimmeridgian boundary. Dinoflagellate cysts successions in poland also received attention by N. Poulsen and the danish team, although with different results.

Organised as the final stage of a several year lasting research project between the Jurassic team of the University of Warsaw, Department of Geology, and Geological Survey of Denmark, the meeting stands as a clean-cut case of good organisation in a convenient and unexpensive conditions for all participants, in the frame of this research project. We can warmly congratulate the organizers for their great effort in offering the participants this chance to revise such classical Oxfordian sections in Poland, and also for the detailed stratigraphic and paleontological work they have done. We sincerely hope for the results to see the light soon as published papers and paleontological monographs. They will, no doubt, help future work of correlation across the boreal and tethyan realm and on future selection of substage and zone stratotype sections, which apperars as the next step in the works of the Jurassic Subcommission. It is only to regret the fact that the submitted contributions are not expected to be published in a proceedings volume.

5.5.1. OXFORDIAN (JURASSIC) MEETING IN POLAND, 26-28 MAY 1997

Report by

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INTRODUCTION

A meeting on the Polish Oxfordian was held in Poland 26-28 May 1997. The meeting was organised and sponsored by the Geological Institute, University of Warsaw and the Geological Survey of Denmark and Greenland (GEUS). The meeting held a varied participation of 25 Jurassic researchers from Denmark, England, Germany, Poland, Portugal and Spain.

SCIENTIFIC CONTENT:

The meeting started with an informal session dedicated to the presentation of ammonite collections at the University of Warsaw and discussions on the detailed ammonite successions by the organizer team. This was intended to provide a palaeontological background for discussion on the biostratigraphic subdivision of the Submediterranean Oxfordian of Central Poland, as well as the recent progress in Oxfordian biostratigraphy towards a wider correlation between the Boreal and the Mediterranean Realm in the Middle and Upper Oxfordian and the Oxfordian - Kimmeridgian boundary in these realms. The ammonite collection covered the Plicatilis and Transversarium Zones (Middle Oxfordian) and the upper Bimammatum and lower Planula Zones (uppermost Oxfordian) and included also ammonites indicative of the Subboreal lowermost Kimmeridgian (Baylei Zone). A poster session including nine posters, which added further interest and recent data to the Oxfordian biostratigraphic zonation and correlation problems.

The fieldwork during the following two days presented some of the most important sections on which the detailed biostratigraphical study have been based.

I. MIDDLE OXFORDIAN AMMONITES
(Ewa Glowniak)

Fauna collected bed-by-bed in the Middle Oxfordian of Polish Jura Chain (e.i. at Wysoka, Niegowonice, Ogrodzieniec, Czestochowa quarries) yielded homogeneous assemblages of perisphinctids. Their succession sets up the framework of the herein proposed biostratigraphical scheme (see the table with the biostratigraphical subdivision in the Meeting materials).

Three zones are distinguished: the Plicatilis Zone, the Transversarium Zone, and the Bifurcatus Zone. Although the traditional index species of the classical subdivision are used in the scheme herein proposed, the boundaries of the biostratigraphical units are redefined.

The base of the Transversarium Zone is marked by the first appearance of *Dichotomosphinctes*, represented by the species *Perisphinctes (Dichotomosphinctes) antecedens* Salfeld and his presumable macroconch, *P. (Perisphinctes) aff. maximus* (Young & Bird). The base of the Bifurcatus Zone is in turn marked the first appearance of *P. (Dichotomosphinctes) wartae* Bukowski, as the representatives of this species display significant affinities to the subgenus *Dichotomoceras*.

The further subdivision is based on phylogenetical relationship between the microconchs of the subgenera *Otosphinctes- Dichotomosphinctes- Dichotomoceras*. For the Paturattensis Subzone typical is the ocurrence of *P. (Otosphinctes) paturattensis* De Loriol and the close species *-P.(O.) montfalconensis*.De Loriol. Macroconchs are represented by the mass occurence of *P. (Arisphinctes) helenae* De Riaz, *P. (A.) trifidus* (J. Sowerby) as well as the common occurence of representatives of *Liosphinctes* - among which *P. (L.) plicatilis* (Sowerby) is the most significant.

For the Ouatius Subzone, typical are early representatives of *P.(Otosphinctes) ouatius* (Buckman), recognized as *P. (O.) ouatius ouatoides* ssp. nov. It is also the place of appearance of *P. (O.) ouatius ouatius* (Buckman) and *P. (Kranaosphinctes) kranaus* (Buckman).

In the Arkelli Subzone- occur *P. (O.) arkelli* sp. nov. [=*P. (Dichotomosphinctes) rotoides*, Arkell 1937, non Ronchadzé, 1917]. Among macroconchs - typical are "English" representatives of *P.(Kranaosphinctes)* and *P.(Arisphinctes)*, such as *P. (K.) kranaus* (Buckman), *P. (K.) decurrens* Arkell, *P. (A.) ariprepes* (Buckman). Representatives of *Liosphinctes* are much less common, being represented mainly by *P. (L.) cumnorensis* Arkell.

In the uppermost part of the Arkelli Subzone a well-defined horizon, the Platysphinctes Horizon, is distinguished. This horizon marks the short term invasion of representatives of the subgenus *Platysphinctes*, together with the abrupt appearance of representatives of "mediterranean" species, such as *P. (Kranaosphinctes) cyrilli* Neumann and *P. (Kranaosphinctes) gyrus*. Buckman

For the lowermost Transversarium Zone, in the Buckmani Subzone, the most typical elements are the representatives of *Dichotomosphinctes* [such as *P. (D.) antecedens* Salfeld, *P. (D.) buckmani* Arkell, *P. (D.) dobrogensis* Arkell, and represenatives of *Perisphinctes* s.str. [such as *P. (P.) aff. maximus* Young & Bird, *P. (P.) tumulosus* Buckman, *P. (P.) parandierii* De Loriol, *P. (P.) aff. parandieri* De Loriol.

The base of Elisabethae Subzone is characterized by first occurence of *P. (Dichotomosphinctes) elisabethae* De Riaz. It is also characterized by closely allied species such as *P. (D.) crotalinus* Siemiradzki, *P. (D.) luciae* De Riaz, *P. (D.) luciaeformis* Enay. Among macroconchs- *P. (Peripshinctes) pumilus Enay* and *P. (P.) aff. andelotensis* Enay appear. At the uppermost part of this subzone the first representatives of Subdiscosphinctes occur. The Wartae Subzone is characterized by occurence of *P. (Dichotomosphinctes) wartae*Bukowski and its macrococh counterpart, *P.(Peripshinctes) cautisnigrae* Arkell. Representatives of *Subdiscosphinctes* are abundant.

The base of the Stenocycloides Subzone is characterized by the first occurence of *P. (Dichotomoceras) bifurcatoides* Enay and *P. (Dichotomoceras) dichotomum*. Buckman. *P. (Dichotomosphinctes) wartae* Bukowski, occurs in the lowermost part of the subzone.

