INTERNATIONAL UNION OF
GEOLOGICAL SCIENCES
COMMISSION ON STRATIGRAPHY

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SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

NEWSLETTER No. 18

December 2001

I. U. G. S Subcommission on Devonian Stratigraphy

Newsletter No. 18, **December 2000**

Rex E. Crick
Department of Geology
UTA Box 19049
University of Texas at Arlington
Arlington, TX U.S.A. 76019-0049

Voice: 817.272.2977 / Facsimile: 817.272.2628 /e-mail: crick@uta.edu
SDS Web Site = http://sds.uta.edu

The *Newsletter* appears annually following SDS meetings. Contributions may be sent to the Editor at any time during the year for inclusion in the next issue. Guidelines for consideration in the preparation of contributions are presented on the inside of the back cover.

The printing of this issue is 150 copies with 113 mailed to titular and corresponding members, 19 to honorary members, Chairmen of the Carboniferous and Silurian Subcommissions, IUGS and ICS officers, friends of the Devonian, and libraries. Remaining copies are available from the Chairman, Secretary, or Editor. The costs of preparation, printing and postage for the *Newsletter* are shared equally by SDS and The Department of Geology, University of Texas at Arlington.

The *Newsletter* can also be viewed in electronic published format via the SDS World Wide Web site at URL **http://sds.uta.edu**.

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EDITORIAL NOTES

Apologies to all members who toiled to meet the initial deadline for submitting material for this issue. The completion of the Newsletter was delayed by the unavoidably late receipt of relevant SDS documents.

The organizers of the 15th International Senckenberg Conference – May 11 – 21, 2001(G. Plodowski, U. Jansen, P. Königshof, E. Schindler) put together a superb meeting. They are to be congratulated.

The Macquarie University group hosts the First International Palaeontological Congress in July 6-10 (2002) in Sydney. Specific questions regarding the Congress should be addressed to IPC2002@mq.edu.au.

Overlapping in real time and geologic time with the First International Palaeontological Congress is the International Symposium on the Geology of the Devonian System July 9-12 (2002) in Syktyvkar, Komi Republic hosted by the ICS of the Russian Academy of Sciences. Please contact organizer CM Vladimir S. Tsyganko at tsyganko@geo.komisc.ru.

In 2003, all SDS members are invited to attend the 10th International Meeting on Early Vertebrates / Lower Vertebrates May 5-9 (2003) in Porto Alegre, Brazil. Expressions of interest should be directed to Dr. Martha Richter via http://www.mct.pucrs.br.

Please make special note of the change in addresses for TM Klapper in the Member News section.

I regret that several figures and tables accompanying reports appear at less than acceptable resolution or in altered formats. Figures and tables included within MS Word documents or as part of an MS Excel spreadsheet do not work well with desktop publishing software. The problem can be solved by supplying all figures and tables as separate image files.

Rex E. Crick

MESSAGE FROM THE CHAIRMAN

Dear SDS members and Devonian fellows,

The 15th International Senckenberg Conference, a joint meeting of IGCP n°421 and SDS, was a multifaceted and edifying event with about 50% of the SDS members present and with more than sixty contributions on Devonian topics. SDS thanks Ulrich Jansen, Peter Königshof, Gerhard Plodowski and Eberhard Schindler for this well organized and most pleasant meeting. At the SDS Annual Meeting the most recent views on the subdivision of Devonian stages have been put forward: a large majority for a twofold division of the Emsian based on a level close to the Daleje Event; a substantiated and well documented analysis of the "Thaganic Biocrisis" proposing two conodont levels that might be used to define an Upper Givetian substage; an agreement on a threefold subdivision for the Frasnian and almost agreement on the stratigraphic levels; substantiated argumentation for either a threefold or fourfold subdivision of the Famennian.

In the context of these discussions I cannot pass over without comments the recommendation of the ICS Executive Committee (Spring 2001, Madison, Indiana) stating that "The ICS Executive Committee discourages formalization of outcrop-based GSSP's for substages or finer subdivisions of stages. However, standardization of global substages or other finer divisions using voted agreements on correlation criteria, such as primary biostratigraphic or magnetic markers, is to be encouraged when appropriate".

Our substage programme largely corresponds to this recommendation, formally defined substage GSSP's being not the essentials of substage definition. Standardization of global substages and their global correlation potential are the ultimate goals and therefore proposals for substage boundaries should be substantiated by recognition of the boundary level in a series of reference sections on different continents and belonging to both the pelagic and neritic realm.

I hope the present substage programme can be completed by 2004 when the International Geological Congress in Florence will be held.

ICS recommended that all Stratigraphic Subcommissions should strive to hold formal business meetings at each International Geological Congress. For the IGC in Florence 2004 SDS proposed a symposium on "Multidisciplinary high resolution stratigraphy of Devonian stages as a tool for standardization of global substages".

The **SDS BUSINESS MEETING 2002** will be held during the Eighth International Conodont Symposium in Europe (ECOS VIII) at the University Paul Sabatier Toulouse III on June 24 in the morning. Please complete the registration form for the SDS Business Meeting on the next page.

SDS supports the International Symposium "Geology of the Devonian System", in Syktyvkar (Russia), July 9-12, 2002.

P. Bultynck (Brussels)

REGISTRATION FORM FOR SDS BUSINESS MEETING 2002

Université Paul Sabatier, Toulouse III, June 24, 2002 (morning)

First name:

Surname:

E-mail address:

Fax:

I will attend the SDS business meeting at the Université Paul Sabatier, Toulouse [yes] [no]

I will present an oral contribution [yes] [no]

I will present a document [yes] [no]

Title of document or oral contribution

This form should be returned as soon as possible (before May 1st 2002) to the SDS secretary or chairman

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MINUTES OF THE 2001 SDS BUSINESS MEETING, FRANKFURT, GERMANY

The Annual Businness Meeting was held in the afternoon of Wednesday, 16th May, in the lecture hall at the Senckenberg museum, Frankfurt a.M. It took place in conjunction with the 15th International Senckenberg Conference, a joint meeting by IGCP 421 and by SDS, and perfectly organized by the Senckenberg people, especially by CM E. SCHINDLER, P. KÖNIGSHOF, G. PLODOWSKI, CM U. JANSEN and others. During the conference more than forty lectures were given and almost fifty posters were presented which mostly concerned the Devonian. With more than 130 attendants, the whole conference was an extraordinary success. It showed how alive Devonian stratigraphic research is and how much general interest in SDS activities exists. Pre-conference excursions led to the Ardenne Mountains, to the Mosel area and to the Lahn/Dill Synclines. A post-congress fieldtrip started in Thuringia and continued to the Barrandian.

ATTENDANCE

The business meeting was attended by a total of 78 people. This is the highest on record since a long time. It is hoped that the same level of interest cam be kept at the forthcoming Toulouse meeting.

Present: Chairman P. BULTYNCK, Secretary R.T. BECKER, TMs I. CHLUPAC, A. EL HASSANI, R. FEIST, HOU HONGFEI, W.T. KIRCHGASSER, R.B. RICHARDSON, J.A. TALENT, S. TURNER, W. ZIEGLER; CMs I. BARDASHEV, E. BENFRIKA, M. BENSAID, A. BLIECK, C.E. BRETT, D. BRICE, G. BROCK, J.A. EBERT, P. CARLS, CHEN XIU-QIN, M. GINTER, M.R. HOUSE, A. IVANOV, A. KIM, S. KRUCHEK, J. MARSHALL, B. MISTIAEN, M. MURPHY, T. OBUKHOVSKAYA, D.J. OVER, N. OVNATANOVA, M.C. PERRI, G. RACKI, P. SARTENAER, E. SCHINDLER, C. SPALETTA, M. STREEL, V. TSYGANKO, J. VALENZUELA RIOS, C. VERSTRAETEN, O.H. WALLISER, T. WRIGHT, G. YOUNG; Guests Z. S. ABOUSSALAM, M.W. AMLER, G. BECKER, J. BOCKWINKEL, M. COEN, C. CORRADINI, C. DOJEN, J. DOPIERALSKA, V. EBBIGHAUSEN, S. GAPKINOGLU, U. HERTEN, H. HÜNEKE, H. JAHNKE, S. KAISER, C. KLUG, P. KÖNIGSHOF, D. KORN, O. KRANENDONCK, I. LAKOVA, M. LEGRAND-BLAIN, LI JUN, LJAU, JAU-CHYN, G. MCINTOSH, M. MOHR, J.-P. NICOLLIN, I. NIGMADJANOV, T. OLIVEIRA, Z. PEREIRA, G. PLODOWSKI, H. REQUADT, G. SCHRAUT, A. SPREY, TIAN SHUGANG, P. WAGNER, H.M. WEBER.

1. INTRODUCTION

The Chairman opened the business meeting at 2.10 p.m. and welcomed everybody, including the numerous guests. He expressed his pleasure with the record attendance and with the conference held jointly with IGCP 421. Written, oral or indirect (via other SDS members) apologies for absence were recorded: Vice-Chairman R. CRICK, TMs J.L. GARCIA-ALCALDE, G. KLAPPER, C.A. SANDBERG, V.V. MENNER, P. MORZADEC, T.T. UYENO, K. WEDDIGE, E.A. YOLKIN; CMs J. HLADIL, R. MAWSON, F. RABBI KHAN, M.A. RZHONSNITSKAYA, L. SLAVIK, M. YAZDI.

A total of eleven reports has been submitted to the meeting which were numbered as follows:

1. WALLISER, O.H. & KIM, A: On lowermost Emsian tentaculites from the Zinzilban boundary section and their utility for correlation. – 2 pp.
2. U. JANSEN: The classical boundary Lower/Upper Emsian in Germany. – 6 pp.
3. YOLKIN, E.A. & IZOKH, N.G.: Emsian, Frasnian and Famennian substages: Today´s glance from Siberia. – 1 p.
4. BECKER, R.T. & ABOUSSALAM, Z.S.: Proposals for the definition of an upper Givetian substage. – 10 pp.
5. BULTYNCK, P, Casier, J.-G., COEN-AUBERT, M. &. GODEFROID, J.: Stop 9. Fromelennes-Flohimont. Middle-late Givetian. – 5 pp.
6. BECKER, R.T., MENNER, V.V., OVNATANOVA, N.S., KUZ´MIN, A. & HOUSE, M.R.: A potential middle Frasnian stratotype section at Chut River (southern Timan, Russia). – 8 pp.
7. PIECHA, M. & SCHINDLER, E.: Frasnian and Famennian subdivisions – results of German Late Devonian Working Group sessions 2000. – 2 pp.
8. CORRADINI, C., PERRI, M.C. & SPALETTA, C.: The Mrakib Section (Morocco) as possible upper Famennian (Devonian) stratotype section: conodont data. – 3 pp.
9. STREEL, M.: The Uppermost Famennian around the World (definition, biostratigraphical and sedimentological context). – 8 pp.
10. M.A. RHZONSNITSKAYA, M.: Interdepartmental stratigraphic Committee of Russian Commission on Devonian System. – 4 pp.
11. BECKER, R.T.: Alternatives for a substage subdivision of the Famennian. – 2 pp.

2. MINUTES OF THE RIO DE JANEIRO MINUTES

Approved.

3. CHAIRMAN'S BUSINESS

The CHAIRMAN noted that SDS is continuing to be one of the most active subcommissions within IUGS and that is has been repeatedly used as a positive example for others. Activities are highlighted by the two recent (2000/2001) SDS volumes published with the generous help of the Senckenberg Institute. These are Courier 220 and 225 which summarize the latest results of biostratigraphy in relation to stage boundaries, regional stage recognition and updates of stratotype investigations. Both volumes together amount to 552 pages. Two more Devonian volumes have been published through the efforts of Prof. EL HASSANI: The Excursion Guidebooks of the 1999 meeting, held jointly with IGCP 421, was published in late 2000 as Notes et Mémoires du Service Géologiques, N° 399 (128 pp.) whilst contributions presented in Errachidia are included in TAHIRI, A & EL HASSANI, A. (Eds.): Travaux de l'Institut Scientifique, Rabat, Série Géologie & Géographie Physique, N° 20 (115 pp.). In order to receive the volumes SDS members may contact A. EL HASSANI. CM OVER commented that the Guidebook of the 1997 Rochester symposium is planned to become available on CD. Guidebooks for the 1994 Moscow Meeting are also still available from Russian colleagues.

Finally the CHAIRMAN reminded that the number of substages is not yet formally decided since only preliminary votes had taken place. Postal votes of TMs will have to take place.

4. DEVONIAN SUBSTAGES

<u>4.1. Emsian</u>

Attention is drawn to the report in Newsletter 17 by CM MAWSON as head of the Emsian Working Group.

CM WALLISER explained the main points of his joint Document 1 with CM KIM on the dacryoconarid correlation between the Zinzilban stratotype and the Barrandian. It was hoped that recent tentaculite monographs by CM ALBERTI and S. GESSA would have allowed an easy solution of correlating the basal Emsian GSSP level into the Prag (= Praha) Formation but ranges of taxa are too disparate. For example, *Turkestanella acuraria* and *Guerichina strangulata* range only ca. to the top of the Prag Formation but well into the Middle *excavatus* (= *gronbergi*) Zone at Zinzilban. Last Central Asian graptolites also range this high and are found well above oldest *Nowakia praesulcata* which, in the Barrandian, do not co-occur with *Turk. acuaria*. There are two possibilities: either extinctions in graptolites and tentaculites were strongly diachronous between the two regions, or the GSSP correlates with a much lower level in the Prag Fm. and the conodont age of the upper Prag and lower Zlichov Limestones need to be revised. The latter explanations fits previous interpretations by CM CARLS & J. I. VALENZUELA-RIOS (see SDS Document 1999).

CM CARLS commented that there may be taxonomic uncertainties concerning *Po. gronbergi* and that oldest relatives may be absent in Morocco. The CHAIRMAN answered that *Po. gronbergi* enters just above *Po. excavatus* in Nevada and emphasized that the species is well represented in the Anti-Atlas. The SECRETARY noted that oldest Moroccan goniatites occur at Bou Tchrafine in the Lower *excavatus* Zone in shales below first *Po. gronbergi* whilst they enter much higher and well above last graptolites at Zinzilban. This supports a mismatch between the Middle *excavatus* Zone between these areas. It was agreed that further detailed revisions of early Emsian conodont ranges are needed. CM CARLS adviced not to use Zlichovian as name for a Lower Emsian substage, commented by the CHAIRMAN that this is anyway not recommended by the outcome of the preliminary votes on the matter.

CM JANSEN briefly summarized Document 2 on the Emsian in the German type area where it is incredibly thick (up to 5 000 meters), but, unfortunately, tectonically mostly complex. Regionally the Emsian was divided into substages (Ulmen, Singhofen, Vallendar, Lahnstein, Laubach, Kondel) which are better taken as lithostratigraphic formation groups. The Upper Emsian commences with the poorly fossiliferous Emsquarzit with *Arduspirifer arduennensis arduennensis* as an important brachiopod marker. It is underlain by the Stadtfeld Formation which still yielded *Anetoceras* as a typical lower Emsian goniatite. A range of other brachiopods seems useful to recognize the regional upper Emsian: forms of *Schizophoria (Pachyschizophoria), Paraspirifer, Plicostropheodonta* and *Iridistrophia*. Further correlation with Moroccan sections (e.g., Dra Valley) gives a very precise pelagic-neritic correlation potential.

The SECRETARY extracted from Document 3 the renewed statement by TM YOLKIN to place an intra-Emsian substage boundary at the base of the *nothoperbonus* Zone. This was strongly rejected by CM CARLS and others. The SECRETARY anounced that a formal vote on two Emsian substages will take place until the next business meeting but also emphasized that available data are still insufficient to decide precisely on a boundary level near the entry of *Now. cancellata*. Supported by CM VERSTRAETEN a call for new data and section descriptions was formulated.

<u>4.2. Givetian</u>

The SECRETARY outlined his joint Document 4 with Z.S. ABOUSSALAM. Detailed investigation of more than 25 sections in the Rhenish Massive, southern France and in Morocco did not provide an optimal section in pelagic facies with good records of conodonts, goniatites and other fauna around the Taghanic Onlap as prime candidate level to separate an upper Givetian substage. The Taghanic Event interval is taken to include time equivalents of the New York Tully Limestone, up to the transgressive base of the Geneseo Shale. Unfortunately, there is no marker conodont or goniatite which easily characterizes the Lower Tully level and initial Taghanic Onlap within the Middle *varcus* or *ansatus* conodont Zone. Several sections proved that supposedly typical middle Givetian *Maenioceras* and last agoniatitids overlap with oldest *Pharciceras* in beds with *Ozarkodina semialternans* (3rd Tully Sequence). *Po. latifossatus* is so rare in investigated sections that it was mostly impossible to recognitze the Upper *varcus* Zone in its strict sense which just postdates first *Pharciceras* in New York. Two levels are proposed which could serve to define an upper Givetian substage: either the entry of *Oz. semialternans* and of first *Pharciceras*, or the base of the *hermanni* Zone and the entry of more advanced pharciceratids (or *Mzerrebites erraticus*).

TM ZIEGLER plead to use either *Po. latifossatus* or *Schmidtognathus hermanni* for a boundary definition since the ancestry of *Oz. semialternans* is unknown. The SECRETARY repeated that the Upper *varcus* Zone was not recognizable in any studied Moroccan section. TM FEIST underlined the trilobite faunal change with the Taghanic Event and confirmed that the *semialternans* level is suitable in the Montagne Noire where it postdates several last occurences of trilobite genera.

The CHAIRMAN introduced Document 5 and reminded that the Belgian Fromelennes Formation is divided into three members. By contrast to former views, the lower member seems to fall still in the Lower *varcus* Zone since *Po. ansatus* has only been found well above the base. The middle member is biostromal and lacks conodonts. The upper member contains *Pandorinellina insita* of the *disparilis* to *falsiovalis* Zone. The *hermanni* Zone is not recogned in the Fromelennes Fm.

CM HOUSE asked for additional coral, brachiopod and magnetostratigraphy data. CM SARTENAER raised a terminology problem concerning most events and proposed to use different terms for recognized discrete event steps. CM VERSTRAETEN explained that the Lower Tully of New York marks the starting point for deepening but rather shallow-water facies is still developed. The maximum of transgression is reached in the Geneseo Shale. Paul Copper stressed that the base of the Tully lead only to a moderate brachiopod extinction and he suspects that the Tully level is difficult to correlate into Canadian reefs. The SECRETARY commented that a study in German reefs has shown that there is a significant extinction and faunal overturn in late Givetian corals but the precise extinction level within the event interval is still unknown. Post-event corals resemble Frasnian faunas (MAY & BECKER 1996). More data can be expected from still unstudied Moroccan pre- and post-event coral faunas. The discussion concluded with the call for additional Givetian data, including the documentation of ranges of different fossil groups.

4.3. Frasnian

CM OVER presented a brief report on the Frasnian Working Group which now has twenty members. Significant discussions have taken place by e-mail and were displayed on the website which is recommended to all SDS members. A straw vote showed a 12 out of 15 majority for three substages with boundaries near the base of *Pa. punctata* and of *Pa. semichatovae*. He drew attention to the fact that there may be different morphotypes within marker species. For example, the type specimen of *Pa. punctata* is from the Rhinestreet Shale which falls in MN Zone 8 whilst early morphotypes enter much lower (?Middlesex Shale, lower Cashaqua Shale) in MN 5. The SECRETARY asked conodont specialists to define morphotypes clearly, to establish their ranges and to clarify synonymies since various taxa are not accepted by all conodont workers. Taxonomic ambiguities affecting boundary level definitions, as at the Middle/Upper Devonian boundary, need to be avoided. The CHAIRMAN distributed extracts of his recent joint publication (GOUWY & BULTYNCK 2000) on graphic correlation of Belgian Frasnian conodont, coral and brachiopod faunas. Similar compilations from other regions would be highly welcomed.

The SECRETARY summarized Document 6 on Chut River, Timan, as a stratotype candidate for the base of a middle Frasnian. He emphasized the co-occurence of rich conodont and goniatite faunas with other fossil groups such as palynomorphs, ostracods, bivalves, nautiloids, fishes and nautiloids. The section can be easily reached from Ukhta and will be shown (again) during the 2002 fieldtrip in connection with the planned Syktyvkar Devonian symposium. A major advance of Chut River is the possibility to recognize a series of conodont and goniatite faunal levels within the *transitans* (MN 4) and *punctata* (MN 5-6) zones. The precise entry level of early morphotypes of *Pa. punctata* needs to be re-assessed by dense resampling around the base of the Domanik Formation. This level coincides with a change in goniatites (described in BECKER et al. 2001, Acta Geol. Pol.).

CM SCHINDLER gave a brief report on results of the German Upper Devonian Working Group (Document 7) which is actively studying various important sections in the Rhenish Massive, Thuringia and in the Fichtelgebirge (Bavaria). The group has decided against a formal redefinition of the German Oberdevonstufen but intends to provide proposals for the discussion on international Upper Devonian substages. Within the group, there is a majority for threefold Frasnian and Famennian subdivisions. The level of the *semichatovae* transgression in the Early *rhenana* Zone (= near base of MN 11) is preferred as base for an upper Frasnian. CM BARDASHEV, however, re-iterated his finding of *Pa. semichatovae* at much older level in Tadzhikistan. CM OVNATANOVA asked whether the zonal identification of the Central Asian *Pa. semichatovae* may be incorrect but this was refuted by CM BARDASHEV. It was agreed that conodont specialists should form a small working group in order to clarify the matter, based on material or illustrations. This shall be reported at the next business meeting. The Frasnian discussion was concluded with the SECRETARIES remark that formal voting on three substages will proceed until the next meeting.

4.4. Famennian

The SECRETARY, in his function as leader of the Famennian Working Group, gave a summary of activities since the Rio meeting (Document 11). Progress generally has been slow since registered working group members did not submit many contributions. Fortunately, the German working group is very active and is currently conducting research on six important sections: Beringhausener Tunnel, Nie Brickwork Quarry, Bohlen, Effenberg, Köstenhof (= Schübelhammer), Kahlleite East. The call for new descriptions of Famennian sections of other countries was repeated.

A significant development is a multi-authored submission by more than thirty Devonian specialists from France, Belgium, the UK, Portugal, Ireland, Brazil, Australia, Belarus and Russia who urge for an uppermost Famennian substage which roughly equals the Strunian. The SECRETARY stated that, although several of these specialists are not current SDS members, SDS would be ill-adviced to ignore such a strong move and declared that the discussion on three or four substages has to continue openly.

CM SPALETTA reported on their joint conodont efforts (Document 8) at Mrakib which had been proposed in 1999 as a type section candidate for an upper Famennian substage (BECKER et al. 1999, see 1999 SDS documents, also published in 2000 in the field guide). Despite its pelagic setting, as evidenced by incredibly rich ammonoid faunas, conodont faunas from thin limestones intercalated with the predominant shales are very poor and lack zonal diagnostic short-ranging species. This excludes the section from further conodont-based discussions. The SECRETARY noted that palynomorph investigations have proceeded by CM HARTKOPF-FRÖDER but results are not complete. Only some samples were productive with acritarchs being present.

CM STREEL introduced the audience to Document 9 on a recommended uppermost Famennian substage. In the meantime 43 specialists from 15 countries have signed their support and subscribed to an informal „Uppermost Famennian Working Subgroup". It was stressed that a fourfold (or even fivefold) division was justified with respect to the much longer duration of the Famennian in relation to the Frasnian and that the Strunian continues to be used in many publications as chronostratigraphic term internationally (69 recent papers, compiled by BRICE et al.). In the Middle to Upper *expansa* Zone interval several significant biostratigraphical markers are available which might be used to define a fourth substage. However, the best choice in pelagic sections may be the entry of *Pa. gonioclymeniae*.

TM HOU declared that Chinese SDS members and Devonian specialists in majority are in favour of an uppermost Famennian substage since it includes a time interval with many Carboniferous-type forms, e.g., amongst corals. Further support came from M. LEGRAND-BLAIN who is a CM of the Carboniferous Subcommission. The SECRETARY asked for an explanation why it is difficult to recognize a „Strunian transgression" in pelagic facies. It was decided to hold a second preliminary vote on substage numbers in the next Newsletter and SDS members are asked to submit short statements which give arguments in favour of three or four substages.

5. GENERAL DOCUMENTS

The topic was cancelled since Vice-chairman CRICK and TM WEDDIGE who both had announced contributions were absent.

6. ICS NEWS

Since time had progressed it was agreed to submit ICS news to the Newsletter. The CHAIRMAN remarked that ICS, under the new leadership, has become rather active. In Rio, the merging of subcommissions was heavily discused but no decisions have been made. All Subcommissions are asked to hold a symposium at the 2004 IGC in Firenze and SDS certainly will be present. Attention was drawn to statute guidelines which recommend limited service times (8 years) for subcommission officers.

7. MEMBERSHIP

The Secretary read a list of members who, according to the guidelines approved in 1999, had completely lost contact with SDS since more than three years, even after they were asked to renew their interest. These will put off the membership list from 2002 on.

7.1. Election of TMs

The Chinese members have proposed to elect CM ZHU Min, director of the Institute of Vertebrate Palaeontology at Beijing, as new TM, replacing YU Changi-min who had stepped down. Since less than fifty percent of TMs had remained at the meeting, election of ZHU Min will take place by postal ballot.

TM HÜNIKE, who has not been in contact with SDS in several years, will be asked to step down and to continue as CM.

7.2. Election of CMs

The following written proposals were presented prior to the meeting:

MA Xueping, Beijing University, proposed by CM BAI (who will step down)

Glenn BROCK, McQuarie University, Sydney, proposed by TM TALENT

Semen KRUCHEK, Minsk, proposed by TM MENNER

Ulrich JANSEN, Senckenberg Institute, Frankfurt a.M., proposed by TM ZIEGLER

Tamara OBUKHOVSKAYA, Minsk, proposed by TMs MENNER and BECKER

Maria SNIGRIEVA, Ekaterinburg, proposed by CM SCHINDLER and TM BECKER

Following a proposal by TM KIRCHGASSER, one vote for all was carried out and all candidates were approved unanimously.

8. Financial Report

Operating accounts

Income for 2001	US $
. carried forward from 2000	687.41
. IUGS-ICS Subvention for 2001	2,000.00
	2,687.41

Expenditure for 2001

. Financial support for 3 SDS members (El Benfrika, Ovnatanova, Tsyganko) to attend the SDS Meeting in Frankfurt	1,800.00
. Secretary expenses	300.00
. Contribution to Newsletter n°18 costs	400.00
. Bank commission	21.83
Total	2,521.83
Balance	165.58

9. Future Meetings

CM TSYGANKO invited SDS members to take part in a Devonian symposium and associated fieldtrips in July in the Timan which holds significant sections for current SDS tasks, only some of which have been visited after the 1994 Moscow symposium. Since there is time overlap with the 1st International Palaeontological Congress it was agreed to find a solution which allows members to take part in both events. [Unfortunately this agreement was not followed subsequently and the time overlap prevails]

TM TALENT repeated his invitation to attend the 1st International Palaeontological Congress in July 2002 in Sydney and recommended the associated excursions which will lead into the Devonian of New South Wales, Queensland and of the Canning Basin. IUGS subcommissions such as SDS are welcomed to show their activities at the 1st IPC and IGCP 421 with its strong emphasize on the Devonian will hold a meeting at the occassion. The 1st circular for IPC 2002 was distributed.