II. UPPER OXFORDIAN PALEONTOLOGY
(B. A. Matyja, N. E. Poulsen and A. Wierzbowski)

AMMONITES:
The detailed biostratigraphical succession at the turn of the Bimammatum and Planula Zone in the Wielun Upland, Central Poland, was presented during the Meeting. Five ammonite horizons have been recognised, viz. the Litocerum horizon and the Broilii horizon in the Hauffianum Subzone of the Bimammatum Zone, and the Minutum horizon, the Proteron horizon and the Planula horizon in the Planula Zone. The stratigraphical position of the *Amoeboceras* layer lies in the Litocerum horizon of the Hauffianum Subzone of the Bimammatum Zone. The layer marks a short-time invasion of the Boreal/Subboreal ammonites into the Submediterranean Province including such forms described previously as *Amoeboceras (Plasmatites) bauhini* (Oppel), *A. (P.) praebauhini* (Salfeld) and *A. (P.) lineatum* (Quenstedt), as well as recently discovered *Pictonia densicostata* Buckman, and *Prorasenia bowerbanki* Spath. The presence of these ammonites, and especially of *Pictonia densicostata*, shows that the lower boundary of the Subboreal Kimmeridgian corresponding to the base of the Baylei Zone, lies not higher than the Litocerum horizon of the Hauffianum Subzone in the Submediterranean Succession; in fact it may lie still lower, somewhere between an upper Bimammatum Subzone and a lower Hauffianum Subzone of the Bimammatum Zone.

DINOFLAGELLATE CYSTS
have been studied from many of the same sections, where the ammonites studies have been carried out. But most of the samples studied from this part of the Jurassic of Poland are very poor in number of dinoflagellate cysts, unlike the Bathonian or the Kimmeridgian-Volgian Jurassic of Poland. Dinoflagellate cysts are to rare in the samples of the Middle-Upper Oxfordian of Central Poland to give any detailed stratigraphy. At best, they do only confirm the ammonite biostratigraphy.

BACKGROUND
(B. A. Matyja, N. E. Poulsen and A. Wierzbowski)
The meeting was part of a study carried of in co-operation between the Geological Institute, University of Warsaw and GEUS. The project is supported financially by the Danish Ministry of Environment and Energy (The Danish Energy Agency). The project:
"Stratigraphy of the Polish Middle to Late Jurassic Epicratonic Basin: Facies and Basin History"

The Project involves a study of the Bajocian-Callovian (Middle Jurassic) organic-rich claystone succession and the succeeding Oxfordian (Late Jurassic) carbonates in central Poland. On the basis of this work, models will be proposed for the regional potential for source rocks and for carbonate reservoirs in association with salt structures. The study includes sedimentological, palynological and organic geochemical facies description (including palynofacies and maturity analyses), and erection of a detailed high resolution correlation between the Polish Submediterranean Province (northern Tethyan realm) and the Subboreal Province of the North Sea area (chronostratigraphy and dinoflagellate zonation). Establishment of a detailed high resolution stratigraphic correlation of the polish Submediterrane (northern Tethys) and the North Sea area Subboreal stratigraphy (chronostratigraphy and dinoflagellate zonation). Description of facies and basin history in relation to the established high resolution stratigraphy. Detailed sedimentological and palynological (including palynofacies and maturity analysis) facies description of the organic rich clay deposits and the overlaying carbonate sequence in the study area. To propose models for the regional possibilities for Jurassic source rocks and carbonate reservoirs in relation to salt structures.

5. 6. REPORT OF THE OXFORDIAN-KIMMERIDGIAN BOUNDARY WORKING GROUP

by
François ATROPS
Conenor

In 1997, efforts have continued to advance the problem of the correlation of the base of theboreal / subboreal Kimmeridgian (Baylei Zone, Densicostata Horizon) with the base of the submediterranean Kimmeridgian which is still classically located between the Galar Subzone and the Platynota Zone (Polygyratus Horizon ; Atrops, 1994).

In the submediterranean province, good ammonite successions, well located on several sections of Swabia (Upper Danube valley and Lochen area, SW Germany), have recently been studied by Schweigert and Callomon (1997) at the transition of the Bimammatum and Planula Zones. Here, the Bauhini Horizon characterized by *Amoeboceras bauhini* (Oppel) marks the youngest horizon of the Hauffianum Subzone (Late Oxfordian) of the Tethyan zonation. The comparison of Amoeboceratids permits a correlation of this horizon with the base of the Subboreal Kimmeridgian (Baylei Zone, Densicostata Horizon) where *Amoeboceras bauhini* (Oppel) is also present. In consequence, it seems now clear that the «Upper Oxfordian» (sub)-mediterranean Planula Zone is completely of Kimmeridgian age in the northwestern european sense.

Concordant results were presented during the Oxfordian meeting which was held in Poland (Warsaw, 26-28 May 1997). Good ammonite successions in the Wielun Upland, Central Poland were presented at the turn of the Bimammatum and Planula Zones. The Hauffianum subzone is subdivided into two horizons, the Litocerum horizon and the Broilii horizon. In the lower (Litocerum horizon), occur, besides submediterranean forms, typical boreal / subboreal ammonites as *Amoeboceras bauhini* (Oppel) and *Pictonia densicostata* Buckman. The presence of these ammonites shows also that the lower boundary of the submediterranean Kimmeridgian takes place into the Hauffianum subzone.

These two new works, carried out in SW Germany and Central Poland, are important contributions for the correlation of the lower boundary of the Kimmeridgian in Boreal and Tethyan provinces. There is now a large agreement to consider that the submediterranean Planula Zone correlates with the major part of the Baylei Zone. The base of the Platynota Zone (Bayi horizon ; Atrops, 1994 b) corresponds to the upper part of the Baylei Zone (Atrops et al., 1993).

Now, it remains to make the last gait, i. e. to choose formally in England the reference section for the Kimmeridgian GSSP. As it was noted in the last Newsletter (Atrops, 1997) and in Schweigert and Callomon (1997), the best choice for a GSSP would be a section located in the Dorset, even if the South Ferriby section (Lincolnshire, Central England) is now well exposed and documented (Schweigert and Callomon, 1997). For the type area it is traditionally the surroundings of Ringstead, but some inconveniences exist. So, in accordance with J.H. Callomon, sections located at the West (Osmington Mills or Black Head) would be more convenient. One of this have to be choosed formally by our English colleagues, as primary standart basal stratotype of the Kimmeridgian.

It is also necessary to select a complementary reference section in the Tethyan Realm. The localities of Crussol and Châteaneuf-d'Oze (SE France) have been proposed (Atrops, 1995). The section of Crussol is the best because it supplies a detailed biostratigraphic resolution and a good magnetostratigraphic scale (Ogg and Atrops in preparation). Some sections in Swabia (SW Germany) are also excellent (Schweigert and Callomon, 1997) and they allow good correlations with the English stratotype. But the Southeastern France sections, particularly the Crussol section are easy to correlate with the German ones.

It would be desirable that the next Working Group Meeting takes place in Southern Gernany (Sttutgart) in order to visit the sections and discuss the definitive proposals of primary

and secondary statotypes. The formal proposition and the vote will be made before the end of 1998.

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THE KIMMERIDGIAN WORKING GROUP

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COPE John. C. W., Univ. Wales, Dept. Earth Sciences, P.O. Box 914, Cardiff CF13YE, U.K. Suggested section: South Ferriby (England). Field of interest: Ammonites.

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5.7. REPORT OF THE KIMMERIDGIAN-TITHONIAN BOUNDARY WORKING GROUP

by
Fabrizio CECCA
Vicechairperson

FIELD MEETING IN SOUTHERN FRANCE

During the printing of the present Newsletter, the 1st Meeting of the Working Group is taking place in Southern France.

François ATROPS has organized a field program devoted to the visit of potential candidate GSSP sections in Ardèche and in Provence.

November 14th will be devoted to discussions on the sections, scientific communications, resolutions, further programs of the WG and revision of ammonite collections.

The results of this Meeting will be summarized in the Newsletter n° 9 of the Working Group on Kimmeridgian - Tithonian Boundary.

The Tithonian Working Group

The Directory of the Working Group has been published in the Newsletter n° 23.

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. These papers correspond **only** to those which have been communicated to the Vicechairperson.

DIMKE M. & ZEISS A. (1997) - Die Hangenden Bankkalke östlich von Liptingen (Unter-Tithon, südwestliche Schwäbische Alb) - Stratigraphie, Faziesübersicht und neue Fossilfunde. **Geol. Bl. NO-Bayern**, 47 (1-4), 71-98, 2 fig., 5 pl., Erlangen.

GEYSSANT J. (1997) - Ammonites. Tithonien. **In**: GROUPE FRANÇAIS D'ETUDE DU JURASSIQUE "Biostratigraphie du Jurassique ouest-européen et méditerranéen: zonation parallèle et distribution des invertébrés et microfossiles", E. Cariou & P. Hantzpergue (Eds.). **Bull. Centre Rech. Elf Explor. Prod.**, Mém. 17, 97-102, pl. 25, 26, Pau.

SARTI C. (1996) - Ptychophylloceras bisulcatum (Ammonoidea): nuova specie di Phylloceratidae nel Titoniano del "Trento Plateau" (Alpi Meridionali, Italia). **Mem. Sci. Geol.**, 47 (1995), 245-251, 3 fig., 2 pl., Padova.

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6. JURASSIC THEMATIC WORKING GROUPS

6.1. WORKING GROUP ON SEQUENCE STRATIGRAPHY

by

Nicol MORTON
Convenor

6.1.1. 1ST CIRCULAR

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3rd February 1997

Dear Colleague,

ISJS Working Group on Sequence Stratigraphy

The new President of the International Subcommission on Jurassic Stratigraphy, Prof. Giulio Pavia, has asked me to take over as Convenor of the Working Group on Sequence Stratigraphy. My predecessor, Prof. Olaf Michelsen, has given this up on his appointment as Secretary General of the International Comission on Stratigraphy.

Historically, the Jurassic has been of great importance in the development of principles and concepts in stratigraphy, and I think Jurassic stratigraphers have a lot to contribute to the development of sequence stratigraphy. We have available to us a detailed widely-applicable biostratigraphic framework using ammonites and other groups which makes possible precise correlations of sequences between different basins, enabling local events and possible global events to be distinguished.

I hope that you can accept this invitation to participate and contribute to the Working Group; agreement with me

6.1.2. NEWSLETTER 1: JULY 1997

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A. Note from Convenor

Dear Colleague,

Thanks to your responses, our Working Group on Jurassic sequence stratigraphy is established and I am particularly pleased to have members working in industry as well as in academia and government organisations. There remain some gaps in representation, e.g USA and South America, so please encourage other colleagues to become involved. The aim of the Group is to enable and encourage cooperation, by exchange of information, ideas and suggestions. This does not have to be done "formally" through the Working Group, though it would be nice to let others know what's happening by sending me information for inclusion in

a future Newsletter. This first Newsletter includes the addresses of participating members with a (very) brief summary of research interests.

Nearly all include an Email address, and I imagine that this is likely to be the main mode of communication, so that this Newsletter is being distributed by Email except to a few members who do not have the facility. Since this is the first time I will have used the facility for most of you, I would be grateful for a brief acknowledgement of receipt, just to know that it has arrived.

B. Acknowledgements

I am grateful to Olaf Michelson for his help and encouragement to me in taking over convenorship of the Working Group, and to Birkbeck College for support (postage, telephone etc.) in the preliminary organisation.

The immediate financial future of the Working Group is secure thanks to donations from the following oil companies in the UK:
Amerada Hess Ltd, London
Amoco (UK) Exploration Co, London
BP Exploration, Sunbury-on-Thames
Elf Exploration UK plc, Aberdeen
LASMO plc, London
Ranger Oil (UK) Ltd, Guildford
Shell UK Exploration & Production, London

C. Jurassic Symposium in Vancouver, August 1998

As most of you already know the 5th International Symposium on the Jurassic System will be held in Vancouver on August 12-25, 1998. The Organizing Committee has agreed to my request for a special session on sequence stratigraphy in the Jurassic and information about format etc. will be included in their second Circular due to be distributed end September.
[If you didn't reply to the first circular contact Paul Smith at University of British Columbia, Email psmith@eos.ubc.ca or their Web Site at http://www.eos.ubc.ca/jurassic/announce.htm]

For the session on sequence stratigraphy I would like to encourage discussion and exchange of ideas and information rather than formal presentations. I understand the Symposium organizors will ask for manuscripts of papers for publication in the proceedings to be submitted at the beginning of the meeting, so this takes care of responsibilities to funding bodies. For the meeting itself we can then get on with something more useful, hence the following suggestions for format and content.

For each contributor the format I suggest is:

1. A poster which would display the information and data on which the interpretations are based (also the conclusions to complete the story and allow the poster presentation to stand alone);
2. A short verbal presentation (? 5 - 10 minutes) of the results, concentrating on the interpretations (and justifying them, including considering other possible interpretations, if only to eliminate them) and emphasising the reliability and precision of dating;
3. Time after each presentation for questions and discussion (? 5 - 10 minutes).

As for "content" I suggest asking each contributor to address the following:

1. What is your data/evidence, and what is its quality?
2. How have sequence boundaries been recognised and defined?
3. How has the sequence stratigraphy been interpreted in terms of causal mechanism? What alternative mechanisms have been considered, and why have these been rejected?
4. What is the evidence, and its quality, for dating the sequences, and especially sequence boundaries? How reliable and how precise are these dates (relative, numerical time-scales are a different problem!)?

Please note that these are suggestions for comment and discussion by the members of the Working Group; also that I would not wish to preclude other styles of presentation (e.g. integrated work by a group on an area or particular stratigraphical interval). We have some time

to modify the suggested formats etc. - suggestions to me or to Terry Poulton at GSC Calgary (Email in membership list).

D. Membership

I hope I have listed all your details correctly, and done justice to your "research interests"; please let me have any corrections. You'll notice that I have excluded titles, because this is an informal Working Group.

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identification/substantiation of sequence stratigraphy in the North Sea both on a regional/sub-regional and reservoir scale through a variety of stratigraphic and sedimentological techniques; effect of sequence development on palynomorph population dynamics.