There were two offers to hold an SDS business meeting in connection with Devonian symposia in 2003. CM ASHOURI has submitted a written invitation for SDS to come to Mashad in NE Iran which is close to important Devonian sites of the eastern Elburz Mts. and not too far from other Devonian regions such as the famous Shotori Range. It is planned to hold an international Devonian symposium and several excursions. The SECRETARY supported an SDS meeting in Iran and reminded of the wonderful IGCP 421 symposium which had been organized by CM YAZDI in Isfahan in 1999.

TM EL HASSANI gave an invitation to hold an international Devonian symposium in 2003 in Agadir, easy to reach by cheap international flights, with excursion to the Dra Valley region which was inaccessible during the last two Moroccan SDS meetings. The Dra Valley is of special significance since it shows cyclic interfingering between neritic and pelagic facies as needed in our substage discussions. Detailed investigations of sections have recently been conducted by the Senckenberg Group and by TM BECKER and his collaborators.

It was proposed to hold one of the two proposed meetings in 2003, and the other in spring 2004, since it is expected that, as at most past IGCs, only a smaller number of SDS members is expected to take part in the rather costly next IGC in Firenze. [The problem of two invitations for 2003 has ben solved in the meantime since TM EL HASSANI agreed to invite to Agadir in spring of 2004. It is hoped that CM ASHOURI will renew his 2003 invitation.]

10. ANY OTHER MATTER

Time had progressed significantly and no other urgent matter was brought forward.

FAMENNIAN WORKING GROUP

FAMENNIAN SUBSTAGES – 2nd PRELIMINARY BALLOT

Since the first preliminary ballot on the number of Famennian substages, there has been a strong move by as many as 43 Devonian specialists from 15 countries who plead for at least four substages, with an Uppermost Famennian to become a rough equivalent of the classical Strunian of the Ardennes. Regional SDS groups have expressed support either for three (Germany) or for (China) substages. All SDS members (TMs and CMs) are herewith asked a second time to express their opinion on three or four Famennian substages. AT THIS STAGE, DEFINING LEVELS ARE NOT YET ASKED FOR but opinions concerning this aspect are welcomed to be submitted to the Working Group leader, TM BECKER. Everybody is asked to make up his/her mind and to consider the various documents and proposals which have been presented since 1997 at the business meetings or in the Newsletter. Please remind the various contributions by TMs ZIEGLER & SANDBERG, TM BECKER, CM STREEL et al., TM YOLKIN etc. Please also consider that substages should be relevant in all facies belts, from terrestrial to deeper marin/pelagic.

Your votes should be submitted until 1st June 2002, either by e-mail (rbecker@uni-muenster.de) or by normal mail to the Working Group leader.

R.T. BECKER

O I am in favour of three Famennian substages

O I am in favour of four Famennian substages

COMMENTS

Name

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REPORTS & DOCUMENTS PERTAINING TO SUBDIVISION OF DEVONIAN STAGES

THE IMPORTANCE OF DEVONIAN SUBSTAGES:A COMMENTARY

TM R. Thomas Becker, Münster

SDS is currently and actively discussing the definition of substages for the Emsian, Givetian, Frasnian and Famennian. For this purpose working groups have been established at the Annual Meeting in Morocco in 1999. Although there has been an extensive intitial discussion on the necessity of substages, I am aware that a number of SDS members still keep reservations and this is both expressed by the low number of contributions received in some of the working groups, by some critical remarks made unofficially or included in the Newsletter (see, e.g., notes by CM's Perri & Spaletta, this ussue). For this reason, I like to re-emphasize the importance of our current substage work which does not mean that other equally important tasks, such as cross-facies correlation, absolute dating and diversity studies, should be neglected or even discouraged. It is, however, a sad experience of the last years, that also only limited contributions in these other important fields were presented to SDS.

The main question that has to be answered first is: What is the sense and significance of chronostratigraphy (= geochronology in the sense of Walsh 2001)? It is nothing less than the attempt to provide all geoscientists with a rigid (precisely defined), internationally accepted (by formal vote) and applicable time framework. It forms a basic of communication and is essential in order to document and analyze all patterns, processes and short-termed events and interactions in the geo- and biosphere of the earth. If we want to progress in this field, we need the finest scale possible but all recognized time units have to be well-defined and must be recognizable as widely as possible. The latter aspect currently precludes to use single biozones such as conodont and ammonoid zones. Despite their incredibly short durations of a few hundred thousand years these fossil groups, as all, are restricted to specific facies and cross-facies correlation at the same time-scale is not (yet) available. I should also remind that there are widely spread rather unfossiliferous Devonian rocks which need to be placed in specific chronostratigraphic intervals.

So, why shouldn't we stay with the currently reached precision: the stages? The answers are easy and multimode:

1. As mentioned above, the stratigraphic subcommissions owe their existence to the original task: to provide a widely applicable time framework which is as fine as possible. If better precision is possible, than we simply have to do our job, as a service to the wider geoscientific community who can make use of our units.
2. A brief look at the other Palaeozoic systems tells us that the number of chronostratigraphic units in the Devonian is much lower than in all other systems. Most Devonian stages are simply too long to allow a roughly even separation of Phanerozoic time intervals.
3. Devonian substages are in wide use by many specialists but without any formal definition and without any consensus. Not only stratigraphical, but also phylogenetic, sedimentological, geochemical, palaeoclimatological and tectonic studies commonly use phrases such as "late Famennian", "lower Emsian", "early Givetian" etc. But every author uses his/her own and mostly unspecified idea about the meaning of such phrases. Only SDS has the capability and justification to bring order into such babylonic writing.
4. It is now widely known that major physical and faunal overturns (global events) took place within established Devonian stages. Since they are mostly connected with significant sea level changes, these can be traced between different environments, using the correlation of different fossil groups or other stratigraphical methods such as chemo-, magneto- and sequence stratigraphy. Our substage definitions strongly have to refer to such major events, in order to allow their easy recognition. Examples are the Zlichov, Daleje, Chotec, Taghanic, Rhinestreet, *semichatovae*, *Annulata* and Dasberg Events. These are not restricted to conodont and ammonoid biofacies and also involve palaeoclimatic signals. Conodont stratigraphy is most useful to study such events and possible substage levels but the application of our future substages will not be restricted to pelagic settings.
5. All substages will consist of packages of biozones. The use of zones cannot replace substages since zones are generally restricted to regions and specific facies. A zonal name cannot be used in a region where the defining fossil does not exist. Therefore, an abstraction from biostratigraphy (or physical stratigraphy) into a time unit is unavoidable.
6. Conodont or ammonoid or tentaculite taxonomy, nomenclature and even zonations are in a steady state of flux. Chronostratigraphic units need a nomenclature and definition which is free from such specialist discussions and controversies. For this reason, the GSSP concept has been successfully established and in order to avoid ambiguity it needs to be applied to any chronological unit.
7. The search for official chronostratigraphic units encourages researchers, enables easier access to research funding and sharpens the mind concerning correlation problems and the current lack of precision. This side-affect of

new high-resolution research data may become more important than the original task, as has been shown at the Frasnian-Famennian boundary, but the past has also shown that progress is highly stimulated by the search for potential stratotype sections throughout the world.

8. It can be foreseen that the substages will be widely used in different fields such as diversity analyses, palaeobiogeography, basin analysis, phylogeny, geochemistry and structural geology. Without formal definitions there will be less precision in the correlation between results of these different fields. To give one example, I recently experienced (Becker & Aboussalam, in press) that Givetian to Frasnian trilobite and conodont diversity trends currently can be compared at the substage but not (yet) at the zonal level. Significant evolutionary events occurred within stages and around (future) substage boundaries.

Finally I like to emphasize that we always should look into the potential for future research. A holostratigraphic approach, correlating biostratigraphic data with high-resolution chemo-stratigraphy, quantitative stratigraphy (such as graphic correlation) and cyclostratigraphy eventually will allow a time-resolution we are currently still dreaming of. I predict that even our substages, as in the Quarternary, will become only a rough frame for even finer chronostratigraphic units. It is our current goal to work on this frame and to do a good job.

SHOULD SDS CONTINUE TO PLAY THE "STRATOTYPE GAME?

John A. Talent & Raimund Feist

Though we believe that the laborious process of definition of series and stage boundaries was important, we worry about the immense amount of work that will be expended in continuing this quest, focused on "global stratotypes" for substages within the Famennian, Frasnian and so on when the criteria for discriminating the individual zones making up the "substage packages" is already accepted (a few nettlesome problems notwithstanding). All that seems to be needed is a final SDS vote/votes about whether there should be a fourth subdivision for the Famennian (Latest/Uppermost/Strunian). In our view, laboriously documenting candidate stratotypes for substages and having them formalised by IUGS is not worth the effort (and, please, no more names to further decrease communication with our fellow scientists!). Far better (and of practical value) would be focussing the energies of SDS on correlating series, stage and zonal boundaries into the shallow water platform sequences that make up more than 90% of the Devonian record: a hard way to go, but a very important one.

Nothing is more ephemeral and so quickly lost than, for example, the "progress reports" that underlay discussions of the 14 stage-boundaries within the Silurian and Devonian. For us, far more important than such ephemeral reports on assorted candidate sections are rigorous biostratigraphic/taxonomic/evolutionary/chemostratigraphic works that will continue to be of interest decades or a century hence, published formally in journals (not necessarily "main-line" ones), rather than informally in newsletters—these days too often on transient internet sites—or as handouts at meetings—too often in too few copies! If the data are pivotal, everyone worth their "salt" will track them down. One good monograph, we believe, is more valuable than 100 multi-authored ephemeral contributions on stratotypes.

Our IGCP 421 proposal formulated six years ago had a strong linkage to SDS. Our 11 international meetings (and a few regional ones) in 1997-2001 were highly successful with peak attendances of 190+ for the IGCP 421 meetings in Esfahan (Iran, 1998) and Peshawar (1999), at both of which there were many SDS people in attendance. A key factor in the success of SDS meetings in Bologna-Modena (1998), Morocco (1999) and Frankfurt (2001) was formal association with IGCP 421. The excursions connected with these three events catered nicely to both IGCP 421 and SDS. These sorts of association should continue.

Though ever-more-precise biostratigraphy continues to underly the work of most SDS colleagues, we believe that SDS needs to resolutely go beyond nuts-and-bolts biostratigraphy/chemostratigraphy into more innovative domains. Having achieved what it set out to do, SDS is presently without a firm focus (other than "more of the same")... Our increasingly precise biostratigraphic pursuits with pelagic carbonate sequences (laudable though we believe them to be) are not getting the sort of accolades from geo- or bio- colleagues we believe we deserve. Virtually no one is getting research grants for such activities from national of international funding bodies these days. SDS needs a new and imaginative focus if it is to regain relevance. Establishing criteria for extending correlations of series, stage and zonal boundaries into the globally important shallow water platform carbonate sequences (far more voluminous than pelagic carbonates by a ratio of perhaps 10:1) could be one of these: a hard way to go, but a very important one. Such an initiative, with strong ("life support") linkages to SDS, like IGCP 421 and hopefully successor projects, could perhaps be the way to go.

SEVERAL REMARKS TO LOCHKOVIAN/PRAGIAN BOUNDARY STRATOTYPE (GSSP)

SLAVIK, L. and HLADIL, J.

Institute of Geology, Academy of Sciences CR, Praha (framework of the CEZ Z-3-013-912 and K1-042-603/6)

LOCATION, GENERAL SITUATION AND A BRIEF SUMMARY OF PREVIOUS STUDIES

Lochkovian/Pragian boundary stratotype (GSSP) is located on the southwest periphery of Prague in Velka Chuchle. The section is exposed in an old quarry, at the foot of the hill Homolka, close to historical limekiln (*GPS positioning: N 50° 00.868´; E 014°2.350´*). The position of the Lochkovian/Pragian GSSP was accepted by SDS, approved by the ICS and ratified by the Executive Committee of IUGS during 1988-1989. In this section, the Lo/Pg stage boundary was defined as the first occurrence of the conodont *Eognathodus sulcatus sulcatus* (Philip). The entry of this species was reported from the bed 12 (Chlupac & Oliver, 1989). The Lo/Pg section with the limestone beds in neighborhoods of Velka Chuchle were studied by many geologists (Kodym & Koliha, 1928; Chlupac, 1953, 1993; Chlupac, Lukes & Weddige, 1988; Chlupac et al., 1985 and 1986). The detailed information on biostratigraphy is involved mainly in the first of these two papers (incl. dacryoconarids by P. Lukes, chitinozoans by F. Paris and conodonts by H. Schoenlaub). An additional conodont study was provided by Weddige (1987).

Considering insufficient documentation of the GSSP-relating conodonts (absence of figures, descriptions or explanations of the taxonomy), we have decided to investigate this section again in order to verify important occurrences of stratigraphically significant taxa and compare the conodont ranges from Velka Chuchle with other Lo/Pg sections. This reinvestigation was a part of Slavik Ph.D. thesis, which was accomplished in spring, dealing with the alternative conodont zonation for the Pragian stage in the stratotype area (Slavik, 2001a, 2001b). According to previous biostratigraphic data (Fig. 1), Velka Chuchle seemed to be a very promising section as regards presence of zonally diagnostic taxa, which are generally very poor in the Pragian of Barrandian sections. The Lower Devonian rocks in this old quarry form an asymmetrical syncline with strongly and disharmonically folded south-eastern part. The Uppermost Lochkovian limestone beds are platy, horizontally and subhorizontally bedded. The limestone is medium to light-gray colored and gradded portions of fine- to medium grained calciclastic material prevail. Supporting micrite is rare (both washed and recrystallized). The irregularly or lamellar-shaped silicifications are mostly colored to blackish-brown hues. The lime-mudstone background of this largely calciturbiditic sediment was reduced to very thin layers and, occasionally, it is almost absent due to sedimentary truncations, non-sedimentation and diagenetic compaction/dissolution on these seams. The medium-grained limestones contain trilobites and other sorted fractions of the benthic bioclasts, which were coming from the upper slope environments, including also scattered peloids and partly micritized grains. The typical Lochkovian assemblages of macrofauna. The fine grained laminae and background sediments contain only "pleurodictyiid" deep water corals and sprinkling of dispersed dacryoconarid and small brachiopod and gastropod shells. The sedimentology of these Lo/Pg beds was mentioned also by Hladikova et al. (1997), and the prevailing calciturbidite character of Lower Devonian deposits in the entire Barrandian (Hladil et al., 1996). These limestone banks are dominated by tentaculite lime-mud facies, as it was exemplified on Pg/Em transitions, with some other facies, like "ammonitico rosso" or coarse- bioclastic proximal-slope deposits with recycled crinoid and holothurian ossicles are.

As mentioned above, the Lo/Pg boundary has been originally linked with the Weddige find of *Eognathodus sulcatus* (Philip) in bed 12 (according to recent numbering). In accordance with past investigations, this species should occur in this bed for the first time. However, the uppermost Lochkovian fauna is still present in the boundary interval, indicating uninterrupted sedimentation without any marked change in lithology. It was proclaimed as a biostratigraphical advatage of this GSSP (Chlupac & Oliver, 1989). The lowermost Pragian shows increased contents of micrite, still mostly gray and laminated but highly grading above into the typical Dvorce-Prokop limestones with typical Pragian tentaculites, dominant nodular dissolution structures and very characteristic, variegated weathering coloring.

NEW DATA AND PROBLEMS FROM THE PAST

The Lo/Pg boundary interval was resampled by seven samples, each ca. 4 kilograms. Thanks to previous numbering by I. Chlupac, the orientation in the section was quite easy and results obtained from past investigations by Schoenlaub, Weddige, as well as from the present studies can be readily compared on corresponding levels.

The first conodont sample VC1 taken from the bed 2 (Fig. 2) confirmed Lochkovian age based on the occurrence of *Ozarkodina remscheidensis remscheidensis* (Ziegler). This species was recognized also in bed 9 together with *Lanea omoalpha* Murphy & Valenzuela-Rios. Stratigraphic position of *L. omoalpha* appear to be relatively high in this region, in comparison with Spanish central Pyrenees and Nevada. First morphotypes (eta) of *Latericriodus steinachensis* (Al-Rawi) were identified in bed 10 (sample VC3). However, occurrences of these forms in association with typical Lochkovian *O. r. remscheidensis* seem to be problematic, when no evidence for possible reworking was found. Possibly the proportion of the sample in which the first and the last occurrences could have been comprised could be seen as a proper reason of such a co-occurrence. Relatively rich conodont assemblages were recovered from the bed 11 (sample VC4), close below the boundary stratotype. On this level, no Lochkovian taxa were found, but the first *Eognathodus sulcatus eosulcatus* Murphy - an index for the sulcatus Zone is present (!). According to new investigations, the first occurrences of *E. s. eosulcatus* could occur somewhat lower in the section, than was previously regarded. It means, that the GSSP point was set up slightly higher than possible entries of this taxon. But the point is, that in the bed 11 already appear also other typical Pragian species, e.g., the eta and beta morphs of *L. steinachensis*. The stratigraphic overlap of both morphotypes (older eta morph and its younger descendant beta morph) may indicate already Pragian sedimentation advanced in time. First occurrences of eta morph are close to lower Pragian boundary in Barrandian and in Carnic Alps, as it was pointed out earlier by Chlupac et al. (1985), and only higher up begin to overlap with beta morph. *Ozarkodina pandora* alpha Murphy et al. and a new taxon *Ozarkodina theresiae* sp. n. with a very distinctive morphology were described also on this level. Nevertheless a few specimens of *O. theresiae* obtained up to now doesn't make possibilities for correlation in the meantime. Bed 12, according to expectation, yielded *E. s. eosulcatus* in association with the both morphotypes of *L. steinachensis* and several other forms comparable with *Icriodus angustoides angustoides* Carls & Gandl.

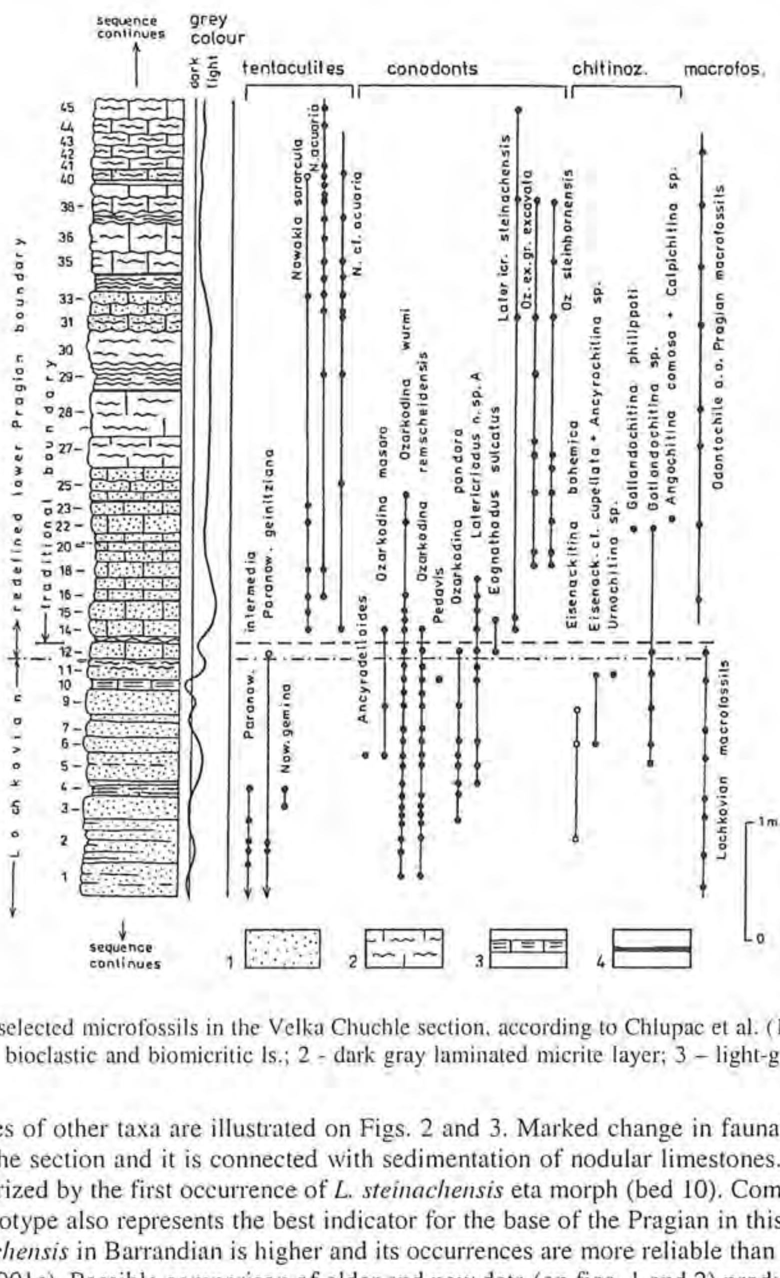

Fig. 1 – Occurrences of selected microfossils in the Velka Chuchle section, according to Chlupac et al. (1985) and Chlupac (1993). 1 – gray-colored, fine-grained bioclastic and biomicritic ls.; 2 - dark gray laminated micrite layer; 3 – light-gray, micritic nodular ls.; 4 - calcareous shales

Distribution and ranges of other taxa are illustrated on Figs. 2 and 3. Marked change in faunal diversity (decrease) can be observed upwards in the section and it is connected with sedimentation of nodular limestones. Newly introduced steinachensis Zone is characterized by the first occurrence of *L. steinachensis* eta morph (bed 10). Compared with other sections in Barrandian, this morphotype also represents the best indicator for the base of the Pragian in this area. Moreover, number of specimens of *L. steinachensis* in Barrandian is higher and its occurrences are more reliable than those of *E. sulcatus* morphotypes (Slavik, 2000, 2001c). Possible comparison of older and new data (on figs. 1 and 2) produce many difficulties. Detailed correlation is not possible due to missing descriptions, figures and systematics of conodont species in original papers (Chlupac et al., 1985, Weddige, 1987). Furthermore, taxonomic names presented in these papers are often incomplete. Therefore it is hard to estimate, what was meant by authors using names such as *O. wurmi*, *O. steinhornensis*, even it is not clear, which of morphotypes *sensu* Murphy et al. (1981) and Murphy (1989) of *E. sulcatus* was regarded to be an index for the sulcatus Zone in the Velka Chuchle. Only one specimen of *E. sulcatus* from this section was figured (Weddige, 1987: Fig. 4). This specimen come from bed 18, corresponding to bed 14 according to coeval numbering. However, Murphy (1989) confirmed this specimen belonging to index taxon *E. s. eosulcatus* (originally eta morphotype), of which first occurrence defines the base of the Pragian. Herein should be noted the inaccuracy by Murphy (1989), who confirmed Weddige's specimen to be an index, but he erroneously mentioned the specimen to come from bed 12 and obtained from sample No.

18, although Weddige has not presented the sample numbers in his paper. Weddige (1987) only mentioned, that morphotypes of *E. sulcatus* (a very broad sense) occur already in bed 16 (corresponds to present bed 12). To conclude, it doesn't exist any figure of the specimen from bed 12. GSSP was defined just on the basis of this unknown specimen. Therefore repeated sampling appeared to be very useful. All the relevant specimens from Velka Chuchle section are figured and will be published during next year.

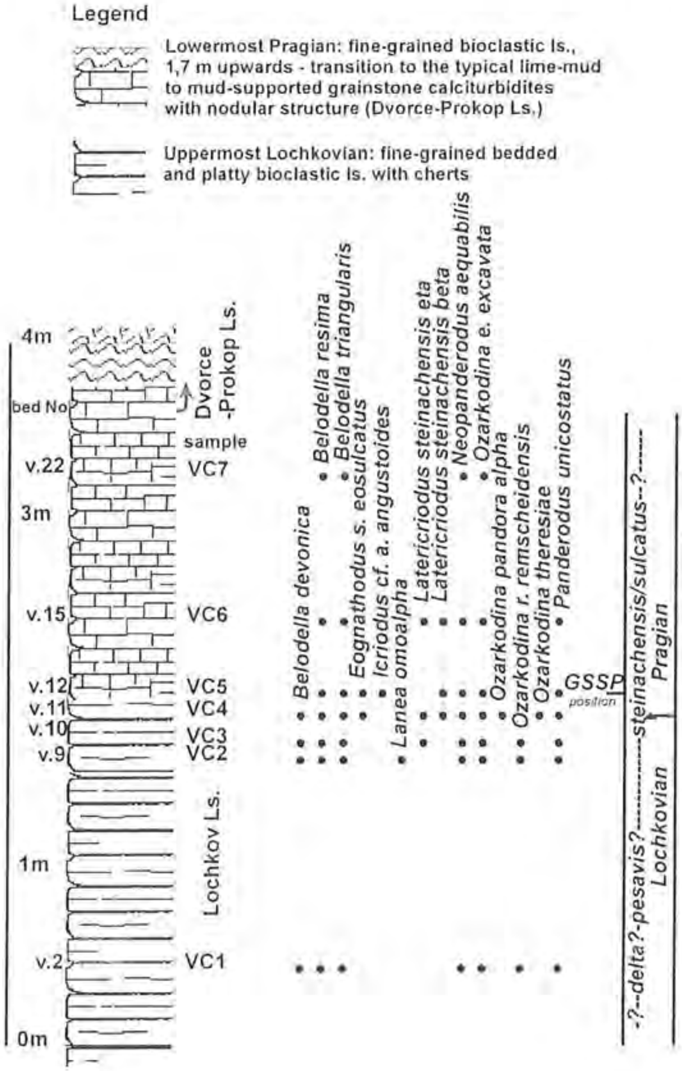

Fig. 2 New conodont data from Lochkovian/Pragian boundary in the Velka Chuchle section

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Fig 3 *Velka Chuchle Section*

sample	1VC	2VC	3VC	4VC	5VC	6VC	7VC	Σ
Σ identified elements	23	58	66	62	48	28	14	299
Belodella devonica	1	2	3	2	-	-	-	8
Belodella resima	1	5	10	5	8	5	2	36
Belodella triangularis	3	15	13	10	5	4	1	51
Eognathodus s. eosulcatus	-	-	-	2	1	-	-	3
Icriodus cf. a. angustoides	-	-	-	-	3	-	-	3
Lanea omoalpha	-	2	-	-	-	-	-	2
Latericriodus steinachensis eta	-	-	3	6	-	1	-	10
Latericriodus steinachensis beta	-	-	-	2	1	1	-	4
Neopanderodus aequabilis	2	7	4	11	8	4	3	39
Ozarkodina e. excavata	4	9	10	15	19	12	8	77
Ozarkodina pandora alpha	-	-	-	2	-	-	-	2
Ozarkodina r. remscheidensis	11	12	18	-	-	-	-	41
Ozarkodina theresiae	-	-	-	3	-	-	-	3
Panderodus unicostatus	1	6	5	4	3	1	-	20

Document submitted to the

IUGS SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

THE CLASSICAL BOUNDARY LOWER/UPPER EMSIAN IN GERMANY

CM Ulrich JANSEN

Forschungsinstitut Senckenberg, D-60325 Frankfurt am Main, Germany

The classical type-region of the Emsian stage is situated in the central Rheinisches Schiefergebirge ("Rhenish Slate Mountains", Germany). The name of the stage, introduced by DORLODOT (1900), has been derived from the city of Bad Ems near Koblenz in the Middle Rhine/Mosel area. The Emsian succession in the type-region is composed of siliciclastic sedimentary rocks reaching in the Mosel Trough thicknesses of up to 4000–5000 metres (MEYER & STETS 1980, 1996). The successions are developed in "Rhenish" facies, they are predominantly marine and characterized by a specific inventory of fossils and sedimentary features (e.g. ERBEN 1962). Pelagic index fossils like conodonts, ammonoids, and dacryoconarids are very rare in the Rhenish facies.