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E. Book review

Last year (1996) Blackwell Science published a book which will be of interest to members of this Working Group. I was asked to review the book for the Journal of Petroleum Geology but I expect many of you will not see this journal (please ask me if you would like information about it), so I am circulating it with this Newsletter.

D. Emery and K.J. Myers (eds.) Sequence Stratigraphy
Blackwell Science, Osney Mead, Oxford OX2 0EL, UK
ISBN 0-632-03706-7; paper covers, 297pp; £29.50

Stratigraphy has become fashionable again. As often happens with the "regeneration" of a subject, there is a reason in the development of a unifying theory. For Geology as a whole, this was the advent of Plate Tectonics in the 1960's. For Stratigraphy, it is Sequence Stratigraphy - part method, part theory. This book, edited by Dominic Emery and Keith Myers from contributions by several of their colleagues, is a timely guide to the subject.

Modern concepts of sequence stratigraphy were largely developed in the oil industry. It is invidious to apportion all credit to individual oil companies (advances in science rarely develop in such isolation), but Exxon researchers are generally acknowledged as founders, with the work of their research group (Peter Vail and colleagues) in the late 1970's and early 1980's. The unifying theory at that time was the role of eustatic sea-level changes in controlling the accumulation of successive packages of sediment, with tectonics relegated to a secondary role. Subsequently through the 1980's and 1990's, many geologists and geophysicists in industry and in academia adopted and practised, well or badly, sequence stratigraphy. The subject is firmly established.

Doubts were expressed by some about the conclusions reached by the Exxon group, particularly concerning the primacy of eustasy as controlling mechanism. "Relative sea-level", without connotations as to cause, came to be adopted by many as the main factor, and the subject of sequence stratigraphy continued to be developed by many individuals and groups; again, those working the oil industry had a leading role. As an interested academic with fairly good links with the industry, my impression is that some of the best work was being done by BP, notably in the Mesozoic of the North Sea, but I hasten to acknowledge many valuable contributions by others.

The contribution by BP was the result of a deliberate policy, as acknowledged in the Preface of this book. A multidisciplinary Stratigraphic Studies Group was set up to develop the subject and apply it in real situations (such as exploration and development in the North Sea) and to provide training particularly (but not exclusively) in-house. This book is based on the unpublished course manuals, and is is a tribute to the authors that the project survived the seemingly interminable company reorganisations (and I write as an outsider !) to be published.

The book is organised in four parts, supported by 21 pages of references and a subject index:

Part 1 Historical Perspective (one chapter, five pages)

This gives a summary historical perspective on the subject (of which more later), but starts off with an unfortunate confusion. Fig. 1.1 purports to show the difference between lithostratigraphy and sequence stratigraphy, but confuses sequence stratigraphy with chronostratigraphy. They are not synonymous, and the figure illustrates the latter. I found this section particularly revealing, because it seems to illustrate the extent to which British universities failed to teach stratigraphy to their students. The authors' training in this field appears to derive only from oil industry courses. Thus, all the discussion centres on American ideas (Gilluly, Sloss etc.), and AAPG and SEPM publications. British and European work, such as on cyclicity in the Jurassic by Tony Hallam or on Carboniferous mesothems by Bill Ramsbottom, is not mentioned.

Part 2 Concepts and Principles(one chapter, 31 pages)

In this chapter the basic concepts and principles of sequence stratigraphy are explained and illustrated. In a subject bedevilled by American theory-derived terminology, the authors have been reasonably successful in their explanations, although it has to be said that jargon remains a problem. This is partly overcome by the illustrations, which are clear and well-presented, though sometimes unnecessarily separated from the relevant text. Criticisms can be made of details, such as the lack of a definition of the term "basin architecture" and of the fixation with rift to passive-margin basins which have a shelf-shelf edge- deeper basin profile. Other basin profiles and tectonic settings are hardly mentioned.

The authors clearly distinguish between relative sea-level (which may be controlled, at least partly, by basin tectonics) and eustatic sea-level (which is independent of basin tectonics), and this is an important plus for them. However, I remain concerned that the Exxon heritage, of sequence stratigraphy being controlled by eustatic sea-level changes, remains like a ghost in the background. It has influenced terminology, particularly of systems tracts (high-stand, low-stand etc.), but may also colour ways of thinking. For example, if basin tectonics is the driving force of sequence stratigraphy, this need not be synchronous in different areas, so that the boundaries of sequences could be diachronous, even within one basin, never mind between basins. The chronostratigraphic significance and correlation of sequences require proof in each case.

Part 3 Sequence Stratigraphic Tools (four chapters, 63 pages)

This part describes the main tools of sequence stratigraphy, but is heavily biassed towards the subsurface, with one chapter each on seismic stratigraphy, outcrop and well data, chronostratigraphic charts and biostratigraphy. Some assumptions about background are made; for example, in the chapter on seismic stratigraphy, the difference between migrated and non-migrated seismic data is not explained, and the definition of vertical resolution is unsuccessful. I would also criticise a tendency for assumptions about depositional environments to creep into some discussions, with possible consequences for objective analyses of data.

The bias towards the subsurface, understandable given the genesis of the book, means that some topics are inadequately covered for more general application. Thus, the chapter on log suites and their interpretation is excellent, but comparison with outcrops and discussion of sequence stratigraphy at the surface is not successfully addressed. Similarly, the chapter on biostratigraphy (which also discusses biofacies well) is good but confined to microfossil groups. Macrofossil groups hardly get a mention, even though they would be at least equally important for sequence stratigraphy at surface outcrops. In some circumstances, such as in the Jurassic, some macrofossil groups would provide the far more precise biostratigraphic dating which is vital to underpin sequence stratigraphy.

Part 4 Applications to Depositional Systems (six chapters, 159 pages)

The final, and longest, part of the book discusses and illustrates the application of sequence stratigraphy to various depositional systems, arranged as chapters on fluvial, paralic, deep-marine clastic and carbonate systems, followed by a chapter on organic-rich facies and hydrocarbon source rocks. These concentrate on the dynamics of depositional systems, and tend to be somewhat theoretical. Some real examples are worked through in illustration, but I would have liked to see more integration of model with example. This section then concludes with a chapter on computer modelling of basin fill. It gives essentially one good example, but not much more and the relevance of this to the rest of the book is questionable.

Sequence stratigraphy is an important and useful tool in the analysis of sedimentary successions. This book is not the last word in a continuously evolving subject, as the authors state in their Preface. It does, however, give clear statements about principles and methods, also some pitfalls, and there are excellent illustrations which will surely be widely copied and used. This book should be a best-seller.

One final word, though. Sequence stratigraphy is a method of analysis based on a theory. It must not be abused by over-interpretation of available data, so that all interpretations of sedimentary successions are forced into a pre-determined model. What if the model is not always relevant or correct?

F. Looking forward

The donations received from the oil companies will ensure that the Working Group can continue, but only if you as members find it useful and contribute to it. For example, please send me items of interest (such as information about forthcoming conferences, planned fieldwork and research projects) for inclusion in future Newsletters.