Stratigraphical research in the Rhenish Emsian began in the 19th century (KOCH 1881, KAYSER 1885, MAURER 1886, FOLLMANN 1891, FRECH 1897). Important stratigraphical traits have already been recognized in that time, and the subdivision into Lower and Upper Emsian has basically been established. However, stratigraphical names and their meanings changed several times; ZIEGLER (1979) described the complicate historical development. During the past 150 years, many palaeontological works concerning Rhenish Emsian fossils have been published, which have led to different biostratigraphies, mainly based on brachiopods and trilobites (e.g. SOLLE 1953, 1971, 1972, MITTMEYER 1982, JANSEN 2001a).

Biostratigraphy in the Emsian of the Rheinisches Schiefergebirge is problematic for some reasons. Within the small outcrops phylogenetic developments of the faunas can hardly be seen because the exposed rock columns normally correspond to very short time intervals. The tectonical situation is generally rather complicate. Considerable parts of the successions are poorly fossiliferous, whereas rich faunas are accumulated in scattered lenses or beds. Further, substantial parts of the Rhenish Emsian were not deposited under full marine conditions. However, if the palaeontological information is combined, and the geological structures are clarified, biostratigraphy is possible. By far not all biostratigraphical possibilities have been exhausted. For example, brachiopod biostratigraphy has concentrated on spiriferids whereas orthids, strophomenids, and terebratulids have been considered very little. Further, palaeopalynological studies (e.g. SCHULTZ 1968, MCGREGOR 1979, RICHARDSON & MCGREGOR 1986) are highly promising because the palynomorphs may allow age-assignments and correlations of sedimentary rocks lacking marine macro-fossils.

Biostratigraphers recommended to consider the classical German boundary in the discussion on an international intra-Emsian boundary stratotype (JANSEN & SCHINDLER 1997, JANSEN 1998, JAHNKE & JANSEN 1998, CARLS & VALENZUELA-RIOS 1999). An overview of the main stratigraphical traits around the classical boundary Lower/Upper Emsian in the type-area shall be given in the following.

Upper parts of the Rhenish Lower Emsian represented by the Vallendar Group contain rich marine faunas with brachiopods, bivalves, trilobites, crinoids, ostracods, tentaculites, corals, and bryozoans. A famous example is the "Stadtfeld fauna" from the Eifel region (DREVERMANN 1902).

However, the uppermost Lower Emsian in the Mosel, Middle Rhine and Eifel regions is composed of poorly fossiliferous sandstones and shales of the Klerf Formation and the Nellenköpfchen Formation. Due to the sedimentary structures and the fossil content, a predominantly intertidal environment is suggested for these (see e.g. SOLLE 1956, 1970, WEHRMANN et al. 2000). The Klerf Formation is characterized by red beds showing a strong terrestrial influence. Therefore, the development of marine faunas in the uppermost parts of the Lower Emsian is little known. However, the Nellenköpfchen Formation at its type locality near Koblenz and at the locality "Kretzers Mühle" has yielded few marine faunas (MAUZ 1935, WENNDORF 1999) which are highly interesting with regard to the faunal development near the boundary Lower/Upper Emsian.

Another important locality is the Grube Braut near Stromberg in the southern Rheinisches Schiefergebirge, where a continuously marine development with brachiopod occurrences is present in the boundary interval Lower/Upper Emsian (WOLF 1930, MITTMEYER & GEIB 1967).

The upper part of the Lower Emsian is biostratigraphically characterized by the presence of *Arduspirifer arduennensis latestriatus* (MAURER 1886) and *Euryspirifer dunensis* (KAYSER 1889) sensu stricto. The subspecies *Arduspirifer arduennensis antecedens* (FRANK 1898) is regarded as ranging through the whole Lower Emsian, late forms seem to be distinguishable from the earlier ones, and the subspecies disappears in the uppermost Lower Emsian. Typical specimens of *Crinistrophia elegans* (DREVERMANN 1902) may be restricted to the lower Vallendar Group although similar forms occur already in Siegenian beds of Morocco and Spain (JANSEN 2001a). *Schizophoria (Rhenoschizophoria) provulvaria* (MAURER 1886) and *Plicostropheodonta virgata* (DREVERMANN 1902) appear in the Siegenian, range through the Lower Emsian and disappear a little below the boundary Lower/Upper Emsian. The same is the case concerning *Tropidoleptus carinatus rhenanus* (FRECH 1897), but this taxon seems to disappear exactly at the boundary Lower/Upper Emsian being abundant up to the uppermost Lower Emsian. The genus is absent in the Upper Emsian of the Rheinisches Schiefergebirge, but it is also present in the Middle Devonian of New York, for example.

Brachiopods from the Hunsrück Shale in its proper sense, also termed Kaub Formation, indicate an early Early Emsian age ("Ulmen age", see MITTMEYER 1973, 1980), for example *Euryspirifer assimilis* (FUCHS 1915). On the other hand, dacryoconarids including *Nowakia praecursor*, *Nowakia* cf. *zlichovensis*, and *Nowakia barrandei* allow an age-assignment to the Early to Late Zlichovian (ALBERTI 1982, 1983). The goniatite fauna with forms of *Anetoceras* and *Mimagoniatites*, described by ERBEN (1960), KUTSCHER (1969), and CHLUPÁC (1976), shows a late Zlichovian age (CHLUPÁC & TUREK 1983).

The Stadtfeld Formation, representing the lower part of the Vallendar Group, has yielded *Anetoceras arduennense* (STEININGER 1853) (see CHLUPÁC 1976). This goniatite allows a correlation with the Upper Zlichovian in the Barrandian area.

In the Stromberg Syncline, polygnathid conodonts have been evidenced in a limestone layer of the upper Vallendar Group (MITTMEYER, WEDDIGE, ZIEGLER, pers. comm.), which is also important for the correlation with the Barrandian stratigraphy. These forms are presently studied (K. WEDDIGE, Frankfurt).

The Upper Emsian in its type-area begins with the Emsquarzit Formation representing the lower part of the Lahnstein Group. The formation is built up of very hard, siliceous rocks (see JANSEN et al. 2001) which contain marine faunas at some localities (VIETOR 1919, SOLLE 1936, 1972, MITTMEYER 1972). In the Middle Rhine/Mosel area, more diverse marine faunas have their onset at the base of the Hohenrhein Formation (upper Lahnstein Group) following above the Emsquarzit Formation. The Hohenrhein Formation is built up of sandstones and silty/sandy shales. In the succeeding formations of the Upper Emsian the lithology becomes increasingly argillaceous. The Hohenrhein Formation is overlain by the Laubach Group, which is followed by the Flaserschiefer and Kieselgallen-Schiefer Formations of the Kondel Group. In the latter, already pelagic faunas are present. The sea-level rise termed "T-R cycle 1b" in JOHNSON et al. (1985) may be documented in the lithological and faunistical development at the base of the Upper Emsian probably related to the global "*cancellata* Event" resp. "Daleje Event" (e.g. HOUSE 1985, CHLUPÁC & KUKAL 1988, WALLISER 1996). However, local crustal activity may also be a reason (CARLS & VALENZUELA-RIOS 1999).

The faunas of the Upper Emsian are clearly different from those of the Lower Emsian, and already the biostratigraphers in the second half of the 19th century were able to distinguish between faunas of the "Untere Coblenz-Schichten" and the "Obere Coblenz-Schichten" (e.g. KAYSER 1885).

One of the most important biostratigraphical markers is the onset of *Arduspirifer arduennensis arduennensis* (SCHNUR 1853) which may have developed from *A. a. antecedens* (FRANK 1898) (see SOLLE 1953, JANSEN 2001a). This subspecies, already occurring in the Emsquarzit Formation and its equivalents, is used for the definition of the beginning of the Upper Emsian (SOLLE 1972, MITTMEYER 1982). It has been determined in West-Europe and North-Africa as well, e.g. in western France (RENAUD 1962, HEDDEBAUT 1981) and Morocco (DROT 1964, HOLLARD 1978) where it has also been used to correlate the base of the Upper Emsian. This is problematic, because the forms from these regions apparently belong to a separate phylogenetic lineage differing from the true *A. a. arduennensis*.

At the Lower/Upper Emsian boundary in the Rheinisches Schiefergebirge, several species appear whose direct phylogenetic ancestors are not known with certainty. In my opinion, they were not present in uppermost Lower Emsian strata due to the unsuitable facies and probably immigrated from other regions near the beginning of the Late Emsian when an open marine environment turned up. Further, a hiatus may be present between Lower and Upper Emsian strata, which has already been proved in the Taunus Hills where high parts of the Lower Emsian have not biostratigraphically been evidenced so far (ANDERLE 1987).

Euryspirifer paradoxus (VON SCHLOTHEIM 1813) is another important species ranging from the base of the Emsian until the Emsian/Eifelian boundary. The ancestor of this species is certainly not *Euryspirifer dunensis* (KAYSER 1889) as may be assumed, but rather a species of the *pellicoi*-group (JANSEN 2001a).

A new species of *Schizophoria* seems to be restricted to the Lahnstein Group, and similar forms occur in the Anti-Atlas Mountains (in the "Rich 3"), in the Armorican Massif (Foulerie Fm., Marettes Fm.), and in the Cantabrian Mountains (Ladrona Fm.) allowing stratigraphical conclusions (JANSEN 2001a-b). The true *Schizophoria vulvaria* (SCHLOTHEIM 1820) appears in the upper Lahnstein Group and has its extinction at the end of the Emsian. It may be subdivided into several subspecies of stratigraphical relevance. *Schizophoria vulvaria* has not developed from Lower Emsian *Schizophoria provulvaria* (MAURER 1886) as considered by SOLLE (1972: 70), but represents a member of a separate phylogenetic lineage (JANSEN 2001a-b). However, it is possible to recognize approximately the boundary between Lower and Upper Emsian using forms of the *vulvaria*-group which I have included in the new subgenus *Schizophoria (Pachyschizophoria)* (JANSEN 2001a).

The genus *Paraspirifer* appears near the boundary Lower/Upper Emsian and reaches up into the Eifelian (SOLLE 1971). It becomes abundant at the first time in the upper part of the Lahnstein Group and is represented by the species *Paraspirifer sandbergeri* SOLLE 1971 there. This species has probably developed from *Brachyspirifer ignoratus* (MAURER 1883) which is confined to the Lahnstein Group (SOLLE 1971).

Further species appearing at the base of the Upper Emsian are *Plicostropheodonta piligera* (G. & F. SANDBERGER 1856) and *Iridistrophia* cf. *hipponyx* (SCHNUR 1851) sensu JANSEN (2001a). The latter species has probably developed from the

Lower Emsian species *Iridistrophia maior* (FUCHS 1915). The onset of *I.* cf. *hipponyx* allows to recognize the boundary in the Dra Plains (S-Morocco; JANSEN 2001a), where it co-occurs with *Mimagoniatites fecundus* (BARRANDE 1865) (det. WALLISER), which is typical of the Upper Zlichovian to Lower Dalejian interval (CHLUPÁC & TUREK 1983).

Shales of the upper part of the Upper Emsian (Kondel Group) have yielded the goniatite *Sellanarcestes wenkenbachi* (Kayser 1884) indicating a Dalejian age in the sense of the Bohemian subdivision (Solle 1972, Chlupác & Turek 1983).

There are different possibilities to recognize the classical boundary between Lower and Upper Emsian in the Rheinisches Schiefergebirge. Further, brachiopods allow to reproduce the classical boundary level in regions of West Europe and North Africa. A direct correlation with the global pelagic biostratigraphies is not possible by means of Rhenish macrofossils. However, in regions with interfingering Hercynian and Rhenish facies (Anti-Atlas, Celtiberian Chains, Cantabrian Mountains, Armorican Massif etc.), the classical boundary may be interpolated into the global conodont/dacryoconarid scale. New palaeontological studies (e.g. brachiopods, palynomorphs) in the Rheinisches Schiefergebirge and in regions in West Europe and North Africa will certainly improve this correlation.

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МЕЖВЕДОМСТВЕННЫЙ
СТРАТИГРАФИЧЕСКИЙ КОМИТЕТ

КОМИССИЯ ПО ДЕВОНСКОЙ СИСТЕМЕ

Санкт-Петербург, 199106, Средний пр., д. 74, ВСЕГЕИ Тел.32891-21

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INTERDEPARTMENTAL STRATIGRAPHIC COMMITTEE OF RUSSIAN COMMISSION ON DEVONIAN SYSTEM

DECISION ON THE BOUNDARY OF THE MIDDLE AND UPPER DEVONIAN IN RUSSIA.

The problem "On recent state of boundary of the Middle and Upper Devonian in Russia" was discussed at the meeting of the Commission which took place in February 1, 2001 at VSEGEI (St. Petersburg). At this meeting there were present 27 specialists on Devonian stiatigraphy and paleontology from different geological organizations from St.Petersburg, Moscow, Ekaterinburg, Saratov, Perm', Ufa, Ukhta, Syktyvkar, Novosibirsk, Novokuznetsk, Chita and Khabarovsk.

The following decision was reached as a result of submitted report and its discussion:

The boundary of the Middle and Upper Devonian, recommended by SDS only by conodont by SDS only by conodont zonation over the Russia territory requires further accurate definition.

The reason of this is

1) the change of this boundary in the type sections of the Western Europe and transfer of stratotype of this boundary from the base of Fromelann suite (beds with *Cyrtospirifer "tenticulum"*, *C. verneuili*). Belgium'in France into Montagne Noire mountains on the level corresponding to the lower part of Frane suite of Belgiun with "*Cyrtospirifer orbelianus*", *Cyrtospirifer stolbovi* Nal., *C. supradisjunctus* (d'Orb.), *Hypothyridina "cuboides* (Sow.)" which characterize the Middle Frasnian substage in Russia;

2) insufficiently accurate characteristic of this boundary by GSSP in Montagne Noire in France according to standard conodont scale (drawing of this boundary inside the lower subzone of *falsiovalis* zone) and the other groups of fauna except Ammonoidea (according to Ammonoidea it should be drawn in the base of *Ponticeras* zone (*Neopharciceras*) (Becker, 1998);

3) such large biotic events as disappearance of mass evolution of *Stringocephalus* fauna and appearance of the Late Devonian *Cyrtospirifer* one were not taken into account;

4) uncertainty of the position of this boundary according to conodonts over the vast territory of Russia embracing the well studied sections of the Russian platform, Timan - Pechora oil-bearing province and western slope of the Urals. Investigations on the South Timan (Becker et al., 2000; House et al., 2000) done during the last years showed that the examined boundary between the Middle and Upper Devonian according to conodonts should be drawn inside Lowermost *asymmetricus* zone.

The Devonian commission of ISC of Russia cannot agree with drawing the boundary of the Middle and Upper Devonian inside the Upper Devonian as the whole Timan horizon both in the lower and upper parts is characterized by the complex of the Late Devonian *Cyrtospirifer* group of *Uchtospirifer nakivkini - Ucht. timanicus*. And what is more in the Lower Timan subhorizon conodonts occur rarely and they are not well studied and in the lower lying Pasha suite they are not found.

The age of Pasha suite and its analogues underlying Timan horizon as well as Timan horizon on the basis of presence of complex of Frasnian miospores of *optivus-krestovnikovi* -zone and Frasnian brachiopods and corals (*Schizophoria ivanovi* Tschern., *Atrypa douvillei* Mans., *Disphyllum paschiense* (Soschk.) should be considered to be the Late Devonian Pasha suite together with the deposits of Timan and Sargaev horizons form indivisible stage in sedimentation and transgressively occur with great washout on Starooskolsk superhorizon with *Stringocephalus burtini* of Givetian stage of the Middle Devonian fiting large natural-geological event on this boundary.

The Devonian Commission of ISC recommends: continue to study the other sections in Timan-Pechra province and the Urals with searching conodonts and the other groups of fauna and flora from the deposits of the Lower Timan subhorizon and Pasha suite. Especially sections of Kynovo (Timan) horizon and Pasha suite of the western slope of the Middle Ural (Pasha village) and also on the western slope of the South Ural in the basin of Nigusha, Ur-juk rivers and in latitude flow of Belaya river are perspective sections. It is necessary to conduct these investigations and also to study the most complete continuous sections of the Middle and Upper Devonian on the eastern slope of Polar Ural. For this purpose the Devonian commission of ISC aska the Ural RISC (chairman B.I.Chuvrashov) to organize investigations for revealing sections in the

Urals where there is gradual transition from the Middle Devonian to the Upper one according to search of conodonts and the other groups of fauna and flora in Kynov horizon and Pasha suite.

The Devonian commission considers that the section of Rudny Altai in the region of Zmeinogorsk town is the other region of Russia where there is continuous and very important section and where according to SDS there was determined the boundary of the Middle and Upper Devonian. This section is characterized by Ammonoides from *Pharciceras lunulicosta* zone to *Manticoceras* zone of the Upper Frasnian conodonts, brachiopods, radiolaria ant the other groups of fauna and flora.

In summer 2000 in this region there took place VII session of the of the Devonian Commission of ISK of Russia on the base of "Rudny Altai expedition (leaders - L.M.Gutak and O.V.Murzin, ors) and rich paleontological material was collected which is studied now. Earlier during many years (from 1939 to 1974) this section was studied by N.L.Bublichenko (stratigraphy, brachiopods), B.I.Bogoslovsky (Ammonoidea), Z.A.Maksimova (trilobites), N.Ja Spassky (tetracorals), V.N.Dubatolov (Tabulata).

Now S.A.Rodygin studied conodonts from this section. He found complex of species (joint appearance of *Ancyrodella binodosa* and *A.pristina*) characterizing the boundary of the Middle and Upper Devonian, taken SDS according to global stratotype point (GSSP) in Col du Puech de la Sugue - E.section in Montague Noire mountain, France. In Rudny Altai section more accurate position of the boundary of the Middle and Upper Devonian taken by SDS according to conodonts and its conformity to natural boundary according to the other tanportant groups of fauna based on their evolutional development is necessary.

The Devonian commission of ISC of Russia considers:

1. General (Global) stratigraphic scale while determining large stratigraphic boundaries such as divisions and stages should take into account the great changes in the evolution of biota. Such approach was successfully used during many decades also for the Devonian system.
2. Now conodont zonal scale is success fully used for wide tracing of already established levels of the boundaries, i.e. it fulfils correlative function. The problems of evolution of conodonts were examined by V.G.Khalymbadzha on the Middle and Upper Devonian boundary. It is necessary to consider the data of his investigation on the evolutional changes of conodonts. For the first time he established the appearance of forms with the features of polygnatide (wide flat platform with deep sculpture) starting from *hermanni -cristatus* zone. It is typical to polygnatides - *Polygnathus asymmetricus* group and *Palmatolepis* genus which appeared in Frasnian stage.

According to O. Walliser's opinion (1985) in the overlying conodont *disparilis* zone there takes place great burst in the evolution of Frasnian conodonts - and therefore this level should be taken as the boundary of the Middle and Upper divisions of the Devonian system.

Thus examining the boundaries of the Middle and Upper Devonian it is necessary to take into account evolutional changes in the main groups of fauna which take place in the base: *Pharciceras* beds among Ammonoidea (the lower parts of Adorf Stage and its analogues), appearance of cyrtospiriferids and the other Late Devonian representatives of brachiopods (the base of Fromelennes suite, Belgium and the base of *disparilis* zone according to conodonts). The presence of single specimens of *Stringocephalus* in the lower part of Fromelennes suite, characterized by the Late Devonian spiriferids cannot influence on attributing this suite to the Middle Devonian.

The version of the examined boundary suggested by us was successfully used in the International Stratigraphic scheme of subdivision of the Devonian system and according to the right of priority should be restored.

M. A. Rzhonsnitskaya

Chairman of the Devonian
Commission of ISC of Russia
4 May 2001

NEWS FROM THE GIVETIAN WORKING GROUP

CONTRIBUTIONS DURING 2001

. ABOUSSALAM, Z.S. & BECKER, R.T. (2001): Prospects for an upper Givetian substage. *Mitt. Mus. Nat. Kd. Berl., Geowiss. Reihe*, **4:** 83-99.

. ABOUSSALAM, Z.S., BECKER, R.T. & SCHULTZE, H.-P. (2001): The global Taghanic biocrisis in the upper Givetian (Middle Devonian). Abstracts 15th International Senckenberg Conference, May 11-21, 2001: 1; Senckenberg, Frankfurt am Main.

. BULTYNCK, CASIER, J.-G., COEN-AUBERT, M. & GODEFROID, J. (2001). Pre-conference field trip (V1); Couvin-Philippeville-Wellin area, Ardenne (May 11-12, 2001). Field trips guidebook 15th International Senckenberg Conference, May 11-21, 2001: 1-44; Senckenberg, Frankfurt am Main.

SUMMARY OF PROGRESS

Aboussalam's & Becker's (2001) prospects are mainly based on conodont and goniatite data from two pelagic successions, Pic de Bissous Quarry (Montagne Noire) and the Bou Tchrafine section (Tafilalt, Morocco) and the correlation of these sections with the Tully limestone (N.Y., USA). They recognize an extended Taghanic Event Interval (Biocrisis) from the base of the initial transgressive pulse at the base of the Tully Limestone up to the base of the Geneseo Shale. They come to the conclusion that the initial Taghanic onlap cannot be accurately dated by conodonts within the *ansatus* (= middle *varcus*) conodont Zone. For definition of an upper Givetian substage they favour either the earliest occurrence of the conodont species *Ozarkodina semialternans* or the base of the Lower *hermanni* conodont Zone. The former level corresponds to a third transgressive pulse within the Tully Limestone and to the spread of the first Pharciceratidae, the latter level coincides with a significant eustatic transgression at the base of the Geneseo Shale in New York and with the entry of the classic multilobate pharciceratids.

Aboussalam, Becker & Schultze (2001) make a global diversity analysis of conodonts, goniatites and trilobites during the Taghanic Biocrisis. They conclude that conodonts were mostly un- affected by the Taghanic onlap and show a small extinction maximum, followed by a radiation at the boundary between the *varcus* conodont Zone (upper part with *Ozarkodina semialternans*) and the Lower *hermanni* Zone. For the goniatites they recognize a rather lasting first extinction event starting in the uppermost part of the *ansatus* Zone and a second extinction near the base of the Lower *hermanni* Zone.

During the SDS Business Meeting in Frankfurt am Main (May 16th, 2001) Becker & Aboussalam favored the base of the Lower *hermanni* Zone for defining the base of an upper Givetian substage.

During the Pre-conference field trip (V1) of the 15th International Senckenberg Conference in the Ardenne the type section of the Fromelennes Formation was visited (Bultynck et al. 2001: 30-34). On this occasion conodont data from the Fromelennes Formation (Bultynck 1974 and 1987) have been updated and a few complementary conodont samples have been analysed. The results are shown in figures V1 stop 9-2 and 3. Conodonts are scarce in the uppermost part of the underlying Mont d'Haurs Formation, however *Polygnathus timorensis* occurs in the middle part of the Mont d'Haurs Formation. *P. varcus* and *P. rhenanus* occur in the lowest part of the Flohimont Mbr (= Lower Member of the Fromelennes Fm), that is assigned here to the *rhenanus/varcus* Zone (= upper part of the Lower *varcus* Zone). The position of this zone above the *timorensis* Zone (= lower part of the *varcus* Zone) is well documented in sections from southern Morocco (Bultynck 1987) and is also recognized by Klapper (1981: 61; late form of *P. timorensis* = *P. rhenanus*) in New York. Rare specimens of *P. ansatus* indicating the *ansatus* Zone (= Middle *varcus* Zone) occur about 9 m above the base of the Flohimont Mbr. *P. denisbriceae* (senior synonym of *P. dubius frons*) appears slightly below and *Bipennatus bipennatus* occurs 3 m above representing the highest record of this species in the Ardenne. Conodonts become rare in the upper part of the Flohimont Mbr. The overlaying Moulin Boreux Mbr is about 80 m thick and consists of micritic/dolomitic limestones, occasionally finely laminated and alternating with biostromal beds mainly yielding domical and branched stromatoporoids. Stringocephalids disappear in the lowest part of the member. Conodonts are almost completely absent in the Moulin Boreux Mbr that is zonally indeterminate. In the Fromelennes area the Upper Member of the Fromelennes Fm (= Fort Hulobiet Mbr) contains *Polygnathus dubius*. In the Sourd d'Ave section at Wellin, about 20 km E of Fromelennes the Fort Hulobiet Mbr is characterized by the presence of *Pandorinellina insita* and is assigned to the *norrisi* Zone or lowest part of the *falsiovalis* Zone.

COMMENTS

The Lower *hermanni* Zone is certainly a precise and important level in the conodont biostratigraphy of the pelagic facies. However, one has to realize that standardized substage boundaries have to be useful for global correlation and that it will be very difficult to recognize the Lower *hermanni* Zone in the shallow-water platform carbonates that globally prevail at this time. Altogether, supplementary bio- and other stratigraphic criteria are required to make this level also useful for the neritic facies.

Johnson et al. (1985) correlated the base of the Fromelennes Formation with the base of T-R Cycle IIa corresponding to the Taghanic onlap in North America e.g. the base of the Tully Limestone in New York, biostratigraphically situated within the *ansatus* Zone. It is noteworthy to mention here the occurrence of *P. rhenanus* in the Tichenor Limestone Member, a transgressive unit within the Moscow Formation (Klapper 1981: 61; Johnson et al. 1985: 578; Brett & Baird 1996). Consequently the deepening event at the base of the Fromelennes Fm, with occurrence of *P. rhenanus* and *P. varcus* and below the entry of *P. ansatus* is likely older than the base of Tully Limestone and may correspond to a transgressive pulse within the Moscow Formation.