At present I think I have some technical limitations. I use Macintosh computers and this text has been written using Microsoft Word version 4.00D (yes, I could use a more up-to-date version). The Email system is Eudora version 1.4. It is my understanding that this text can be received and read by any computer system, but I cannot format the text (e.g. using bold, italics,

etc.). As an alternative I could send the Newsletter as an attachment, with formatted text and even diagrams, but how many of you could read it? Some "technical" comments about the situation at your end from you would be appreciated.

For the future I am considering setting up a Web site here that any of you could log into to obtain information or post information for others. Again, a question - is this a useful thing to do? The other suggestion is to establish an electronic user discussion group using Mailbase.

Finally, because this is the first time of using an Email distribution with the Working Group, I would appreciate a message that the Newsletter arrived in readable condition. But please do not do this as a simple reply, or I might get the whole document back as well!!!

With all best wishes, and I hope we can all meet up in Vancouver.
Nicol MORTON

6.2. REPORT OF ACTIVITIES IN THE JURASSIC MICROFOSSIL GROUP IN 1995-97

by Niels POULSEN
Convenor

The Jurassic Microfossil Group is an informal group of the ISJS, and as such has held no meetings since the past meeting in 1994 of the ISJS in Mendoza, Argentina. The current membership includes more than 150 members and a computer database of all the member that includes individual addresses, specialities, current projects, and recent publications.

A newsletter has been produced by the secretary (the co-secretary Karen Dybkjaer has been on maternity leave and has not participated in the work of the JMG secretariat). The Newsletter contained information on ongoing activities of the working groups of ISJS, on upcoming meetings within and outside ISJS, summaries of current research of working groups, proceedings of meetings, information on Internet databases (home pages), and directory of the ISJS and working groups. A meeting of the JMG is being planned for the next meeting of ISJS in Canada in 1998.

7 - UP-DATED DIRECTORY OF THE ISJS

BUREAU 1996-2000

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WORKING GROUP LEADERS

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MICROFOSSIL WG: POULSEN N. E.

8 - ENCLOSURES

8.1. 5th INTERNATIONAL SYMPOSIUM ON THE JURASSIC SYSTEM

2nd CIRCULAR

REGISTRATION

Fees
Refer to attached blue Registration form and Request for Accommodation form for all details on registration, fieldtrip and accommodation fees.

Please note that all costs are given in Canadian dollars; check the current exchange rate with your bank or other financial institution. PAYMENT MUST BE IN CANADIAN DOLLARS. The easiest method of payment for overseas visitors is by credit card (Visa, Mastercard) because debits are made automatically in Canadian dollars. Alternatively, you may pay using a Canadian dollar money order.

Payments for Registration/Fieldtrips, and for Accommodation, must be made separately.

Deadline for payment of Symposium Registration/Fieldtrip fees is March 2, 1998, after which the fee increases by 25%. The deadline for fieldtrip registrations is March 2, 1998. Cancellations received prior to July 1, 1998 will receive a reimbursement of 80% of the original payment; all refunds will be processed after the Symposium.

Costs of the Symposium Programme and Abstracts volume, the Proceedings volume, Opening Reception, Symposium banquet, and coffee breaks are included in the Registration fee for all Participating members. The special reduced rate for students does not include the Symposium Proceedings. The costs of the Symposium Dinner and Opening Reception are included in the Registration fee for Accompanying members.

	BY MARCH 2 1998	AFTER MARCH 2 1998
Participating Member	**CAN $300**	**CAN $375**
Student Member	**CAN $160**	**CAN $200**
Accompanying Member	**CAN $100**	**CAN $125**

Financial Assistance
The Organizing Committee is exploring ways of helping to defray expenses for Participating members in need of assistance, especially those from developing countries. Such members may request a subsidy for one or more of the following:

1. Waiver of the Symposium registration fee;
2. Accommodation expenses in Vancouver;
3. Up to 50% of airfare between home country and Canada.

All applications will be judged according to the applicant's scientific qualifications, intentions of active participation in the Symposium, and demonstrated financial needs. A single-page statement outlining relevant information on these criteria should be provided to the Organizing Committee as early as possible.

To help the Organizing Committee offer financial assistance to deserving colleagues, personal donations are being requested. If you are able to assist in this way, please send a donation to Paul Smith, noting it as a contribution to the Financial Assistance program. Cheques should be made payable to U.B.C.

Accompanying Members
Information on events and places to visit and assistance with bookings and travel, will be provided at the Symposium each day.

GENERAL INFORMATION

Canada Customs and Entry Regulations
Citizens or permanent residents of the United States can cross the border either way, usually without difficulty, delay, or the need for passports or visas. However, to speed the crossing, visitors should carry identification, such as a passport, birth or naturalization certificate, as they may be asked to prove citizenship. A driver's licence is NOT accepted as proof of citizenship. Persons visiting from countries other than the U. S. must have a valid passport, and may require other documentation such as visas. Please check with travel agents, airlines and/or Canadian consulates in your country well in advance of travel for information on visa requirements. All persons entering Canada must fill out a declaration for Canada Customs

Currency and Exchange
The Canadian currency is the Canadian Dollar which currently is worth approximately U.S.$ 0.71 **(please note that all prices in this Circular are in Canadian dollars)**. The most commonly accepted credit cards throughout Canada are Visa, Mastercard and American Express.

Medical Insurance
Medical insurance is essential and proof of insurance is required for fieldtrip participants. It is the responsibility of everyone attending the Symposium and its field trips to arrange their own coverage through their insurance or travel agent. If you have difficulty obtaining insurance in your own country, we suggest you contact the British Columbia Automobile Association and inquire about their visitor's insurance scheme. They can be reached at (604) 268-5555 or 1-800-663-1956.

Climate
Warmed by the Japanese Current and protected by a ring of mountains, Vancouver enjoys mild temperatures all year. Summer temperatures are in the low 20s Celsius (mid-70s Fahrenheit).

Electricity
Outlets and voltage (110 V) are the same as in the United States. Small appliances such as razors, hair dryers, irons can be used in Canada. For those from other countries, adapters are required for electrical appliances; power outlets for domestic appliances and computers usually have 2 flat, parallel pins.

Tax
British Columbia has a provincial room tax of 8%. A provincial sales tax of 7% applies to all retail purchases except liquor (10%). The Federal Goods and Services tax (GST) of 7% is an additional tax applicable to most purchased goods and services, but can be partially recovered by non-residents of Canada. Foreign visitors may claim a full rebate of GST paid on goods which they take out of the country within 60 days of purchase, and on short-term accommodation (defined as less than one month per location). A rebate cannot be claimed for the GST paid on alcohol, tobacco or gasoline. The application form is found in a Revenue Canada publication, GST Refund for Visitors, which is available at Canada Customs offices throughout the Province, at border crossings, and at many hotels. Claims, which must be for a minimum amount of $7 (representing $100 in goods and accommodation purchased), can be submitted up to one year after the date of purchase. For more information or assistance, call the following numbers:
From outside Canada: (902) 432-5608
From inside Canada: 1-800-66VISIT (1-800-668-4748)

Travel Notes
Please note that only Fieldtrips B2 and B3 begin and end in Vancouver. For the other trips you must arrange your own flights as described in the section of this Circular dealing with Fieldtrips.