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P. Bultynck (Brussels)

PROSPECTS FOR AN UPPER GIVETIAN SUBSTAGE

Z. Sarah Aboussalam[1] & *R. Thomas Becker*[1]

3 plates (not supplied)

ABSTRACT

New ammonoid and conodont data from Germany, the Montagne Noire (France) and southeastern Morocco document a complex sequence of sedimentary events and faunal changes within an extended Givetian (late Middle Devonian) Taghanic Event Interval or Taghanic Biocrisis. Direct association of supposed typical middle Givetian ammonoids, trilobites and corals with upper Givetian marker taxa such as pharciceratids have been found, for example, in Moroccan and French time equivalents of the New York Upper Tully Limestone. The initial and eustatic Taghanic Onlap level is not known to be characterized by the first appearance of any widespread index conodont, goniatite or other taxon. A future upper Givetian substage, therefore, might be based either on the entry of *Ozarkodina semialternans* or on the first appearance of *Schmidtognathus hermanni*. The *semialternans* Zone correlates with a third sedimentary cycle within the Tully Limestone and with the spread of the first Pharciceratidae, Eobeloceratidae (*Mzerrebites juvenocostatus*) and Archoceratidae n. fam. (*Atlantoceras*). The (Lower) *hermanni* Zone is marked by a post-event transgression which led to a significant conodont radiation and to a further diversification of Pharciceratidae and Eobeloceratidae (*Mz. erraticus*).

Keywords: Middle Devonian, ammonoids, Archoceratidae, conodonts, trilobites, chronostratigraphy, global events, Morocco, France.

ZUSAMMENFASSUNG

Neue Ammonoideen- und Conodonten-Daten aus Deutschland, Frankreich (Montagne Noire) und aus Südost-Marokko belegen eine komplexe Abfolge sedimentärer Ereignisse und von Faunenwechseln in einem längerfristigen Taghanic-Event-Intervall bzw. einer Taghanic-Biokrise des Givetiums (oberes Mittel-Devon). Direkte Vergesellschaftungen von Ammonoideen, Trilobiten und Korallen, die früher als typische Mittel-Givetium-Formen angesehen wurden, mit Leitformen des Ober-Givetiums (z.B. Pharciceraten) konnten in Marokko und Frankreich in Zeitequivalenten des Oberen Tully-Kalkes von New York nachgewiesen werden. Der initiale und eustatisch bedingte Taghanic Onlap ist bisher nicht durch das Einsetzen eines weit verbreiteten Index-Conodonten, -Goniatiten oder eines Vertreters anderer Fossilgruppen gekennzeichnet. Eine künftige Ober-Givet-Unterstufe sollte daher entweder durch das Einsetzen von *Ozarkodina semialternans* oder durch das erste Auftreten von *Schmidtognathus hermanni* definiert werden. Die *semialternans*-Zone korreliert mit einem dritten Sedimentations-Zyklus im Tully-Kalk und mit der Ausbreitung erster Pharciceratidae, Eobeloceratidae (*Mzerrebites juvenocostatus*) und Archoceratidae n.fam. (*Atlantoceras*). Die (Untere) *hermanni*-Zone ist durch eine Post-Event-Transgression gekennzeichnet, welche eine wichtige Conodonten-Radiation und eine weitere Diversifizierung der Pharciceratidae und Eobeloceratidae (*Mz. erraticus*) ermöglichte.

Schlüsselwörter: Mittel-Devon, Ammonoidea, Archoceratidae, Conodonta, Trilobita, Chronostratigraphie, Globale Events, Marokko, Frankreich.

[1]Museum für Naturkunde, D-10115 Berlin, Invalidenstr. 43, Germany, thomas.becker@rz.hu-berlin.de, sarah.aboussalam@rz.hu-berlin.de

INTRODUCTION

In the classical subdivision of the German Upper Devonian by Wedekind (1913), the *Pharciceras lunulicosta* Zone or do I♋ (originally to I♋) was taken as the base of the Upper Devonian. House (1982) correlated this with the *Pharciceras*-bearing (House 1962) Tully Limestone of New York and with the base of the Assise de Fromelennes, which mostly was taken as the base of the Upper Devonian in Belgium. This interpretation was adopted by subsequent authors (e.g., Johnson et al. 1985). When the revised Middle/Upper Devonian boundary was placed at the much younger base of the *Ancyrodella. rotundiloba* Zone (Klapper et al. 1987, = base of MN Zone 1 sensu Klapper 1989), almost all pharciceratid faunal levels or most of the *Pharciceras* Stufe (House 1985) fell into the late Givetian. This interval was of considerable duration (more than 2 ma following House 1995) and spans as many as 5 goniatite zones (House & Becker 1999) and 6 ½ zones of the traditional conodont zonal scheme: the upper part of the Middle *varcus* Zone, the Upper *varcus* Zone, the Lower *hermanni* Zone, the Upper *hermanni* Zone, the Lower *disparilis* Zone, the Upper *disparilis* Zone, and the *norrisi* Zone (lowest part of the Lower *falsiovalis* Zone = former Lowermost *asymmetricus* Zone).

With respect to the classical boundary and to significant global faunal differences (e.g., the boundary between the *Maenioceras* = MD II and *Pharciceras* Stufe = MD III) caused by the global Taghanic Event (House 1985), it seems logical to place the base of an upper Givetian substage at the position of the old Upper Devonian base. Recent detailed work on the Taghanic Event in North America (Brett et al. 1999), in Germany, the Montagne Noire and Morocco (Aboussalam 2000), including a lot of new conodont and goniatite data, however, showed that the sequence of faunal and sedimentary changes is rather complex (Fig. 1). It also should be noted that the term upper Givetian has been used in the past by various authors working on neritic successions of the western and eastern Rhenish Massive in rather different ways and including older levels (e.g., in the sense of the "Iserlohnium", see Struve 1992) .

In all investigated areas it is evident that there is not just one level of global extinction, faunal change and of eustatic rise associated with the "Taghanic Onlap" (Johnson 1970), but a staged sequence of events (Fig. 1). For example, the New York Tully Limestone cannot only be divided into lower and upper members (Heckel 1973) but Brett et al. (1999) recognized three sedimentary sequences, with a second sequence boundary and start of a third division beneath the Bellona-West Brook Beds, within Heckel's upper member. Equivalents of $1^{st}/2^{nd}$ (lower member to lower half of upper member) and of the 3^{rd} Tully sequence (Bellona-West Brook, Moravia and Fillmore Glen Beds) can be recognized in many European and Moroccan sections. Recognition of three Tully subdivisions with separation of a West Brook Member goes back to Cooper & Williams (1935) and Cooper (1967). The whole period from the sharp regression at the top of the Hamilton Group (from the sub-Tully sequence boundary of Brett & Baird 1996) to the base of the Geneseo Shale, the Tully Limestone time equivalents (compare House 1983, 1989), is taken as extended Taghanic Event Interval or Taghanic Biocrisis (Fig. 1).

Abbreviations: *Po.* = *Polygnathus*, *Schm.* = *Schmidtognathus*, *Oz.* = *Ozarkodina*, *I.* = *Icriodus*, *Ph.* = *Pharciceras*, *Maenio.* = *Maenioceras*. All illustrated material is deposited in the Museum für Naturkunde, Berlin.

INVESTIGATED SECTIONS WITH NEW AMMONOID AND CONODONT DATA

Late Givetian sections have been described from around the world but none has been documented so far in sufficient detail to serve as a reference section for the middle/upper Givetian transition. It is recommended to search for a section in pelagic facies with good representation of several faunal groups, including diverse benthic organisms and, if possible, also miospores. Among the numerous European-North African localities studied by us in the last years in detail, none gave a perfect sedimentary and faunal sequence. German sections in pelagic limestone facies (e.g., Syring and Blauer Bruch, Kellerwald, see Ebert 1993) are all very poor in macrofauna. Sealevel changes associated with the Taghanic Onlap and later regressive events often cause unconformities, for example along the Mont Peyroux and in the Cabrières area of the Montagne Noire (Feist & Klapper 1985), or on the central Tafilalt Platform of southeastern Morocco (Jebel Amelane, Jebel Mech Irdane, Seheb-el-Rhassal, Hamar Laghdad). More basinal and less condensed sections of southern Morocco are often incredibly rich in well preserved goniatites (Hassi Nebech, Tata region, Bensaid 1974) but the conodont record is very poor, even in intercalated limestone beds. Only two well-known sections currently have good goniatites and a sufficient record of important marker conodonts: Pic de Bissous Quarry of the Montagne Noire, and Bou Tchrafine in the Tafilalt.

PIC DE BISSOUS QUARRY (MARBRIÈRE NORD)

The marble quarry on the northern slope of Pic de Bissous, ca. 3 km N of Cabrières (Fig. 2; precise location see Feist & Klapper (1985: text-fig. 3), or Becker (1993: fig. 15), has been long known as an important Middle Devonian fossil locality. The succession is completely overturned but the succession is not disturbed by tectonics. Hematite-rich, red Givetian hemipelagic limestones are strongly cyclic (House 1995) and contain goniatites, orthocones, crinoid remains, trilobites, solitary rugose corals, rare tabulate corals, inarticulate brachiopods, bivalves, ostracods, dacryoconarids, agglutinating foraminiferans and moderately rich conodont assemblages. The dominating lithologies are internally layered and often styliolinid-rich bioclastic wackestones to packstones with ostracods, trilobites and crinoidal debris (Pl. 3: 8). Goniatites are enriched in specific thin units such as Beds $26e_1$ (*Maenioceras* Bed = youngest subunit of Bed R in House 1995) and $26e_6$ (Pl. 3: 7) which may reflect levels of minor deepening and of increased trophic level. Episodic coarse crinoidal debris limestones (e.g., Beds 25(11), 26a(1), 26d2(1), see Pl. 3: 5) were deposited during storms or short-termed shallowing phases.

Apart from some preliminary data of Walliser (1990), whose bed numbering has been mostly adopted and extended, the conodonts of the quarry have largely remained unstudied. Faunas from the upper part of Middle *varcus* Zone to basalmost Frasnian, however, were described from a nearby section at the western slope of Pic de Bissous (Feist & Klapper 1985: section VS-W; goniatites in House et al. 1985). Our conodont succession (Table 1) starts with Bed 24c which falls in the *ansatus* Zone (ca. middle part of Middle *varcus* Zone). *Po. ansatus* was found in Bed 25(1) but Walliser (1990) noted it at a much older level higher up in the quarry (youngest part of Bed 17). *Latericriodus* (Pl. 2: 18; compare records in Feist & Klapper 1985) forms a minor element of Montagne Noire *ansatus* (Middle *varcus*) Zone faunas. A significant unconformity with erosional contact at the boundary between Beds 26a and 26b has previously been unnoticed. In sequence stratigraphic terms, it seems likely that this sedimentary break correlates with the regression-transgression couplet of the initial Taghanic Event.

The mass occurrence of *Maenioceras terebratum* Group (e.g., MB.C.3607) in Bed $26e_1$ (= Bed 26c in Walliser 1990) at the floor of the quarry still falls in the *ansatus* (Middle *varcus*) Zone. It is tempting to correlate this unusual unit with the 2nd Tully transgression at the base of its upper member. There is evidence of an additional sedimentary break and erosional events within haematite-rich styliolinid wackestones of Bed $26e_5$ (Pl. 3: 6). The dark red and nodular Bed $26e_6$ is only exposed in the eastern quarry corner and yielded for the first time in Europe *Pharciceras amplexum* (Pl. 1: 1-2) together with rather evolute *Ph.* cf. *tridens* (Pl. 1: 7). As in the Moravia Bed of New York, this unit contains *Oz. semialternans* (Pl. 2: 9) and can be precisely correlated with the 3rd Tully sequence. The erosional unconformity of Bed $25e_5$ indicates a sequence boundary just below, still in the topmost *ansatus* Zone (Middle *varcus* Zone). The *semialternans* Zone, unfortunately, is very condensed since the following Bed 27a gave a typical and diverse *hermanni* Zone fauna with *Po.*

limitaris (Pl. 2: 20), *Schm. latifossatus* and others. Pharciceratids from Bed 27b are too poorly preserved for identification.

The described sequence suggests that more effort should be undertaken to investigate the Pic de Bissous rugose corals, trilobites and ostracods.

BOU TCHRAFINE

The Bou Tchrafine section S of Erfoud in the central Tafilalt has been described by a wide range of authors. The middle to late Givetian conodont succession was investigated by Bultynck & Hollard (1980), Bultynck & Jacobs (1981), Ziegler & Klapper (1982), Bensaid et al. (1985), Bultynck (1987) and Ebert (1993). Goniatite data were included in Bensaid et al. (1985) and Ebert (1993); a more detailed summary was provided by Becker & House (1999). Based on this background we have specifically resampled the levels from below the Taghanic Event (upper *Maenioceras* Marls) to the Lower Marker Bed (Fig. 3) of the *Po. cristatus* Zone (= Upper *hermanni* Zone).

The sequence consists of yellowish-grey, nodular marls (Bed A0 = BT 30), massive and very solid, bluish-grey micrites with some goniatites, relative rich conodonts and bioturbated upper surfaces (*Sellagoniatites* Limestone and Lower Marker Bed), thin shale/marl interbeds, and yellowish, styliolinid-rich and somewhat argillaceous, fossiliferous, bioturbated, partly still layered micrites with goniatites, orthocones, *Pterochaenia*-like bivalves, brachiopods, crinoid remains, rare tabulate corals, foraminiferans (e.g., *Webbinelloidea*, Pl. 2: 16), smooth ostracods, phacopids, harpids and tentaculites (Beds A4 to B4). A microfacies analyses (Pl. 3: 1-4) showed that carbonates rather uniformly consist of styliolinid wackestones to packstones with ostracods, trilobites and rare crinoid remains. Mudstone intervals (Pl. 3: 2) indicate episodic deepening, packstones (Pl. 3: 1) formed during minor shallowing phases with increased bottom turbulance and removal of fine micritic matrix. It is obvious that most beds consist of several depositional units, perhaps each representing one orbital cycle, and separated by inconspicuous unconformities. Bed boundaries reflect somewhat stronger signals of sedimentary cyclicity and sealevel fluctuations.

Beds A0 to A3 (BT 30 – 31c, Table 2) fall in the higher part of the *ansatus* Zone (Middle *varcus* Zone); Bultynck (1987) and Lotmann (1990) recorded *Po. ansatus* from well below the *Maenioceras* Marl (= Bed A0). An intermediate between *Po. ansatus* and *Oz. semialternans* was found by Bultynck (1987) in his sample 30bis near the top of Bed A0. *Po. ovatinodosus* (Table 2, Pl. 2: 1) is now locally first recorded from the middle part of the *Sellagoniatites* Limestone (Bed A2 = BT 31b) which contains the name-giving marker goniatite. At its top (top of Bed A3) there is a distinctive erosional surface and a thin shale unit. Based on sequence stratigraphy, we correlate the overlying styliolinid-rich Bed A4 (Pl. 3: 2, = BT 32 in Bensaid et al. 1985 and Ebert 1993), which has poor macrofauna and which consists of two subunits, with the 1st/2nd sequences of the Tully Limestone. Conodonts still fall in the *ansatus* Zone (Middle *varcus* Zone) and its top is also rather irregular suggesting another discontinuity surface.

Bed B1b (= BT 33a in Ziegler & Klapper 1982, Bensaid et al. 1985 and Ebert 1993; BT 32 in Bultynck & Jacobs 1981, includes Bed B2 of Becker & House 1999) is the famous unit with *Pharciceras* aff. *amplexum* (which will be placed in a new species, Pl. 1: 3-4). Detailed sampling showed that poorly preserved *Maenioceras* are still rather abundant (MB.C.3305.1-7) and associated with the last rare *Sellagoniatites* (Pl. 1: 5-6) and the first *Epitornoceras*. The presence of *Oz. semialternans* was confirmed (Pl. 1: 8) but conodont samples are not rich. The overlying Beds B2-B4 (= BT 33b-d) have a typical and rather diverse fauna of the *hermanni* Zone. At the base of the zone (Bed B2), *Schm. hermanni* (Pl. 2: 4), *Sch. pietzneri* (Pl. 2: 2-3), *Schm. wittekindti* (Pl. 2: 5), *Po. limitaris* (Pl. 2: 14a-b), *Schm. latifossatus* (Pl. 2: 13) and *Oz. proxima* (Pl. 2: 7) enter. Bed B2 (= BT 33b, including fauna placed in Bed B3 in Becker & House 1999), yielded *Mzerrebites erraticus* and a closely related, somewhat thicker form (compare specimen from Jebel Amelane, Pl. 1: 14-15) but no pharciceratids. In neighbouring sections (Seheb el Rhassal), the multilobate and evolute *"Pharciceras" lunulicosta* Group (Gen. nov.) enters in equivalents of Beds B3/B4.

The lower part of the Upper Marker Bed (Bed C1 = BT 34) has been dated by Bensaid et al. (1985) and Ebert (1993) as Upper *hermanni* Zone which is defined by the entry of *Po. cristatus* Hinde. As repeatedly noted (Kirchgasser 1970, Huddle 1981; compare discussion in Ziegler & Klapper 1982), the holotype of *Po. cristatus* differs from *Po. cristatus* sensu Bischoff & Ziegler (1957) in ornamentation (with partly fused nodes in two rows, the outer of which runs around the platform margin) and in its dorsal carina which does not reach the posterior tip of the platform. It is probably appropriate to restrict the name *Po. cristatus* to morphotypes resembling the holotype. In such a taxonononic concept, *Po. ectypus* Huddle becomes available as the correct name for *Po. cristatus* sensu Bischoff & Ziegler. The *cristatus* lectotype lies outside the variation of an Illinois population illustrated by Orr (1964) but he (text-fig. 4C), as well as Bultynck & Jacobs (1981, pl. VII, figs 11a-b), illustrated single specimens with *ectypus*-type nodation and *cristatus*-type short median carina. Both taxa seem to have come from the same stratigraphical level (North Evans Limestone) of New York.

POSSIBLE LEVELS FOR THE BASE OF AN UPPER GIVETIAN SUBSTAGE

The discovery of intermediate pelagic faunas with mixtures of previously supposed typical middle and upper Givetian taxa together with other data on ammonoid and conodont occurences allow a critical evaluation of three levels which should be considered for a formal definition of an upper Givetian substage: the initial Taghanic Onlap, levels around the base of the traditional Upper *varcus* Zone, and the base of the *hermanni* Zone. Any decision should incorporate additional data based on miospores, vertebrates and neritic faunas but these have not yet been used for detailed international correlation. It is worth mentioning that stringocephalid brachiopods range above all the levels under discussion.

BASE OF TAGHANIC ONLAP

The initial transgressive pulse at the base of the mostly unconformable Lower Tully Limestone (Fig. 1) has been correlated with the Belgian transgression of the Fromelennes Formation over the Calcaire de Givet and with many other regional deepening events of North America and Eurasia (House 1975, 1983, Johnson et al. 1989, Ebert 1993, Day 1996a). New data by Bultynck et al. (2001), however, indicate that the Fromelennes Formation began as early as in the upper part of the Lower *varcus* Zone (*timorensis* Zone). This is in conflict with a record of *Stringodiscus? birenheidei* in the basal Fromelennes Formation (Struve 1992), a species which otherwise is only known from Flinz limestones (Schleddenhof Beds) above the thick middle Givetian reef limestones (Massenkalk Formation) of the Iserlohn area in the northern Rhenish Massive.

Johnson et al. (1985, 1989) recognized the Taghanic Onlap as the start of their international Depophase IIa. The initial pre-Tully regression/Tully transgression couplet is assumed to have coincided with significant extinctions in ammonoids (House 1985, 1989, Becker & House 2000) and trilobites (Cheiruridae, Lichidae, Calmoniidae, Eremiproetinae, Cyphaspidinae, most Proetinae, many Dechenellinae, Otarioninae and Aulacopleurinae; Feist 1991, Chlupac et al. 2000). Many other faunal groups, such as rugose and tabulate corals (e.g., Oliver & Pedder 1994), brachiopods (Cooper & Williams 1935, Dutro 1981), stromatoporoids (e.g., Mistiaen in Brice et al. 1976) and ostracods (e.g., Lethiers in Brice et al. 1976) were affected by the Taghanic Event but the precise timing of their extinctions is either still unknown, was stepwise (Dutro 1981, Day 1996b), or much influenced by regional factors. A first range compilation of many faunal groups by Ebert (1993), unfortunately, needs considerable revision and elaboration. Despite the fact, that the Taghanic Onlap seems to be recognizable on a global scale, serious reasons speak against its use as substage boundary level:

a. The initial Taghanic Onlap falls within the Middle *varcus* Zone (*ansatus* Zone of Bultynck 1987) and currently there is no index conodont, ammonoid or any other international faunal marker available that allows an easy recognition of the onlap level. In many of our sections the identification of the onlap level had to be based on sequence stratigraphy. In North American interior basins, Day (1996a, 1996b) underlined the immigration of longer-ranging Old World Realm and Eastern American brachiopod groups with the Taghanic Onlap but did not note important evolutionary innovation at that time.

b. In the Lower Tully, but not at its very base (in the Carpenter Falls Bed, Ziegler et al. 1976), and in various other North American regions (e.g., Dawson Bay Formation of Manitoba, Norris & Uyeno 1971; Bassett Member of the Little Cedar Formation, Iowa, Witzke et al. 1989; Buffalo River Member of the Pine Point Formation, Northwestern Territorries, Lantos 1983), *Po. alveolipostícus* is a useful index species but it occurs only very rarely outside America and not always at the same level. In the Tafilalt of southern Morocco, we have found one specimen (Pl. 2: 14) in the immediate pre-event interval (shallowing upwards *Sellagoniatites* Limestone, topmost MD II-C). At Martenberg in the Rhenish Massive, another specimen (Pl. 2: 15) was discovered in the *disparilis* Zone which is also the age of most original material from the basal New Albany Shale and lower Antrim Shale of Indiana (Orr & Klapper 1968). Species such as *Po. ovatinodosus* and *Po. tuberculatus* experienced some blooms in the transgressive episode but also range into pre-onlap levels of the Middle *varcus* Zone (*ansatus* Zone). Conodonts show no significant extinction at all at the initial Taghanic Event (Aboussalam & Becker 2000).

c. The new data from Morocco (Bou Tchrafine, Ouidane Chebbi) and from the Montagne Noire showed that both *Maenioceras* and *Sellagoniatites*, supposed typical middle Givetian index goniatites, may still co-occur with the oldest *Pharciceras* in equivalents of the 3rd Tully sequence (MD III-A). Directly associated *Maenio.* aff. *terebratum* (Pl. 1: 8-9) and *Ph.* aff. *amplexum* (Pl. 1: 12-13) are illustrated from the *semialternans* Zone (see Pl. 2: 10) of Col de Tribes South, at the eastern slope of the Mont Peyroux of southern France, just N of section MP-E of Becker (1993). In more basinal sections of the Tafilalt (Hassi Nebech) and in the Dra Valley (Tata region: sections Oufrane, Tiguisselt, Oued Mzerreb), litho- and sequence stratigraphical correlations suggest that a deepening and black shale interval with *Afromaenioceras sulcatostriatum*, the last *Wedekindella brilonensis* and *Trevoneites* (MD II-D) correlates with the 1st/2nd Tully sequences. It is conformably overlain by black shales with the oldest *Pharciceras* (MD III-A).

d. A range of supposed typical middle Givetian trilobite groups survived the pre-Tully regression and initial onlap. The last representative of the Proetinae (*Gerastos*) was found at Ouidane Chebbi (eastern Tafilalt) in equivalents of the 1st/2nd Tully sequence (Bed 2). This has parallels in little noticed contemporaneous records of *Crassiproetus* from the Bassett Member of the Little Cedar Formation of Iowa; the genus may range even higher in Iowa (Witzke et al. 1989). Homalonotids (*Dipleura decayi*), Hamilton-type phacopids (*Geesops rana*), otarionids (*Harpidella*), asteropygids (*Greenops*) and Dechenellinae (*Monodechenella macrocephala*, *Basidechenella rowi*) re-appear in New York in the Upper Tully Limestone (Richter & Richter 1926, Cooper & Williams 1935). They are associated with various Hamilton-type brachiopods of the *Elytha fimbriata* Zone (see Heckel 1973). In the discussion of trilobite extinctions associated with the Taghanic Onlap little attention has been paid so far to the lower Callaway Formation of Missouri which has been correlated with the (post-onlap) lower part of the Cedar Valley Formation of Iowa (e.g., Witzke et al. 1989, Day 1996b). Faunas listed in Fraunfelter (1967) include brachymetopids (*Mystrocephala pulchra*), crassiproetines (*Crassiproetus calhounensis*), *Greenops*, *Phacops*, scutelluids, dechenellids (*Dechenella* aff. *nortoni*, *Pseudodechenella* *elevata*) and others. A single *Aulacopleura (Paraaulacopleura)* was mentioned by Basse (1998) from the Tentaculitenschiefer of the northern Rhenish Massive; the drowning of most of the massive reefs of the region by this dark shale unit probably has been caused by the Taghanic deepening. On a global scale, there is a remarkable lack of well documented late Givetian trilobite faunas. But it seems clear that only ca. half of all middle Givetian trilobite genera ranged into the event interval.

e. Survival of the initial Taghanic Onlap is also true for some North American brachiopods (Dutro 1981) rugose and tabulate corals (Heckel 1973) which re-occur in the Bellona and West Brook Beds of the Upper Tully Limestone. In the Tafilalt (Ouidane Chebbi), the cladochonid *Bainbridgia alternans* was recently discovered to range into the level with oldest *Pharciceras*. It is expected that future work will show the presence of more typical middle Givetian faunal groups in Tully Limestone equivalents.

BASE OF UPPER *VARCUS* ZONE

The base of the Upper *varcus* Zone is traditionally defined by the entry of *Po. latifossatus* (Ziegler et al. 1976) which for phylogenetical and morphological reasons (large basal cavity, see Pl. 2: 13) is better placed in *Schmidtognathus*. Although the species has been recorded almost worldwide (Nevada, Iowa, New York, Morocco, Montagne Noire, Pyrenees, Northern Spain, Sardinia, Austria, Germany, South China: Guangxi, Yunnan, Australia: New South Wales, Queensland), several reasons argue against its use as upper Givetian index conodont:

a. The species enters within the Upper Tully Limestone (within the Moravia Bed of the 3rd sequence) and just postdates the entry of *Pharciceras amplexum* (Ziegler & Klapper 1982). A "*latifossatus*-boundary" would not include the earliest part of the *Pharciceras* Stufe and would not correlate precisely with significant faunal change in other groups.

b. In all our investigated sections from Germany (but including none of the three described by Ziegler et al. 1976), the Montagne Noire and from Morocco, *Schm. latifossatus* is a rather rare species and it was mostly impossible to recognize the Upper *varcus* Zone in its strict sense. Much easier to place is the entry of its ancestor (see Bultynck & Hollard 1980), *Oz. semialternans*. We, therefore, propose to replace the Upper *varcus* Zone by a *semialternans* Zone in the standard zonal scheme. Already Bultynck (1987) has introduced a *semialternans-latifossatus* Zone. Rare oldest *Oz. sannemanni* (Wirth 1967) and *Elsonella rhenana* (new record from Ouidane Chebbi) enter at the same time as *Oz. semialternans*.