Vancouver International Airport is approximately a 20 minute drive from the UBC campus. Taxi is the most convenient way to make the journey. On departure from Vancouver, a fee is levied by the airport authority ($15 for international; $10 for the U.S. and flights within Canada; $5 for flights within British Columbia) and is payable as you enter the gate security area.

If you are taking part in Fieldtrip A2 to Nevada, or if you plan to visit the U.S. before or after the Symposium, you should contact the American Consulate to obtain the necessary visa before leaving home. Allow plenty of time to make these arrangements.

Symposium Dinner (Wednesday, August 19)
This event is included in the Registration fee for all Participating and Accompanying members. You will be treated to a traditional First-Nations alder-smoked salmon barbeque on the grounds of the Museum of Anthropology, dramatically located atop the Point Grey cliffs and overlooking the Pacific Ocean and Coast Mountains. You will also be taken on a guided tour of the Museum which exhibits a spectacular collection of Northwest native art, including totem poles and ceremonial artifacts.

SCIENTIFIC PROGRAMME

All Plenary Sessions, Scientific Sessions, Working Group meetings and Poster Sessions will be held on the campus of The University of British Columbia. Each presentation will be 15 minutes long with 5 minutes for discussion. Each meeting room will be equipped with two 35 mm slide projectors (5 x 5 cm transparencies), two screens and one overhead projector. Glass mounted slides are not acceptable.

Official Language
In all sessions and publications, English will be the preferred language of communication. No facilities for simultaneous translation will be available.

Scientific Sessions
Talks and papers on all aspects of the Jurassic System are welcome, particularly those dealing with stratigraphy, correlation, environmental evolution, paleogeography, paleontology, and economic geology. In addition, the following **Special Sessions** have been proposed. If you would like your talk or paper to be included in one of these Special Sessions, please include a note to that effect with your Abstract.

1. *The Hispanic Corridor: Tethyan-Pacific Connections in the Jurassic.*
Organizers: Paul L. Smith & Giselle K. Jakobs.
In the Late Triassic, rifting of Pangaea began that eventually led to Middle Jurassic drifting and the birth of the Atlantic Ocean. The Hispanic Corridor was a marine connection along the North Atlantic and through central America that linked the western Tethyan and eastern Pacific oceans. It was undoubtedly influenced by eustatic sea level changes and it may have preceded drifting by many millions of years. We invite contributions to this Special Session that will shed light on the timing of formation of the Corridor and its subsequent impact on the biosphere, lithosphere, atmosphere and hydrosphere. Of particular interest are its links with climate, ocean circulation, biogeography and orogeny. By involving the geophysical, geological and paleontological research communities we hope to further significantly our understanding of this fascinating Jurassic event.

2. *Jurassic Magmatism, sedimentation, and metallogeny in British Columbia: a window into the nature and assembly of the outboard Canadian Cordilleran terranes.*

Organizers: Bob Anderson and Larry Diakow.
Volcanic arc magmatic and successor basin sedimentary rocks help record the final terrane-specific and later amalgamation and accretionary tectonic events involving the Paleozoic to Jurassic outboard terranes of the Canadian Cordillera. As well, the Jurassic arcs are disproportionately endowed with base and precious metal deposits, relative to their area and distribution, compared with other terranes. Deposits occur as a variety of types including porphyries, mesothermal and epithermal veins, volcanogenic massive sulphides, and skarns. Biochronology, geochronology, and development of new time scales for the Jurassic are critical tools which permit correlation of the arc rocks around the areally more significant successor Bowser Basin. Geochemical character of the volcanic rocks helps define discrete petrological provinces and potential facing directions for the arcs. Sedimentation patterns and facies in the basins help unravel distinctive uplifted areas prior to, during, and after the Middle Jurassic amalgamation of the outboard terranes to North America.

3. *Jurassic Terrestrial Ecosystems*
Organizers: Christine E. Turner and Fred Peterson.
This Session will be devoted to examining and interpreting terrestrial ecosystems that existed anywhere on the globe during Jurassic time. The scope is broad and will include any specialties such as geochemistry, plant and animal paleontology and micropaleontology, trace fossils, sedimentology, stratigraphy, paleopedology, petrography, and paleogeographic and paleoclimatic reconstructions that might shed light on the nature of Jurassic environments. A special part of the Session will be devoted to reconstructing the Late Jurassic ecosystem of the Morrison Formation in the Western Interior of the U.S. and Canada.

4. *Sequence Stratigraphy in the Jurassic*
Organizers: Nicol Morton and Terry Poulton
This Session will compare results of sequence stratigraphic analyses in different basins by addressing the following questions: 1) what data/evidence do you have and what is its quality ?, 2) how have sequence boundaries been recognised and defined ?, 3) how has the sequence stratigraphy been interpreted in terms of causal mechanisms ? What alternative mechanisms have been considered and why have these been rejected ?, and 4) what is the evidence and its quality for dating the sequences and especially the sequence boundaries ? How precise and reliable are these dates ? The text of each paper should be submitted in the normal way as for other Symposium contributions, but presentation should be in the form of a poster displaying the information and data (with conclusions) with a short (5-10 minute) verbal presentation which concentrates on justifying interpretations and dating.

5. *The Jurassic Time Scale*
Organizer: József Pálfy
During the last few years considerable progress has been made in refining the Jurassic time scale. This Session will provide an opportunity to showcase recent research in radiometric dating, magnetochronology, Sr isotope stratigraphy, cyclostratigraphy, and integration of these approaches with biostratigraphy. This discussion on the present state of time scale calibration is expected to chart the course for future studies.

6. *Extinctions and Recoveries*
Organizers: Elizabeth Carter and József Pálfy
This Special Session will present recent research on the timing and causes of extinction and the dynamics of subsequent recovery for all groups from the Triassic-Jurassic boundary mass extinction until the end of the Jurassic. Contributions should emphasise causes, processes/mechanisms, rates of recovery, and multitaxial or theoretical approaches.

Poster Sessions
So that participants have adequate opportunity to study poster presentations and interact with authors, two late afternoon sessions (Monday, August 17 and Tuesday, August 18) have been set aside on the Programme as "Beer and Poster" sessions, when authors will be present for discussion; Posters will remain on display throughout the day. Presenters will have one side of a two-sided Poster board, measuring 8 x 4 feet (2.4 x 1.2m), which will be provided by the Organizing Committee.

Invited Lectures
Following the Opening Ceremony, several invited lectures will be presented covering the tectonic, magmatic and biostratigraphic frameworks of the Jurassic System in western Canada.

Virtual Attendance, Exhibits and Computer Displays
We can provide video facilities for those unable to attend the meeting but willing to record either a talk or a guided tour of a poster. You must provide us with your video cassette at least 2 months before the Symposium. There will be a charge for converting PAL videos to the North American video system.