The base of the *semialternans* Zone correlates with the entry of first *Pharciceras* (base of international division MD III-A = *Pharciceras* Genozone) in New York, Morocco, and in the Montagne Noire (new fauna from Col de Tribes South). It coincided with the deepening phase of the 3rd Tully sequence in the type region and with transgressive episodes elsewhere. A range of middle Givetian "holdover taxa" amongst goniatites, corals, brachiopods and trilobites obviously did not overlap with *Oz. semialternans* in the Tully Limestone. In the Tata region of southern Morocco, the oldest simple-lobed *Pharciceras* are associated with first Eobeloceratidae (*Mzerrebites juvenocostatus*, Bensaid 1974). Regionally typical is also the appearance of *Atlantoceras*, the first member of the Archoceratidae n. fam. (Gephurocerataceae; also including *Archoceras* and a related new genus from Ouidane Chebbi) which are defined by only four mature lobes and with very deep, v-shaped ventral and dorsal lobes (true septal folds) as in juvenile Maenioceratidae, but unlike that found in any Anarcestina or Agoniatitina.

An upper Givetian substage defined by *Oz. semialternans* should be considered as a serious option since the species also has an almost worldwide record of first occurrences (Iowa, New York, Morocco, Montagne Noire, Pyrenees, Sardinia, Rhenish Massive, South China, Kolyma of eastern Siberia). A current disadvantage is the unclear ancestry since there are only very few true ozarkodinids in the preceding main Middle *varcus* (*ansatus*) Zone. Bultynck (1987) suggested that *Oz. semialternans* was derived from *Po. rhenanus* and documented an intermediate specimen with platform remains from an immediate pre-Taghanic level of Morocco (Bou Tchrafine). Consequently, he placed the species in *Polygnathus* which, however, comprises a number of widely different and not closely related lineages.

BASE OF (LOWER) *HERMANNI* ZONE

The base of the zone is defined by the entry of *Schm. hermanni* or of alternative index conodonts such as *Schm. wittekindti, Schm. pietzneri* and *Po. limitaris*. *Po. dubius* and *Po. ordinatus* also enter within the zone. Using its base for the definition of an upper Givetian would have some advantages:

a. As just outlined, the base of the *hermanni* Zone is marked by a significant post-Taghanic conodont radiation and can be easily recognized by a number of index species belonging to different phylogenetic lineages.

b. The boundary between the *varcus* and *hermanni* Zones is also characterized by a small-scale global conodont extinction (Aboussalam & Becker 2000) which terminated, for example, *Po. linguiformis mucronatus* (compare Pl. 2: 11-12), *Po. linguiformis klapperi, Po. linguiformis transversus*, the last *Po. parawebbi*, and, perhaps, the last *Bipennatus*. In many sections, *Po. linguiformis linguiformis* became rare with the end of the *varcus* (*semialternans*) Zone.

c. The conodont extinction event coincided with the final extinction of Maenioceratidae and of the last Agoniatitidae; both were always regarded as typical middle Givetian groups. Similar Taghanic Onlap survivor extinctions may apply to some corals and brachiopods. Only half of the known trilobite genera (*Phacops, Cyphaspis, Longicoryphe, Richteraspis,* *Scutellum, Harpes, Greenops, Bradocryphaeus, Heliopyge, Neometacanthuis, "Dudleyaspis"*) survived into the post-event late Givetian.

d. The base of the *hermanni* Zone correlates with the entry of easily recognizable goniatites such as *Mzerrebites erraticus* (in North Africa and in the Rhenish Massive) and of advanced (involute or multilobate) pharciceratids (MD III-B). Surprisingly, this significant gradual upper Givetian radiation is not known to have been paralleled in the trilobite evolution.

e. The base of the *hermanni* Zone coincided with a significant eustatic transgression. In New York this is well marked by the base of the Geneseo blackshale (House 1983) which sits on a post-Tully erosional unconformity (Brett & Baird 1996), partly marked by the oldest Leicester Pyrite (Huddle 1981). In Iowa the global sealevel rise was recognized as base of a middle subdivision of the eustatic Depophase IIa (IIa-2, Witzke et al. 1989), or as regional T-R cycle 3B (Day 1996b).

Disadvantages of a *hermanni*-defined substage would be as follows:

a. The basal part (first zone, MD III-A) of the *Pharciceras* Stufe as defined by House (1985) would be excluded from the upper Givetian.

b. The base of the substage would lie 1 ½ conodont zones and up to two ammonoid zones (Fig. 1) higher than the initial Taghanic Onlap.

CONCLUSIONS

Two different conodont-goniatite levels are available which might be used to define an upper Givetian substage: the base of the *Oz. semialternans* Zone = base of *Pharciceras* Genozone (MD III-A), or the base of the *Schm. hermanni* Zone = base of *Stenopharciceras* Genozone (MD III-B, regional *Mzerrebites erraticus* Zone of SE Morocco, House & Becker 1999). Both levels correlate with eustatic transgressions subsequent to the initial and main Taghanic Onlap and can be recognized nearly worldwide, at least in pelagic facies.

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Fig. 1. Middle to upper Givetian chrono-, bio-, litho- and sequence stratigraphy.

Fig. 2. Sedimentary and faunal succession in the middle to upper Givetian at Pic de Bissous Quarry (Marbriére Nord) showing the position of conodont samplex and of macrofaunal levels. The extended Taghanic Event Interval is shaded.

Fig. 3. Sedimentary and faunal succession in the middle to upper Givetian at Bou Tchrafine (section of Bultynck & Hollard 1980 and Bultynck 1987) showing the position of new conodont samples and the macrofaunal record. Shaded area = Taghanic Event Interval.

Table 1

Conodont succession at Pic de Bissous Quarry. W = records of Walliser (1990). Shaded areas = extended Taghanic Event Interval.

Table 2

Middle to late Givetian conodont succession at Bou Tchrafine, based on new samples and records of Bultynck (1987: B) and Ebert (1993: E). Shaded area = Taghanic Event Interval.

Plate 1. Goniatites from around the Taghanic Event Interval of Morocco and of the Montagne Noire.

1-2. *Pharciceras amplexum* (Hall), MB.C.3300.1, Pic de Bissous Quarry, Bed 26e6, *semialternans* Zone, incomplete specimen, x 1; 1, lateral view, and 2, ventral view showing typical, strong ventrolateral furrows and cross-section with flat venter.

3-4. *Pharciceras* aff. *amplexum* (Hall), MB.C.3151.3, Bou Tchrafine, Bed B1b, *semialternans* Zone, small specimen with sutures; 3, lateral view, x 2.2, and 4, ventral view, x 2.5, showing the rounded cross-section at ca. 20 mm diameter lacking prominent furrows.

5-6. *Sellagoniatites discoides* (Waldschmidt), MB.C.3302.1, Bou Tchrafine, Bed B1b, *semialternans* Zone, x 1; 5, lateral view showing rapid whorl expansion, and 6, ventral view showing typical and strong shell compression.

7. *Pharciceras* cf. *tridens* (Sandberger & Sandberger), MB.C.3301, Pic de Bissous Quarry, Bed 26e6, *semialternans* Zone, relative evolute and compressed morphotype (or subspecies) lacking furrows, x 1.5, lateral view. The irregular coiling of early whorls is an artefact of preparation.

8-9. *Maenioceras* aff. *terebratum* (Sandberger & Sandberger), MB.C.3303.1, Col de Tribes South, Bed 45, *semialternans* Zone, x 1.5; 8, lateral view showing strong ventrolateral furrows, and 9, ventral view, showing thicker whorls than in the *terebratum* lectotype of Becker & House (1994).

10-11. *Maenioceras terebratum* (Sandberger & Sandberger), MB.C.3306, Jebel Amelane, Section 1 (see Becker & House 1994), loose specimen from *Maenioceras* Marls (*terebratum* Zone), typical strongly compressed morphotype, x 1.5; 10, lateral view, and 11, ventral view showing thinner whorls than in *Maenio.* aff. *terebratum* (see Fig. 9).

12-13. *Pharciceras* aff. *amplexum* (Hall), MB.C.3304.1, Col de Tribes South, Bed 45, *semialternans* Zone, x 1.5; 12, lateral view showing biconvex growth lines, and 13, ventral view showing broad whorl profile and weak ventrolateral furrows at 30 mm diameter.

14-15. *Mzerrebites* aff. *erraticus* (Petter), MB.C.3166, Jebel Amelane, Section 1, loose specimen, probably from the *erraticus* Zone, x 1.5; 14, lateral view, and 15, ventral view showing wider whorls than in typical *Mz. erraticus*.

Plate 2. Conodonts and foraminiferans from around the Taghanic Event Interval of Morocco and of the Montagne Noire

1. *Polygnathus ovatinodosus* Ziegler, Klapper & Johnson, Bou Tchrafine, Bed A2, middle *Sellagoniatites* Limestone, upper part of *ansatus* Zone, incomplete and relatively weakly ornamented specimen, x 55.

2. *Schmidtognathus pietzneri* Ziegler, Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, large specimen, x 50.

3. *Schmidtognathus pietzneri* Ziegler, Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, small specimen, x 85.

4. *Schmidtognathus hermanni* Ziegler, Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, incomplete specimen, upper view, x 85.

5. *Schmidtognathus wittekindti* Ziegler, Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, incomplete specimen, x 85.

6. *Ozarkodina sannemanni* Bischoff & Ziegler, Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, upper view, x 55.

7. *Ozarkodina proxima* (Pollock) Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, upper view, x 55.

8. *Ozarkodina semialternans* Wirth, Bou Tchrafine, Bed B1b, *Pharciceras* aff. *amplexum* Bed, *semialternans* Zone, fragmentary specimen, lateral view, x 55.

9. *Ozarkodina semialternans* Wirth, Pic de Bissous Quarry, Bed 26e6, *Pharciceras amplexum* Bed, *semialternans* Zone, lateral view, x 85.

10 *Ozarkodina semialternans* Wirth, Col de Tribes South, Bed 46, *Pharciceras* aff. *amplexum* Beds, *semialternans* Zone, lateral view, x 85.

11. *Polygnathus linguiformis mucronatus* Wittekindt, Bou Tchrafine, Bed A3, top *Sellagoniatites* Limestone, upper part of *ansatus* Zone, slightly oblique view, x 55.

12. *Polygnathus linguiformis mucronatus* Wittekindt, Bou Tchrafine, Bed A3, top *Sellagoniatites* Limestone, upper part of *ansatus* Zone, upper view of a second specimen, x 55.

13. *Schmidtognathus latifossatus* (Wirth), Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, lower view of incomplete specimen showing the *Schmidtognathus*-type large basal cavity, x 55.

14. *Polygnathus alveoliposticus* Orr & Klapper, Seheb el Rhassal, top Bed D2, top *Sellagoniatites* Limestone, upper part of *ansatus* Zone, wide morphotype, x 55.

15. *Polygnathus alveolipoticus* Orr & Klapper, Martenberg (Rhenish Massive), section at northern corner, top Bed –3B, (Lower) *disparilis* Zone, narrow morphotype, x 55.

16. *Webbinelloidea similis* Stewart & Lampe, unusually complex morphotype (= *Webb. disparicella* Summerson, see *similis* Subgroup IIIA in Conkin & Conkin 1970), Bou Tchrafine, Bed B1b, *Pharciceras* aff. *amplexum* Bed, *semialternans* Zone, x 30.

17. *Polygnathus timorensis* Klapper, Bou Tchrafine, Bed A3, top *Sellagoniatites* Limestone, upper part of *ansatus* Zone, specimen with asymmetric platform, x 85.

18. *Latericriodus latericrescens* (Branson & Mehl), Pic de Bissous Quarry, Bed 26a(1), *ansatus* Zone, incomplete specimen, x 85.

19. *Polygnathus limitaris* Ziegler, Klapper & Johnson, Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone, slightly oblique (a) and upper view(b), x 50.

20. *Polygnathus limitaris* Ziegler, Klapper & Johnson, Pic de Bissous Quarry, Bed 27a, basal (Lower) *hermanni* Zone, incomplete specimen, x 85.

Plate 3. Microfacies of beds around the Taghanic Event Interval at Bou Tchrafine and Pic de Bissous (Scale bars = 1 mm).

1. Bou Tchrafine, Bed A3, top of *Sellagoniatites* Limestone, upper part of *ansatus* Zone: styliolinid-rich wackestone, followed above a haematite-encrusted small-scale discontinuity surface (ca. 1/3 above base of figure) by styliolinid packstone. The lower styliolinid wackestone contains some thick-shelled, benthic ostracods, crinoid debris, trilobite remains and disarticulated brachiopod shells. In the stylionid packstone the dark micrite was washed out pointing to episodically increased bottom turbulence and condensation. Towards the top of the bed the styliolinid abundancy decreases again.

2. Bou Tchrafine, Bed A4, Styliolinid Bed, top part of *ansatus* Zone: bioturbated stylionid mudstone-wackestone with some tentaculites (middle left margin), small orthocones, trilobite remains and rare angular quartz grains, followed above an undulating and non-encrusted minor discontinuity surface by styliolinid-richer wackestone.

3. Bou Tchrafine, Bed B1b, *Pharciceras* aff. *amplexum* Bed, *semialternans* Zone: styliolinid wackestone with brachiopods, trilobite remains and rare angular quartz grains, followed above an inconspicuouse undulating discontinuity surface by less fossiliferous, bioturbated styliolinid wackestone/mudstone with rare crinoid debris. Remains of large tabulate/stromatoporoid colonies form unusual shallow-water allochems in the otherwise typical pelagic microfacies.

4. Bou Tchrafine, Bed B2, *erraticus* Bed, basal (Lower) *hermanni* Zone: detailed view of bioclastic wackestone with styliolinids, ostracod and brachiopod remains and some pyrite/(secondary) haematite.

5. Pic de Bissous Quarry, Bed 26d2, *ansatus* Zone: crinoid grainstone/rudstone with some haematite coating and sparite and peloids

between partly complete and partly broken ossicles.

6. Pic de Bissous Quarry, Bed 26e5, *Maenioceras* Bed, top *ansatus* Zone: lower part (A) composed of haematite-rich styliolinid wackestone with ostracods and shell filaments, truncated by an haematite-coated erosional channel (B) which has mostly removed a second wackestone unit (C) which is separated by an undulating stylolitic unconformity surface. The channel is filled by a shallowing upwards wackestone unit (D) with many styliolinids, intraclasts, crinoid debris, ostracods, filaments and trilobite remains.

7. Pic de Bissous Quarry, Bed 26e6, *Pharciceras amplexum* Bed, *semialternans* Zone: haematite-rich, red, bioturbate and nodular wackestone with ostracods, styliolinids and intraclasts in microsparitic matrix. The original internal bedding has been largely destroyed by diagenetic overprinting.

8. Pic de Bissous Quarry, Bed 27a, basal (Lower) *hermanni* Zone: styliolinid packstone with thin-shelled, pelagic ostracods, haematite and crinoid debris, followed gradually (in the middle part of the section) by less fossiliferous styliolinid wackestone.

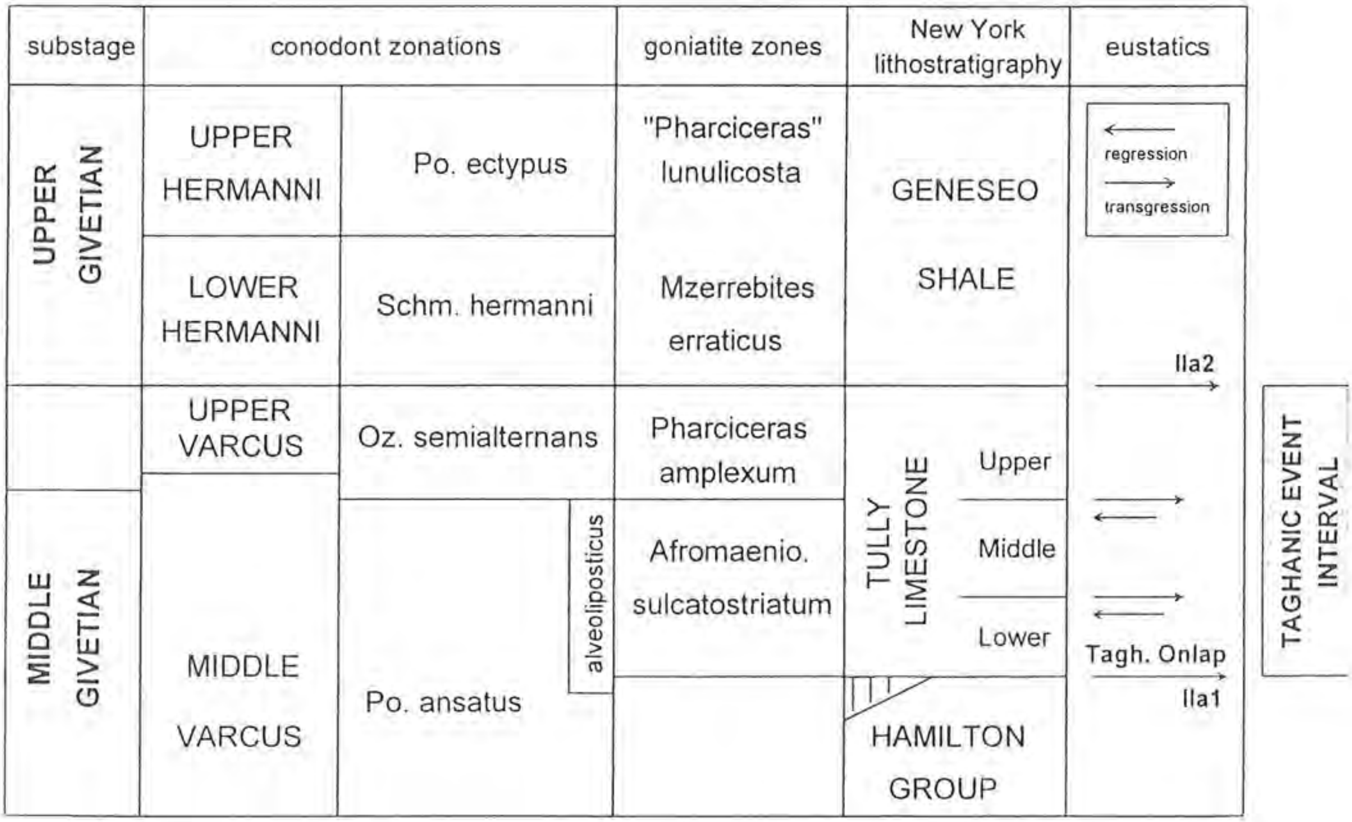

Fig. 1. Middle to upper Givetian chrono-, bio-, litho- and sequence stratigraphy.

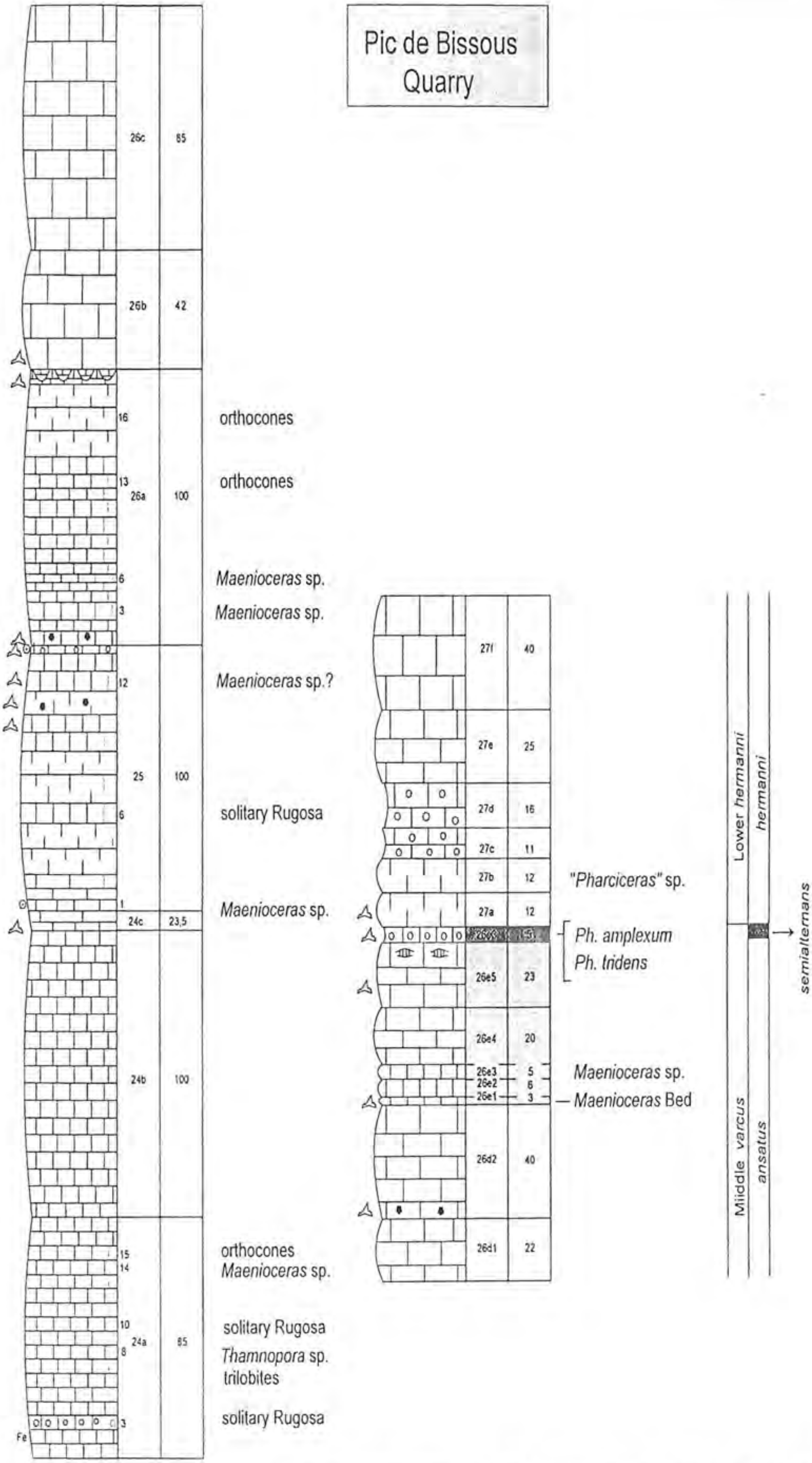

Fig. 2. Sedimentary and faunal succession in the middle to upper Givetian at Pic de Bissous Quarry (Marbriére Nord) showing the position of conodont samplex and of macrofaunal levels. The extended Taghanic Event Interval is shaded.

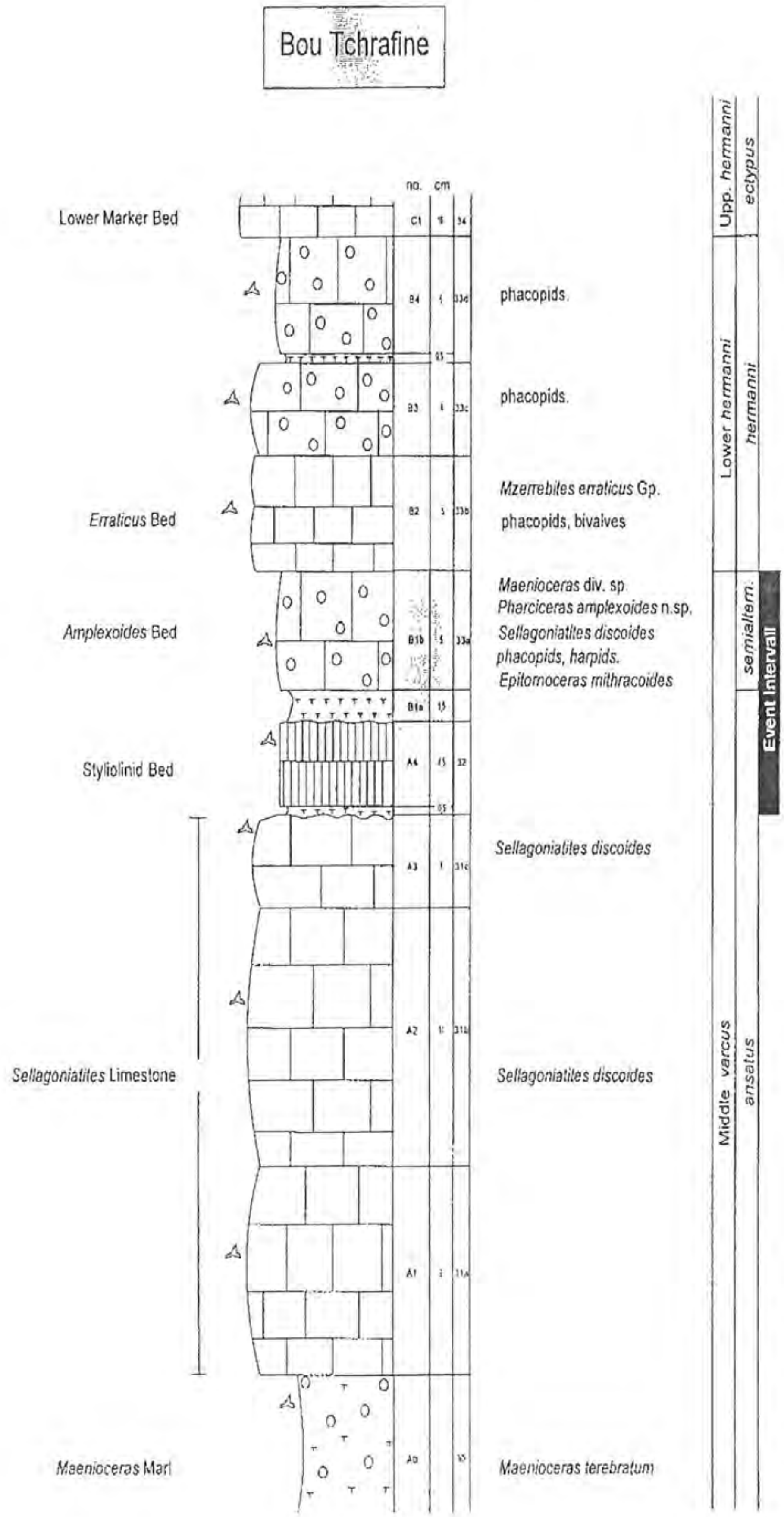

Fig. 3. Sedimentary and faunal succession in the middle to upper Givetian at Bou Tchrafine (section of Bultynck & Hollard 1980 and Bultynck 1987) showing the position of new conodont samples and the macrofaunal record. Shaded area = Taghanic Event Interval.