Symposium participants are encouraged to bring and demonstrate any Web site or software applications or developments relevant to research and teaching. The Organizing Committee will need to know beforehand the computer platform and operating system each participant requires. These demonstrations will be run during the Opening Reception (Sunday night, August 16). Publishers and manufacturers who wish to have exhibit facilities at the Symposium should contact Paul Smith to discuss their requirements and the costs involved.

PUBLICATIONS

Call for Abstracts.
Abstracts for both talks and posters should be submitted by MARCH 2, 1998. Please indicate whether your submission is for a talk or a poster. Use a simple layout, where the Title is followed by the Author(s) name(s) and affiliation(s). In the case of multiple authorship, indicate with an asterisk (*) the name of the speaker or presenter of the poster session. The text must be in English, and should not exceed one page (about 450 words) in length. Do not include any figures and avoid citing and giving references. Two paper copies should be sent to Dr. Paul Smith (Department of Earth and Ocean Sciences, University of British Columbia, 6339 Stores Road, Vancouver, B.C. V6T 1Z4, Canada). It is strongly recommended that you also send an electronic version, either on a diskette formatted for IBM PC, or by e-mail. Use a file format readable for MS Word for Windows 7, or provide a plain text file. E-mail submissions should be addressed to:

<jurassic@eos.ubc.ca>.

The Abstract may appear in the body of your message or be included as a file attachment.

Accepted Abstracts will be printed in a uniform format and compiled into an Abstract Volume that will be made available to Participating members.

Proceedings.
Participants giving oral or poster presentations are invited to submit manuscripts for review and publication in the Symposium Proceedings.

All manuscripts must be received by the Publications Committee prior to, or during, the Symposium in Vancouver, August 1998.

Please provide **three** copies of the manuscript and all illustrations (do not submit original illustrations at this point). The Proceedings will be published by Transtec Publications, Switzerland in a format similar to that of the Mendoza Congress volume, "Advances in Jurassic Research". Papers should not exceed 10 pages of typed manuscript, single-spaced, including all maps, figures, and tables, which should be included within the text as numbered Figures, leaving appropriate space to separate captions from surrounding text clearly.

Text and illustrations must fit within the following page boundaries: width, 17 cm; height, 25 cm. All pages, including figures, will be reduced by approximately 20% during the printing process; keep this in mind when designing illustrations and selecting typeface.

Each paper should begin with a Title, followed by Author(s) name(s), address(es), Abstract, and Keywords, then the body of the text. All text formatting and reference citations should follow the pattern used by the Journal of Paleontology; see "Instructions to Authors" published in Journal of Paleontology, volume 69(1), pages 182-186 (1995).

Two reviewers will be asked to evaluate each paper; based on these reviews, selected papers will be returned to authors for revision and return to the Publications Committee by January 1, 1999. It is intended that the Proceedings volume be ready for distribution by the end of 1999.

FIELD TRIPS

Due to difficulties of access to many outcrops, and restrictions imposed by transportation and accommodation needs, the number of participants on most Fieldtrips will be limited. If necessary, preference will be given to active research scientists without accompanying family members. Please note that your family is welcome to stay in the UBC Conference Centre Accommodations while you attend a fieldtrip. Stout footwear is strongly advised on all trips. Weather conditions in coastal and mountain areas can be severe and participants are advised to come prepared for a range of weather conditions.

The deadline for all Fieldtrip registrations (with full payment) is March 2, 1998.

1. PRE-SYMPOSIUM FIELDTRIPS (A)
   Wednesday, August 12 to Sunday, August 16

Fieldtrip A1 Calgary to Vancouver
Registration fee: CAN $ 800.00
Leaders: Russell Hall, Jim Monger, Terry Poulton

Starting at Calgary, Alberta, ending at Vancouver, B. C.

Days 1, 2: Fernie Formation in Alberta Foothills and Rocky Mountains. Sinemurian basal contact with Triassic, Pliensbachian beds with mixed Tethyan/Boreal faunas, Toarcian black shales (ammonites, belemnites, squid), Bajocian grey shales (ammonites, fish, belemnite battlefield), Bathonian and Oxfordian marine units, and transition to non-marine uppermost Jurassic and Cretaceous.
Day 3: side-trip to Walcott Quarry in Cambrian Burgess Shale, Yoho National Park; moderately strenuous 10-hour, 21 km roundtrip hike, with 800 m elevation change each way.
As Parks Canada allows only 30 people per day to visit this site, all registrants may not be able to complete the Walcott Quarry hike; if, for physical reasons, you do not wish to make the hike but wish to register for the remainder of Fieldtrip A1, please indicate this on your application. For those unable to make the hike, attractive alternatives will be provided.
Days 4, 5: crossing of Cordilleran allochthonous terranes, examination of selected Jurassic strata, intrusives and bounding faults, discussion of timing of amalgamation of terranes to craton. Arrival in Vancouver.

Registration fee includes all meals, shared accommodation, transportation and guide. Note that this trip begins in Calgary, Alberta and ends in Vancouver, B.C.

Maximum number of participants: 40

Fieldtrip A2 Nevada
Registration fee: CAN $945.00
Leader: David Taylor

Starting at Reno, Nevada and ending at Reno.

Early Mesozoic back-arc marine record in western Nevada. Emphasis on Upper Triassic and Lower Jurassic marine strata, invertebrate fauans, and the exceptional Triassic/Jurassic boundary sequence in New York Canyon. We will travel to the Shoshone Mountains, Gabbs Valley Range, and Pamlico to examine the Luning, Gabbs, and Sunrise formations.

Arrive in Reno August 11; August 12-15 in Hawthorne; return to Reno on August 16. From Reno participants can take Reno Air flight 411 direct to Vancouver (leaves 3:15 p.m., arrives 5:15 p.m. Come prepared for hot, dry weather conditions. Fee includes hotels, transportation and lunches for 3 days in the field. Air fare from Reno to Vancouver NOT INCLUDED.

Maximum number of participants: 20

2. POST-SYMPOSIUM FIELDTRIPS (B)
   Friday, August 21 to Tuesday, August 25

Fieldtrip B1 Haida Gwaii (Queen Charlotte Islands)
Registration fee: CAN $ 900.00
Leaders: Howard Tipper, Elizabeth Carter, James Haggart, Russell Hall, Giselle Jakobs, József Pálfy.

Starting at Sandspit, Queen Charlotte Islands, British Columbia and ending at Sandspit.

This excursion provides an introduction to the Jurassic geology and Haida Indian culture of this unique archipelago whose rich faunas are known worldwide. Representative sections of the Hettangian through Callovian stages, the Triassic-Jurassic boundary, and typical Jurassic volcanic and sedimentary formations will be visited. Diverse Jurassic faunas may be collected, including ammonites, belemnites, bivalves, brachiopods, and samples for radiolarian and foraminiferal studies.

This fieldtrip is strenuous and not for the faint-hearted, but will give participants a once-in-a-lifetime experience ! We will visit rugged shorelines in open boats and traverse heavily forested trails. Participants need to be properly equipped with sturdy boots, tough clothing (including warm layers), and raingear.