Table 1

Conodont succession at Pic de Bissous Quarry. W = records of Walliser (1990). Shaded areas = extended Taghanic Event Interval.

Pic de Bissous Quarry												
conodont zones	*ansatus Zone*										*sem.Z.*	*her.Z.*
bed and sample no.	24c1	25 (1)	25 (10)	25 (11)	26a(1)	26a(18,19)	26b(1)	26d2	26e 1	26e 5	26e 6	27a
Po. varcus	2	*	1	3	4	7	1	3	*	7	*	3
Po. ling. klapperi	1	*	2	1	*	*	*	3	1	3	1	
Po. ling. linguiformis	13	*	25	32	33	13	8	25	3	23	3	
Po. hemiansatus		W										
Po. ansatus	*	W	*	*	*	*	*	*	W			
Po. ling. mucronatus			1	*	1	*	*	*	*	2		
Po. ling. weddigei				1	3	*	1	*	*	1		
Po. timorensis					2	1	*	1	1	4	*	W
I. difficilis					2							
Lateri. latericrescens					1							
Oz. semialternans					W?						2	1
Tortodus spp.							1	*	*	*	*	2
I. obliquimarginatus									W	1	*	2
Po. xylus										3	*	5
Po. ovatinodosus										1	*	23
Schm. latifossatus												4
Schm. hermanni												2
Schm. wittekindti												2
Po. limitaris												4

Table 2

Middle to late Givetian conodont succession at Bou Tchrafine, based on new samples and records of Bultynck (1987: B) and Ebert (1993: E). Shaded area = Taghanic Event Interval.

Bou Tchrafine										
conodont zones	*ansatus* Zone					*semi*Z.	*hermanni* Zone			*ect*.Z.
bed and sample no.	A0	A1	A2	A3	A4	B1b	B2	B3	B4	C1
Po. varcus	1	2	30	39	4	E,B	13	9	*	B
Po. rhenanus	B	*	B?							
Po. ling. linguiformis	20	21	224	121	34	4				
Po. ling. mucronatus	1	3	7	4	2					
Po. ling. weddigei	1	1	24	8	3	1				
Po. timorensis	B	*	23	10	1	E	3			
Tort. beckmanni	B	*	*	*		B				
Po. ansatus	*	*	27	7		*	8			
Po. xylus	*	*	20	9	B	*	3	6	4	
Po. ling. klapperi	*	*	7	6	1					
I. difficilis	*	*	2	*	*	*	8			
Po. ovatinodosus			12	1	2	E	8	8	*	B
Tortodus spp.				4	1	1				
Oz. semialternans						1	2	*	1	B
Oz. proxima							3			
Oz. sannemanni							1			
Schm. latifossatus								1	*	B
Schm. hermanni							27	11	2	B
Schm. wittekindti							4	6	1	B
Schm. pietzneri							1	1	*	B
Po. limitaris							1	4	2	
Elsonella rhenana								1		
Po. ectypus										B

NEWS FROM THE FRASNIAN SUBSTAGES WORKING GROUP

D. Jeffrey Over, SUNY-Geneseo, Geneseo, NY 14454 (over@geneseo.edu)

FRASNIAN SUBSTAGES WORKING GROUP PROGRESS REPORT - MAY 2001

The working Group on Frasnian Substages has added new members and currently stands at 28 individuals (Table 1), a web site is available to review news and to post new information at http://www.geneseo.edu/~frasnian/

Fifteeen members of the working group members voted to determine the number of Frasnian substages to work towards. Three substages was a preference of 12 of 15 cast votes, also favored by no more than three ballots were none, two, three, four, and five. Clearly a three-fold substages division should be considered.

Proposals for the lower-middle boundary utilize the first occurrence of *Palmatolepis punctata*.

Proposals for the midle-upper boundary utilize the first occurrence of *Palmatolepis semichatovae*.

STRATOTYPE PROPOSALS ARE:

1. Becker, R.T., and House, M.R., 1998, Proposals for an international substage subdivision of the Frasnian: SDS Newsletter No. 15, p. 17-22. See for detailed discussion and review of possible stratotypes and reference sections; also see comments by Sandberg, C.A. and Ziegler, W., 1998, Comments on proposed Frasnian and Famennian subdivisions: SDS Newsletter No. 15, p. 43-46.
2. Rzhonsnitskaya, M.A., 1998, Proposals for an International substages subdivision of the Devonian stages: SDS Newsletter No. 15, p. 53-61. See for correlation table and discussion of reference section.
3. Yolkin, E.A., 1998, Devonian substages in West Siberia sequences: SDS Newsletter No. 15, p. 62.

TABLE 1. FRASNIAN SUBDIVISIONS WORKING GROUP

Bardashev, Igor (Tajikistan) ibard@geol.tajik.net
Becker, R. Thomas (Germany) thomas=becker@rz.hu-berlin.de
Bultynck, Pierre (Belgium) bultynck@d5100.kbinizsnb.be
Cook, Alex (Australia) alexc@qm.qld.gov.au
Crick, Rex (USA) crick@uta.edu
Dastanpour, Mohammad (Iran) FAX 98-341-267681
Day, James (Jed) E. (USA) jeday@mail.ilstu.edu
Ellwood, Brooks (USA) ellwood@geol.lsu.edu
Feist, Raimund (France) rfeist@isem.univ-montp2.fr
Hartkopf-Froder, Christoph (Germany) hartkopf-froeder@gla.nrw.de
Lelievre, Herve (France) lelievre@cimrs1.mnhn.fr
Hladil, Jindri (Czech Republic) hladil@gli.cas.cz
Menner, Vladimer (Russia) amenner@glasnet.ru
Over, D. Jeffrey (United States) over@geneseo.edu
Ovnatanova, Nonna (Russia) ovn@ovn.msk.ru
Perri, Maria Cristina (Italy) perri@geomin.unibo.it
Pickett, John (Australia) pickettj@cherry.com.au
Racki, Grzegorz (Poland) racki@uranos.cto.us.edu.pl
Richardson, John (England) jbr@nhm.ac.uk
Sandberg, Charlie (United States) sandberg@usgs.gov
Schindler, Eberhard (Germany) eschindl@sngkw.uni-frankfurt.de
Spalletta, Claudia (Italy) cspal@geomin.unibo.it
Streel, Maurice (Belgium) maurice.streel@ulg.ac.be
Talent, John (Australia) jtalent@laurel.ocs.mq.edu.au
Turner, Sue (Australia) suet@qm.qld.gov.au
Uyeno, Tom (Canada) tuyeno@nrcan.gc.ca
Wang Cheng-Yuan (China) FAX 025-3357026
Ziegler, Willi (Germany) williziegler@t-online.de

END OF MAY 2001 REPORT.

Frasnian subdivision working group members were asked to propose stratigraphic sections to be considered for substage stratotypes. In doing so members can consider the merits of individual localities and the nature of the strata, fauna, geochemistry, accessibility, and political stability of the location, as well as stimulate further study of these locations and other sites. Submissions should have the following information that will be posted on the Frasnian website:

- Frasnian Substage (e.g., Lower/Middle):
- Section name (e.g., Buck Run):
- Location: (e.g., Mt. Morris, New York):
- Country (e.g., USA):
- District (e.g., Livingston County, western New York)
- Map reference sheet (e.g., Mt. Morris Quadrangle 7.5' USGS):
- Main references: (e.g., Colton, G.W., and de Witt, W., Jr., 1958, Stratigraphy of the Sonyea Formation of Late Devonian age in western and west-central New York, USGS Oil and Gas Investigations Chart, OC-0054.):
- Current workers and field of study: (e.g., Over, D.J., conodonts):
- Positive features of this locality (e.g., exposure 30 m thick, excellent conodonts, trilobites, brachiopods, spores, MS and isotope stratigraphy, unfaulted, in abandoned quarry now a geological reserve near major airport on tropical island):
- Negative features (e.g., 2 m thick, no conodonts, no brachiopods, no nowakids, highly faulted, overturned, thermally mature, exposed in cataract on island in Arctic Canada accessible only by kayak):
- Other Comments:

To date, only one section has been submitted (below), although Becker and House (1998) in Newsletter 15 list several sections and references that could be considered.

"I would like to propose the Polish reference section for the Lower/Middle Frasnian boundary. Even if several excellent upper Frasnian exposures were described by Szulczewski (1971) from Holy Cross Mts, conodont successions, as recognized till now, are not very diagnostic (sporadic *Palmatolepis semichatovae* only).

Frasnian (Lower/Middle):
Section name: WIETRZNIA-I
Location:
country POLAND
district KIELCE
map reference Sheet KIELCE - Geological Map of Poland 1:50 000

MAIN REFERENCES:

Szulczewski, M. 1971. Upper Devonian conodonts, stratigraphy and facial development of the Holy Cross Mts. Acta Geologica Polonica 21, 1-129. [the overall measured section, lithology and conodont biostratigraphy]

Racki, G. & Bultynck, P. 1993. Conodont biostratigraphy of the Middle to Upper Devonian boundary beds in the Kielce area of the Holy Cross Mts. Acta Geologica Polonica 43, 1-25. [the measured section and refined conodont biostratigraphy for Lower Frasnian]

Racki, G., Makowski, I., Miklas, J. & Gawlik, S. 1993. Brachiopod biofacies in the Frasnian reef-complexes: an example from the Holy Cross Mts, Poland. Prace Naukowe Uniwersytetu Slaskiego w Katowicach, Geologia 12/13,64-109. [the measured section and brachiopod sequence]

Makowska, M. 2001. Early Frasnian conodont biofacies in the Wietrznia section at Kielce [in Polish]. Unpublished M. Sci. thesis, Silesian University, Sosnowiec.

CURRENT WORKERS AND FIELD OF STUDY:

The well-known deep reef-slope sequence is investigated by the Belgian-English-Polish group for Late Devonian chemostratigraphy, and a major positive carbon isotopic shift is evidenced in the punctata Zone (J. Yans et al., submitted to Science). High resolution conodont ecological analysis is just finished and presented in unpublished thesis. Current workers are grouped at Silesian University (G. Racki, P. Filipiak, E. Gluchowski, T. Wrzolek, and others). Integrative-stratigraphic project in cooperation with Belgian group (A. Preat, J.C. Casier, P. Bultynck) is submitted to the Polish State Committee for Scientific Research. Furthermore, other Lower/Middle Frasnian localities in the Holy Cross Mts will be also examined during this study, especially the reference basin succession at Kostomloty (see Racki & Bultynck, 1993).

POSITIVE FEATURES OF THIS LOCALITY:

WietrzniaI-I section, ca. 75 m thick, was presented during the ECOS-VI excursion. This is western fragment of large abandoned quarry now a geological reserve, located in southern part of the Kielce town. The Lower/Middle Frasnian boundary is established within well-bedded, micritic-marly sequence containing many detrital, reef-derived intercalations (set C of Szulczewski, 1971; Racki & Bultynck, 1993). The unfaulted and excellently exposed strata are conodont-rich, and several macrofaunal open-marine groups (mostly brachiopods, corals, crinoids) occur also very abundantly.

NEGATIVE FEATURES:

In conodont biofacies terms, the Lower/Middle Frasnian transition is characterized by rarity of palmatolepids and dominance of narrow-platformed polygnathids, icriodids and ancyrodellids. Thus, the first occurrence of Palmatolepis punctata is still not very easy to recognition, but this is reliably supplemented by entry of Ancyrodella gigas. Cephalopods seem totally absent, but are known from the nearby Kostomloty locality (see Racki, 1985, Acta Geologica Polonica 35, 265-275). Wietrznia Beds are relatively thermally mature."

These will be posted on the Frasnian website. I hope more submissions come in, or at least communicate the plan to submit a potential site. I hope that in the next few years these localities can be visited by interested parties and complete work can be done as preparation for a vote by the subcommission.

DOCUMENT SUBMITTED TO THE INTERNATIONAL SUBCOMMISSION ON DEVONIAN STRATIGRAPHY (SDS), ANNUAL BUSINESS MEETING, FRANKFURT 2001

A POTENTIAL MIDDLE FRASNIAN STRATOTYPE SECTION AT CHUT RIVER (SOUTHERN TIMAN, RUSSIA)

- a preliminary account -

R. Thomas Becker, V.V. Menner, N.S. Ovnatanova, A. Kuz´min & M.R. House

1. INTRODUCTION

The Timan of northern Russia is one of the classical and, with respect to the extensive hydrocarbon resources, one of the most important Frasnian regions of the world. Its sedimentary and faunal sequences have been well studied in recent time by numerous Russian geologists and palaeontologist and significant stratigraphical progress was made in the frame of INTAS project 93-750 which, apart from the authors, included P. BULTYNCK and S.V. YATSKOV. Results have been published by KUZ´MIN et al. (1997), OVNATA-NOVA et al. (1999a, 1999b), BECKER et al. (2000), and HOUSE et al. (2000). For further information on regional and structural geology, general lithostratigraphy, Frasnian biozona-tions and additional references see these publications.

Chut River is a tributary to the Ukhta River ca. 12 km east of the city of Ukhta (Fig. 1). It is situated in the Ukhta region of the southern Timan, or on the Ukhta-Izhma-Swell of the southern Timan Range formed by Devonian outcrops. The stream exposes a number of sections on its left and right (in downstream view) banks which show the upper part of the Ust´yarega Formation and the lower member of the Domanik Formation, partly in steep cliffs. Chut River is known as a fossiliferous area since HOLZAPFEL´s (1899) first Timan ammonoid monography. Rough descriptions of several sections and their goniatite faunas were provided by BOGOSLOVSKIY (1969). KUSHNAREVA et al. (1978) included Chut River in their description of the regional upper Ust´yarega to Domanik litho- and biostratigraphy and provided ammonoid, conodont, dacryoconarid and miospore data which partly needed subsequent revision. Detailed investigations continued with YUDINA & MOSKALENKO (1988, 1994, 1998) who concentrated on their Outcrop 7 just N of the new road bridge W of Ukhta. This is the section which was further examined by us and which is presented here. Conodont data were published by OVNATANOVA & KUZ´MIN (1991), KUZ´MIN (1998), KUZ´MIN & YATSKOV (1999), OVNATA-NOVA et al. (1999b: named as Outcrop 1) and ZIEGLER et al. (2000). Many identifications have been updated during a joint "workshop" of A. KUZ´MIN, N. OVNATANOVA and G. KLAPPER in summer 1999 (see summaries in BECKER et al. 2000 and HOUSE et al. 2000).

The section presented here has been visited by a number of SDS members during the fieldtrip after the 1994 annual SDS meeting in Moscow. Re-sampling and re-study will be possible during the forthcoming fieldtrip in conjunction with the Syktyvkar symposium in summer 2002. The South Timan field trip of 2000 (BELYAEVA & IVANOV, Eds. 2000) led to two neighbouring downstream outcrops which are closer to the mouth of Chut River into Ukhta River. The proposed Lower/ Middle Frasnian boundary and base of the MN 5 Zone (= base of the *punctata* Zone) coincides about with the conformable transition from the topmost Ust´yarega to the basal Domanik Formation. This lithological change from condensed pelagic carbonates to more argillaceous and cherty beds is caused by an important regional deepening episode which seems to correlate with the North American transgressive Middlesex Event (HOUSE et al. 2000) and with the base of Depophase IIc of JOHNSON et al. (1985). The natural outcrop is far from any housing and not endangered by human activites. Thermal maturation is low; sediments are in the "oil window" which provides optimal conditions for palyno- and chemostratigraphy. Faunas are mostly pelagic (cephalopods, fishes, dacryoconarids, radiola-ria, ostracods, conodonts) but some units do contain deeper-water benthos such as bivalves, inarticulate (lingulids) and rare articulate (rhynchonellids) brachiopods.

2. GENERAL STRATIGRAPHY

Based on literature data (especially BOGOSLOVSKIY 1969: Outcrop 15g, YUDINA & MOSKALENKO, Eds. 1994, KUZ´MIN 1998) and new collections (e.g., BECKER et al. 2000), the preliminary succession from around the water level to the top of the forrested cliffs is as follows (Fig. 2):

<u>Upper Ust´yarega Formation (D_3 ujr 1)</u>

Upper *Timanites* Bed

Ca. 15 cm middle to dark grey, brownish weathering, solid, crystalline limestone (Bed 1) with bioturbate upper surface, containing ammonoids, fish remains, ostracods and conodonts (samples 90 and D9101-02):

Timanites keyserlingi (up to 10 cm)
Ptyctodontidae gen. indet.
Moythomasia sp. and Palaeonisci indet.
Oletangiella fabosi
Ungerella aff. calcarata
Richteria scabrosa

Further fish taxa (*Plourdosteus, Eastmanosteus*) are known downstream (BELYEVA & IVANOV 2000).

[More than 1 m covered interval (Bed 2)]

BED 3

Grey clays with miospores (det. T.G. OBUKHOVSKAYA):

Archaeozonotriletes variabilis var. insignis
Archaeozonotriletes densus
Converrucisporites curvatus
Lophotriletes perspiquis
Trachytriletes minutus
Stenozonotriletes conformis
Retusotriletes communis
Kedoesporis livnensis
Geminospora basilaria

Uppermost Ust´yarega Formation (D_3 ujr 2, *Komioceras* Beds)

Beds A-B (= lower part of Bed 4)

24 cm middle grey, solid, platy, fine bioclastic, very fossiliferous limestone with goniatites, bactritids, bivalves, gastropods, abundant styliolinids, breviconic nautiloids, rare rhynchonellids, fish remains, ostracods and conodonts (samples 92, K911A-B, RTB-A):

Komioceras stuckenbergi
Timanites n.sp.
?Uchtites n.sp.
Manticoceras sp.
Tornoceras typum
Domanikoceras timidum
?Truyolsoceras keyserlingi
Lobobactrites timanicus
Pterochaenia fragilis
Lunulicardium cf. ornatum
Buchiola prumiensis
Ungerella aff. yaregae
Reversocypris (?) uchtaensis
Reversocypris sp. nov.

Beds C-D (= middle part of Bed 4)

25 cm middle grey, fine bioclastic limestone with goniatites, bactritids, ostracods, bivalves, abundant styliolinids and other fauna:

Tornoceras typum
Komioceras stuckenbergi (according to YUDINA & MOSKALENKO 1994)
Timanites n.sp. (det. Tim. keyserlingi in YUDINA & MOSKALENKO 1994)
?Truyolsoceras keyserlingi (according to YUDINA & MOSKALENKO 1994)
Lunulicardium sp.
Buchiola prumiensis

BED E

Ca. 5cm grey, micritic limestone sandwiched between between thin shales, top of bed iron-stained.

BEDS F-G (UPPER PART OF BED 4)

17-20 cm dark grey calcarenites with relative poor macrofauna and conodonts (sample K911C, sample 94 somewhere near here).

Basal Domanik Formation (basal part of lower member, basal D_3 dm_1)

Bed H (BEDS 5-6)

48 cm of green shale at the base and cherty shale higher up, without macrofauna but with miospores (det. T.G. OBUKHOVSKYA):

Archaeozonotriletes variabilis
Archaeozonotriletes variabilis var. insignis
Archaeozonotriletes densus
Lophozonotriletes excisus
Cristatisporites deliquescens
Geminospora semilucensa
Bascaudaspora dobridae

Bed I (?LOWER part of Bed 7)

12 cm lenticular, dark grey calcarenite with poor macrofauna, ca. sample D911.

Bed J (Bed 7)

10 cm dark grey, platy limestones with styliolinids, ca. sample D911A and 95 (not re-studied). From about this level KUSHNAREVA et al. (1979) reported last *Komioceras stucken-bergi* and *Manticoceras* but this has not yet been confirmed my new collecting. YUDINA & MOSKALENKO (1994) added *Buchiola* sp., *Pterochaenia cashaquae*, *Lingula loewinsoni*, and fish remains (*Acanthodes*).

Beds K-M (Bed 8)

96 cm of siliceous/cherty shale with lenticular, dark grey, recrystallized styliolinid limestones (Bed L, ca. sample D911B), poor in macrofauna.

Bed N (Bed 9)

11.5 cm, dark grey, bioclastic, solid, very fossiliferous limestone with styliolinids, many bivalves, goniatites, bactritids and conodonts (sample 96 near here, ca. sample D912):

Tornoceras typum
Domanikoceras timidum
Lobobactrites sp.
Pterochaenia sp.
Buchiola sp.

Bed O (ca. Bed 10)

Thin layer of dark limestone as Bed N, ca. samples 97 and D913:

Ponticeras cf. *tschernyschewi*
Domanikoceras timidum
Tornoceras typum

Lower part of lower member of Domanik Formation (dm_3 dm_1)

BEDS 11-17

Ca. 300 cm calcareous and siliceous/cherty shales with lenticular cherts and interbeds of dark to brownish grey, partly siliceous styliolinid limestones (samples D914-D919).

[Ca. 200 cm covered interval]

BED 18

Ca. 150 cm calcareous and siliceous/cherty shales as Beds 11-17, no macrofauna.

1ST *PONTICERAS* BED (BEDS 19-20)

10-15 cm middle grey, brownish weathering, fossiliferous, fine bioclastic limestone with abundant goniatites, styliolinids, ostracods, bactritids, bivalves and conodonts (samples D9210, RTB-B):

Ponticeras tschernyschewi
Ponticeras bisulcatum
Ponticeras uchtense
Ponticeras keyserlingi
Ponticeras domanicense
Chutoceras manticoides (loose specimen)
Uchtites syrjanicus
Tornoceras typum
Linguatornoceras aff. clausum
Pterochaenia sp.

Upper part of lower member of Domanik Formation

[Ca. 6 m covered interval]

2ND *PONTICERAS* BED (BED 21)

Ca. 40 cm of platy, middle grey, bioclastic limestone with ammonoids, orthocones, styliolinids, bivalves, ostracods and conodonts (sample D9211):

Ponticeras uchtense
Ponticeras lebedeffi
Manticoceras ammon
Tornoceras typum
Pterochasenia sp.
Buchiola sp.

[Ca. 1m covered interval]

Bed 22

Ca. 150 cm calcareous and siliceous/cherty shales, poor in macrofauna.

3rd *Ponticeras* Bed (Bed 23)

Ca. 40 cm platy limestone as Bed 21 (sample D9213):

Ponticeras bisulcatum
Ponticeras lebedeffi
Ponticeras uralicum
Ponticeras uchtense
Ponticeras auritum
Ponticeras keyserlingi
Ponticeras ?regale
Ponticeras domanicense
Manticoceras ammon
Tornoceras typum
Tornoceras contractum
?Truyolsoceras keyserlingi
Lobobactrites timanicus
breviconic nautiloids

Bed 24

Ca. 3 m of calcareous and siliceous shales as lower down, poor in macrofauna.

Beds 25-26

Ca. 50 cm shales with limestone concretions (samples D9214 and D9215).

Middle member of Domanik Formation

Following a ca. 3m covered interval, the middle member starts with calcareous and siliceous shales (samples D9216 and D9217).

3. CONODONT STRATIGRAPHY

Table 1 shows the ranges of selected conodont species including all significant stratigraphical markers. Some authors regard *Mes. falsiovalis* and *Mes. costalliformis* as intraspecific variants of *Mes. asymmetrica* and the three forms are here summarized. The total ranges of *Mes. asymmetrica* and *Mes. falsiovalis* are almost identical. The last *Mes. costalliformis* (morpho-type) was recorded in the *Komioceras* Beds (sample K911B). Several Lower Domanik palmatolepid species of KUZ´MIN (1998: *Pa. keyserlingi, Pa. triquetra, Pa. rotundilobata*) are not (?yet) widely accepted. Even if these are regarded as morphological variants (of *Pa. transitans* or *Pa. punctata*), their stratigraphical potential in the lower part of MN Zone 5 (in the lower *punctata* Zone; samples D911B to D914) needs to be realized. No undoubted specimens of KUZ´MIN´s species have been recorded from below the entry of early morphotypes (see KUZ´MIN 1998: Pl. 7, Figs. 2-3) of *Pa. punctata*. A range of polygnathids (*Po. xylus, Po. pseudoxylus, Po. pennatus, Po. strictus, Po. decorosus, Po. efimovae, Po. brevilamiformis, Po. webbi, Po. dubius, Po. angustidiscus*) has been recorded or listed from various levels (KUZ´MIN 1998, OVANATNOVA et al. 1999, ZIEGLER et al. 2000) of Outcrop 7 but have not yet been utilized to distinguish faunal levels. Other species, such as *Po. uchtensis*, were figured from nearby Chut River localities.

The following stages which partly seem to have significance for international correlations in the interval of MN Zone 4 to 6 (*transitans* to *punctata* Zones) can be recognized at Chut River:

a. Faunas from the *Timanites* Beds fall in the lower part of MN Zone 4 (lower *transitans* Zone, lower part of regional TP III-assemblage of OVNATANOVA et al. 1999a, 1999b, samples 90, K9101, 9102). They are characterized by various *Ancyrodella* (including *Ad. africana*) and morphologically diverse *Mesotaxis* but *Pa. transitans*, the zonal index, is rather rare. As discussed in BECKER et al. (2000), *Ad. africana* ranges lower than *Pa. transitans* in the Timan, for example into the middle part of the Ust´yarega Formation (*Hoeninghaisia nalivkini* Zone, UD I-B, TP II-assemblage).

b. The *Komioceras* Beds (Beds A-C, samples K911A, K911B, RTB-A) have a distinctive fauna characterized by *Mes. bogoslovskiy* and *Playf. primitiva*; this allows the separation of an upper part of MN Zone 4. In other regions (composite range in KLAPPER 1997) *Playf. primitiva* enters earlier but *Mes. bogoslovskiy* is an important marker that also occurs elsewhere (e.g., Montagne Noire) above oldest *Pa. transitans*.

c. Above the *Komioceras* Beds and near the top of the Ust´yarega Formation there is a significant small-scale conodont extinction ("Domanik Crisis" of KUZ´MIN et al. 1997) which affected in the Timan *Ad. alata, Ad. pramosica, Mes. bogoslovskiy, Mes. costalliformis* and *Playf. primitiva*. These taxa are also known elsewhere (composite ranges in KLAPPER 1997 and GOUWY & BULTYNCK 2000) not to range higher than the MN 4 Zone (*transitans* Zone).

d. The entry of *Pa. punctata* as marker species for the base of MN Zone 5 (base of the *punctata* Zone, base of the TP-IV assemblage of OVNATANOVA et al. 1999) is so far only approximately documented in relation to the detailed lithostratigraphy or in relation to the basal Domanik deepening. *Pa. punctata* was found in sample 94 (YUDINA & MOSKALENKO 1994) which came from near the base of the Domanik Formation. It also occures in sample D911B ca. 1.5 m above the Domanik base; records (KUZ´MIN 1998) from samples D911 and D911A (ca. 80 cm above base) have not been confirmed during the 1999 revision. Clearly, some re-sampling is needed in order to reach maximum precision. As in other regions (BULTYNCK et al. 1988, KLAPPER 1997, GOUWY & BULTYNCK 2000), early morphotypes of *Ad. gigas* (e.g., record of KUZ´MIN 1998 from sample K911C) may appear just before oldest *Pa. punctata*.

e. The entry of *Mes. johnsoni* (sample 96) and of *Pa. maximovae* (sample D912) mark a distinctive second faunal interval within the lower part of MN Zone 5 and in the lower part of the Lower Domanik. Not only in the Timan, but also in North America (KLAPPER 1997), *Mes. johnsoni* appears in younger levels than oldest *Pa. punctata*. Higher up in Outcrop 7 entries of *Mes. distinctus* (sample 97), *Po. timanicus* (samples D914 and 100) and of *Po. vjalovi* (sample D917) are noteworthy. In the composite standard of KLAPPER (1997), *Po. timanicus*, however, enters at the same level as *Mes. johnsoni* at 101.0 CSU.

f. A significant third faunal level within MN Zone 5 or within the lower part of the *punctata* Zone is reached with the 1st *Ponticeras* Bed where *Pa. gutta* starts and it becomes an abundant component of succesive faunas (samples D911B to D912).

g. The youngest fauna of MN Zone 5 from the 3rd *Ponticeras* Bed (samples D9213) yielded the first early morphotype of *Ad. curvata*. This is in accordance with its entries in the composites of KLAPPER (1997) and GOUWY & BULTYXNCK (2000). Goniatite matrix (sample RTB-B) included a single *Ag. ancyrogna-thoideus*.

h. As emphasized by KUZ´MIN & YATSKOV (1997), there is a remarkable regional extinction of last *Mesotaxis* near the top of the Lower Domanik. In other regions such as North America and the Montagne Noire, *Mes. asymmetrica*, *Mes. johnsoni* and *Mes. ovalis* range into MN Zone 6 (see composite range in KLAPPER 1997).

i. MN Zone 6 (upper part of *punctata* Zone, TP V-assemblage of OVNATANOVA et al. 1999a, 1999b) has been recognized at Outcrop 7 in the basal part of the Middle Domanik. This is based on the entry of *Pa. bohemica* in sample D9216 and of *Pa. spinata* in sample D9217.

4. CORRELATION WITH OTHER FAUNAL GROUPS

The *Timanites* Beds fall in the regional *Timanites keyserlingi* Zone (UD II-C1), The base of the upper part of MN Zone 4 with *Mes. bogoslovskyi* coincides with the base of the regional *Komioceras stuckenbergi* Zone (UD I-C2). The small-scale conodont extinction at the top of the Ust´yarega Formation is also evident in the goniatite faunas and led to the extinction of *Timanites*. The base of MN Zone 5 either lies within the range of last *Komioceras* or just postdates it. In the regional miospore succession it correlates ca. with the boundary between the *optivus-krestovnikovii* and *semilucensa-donensis* Zones. There is also a change in the ostracod sequence: from the regional *Cavellina chvorostanensis-Richteria scabrosa* to the *Richteria distinica-Nehdentomis foveatisulcatus* Zones (MOSKA-LENKO in BELYAEVA & IVANOV, Eds. 2000).

The interval with oldest *Mes. johnsoni* and *Pa. maximovae* within the lower MN Zone 5 correlates with the base of the regional *Ponticeras domanicense* Zone (UD I-E). An informal upper division of the latter, the 3rd *Ponticeras* Bed with *Ponticeras auritum* and oldest *Manti-coceras sinuosum*, correlates with the entry of early morphotypes of *Ad. curvata*. The regional extinction of *Mesotaxis* again has a parallel in the ammonoid sequence, with the complete extinction of *Ponticeras* faunas near the top of the Lower Domanik.

5. SUMMARY

According to current and published knowledge, Outcrop 7 at Chut River has the best potential to understand and document in detail the sedimentary and faunal sequence across the boundary between MN Zones 4/5 (*transitans-punctata* Zone boundary). Advantages are as follows:

a. The section is an easily accesible natural outcrop with a wide range of nearby auxiliary sections.

b. Thermal maturation is very low.

c. Many beds are very fossiliferous.

d. Both marine faunas and miospores are present.

e. The section allows detailed correlations between conodont, goniatite, ostracod, radiolarian and miospore zones.

f. Although in pelagic facies, the section is not too condensed.

g. Conodonts are abundant and show a sequence of several faunal levels within established zones.

h. Vertebrates remains are present.

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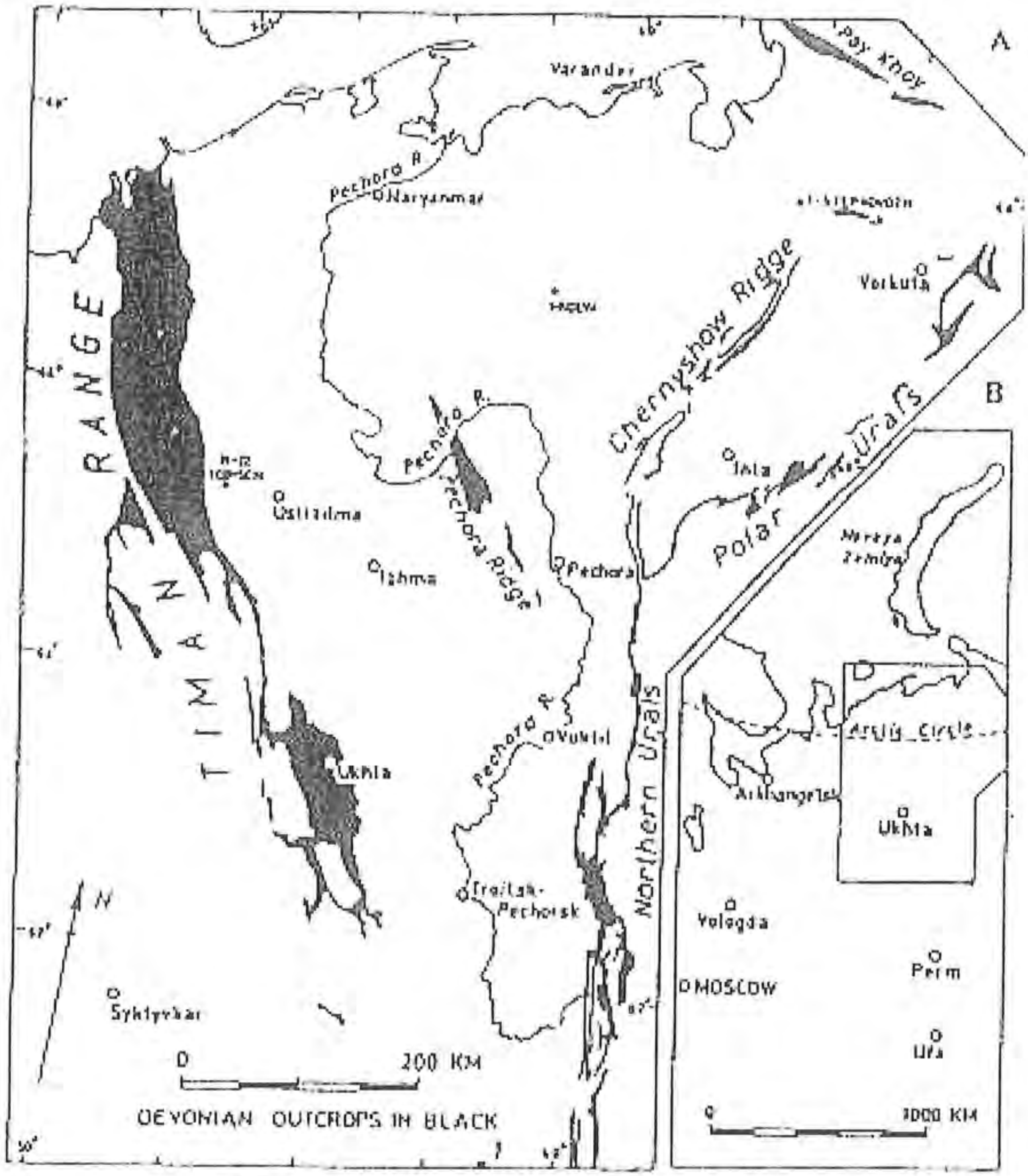
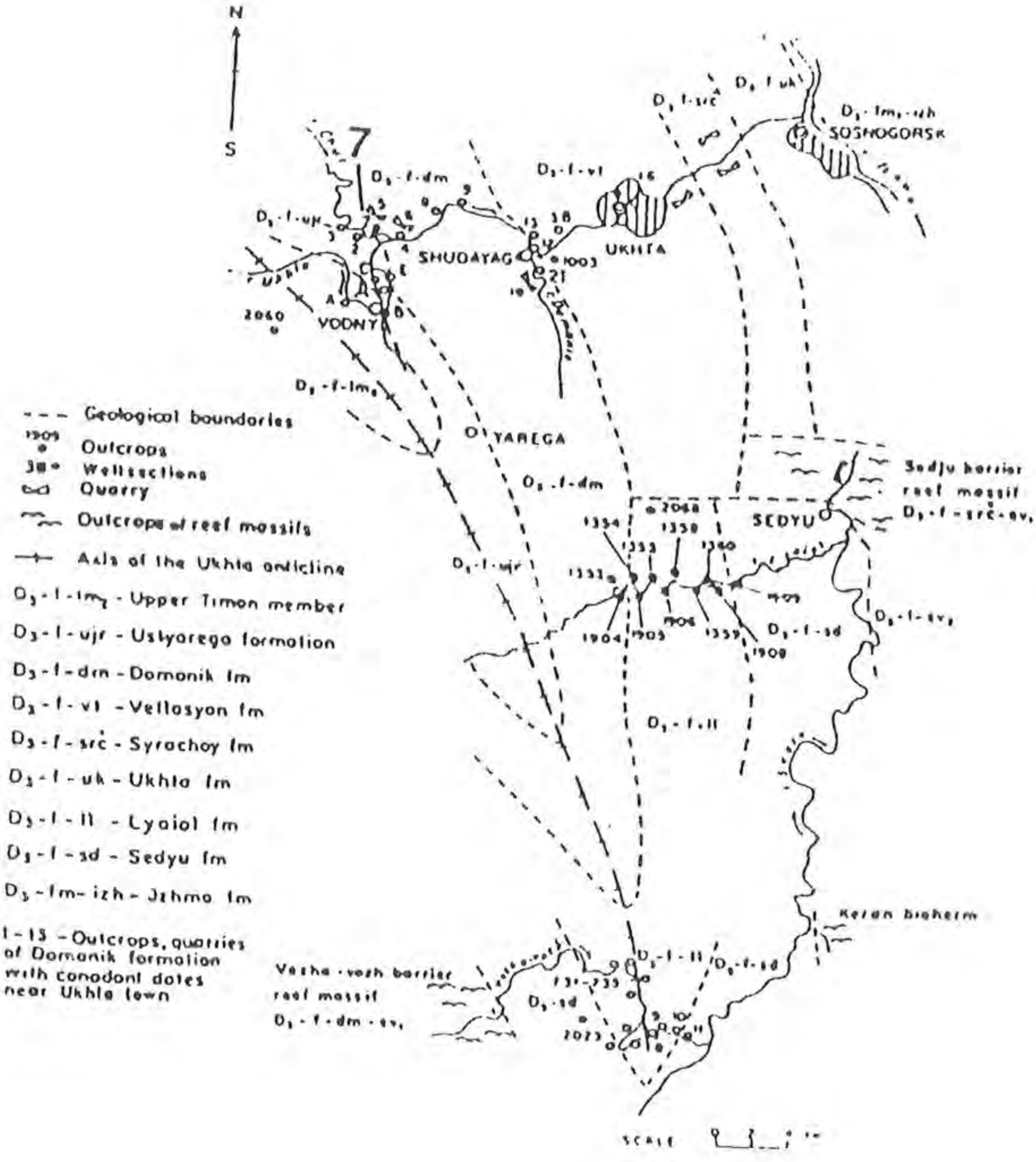


Fig. 1: Map of the northeastern part of European Russia showing Devonian outcrops along the Timan Range and in the Pechora Basin as well as the position of Outcrop 7 west of Ukhta.


N
S
7
SOSNOGORSK
UKHTA
SHUDAYAG
VODNY
YAREGA
SEDYU
Sedju barrier reef massif
Keran bioherm
Vezha-vozh barrier reef massif
D3-f-dm-ev
SCALE
--- Geological boundaries
Outcrops
Wellsections
Quarry
Outcrops of reef massifs
Axis of the Ukhta anticline
D3-f-tm2 - Upper Timan member
D3-f-ujr - Ustyarega formation
D3-f-dm - Domanik fm
D3-f-vt - Vetlosyan fm
D3-f-src - Syrachoy fm
D3-f-uk - Ukhta fm
D3-f-ll - Lyaiol fm
D3-f-sd - Sedyu fm
D3-fm-izh - Izhma fm
1-13 - Outcrops, quarries of Domanik formation with conodont dates near Ukhta town

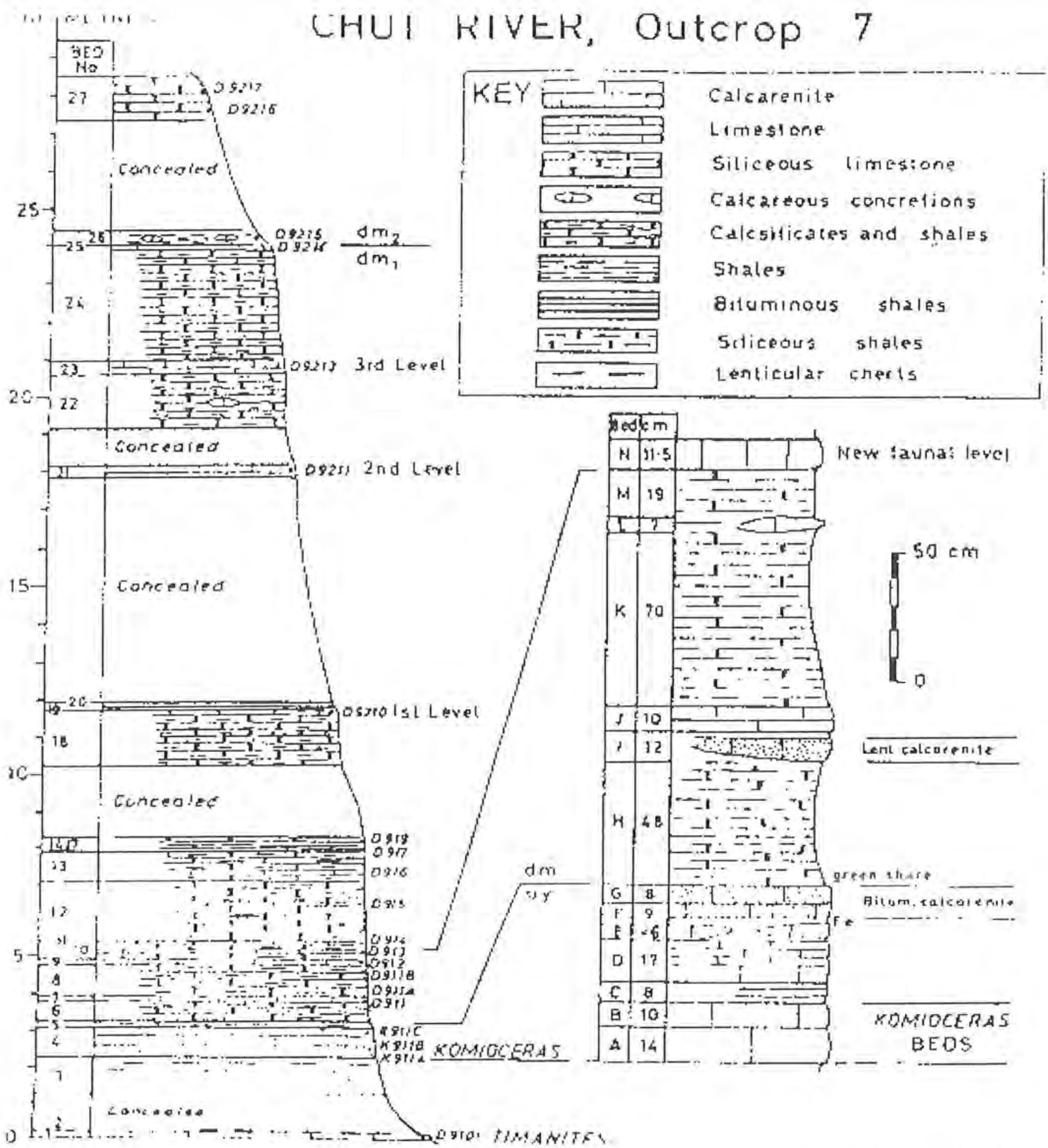


Fig. 2: Sedimentary succession at Chut River, Outcrop 7, showing the position of conodont samples and of ammonoid marker beds (from BECKER et al. 2000: Fig. 6).

Tab. 1: Ranges of selected conodont species in the upper Ust´yarega and lower Domanik Formations of Outcrop 7, based on KUZ´MIN 1998 (K) and on subsequently revised identifications by N. OVNATANOVA, A. KUZ´MIN and G. KLAPPER (X). *Pa.* = *Palmatolepis*. *Ad.* = *Ancyrodella*. *I.* = *Icriodus*. *Mes.* = *Mesotaxis*. *Playf.* = *Playfordia*. *Po.* = *Polygnathus*. Entries of important marker taxa are given in bold.

species/sample	90	K9101	K9102	92	K911A	K911B	K911C	94	D911	D911A
Pa. transitans	--	K	K	--	K	x	K	x	x	x
Ad. africana		x	--	--	x	x	--	--	x	x
Ad. alata		x	x	--	x	?				
Ad. rugosa		x	x							
Ad. n.sp.		x	x							
Mes. asymmetrica		x	x	x	x	x	K	--	x	x
Mes. ovalis			K	--	K	K	K	x	x	x
Mes. bogoslovskyi					x	x				
Playf. primitiva					x	x				
Ad. pramosica						x				
Ad. gigas							K	--	K	K
Pa. punctata								x	--	?
Lithostratigraphy	*Timanites* Beds			*Komioceras* Beds			basal Lower Domanik			

(continued)	D911B	96	D912	97	D913	D914	D915	100	D917	D919
Pa. transitans	x	x	x	x	x	x	x	x	x	--
Ad. africana	--	--	x	x	--	--	--	x		
Mes. asymmetrica	K	--	?	--	--	K	x	x	x	x
Mes. ovalis	x	--	K	x	--	--	x	x	x	x
Pa. punctata	x	--	K	x	K	x	--	--	--	x
Ad. gigas	--	--	--	--	--	--	--	--	--	--
Mes. johnsoni		x	--	--	--	--	--	--	--	x
Pa. maximovae			x	x	--	x				
Mes. distinctus				x						
Po. timanicus						K	--	x	x	--
Po. vialovi									x	--
Lithostratigraphy	lower member of Domanik Formation									

continued	D9210	D9211	D9213	D9214	D9215	D9216	D9217
Pa. transitans	--	K	K	K	--	--	K
Mes. asymmetrica	--	--	K	x	K		
Mes. ovalis	x	x	x	x	x		
Pa. punctata	?	--	x	x	x		
Ad. gigas	K	K	x				
Mes. johnsoni	x	x	x	x			
Po. timanicus	x	K	x				
Pa. gutta	x	x	x				
Ad. curvata			x				
Pa. bohemica						x	
Pa. spinata							x
Lithostratigraphy	*Ponticeras* Beds			L./M. Domanik		M. Domanik	

The Uppermost Famennian around the World
(definition, biostratigraphical and sedimentological context)

Maurice STREEL, Belgium

A. The need of smaller chronostratigraphic units within the Famennian Stage have led authors around the world to use, for a long time, phrases such as lower, middle, upper or uppermost Famennian but, unfortunately, without any constant definitions. Definitions however are necessary to make progress in fields such as paleodiversity and biogeographic change with time. For that purpose, proposed substage boundaries should have a high degree of synchroneity in different regional entities and facies belts.On the other hand, the great number of Famennian sedimentary sequences and events (among others : *Cheiloceras*, Condroz, Enkeberg, *Annulata*, Dasberg, Epinette, Hangenberg Events), recognized in many regions around the world, offers also many opportunities for Substage boundaries.

B. A fourfold subdivision would be appropriate (see the list of 43 scientists from 15 countries supporting this suggestion, a list inadvertently omitted in SDS Newsletter 17, updated and reproduced here as appendix 1).). If the 5 Ma Frasnian is to be subdivided into 3 substages, the 10 Ma Famennian might well be subdivided into 4 or even 5 substages allowing approximately equal subdivisions of the Stage (see for instance the text-figure in Sandberg, Ziegler & Morrow 2000).

C. In the highest part of the Famennian, one unformal chronostratigraphic unit has been used, for a long time and is still used in many countries, named Etroeungt Zone or Strunian, or simply, uppermost (or latest) Famennian (see the non-exhaustive reference list of papers using this unit, presented by D. Brice). The lower boundary of this unit were considered, in large countries around the world and for a long time, as the official lower boundary of the Carboniferous System, being so considered as a major limit. It has however to be properly defined because having received different interpretations within the Middle and Upper/Late *expansa* Zones interval

D. Several faunal and floral bio-markers are available for characterization and for correlation of convenient stratigraphic levels in the late to latest Famennian time-range. Eighteen bio-markers belonging to acritarchs, ammonoids, conodonts, foraminifers, miospores and ostracods are grouped in 10 biostratigraphic levels in Table 1, with emphasize on the Middle and Upper/Late *expansa* Zones interval. In the type late and latest Famennian (Fa2c /Fa2d/Tn1a) of eastern Ardenne (Belgium) for instance, 9 of these bio-markers are present in succession.

E. Sedimentary sequences and events are now defined in the eastern Ardenne (Thorez & Dreesen, in prep.) and can be correlated with other parts of the world (Figure 1). For instance, the eustatic rise (at level 1) which is the most significant onlap interrupting general Famennian regression in western United States (fourth transgression, Sandberg et al. 1989) is matched by the «Beverire» marine incursion in the eastern Ardenne. The fifth transgression in western United States corresponds to the «Fontin Event» (between levels 2 and 3), and the sixth transgression, to the «Epinette Event» (at level 3). The fifth and sixth transgressions in western USA are minor pulses compared to the fourth one. On the contrary, transgressions in eastern Ardenne (the «Epinette Event») as well as in New York and Ohio (central and eastern USA, in Upper Cleveland and Lower Bedford beds, after House 1985) are more conspicuous upwards.

F. In eastern Ardenne (Chanxhe section), the maximum of flooding is reached soon after the «Epinette Event» and, slowly, the regressive trend starts in a Highstand Systems Tract (HST in Van Steenwinkel, 1993) as demonstrated (Figure 2) by a quantitative study of ecologically significant miospores. A main changeover is at level 6c, (where happens also the abundant occurrence of miospore *Retispora lepidophyta* var. *minor*), also characterized by the first occurrence of the foram. *Quasiendothyra kobeitusana kobeitusana* (6a). Biostratigraphic levels 3 and 5 to 8 (bio-markers 5, 6a, 6c, 7b, 7c, 8) occur in succession at Chanxhe which is a key section for neritic facies.

G. Correlation with other neritic facies.

a. Correlation with the Avesnois (the type Etroeungt, in northern France) by bio-markers 3 (*R. lepidophyta* var *typica*) and 6a (*Quasiendothyra kobeitusana kobeitusana*) after Conil et al., 1964, Conil & Lys, 1980 and Sartenaer & Mamet, 1964. Additional interest is the first occurrence of foram. *Quasiendothyra communis radiata* and the related taxon *Quasiendothyra eokobeitusana* (bio-marker 4a), together with the first radiation of Rugosa taxa (Poty 1999)

b. Correlation by foraminifers (Bio-markers 4a and 6a) with southern China (Hunan) after Hance 1996.

c. Correlation by conodonts, foraminifers and miospores (Bio-markers 2, 3, 4a, 5, 6a, 6c, 7b, 8) with eastern Europe (Pripyat, Belarus) after Obukhovskaya & Kruchek (in press.) and with easternmost Europe (Timan-Pechora, Russia) after Durkina (in press.). See also **Table 2** by Durkina, Dreesen & Streel.

d. Correlation by acritarchs, conodonts and miospores (Bio-markers 5, 6c, 7a, 7b, 7c) with the upper Mississippi Valley (USA) after Sandberg, Streel & Scott (1972) and with the Michigan Basin (USA) after Gutschick and Sandberg (1991)

H. Correlation between neritic and pelagic facies

Neritic and pelagic faunas are only known, in a same section, in the Sudetes Mts. (Poland) where, in the ancient quarry of Wapnica Hill near Dzikowice (former Kalkberg near Ebersdorf), forams (4a in the Main Limestone and 6a in the lower part of the «Clymeniid Limestone», after Gorecka & Mamet, 1970) and rare corals and stromatoporoid (Mistiaen & Weyer, 1999) occur with ammonoids, trilobites, conodonts and entomozoid ostracods. (Work in progress on conodonts by J. Haydukiewice and on corals by B. Berkowski). The «Clymeniid Limestone» is well dated (6d) by ammonoids as belonging to the lower/middle Wocklumeria genozone (Kalloclymenia subarmata Zone and lower part of the Parawocklumeria paradoxa Zone).

I. Correlation within pelagic facies

a. Correlation by conodonts (1, 2, 5, 7a, 9), entomozoacean (4c) and Thuringian ecotype (4b and 7d) ostracodes in Germany (after Groos-Uffenorde et al., 2000)

b. Correlation by conodonts (1, 2, 5, 6b, 7a, 9) and ammonoids (6d) with the chrono-stratigraphic German Substages (after Korn & Luppold, 1987, Becker & House, 2000 and Korn, 2000)

c. Correlation by conodonts (1, 2, 5, 6b, 7a, 9) in the Pyrénées Mountains (after Barnolas & Chiron, 1995)

J. Selection of a stratigraphical level and bio-marker to characterize the base of an uppermost Famennian.

Table 3 summarizes the data given from §F to §I. Level 5, the lower boundary of the Upper/Late expansa Zone, have been proposed by Streel et al., 1998, to characterize the base of an uppermost Famennian. However, obviously, level 6 offers more possibilities of correlation in both neritic and pelagic facies than level 5. Biomarker 6b, entry of conodont Palmatolepis gracilis gonioclymeniae, might be selected to define the base of the uppermost Famennian. Level 6b approximately matches an old Strunian definition (level 6a) and a new Wocklumian definition (6c).