Registration fee includes shared accommodation, breakfasts, most lunches, and a Haida Feast (other dinners NOT INCLUDED). The Registration fee DOES NOT INCLUDE the roundtrip airfare from Vancouver to Sandspit, Queen Charlotte Islands. The current domestic airfare is CAN$ 445; participants may get a substantially better rate by booking from their home country. The following flights must be booked by participants as early as possible to ensure seating: August 21, 1998, Canadian Airlines Flight CP 1265, departing Vancouver 8:25 a.m., and August 25, 1998, Canadian Airlines Flight CP 1268, departing Sandspit 5:55 p.m. and arriving Vancouver at 7:10 p.m. Allow for possible delays and leave plenty of time for connections when booking your return flight home.

Due to facilities on the Queen Charlotte Islands, the maximum number of participants will be 30; space is very limited and early bookings are essential.

Fieldtrip B2 Coast Mountains
Registration Fee: CAN $810
Leaders: Paul Smith, Andrew Arthur, Steve Irwin, Jim Monger, Terry Poulton.

Starting at Vancouver and finishing at Vancouver.

The Coast Mountain trip includes Fieldtrip B3 (described below), then continues north through the spectacular Fraser Canyon, west across the Coast Mountains, returning southwards along the scenic sea-to-sky highway to Vancouver. This is an adventurous trip, much of it on gravel roads. Sturdy footwear, cold-weather clothing, rain gear, and general fitness are required. Brief hiking excursions are necessary and one day will be spent flying by helicopter to several localities at 2,500 m (8,000 ft) elevation. There should be opportunities to view wildlife. Registration fee includes transportation, shared accommodation and guide; with exception of one sack lunch and some refreshments, meals are NOT INCLUDED.
Southwestern British Columbia is a collage of tectonic terranes whose often fossiliferous rocks range from coarse, shallow water clastics to oceanic cherts and limestones. Our interpretation of the oceanic rocks relies on microfossils. Igneous activity was common in the Jurassic, producing intrusions, lava flows, and ash beds whose radiometric dates provide an opportunity for time scale calibration. In the Ashcroft area, the Jurassic succession rests unconformably on igneous and Triassic sedimentary rocks and consists of Pliensbachian to Bajocian clastic rocks that contrast markedly with correlatives examined at Harrison Lake, part of a different terrane. In the Tyaughton Creek area we will examine the Triassic-Jurassic contact and overlying Hettangian and Sinemurian succession including the controversial *Badouxia* fauna. We will also examine a section that begins in the Lower Oxfordian, with *Cardioceras*, and extends into the Berriasian. The post-Early Oxfordian rocks are zoned by the bivalve *Buchia* in most of western and Arctic Canada, ammonites being rare or absent, and this section contains several species of *Buchia* characteristic of the succession.

Maximum number of participants: 18

Fieldtrip B3 Harrison Lake
Registration Fee: CAN $35
Leaders: Paul Smith, Andrew Arthur, Steve Irwin, Terry Poulton.

Starting at Vancouver and finishing at Vancouver.

A one-day trip, Friday, August 21. Harrison Lake, about 100 km east of Vancouver, occupies a long fault valley in the southern Coast Mountains, to the west of which is an unmetamorphosed succession of acid to intermediate lava flows, pyroclastics and fossiliferous volcaniclastic rocks ranging in age from Toarcian to Oxfordian. The Callovian is particularly fossiliferous. Registration fee includes transportation, sack lunch and guide. At the end of the day you will be returned to Vancouver.

REGISTRATION AND ACCOMMODATION FORMS

Please type or print clearly all information requested on the attached blue Registration forms; include all information for accommodation and Fieldtrip bookings.

Forms, with full payment (separate amounts for Symposium Registration/Fieldtrips, and for Accommodation), should be returned to the Jurassic Symposium Secretariat at the U.B.C. Conference Centre by March 2, 1998 or earlier.

Accommodation in Vancouver
All Symposium sessions and the Symposium dinner will be held on the campus of The University of British Columbia; the Organizing Committee therefore strongly recommends that all attendees take advantage of the lower rates, advantageous location, and high quality rooms provided by the Walter Gage Residence right on campus. Rooms and suites are modern, comfortable, and many provide stunning views of the mountains and ocean. There is a cafeteria nearby which provides light meals (7 a.m. to 7 p.m.) and a mini-mart where breakfast foods and groceries are available for those wishing to prepare some meals if their Residence suite has a kitchen.

U.B.C. accommodation prices are shown on the attached blue Request for Accommodation Form, which should be completed as soon as possible and sent to:
Reservations Office, U.B.C. Conference Centre,
The University of British Columbia,
5961 Student Union Boulevard,
Vancouver, B.C., Canada V6T 2C9.

It is also possible to register electronically at the Web site where you can pay by credit card:
http://www.conferences.ubc.ca

Vancouver Hotels
Rates for single rooms, and telephone numbers for reservations at selected hotels in Vancouver are also provided below; attendees choosing to use off-campus accommodation will be responsible for making their own bookings and for transportation to and from all sessions on campus (about 20 minutes by taxi). All phone numbers below are in Area Code 604; all rates are for one person.

Hotel Name	Single rate	phone
Barclay Hotel	49-129	688-8850
Georgian Court Hotel	150-175	682-5555
Holiday Inn on Broadway	159-194	879-0511
Hotel Georgia	145-180	682-5566
Pacific Palisades	145	688-0461
Landis Hotel	150-160	688-1234
Ramada	155-170	872-8661
Landmark Hotel	180-210	687-0511
Sylvia Hotel	75-150	681-9321

FIRST CIRCULAR RESPONSE

Replies to the First Circular questionnaire totalled 214 from 36 countries.

Africa	6
America (North and Central)	36
America (South)	13
Asia	29
Europe	124
Oceania	6

SYMPOSIUM WEBSITE

http://www.eos.ubc.ca/jurassic/announce.htm

SECOND AND THIRD CIRCULARS

The Second Circular is being mailed to all those who responded to the First Circular questionnaire and others who have expressed an interest. The Third Circular will be sent only to those who have returned the pale blue Registration Forms contained in the Second Circular along with the required fees by the deadline date of March 2, 1998.

Confirmation of a place on Fieldtrips will be by letter from the Fieldtrip leader; included will be detailed information on times and places of departure, accommodation, and local conditions.

CORRESPONDENCE

Correspondence concerning the Symposium should be addressed to:
Dr. Paul Smith,
Department of Earth and Ocean Sciences,
University of British Columbia,
6339 Stores Road,
Vancouver, B.C., Canada V6T 1Z4

telephone: (604) 822 - 6456
Fax: (604) 822 - 6088
e-mail: psmith@eos.ubc.ca

Correspondence concerning Symposium Registration should be addressed to:
Jurassic Symposium Secretariat,
U.B.C. Conference Centre,
5961 Student Union Boulevard,
Vancouver, B.C., Canada V6T 2C9

Fax: 1 (604) 822-1069

Correspondence concerning accommodation at The University of British Columbia should be addressed to:
Reservations Office, U.B.C. Conference Centre,
5961 Student Union Boulevard,
Vancouver, B.C., Canada V6T 2C9

Fax: 1 (604) 822-1001
Tel: 1 (604) 822-1010