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Table 1 : Characterization by 18 bio-markers of 10 biostratigraphic levels, from the base of the conodont Lower/Early *expansa* Zone to the Hangenberg Event, with emphasize on the Middle and Upper/Late *expansa* Zones interval

(the use of the same number for several bio-markers indicates that their respective stratigraphic position is uncertain but close).

*10 Entry of miospore *Verrucosisporites nitidus* (base of *R. lepidophyta-V.nitidus*-LN Zone) (Higgs & Streel 1994). Base of the Hangenberg Event sensu Walliser (1984)

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*9 Extinction of conodont *Palmatolepis gracilis gonioclymeniae*, lower boundary of the Middle *praesulcata* Zone (Ziegler & Sandberg 1984)

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*8 Entry of miospore *Indotriradites explanatus* (base of the *R. lepidophyta-I. explanatus*-LE Zone) (Maziane et al. 1999).

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*7a Entry of conodont *Siphonodella praesulcata*, lower boundary of the Lower/Early *praesulcata* Zone (Ziegler & Sandberg 1984).

*7b Entry of miospore *Tumulispora malevkensis* (Maziane et al. 1999).

*7c Entry of acritarch *Gorgonisphaeridium winslowiae* (Maziane & Vanguestaine 1997)

*7d Base of Thuringian ecotype ostracode zones 8 in Groos-Uffenorde et al. (2000, fig. 5) (see also Blumenstengel 1997)

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*6a Entry of foraminifer *Quasiendothyra kobeitusana kobeitusana* (Df3ε Zone)

*6b Entry of conodont *Palmatolepis gracilis gonioclymeniae* (Ziegler & Sandberg 1984).

*6c Abundant occurrence of miospore *Retispora lepidophyta* var. *minor* (Streel 1966, Maziane et al.,in press)

*6d Entry of ammonoid *Kosmoclymenia sublaevis* replacing (Korn & Becker, in preparation) the rather rare *Sphenoclymenia brevispinosa* to characterise the lower boundary of the Wocklumeria Stufe-VI (Becker & House 2000)

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*5 Entry of conodont *Bispathodus ultimus*, lower boundary of the Upper/Late *expansa* Zone (slightly below the base of

				Forams	Forams	Miospores	Miospores	Conodonts	Conodonts	Regional subdivision	Regional subdivision
				Timan-Pechora	West. Eur.	Timan-Pechora	West. Eur.	Timan-Pechora	Western Europe	Pripjatsky Depression	Russian Platform
xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxx	xxxxxxxxxxxxxxxx	xxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxx
Njumylga-1	Zap.Sopljas-	Vezhaju-835	Vezhaju-825								
xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxx								
	412 - ? m	362.3 - 373.5 n	285 - 286 m	8 Q. dentata - Q. kob. grandis Zone		8 LE Zone	LE	8 <u>Middle expansa to Middle praesulcata</u>	Early praesulcata Z.	8 Borovskie beds (upper part)	
	432- 436 m			6a-6c Q. kobeitusana Zone	Df3epsilon	6a-6c (LMb Zone)	LL	6a-6c <u>Middle to Late expansa</u>	Late expansa Z.	6a-6c Borovskie beds (lower part)	Hovanskie beds (lower part)
	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxx	xxxxxxxxxxxxxxxx	xxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxx
	452 - 464 m		431 - 433 m	4a-5 Q. eokobeitusana (=Q. radiata) Zone	Df3delta	4a-5 LL Zone	LL	4a-5 <u>Middle to Late expansa</u>	Middle or Late expansa Z.	4a-5 Stvizhskie beds	Ozerskie beds (upper part)
	518.3 - 521.8 m			Q. regularis Zone	Df3gamma	LV Zone	LL			Starobienskie beds (upper part)	Ozerskie beds (middle part)
	518.3 - 521.8 m		433 - 437m	3 Q. regularis Zone	Df3gamma	3 LF Zone		3 <u>Middle expansa</u>	Middle expansa Z.	3	Ozerskie beds (lower part)
xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxx	xxxxxxxxxxxxxxxx	xxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxx
923 - 933 m		546.7 - 549.7 m		2 Q. regularis Zone	Df3gamma	2 R. l. tenera - t. minor		2 <u>Middle expansa, at least</u>	Middle expansa Z.	2 Starobienskie beds	Ozerskie beds
946 - 953.7 m				Q. c. com. - Q. b. crassa Subzone		VF Zone	VCo	(postera to early expansa ?)			
953.7 - 958 m				Q. c. com. - Q. b. crassa Subzone		VF Zone	VCo			Ljubanskie beds	Kudejarovskie beds
958 - 963 m				Q. c. venusta - Q. b. bella Subzone		VF Zone	VCo	<u>Early postera to early expansa</u>	postera Zone		

the former Middle *costatus* Zone) (Ziegler & Sandberg 1984). Proposed as the lower boundary of an Uppermost Substage of a fourfold Famennian (Streel et al. 1998). *B. ultimus* being unknown in the Great Basin and Rocky Mountain regions of North America, the lower boundary of the Upper/Late *expansa* Zone was defined, there, by the lowest occurrence of *Pseudopolygnathus marburgensis trigonicus, Polygnathus vogesi, or Protognathodus meischneri* (Sandberg 1979, p.97)

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*4a Entry of foraminifer *Eoendothyra communis radiata* (Df3δ Zone) and of the related taxon *Quasiendothyra eokobeitusana.*

*4b Base of Thuringian ecotype ostracode zones 7 in Groos-Uffenorde et al. (2000, fig. 5) (see also Blumenstengel 1997)

*4c Base of entomozoacean ostracode upper *hemisphaerica-dichotoma* in Groos-Uffenorde et al. (2000, fig. 3)

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*3 Entry of miospore *Retispora lepidophyta* var. *typica*

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*2 Entry of conodont *Bispathodus aculeatus*, lower boundary of the Middle *expansa* Zone (slightly above the base of the former Lower *costatus* Zone) (Ziegler & Sandberg 1984).

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*1. Entry of conodont *Palmatolepis gracilis expansa*, lower boundary of the Lower/Early expansa Zone (base of the old Upper *styriacus* Zone) (Ziegler & Sandberg 1984), proposed as the lower boundary of an Upper Substage of a threefold Famennian (Ziegler & Sandberg 1997, Sandberg & Ziegler 1998)

		F.	Ga	Gb	Gc	Gd	H	Ia	Ib	Ic
V. nitidus	10									
Middle praesulcata	9							X	X	X
I. explanatus	8	X			X					
Early praesulcata	7a					X		X	X	X
T. malevkensis	7b	X			X	X				
G. winslowiae	7c	X				X				
Thur. ecotype 8	7d							X		
Q. kob. kobeitusana	6a	X	X	X	X		X			
P. grac. gonioclymeniae	6b								X	X
R. lepidophyta minor	6c	X			X	X				
K. sublaevis	6d						X		X	
Late expansa	5	X			X	X		X	X	X
E. com. radiata	4a			X	X		X			X
Thur. ecotype 7	4b							X		
Upper hem. dichotoma	4c							X		
R. lepidophyta	3	X	X		X					
Middle expansa	2				X			X	X	X
Early expansa	1							X	X	X

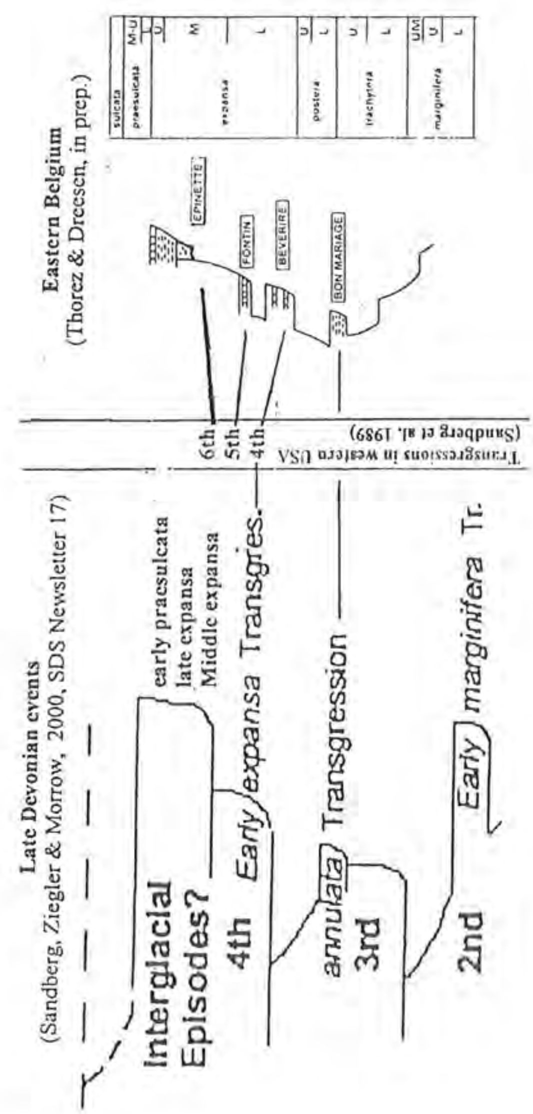

Figure 1 : Compared sedimentary sequences

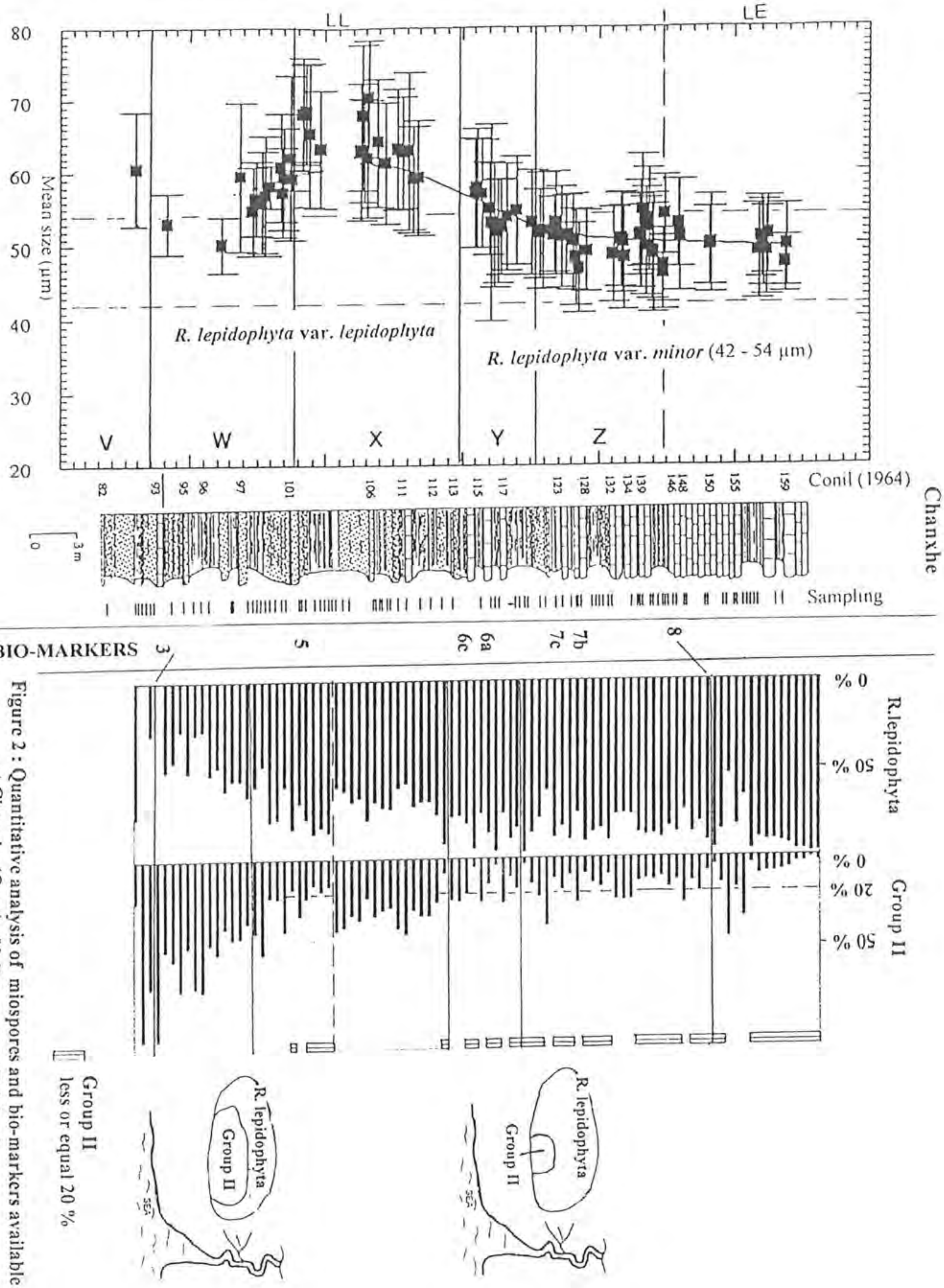

Figure 2 : Quantitative analysis of miospores and bio-markers available at Chanxhe (Ourthe Valley, eastern Belgium)

Appendix 1 : List of participants to the uppermost Famennian Working Subgroup

Blieck, A. (Lille, France),	Alain.Blieck@univ-lille1.fr
Brice, D. (Lille, France),	denise.brice@fls.fupl.asso.fr
Degardin, J-M. (Lille, France),	Alain.Blieck@univ-lille1.fr
Derycke, Cl. (Lille, France),	Claire.Derycke@univ-lille1.fr
Dreesen,(Mol,Belgium),	Roland.Dreesen@vito.be
Durkina, A. V. (Ukhta, Russia)	Meln@online.ru
Groessens, E. (Bruxelles, Belgium),	Eric.Groessens@pophost.eunet.be
Hance, L. (Louvain-la-Neuve, Belgium),	hance@geol.ucl.ac.be
Hartkopf-Froeder, C. (Krefeld, Germany)	christoph.hartkopf-froeder@gla.nrw.de
Higgs, K.T. (Cork, Ireland),	k.higgs@ucc.ie
Hou Hong-fei (Bejing, China)	hfhou@public.fhnet.cn.net
Kruchek, S.A. (Minsk, Belarus)	kruchek@ns.igs.ac.by
Legrand-Blain, M. (Talence, France),	legrand@egid.u-bordeaux.fr
Lethiers, F.(Paris, France),	lethiers@ccr.jussieu.fr
Loboziak, S. (Lille, France),	Stanislas.Loboziak@univ-lille1.fr
Luksevics, E. (Riga, Latvia.)	erluks@lanet.lv
Mamet, B.(Bruxelles, Belgium)	apreat@ulb.ac.be
Maziane, N. (Rabat, Marocco)	n_maziane@hotmail.com
Melo, J.H.G.(Rio, Brazil),	jhmelo@cenpes.petrobras.com.br
Marshall, J.E.A. (Southampton, UK)	jeam@mail.soc.soton.ac.uk
Milhau, B. (Lille, France),	bruno.milhau@fls.fupl.asso.fr
Mistiaen, B. (Lille, France),	bruno.mistiaen@fls.fupl.asso.fr
Nekryata, N.S. (Minsk, Belarus),	kruchek@ns.igs.ac.by
Nicollin, J-P. (Lille, France)	jean-pierre.nicollin@fls.fupl.asso.fr
Obukhovskaya T.G. (Minsk, Belarus),	kruchek@ns.igs.ac.by
Oliveira, J.T. (Lisboa, Portugal),	Tomas.Oliveira@igm.pt
Owens, B. (Sheffield, UK),	bowens@palyno.freeserve.co.uk
Pereira, Z.M.(Lisboa, Portugal),	Zelia.Pereira@igm.pt
Playford, G. (Brisbane, Australia),	geoff@sol.earthsciences.uq.edu.au
Poty, E. (Liège, Belgium),	e.poty@ulg.ac.be
Quadros, L.T. de (Rio, Brazil),	quadros@cenpes.petrobras.com.br
Richardson, J.B. (London, UK)	J.Richardson@nhm.ac.uk
Rohart, J-C. (Lille, France),	jean-claude.rohart2@fnac.net
Sartenaer, P. (Bruxelles, Belgium),	sartenaer@kbinirsnb.be
Simakov, K.V. (Magadan, Russia),	simakov_kv@chat.ru
Stempien-Salek, M. (Warszawa, Poland	mstempie@twarda.pan.pl
Streel, M. (Liège, Belgium),	maurice.streel@ulg.ac.be
Strelchenko, T.V., (Minsk, Belarus),	kruchek@ns.igs.ac.by
Thorez, J. (Liège, Belgium),	j.thorez@ulg.ac.be
Turnau, Elzbieta (Krakow, Poland)	ndturnau@cyf-kr.edu.pl
Traverse, A. (State College, USA)	traverse@ems.psu.edu
Vachard, D. (Lille, France),	Daniel.Vachard@univ-lille1.fr
Vanguestaine, M. (Liège, Belgique)	m.vanguestaine@ulg.ac.be

THE LATE FAMENNIAN AND EARLY FRASNIAN DATINGS GIVEN BY TUCKER ET AL (1998) ARE BIOSTRATIGRAPHICALLY POORLY CONSTRAINED, A COMMENT

Maurice Streel, July 2001

In Streel 2000, p.59 (quoting Streel et al. 2000, p. 129), we have questioned the identification of the ash beds exposed at Little War Gap in eastern Tennessee as Frasnian. (See foot note). G. Klapper (personnal communication, June 2001) informs us about new data which give new light on that question.

Tucker et al., (1998, p. 181 explain that *«Roadcuts in the Devonian part of the Chattanooga Shale at Little War Gap, east Tennessee, expose four K-bentonite intervals corresponding to beds 59, 61, 65, and 67 in the measured section of Dennison and Boucot (1974)»*. They emphasize one of the four ash beds (bed 61 in Dennison and Boucot's section) as having the most abundant and best developed zircon crystals for radiometric dating. Quoting Harris (written communication to R.E. Kepferle, 1977), who identified the Frasnian conodont *Palmatolepis punctata* from shale within the interval beds 61-64, they give more weight to this unpublished information than to the Eifelian brachiopod based age given by Dennison and Boucot (1974), a conclusion we have questionned.

G. Klapper reminds us that the brachiopod (*Leiorhynchus limitare*) identified by Art Boucot (in Dennison an Boucot, 1974, p. 98) is from bed 58, more than 11 feet (3.3 m) below ash bed 61. He also confirms that, after having seen, with Jeff Over, a number of new collections immediately above ash bed 61, they are correlative with Montagne Noire Zone 8 (equivalent to the Lower *hassi* Zone of the standard zonation)

The volcanic ash bed 61 at Little War Gap is thus interbedded between a brachiopod constrained Eifelian age and a conodont constrained Middle Frasnian age and, on these bases, we continue to question the Frasnian age given to the ash bed 61.

G. Klapper (personnal communication, June 2001) argues that the Little War Gap ash bed 61 cannot be the same as the radiometrically dated 10 million years older Tioga ash bed of Pennsylvania and Virginia (Tucker et al., 1998), shown, in western New York State, to lie within the Eifelian conodont *costatus* Zone. This is fair, but we do not know the radiometric age of the lower part of the Little War Gap section (below bed 61) unless we extend the radiometric date of bed 61 to the subjacent ash bed 59.

The Late Famennian radiometric dates given by Tucker et al (1998) are bracketted by miospores which allow a rather poor correlation (from the Latest *marginifera* to the Late *expansa* conodont zones). On the contrary a very well biostratigraphically constrained date of the D/C Boundary is available at Hasselbachtal (*sulcata* Zone at about 354 Ma, Claoue-Long et al., 1992).

We maintain therefore that the Late Famennian and Early or Middle Frasnian datings given by Tucker et al (1998) are still biostratigraphically poorly constrained. If new data below ash bed 61 of the Little War Gap section would confirm the about 381 Ma of the Middle Frasnian, we would face a critical situation with a very well biostratigraphically constrained date of the D/C Boundary at Hasselbachtal and a 27 Ma older date for the Middle Frasnian! This long duration of the interval Middle Frasnian - Lowermost Carboniferous would probably be quite artificial and better explained by discrepancies between zircon dating using the Sensitive High Resolution Ion Microprobe (SHRIMP) used at the D/C Boundary, and the method of multigrain isotope dilution used in R.D. Tucker's laboratory. But such discussion is far beyond the scope of the present comment.

From Streel 2000, p. 59 : «The new Early Frasnian data are claimed by Tucker and others (1998) to characterize the *punctata* to Late *hassi* conodont Zones. It is based on an unpublished determination by them of *P. punctata* from the Chattanooga Shale at Little War Gap, east Tennessee (USA), formerly attributed by Dennison & Boucot (1974) to the Eifelian on the basis of brachiopod data. However the presence of the brachiopod *Leiorhynchus limitare* in the Tioga tuffaceous beds at the base of the Chattanooga Shale still supports an Eifelian age (a late Eifelian age according to P. Sartenaer, personnal communication, December 1999).»

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SUBDIVISION AND SUBSTAGES OF THE FAMENNIAN, AN OPINION AND POSSIBLE CANDIDATES FOR THE UPPER PART

Claudia Spalletta and M. Cristina Perri

Dipartimento di Scienze della Terra e Geologico Ambientali, Università di Bologna, via Zamboni 67, I-40126 Bologna, Italy; cspal@geomin.unibo.it; perri@geomin.unibo.it.

Recently the SDS members received a brief e-mail from Secretary Thomas Becker (September 16, 2001) in which he stated, as co-ordinator of the Famennian Working Group, that he was impressed by the quality of the Carnic Alps sections visited some days before. He suggested that some of these sections should be considered in the search for substage boundaries.

Though we have relevant data in the Carnic Alps, we nonetheless have some reservations about the necessity of establishing Devonian substages.

Not all SDS members believe that there is a need for naming substages, and above all for specification of formal boundary stratotypes. Some eminent members have strong reservations about divisions of the Famennian, Frasnian, Givetian, Emsian or other Devonian stages, even though these opinions have not been presented publicly. Their opinion, altough a minority viewpoint, has a philosophical basis.

What is, after all, the purpose of formalisation of substages within the Devonian and how does it improve our ability to correlate stratigraphic sections globally? And how do substages increase the resolution of the relative Devonian time scale? Of prime importance is the contention that if conodont zones are good enough for correlation, all lower boundaries suggested for substages of the Frasnian and Famennian may be defined in relation to the lower boundaries of conodont zones. In short, all necessary criteria are already available. Regarding the Famennian, all that would be needed is a final vote/votes after deciding if there is to be a fourth subdivision or not. The long, laborious documenting of candidate stratotypes for such subvisions and having them formalised by IUGS may not be worth the extraordinary effort.

Biostratigraphic correlation is the main focus of our scientific endeavours; definition of substages on the Devonian may add nothing of significance. It is argued that it would be better and of more practical value to focus the energies of SDS on correlating series, stage, zone and subzonal boundaries into the shallow water platform situations, even though this will be an arduous undertaking. Some SDS members have already tried to correlate the proposed conodont-based Upper Devonian substage boundary-levels into such contexts using the neritic and terrestrial miospore zonation (Streel and Loboziak, 2000). Activity of this kind involving various facies, fossil groups and stages has to be strongly encouraged by SDS.

It would be of great help in correlation if rigorous attempts could be made to improve the already very serviceable conodont zonation presently available for the Famennian. Something desirable (and possible) is better alignment with the ammonoid zonation, specifically as a result of work in sections and facies with the two groups co-occurring. Alignment with biozonations based on other groups could also be undertaken. In this context, some of the Carnic Alps Famennian sections may be considered for additional team-study, or considered as candidate sections purely on the basis of conodont biostratigraphy (especially for the upper subdivision) if a majority of the SDS members wish to continue this goal.

THE CARNIC ALPS SECTIONS

In the Carnic Alps, in the Pizzo Timau-Pramosio area, N of Udine (IGM Map, Sheet 14 IV NW Pizzo di Timau, 1:25,000), there are at least two sections that may be seriously considered in the search for the upper Famennian substage boundary stratotype both for a threefold and a fourfold subdivision.

The first section, Pramosio Bassa (PB), is located near Pramosio Hut (Perri, Spalletta and Pondrelli, 1998), near the unpaved road leading to Pramosio Lake. Only 8 samples from the first 5 m of the outcropping sequence have been investigated for conodonts to date, but 13 m of sequence is available for study. The interval from the base of the section up to sample PB5 has been referred to the Upper *trachytera* Zone due to the presence of *Pseudopolygnathus granulosus* Ziegler, 1962, in sample PB1 (Fig. 1, reporting the numerical distribution of conodonts in the Pramosio Bassa section, modified from Perri, Spalletta and Pondrelli, 1998). The 0.80 m between samples PB5 and PB6A have been attributed to the Lower *postera* Zone on the base of occurrence, in sample PB5, of *Polygnathus margaritatus* Schäfer, 1976; its global distribution starts in the upper half of the peculiar biozone. The last sample, PB7, owing to the presence of *Palmatolepis gracilis expansa* Sandberg and Ziegler, 1979, is assigned to the Lower *expansa* Zone. It is notheworthy that at the base of bed PB5, 0.32 m below sample PB5, a 0.1 m interval is enriched with the goniatite *Prionoceras*. This interval may equate with the Wagner Bed at Bohlen in Thuringia (T. Becker, pers. comm.) deposited at the base of the Lower *postera* Zone, just above the *Annulata* event. A new conodont sample from the base of bed PB5 is under investigation, as well as other three samples, one from the interval between PB6 and PB6A and the other two between PB6A and PB7. The latter samples were taken to test for the presence of the Upper *postera* Zone in the quite long (1.31 m) unsampled interval below PB7. *Palmatolepis perlobata postera* Ziegler, 1960, is lacking in this section, as well as in most sections from the Carnic Alps, where it seems to be a quite rare taxon. The Pramosio Bassa section has a rich, well preserved conodont fauna, though the CAI is between 4

Pramosio Bassa (PB)

		Upper trachytera Zone				Lower postera Zon			L.exp.	
Samples		PB 1	PB 2	PB 3	PB 4	PB 5	PB 6	PB6A	PB 7	Total
Weight (g)		2090	1365	1425	1250	1695	1350	2275	1900	
Distance from the base of the section (m)		0.40	0.83	1.41	1.68	2.31	2.51	3.15	4.46	
Species										
Bispathodus stabilis M1	Pa	3	2	7	5	40			14	71
Branmehla werneri	Pa	12	1					228		241
Mehlina strigosa	Pa	1		3		3	1	13	3	24
Palmatolepis gracilis gracilis	Pa	6	5	9		31	4	40	45	140
Palmatolepis minuta minuta	Pa	2								2
Palmatolepis perlobata schindewolfi	Pa	12	8	6	3	36	6	65	110	246
Palmatolepis rugosa trachytera	Pa	19	7	5						31
Polygnathellus typicalis	Pb	1		1					1	3
Polygnathus granulosus	Pa	2				18	1	137		158
Pseudopolygnathus granulosus	Pa	2	3	2	3					10
Alternognathus beulensis	Pa		7		1	15		35		58
Alternognathus regularis	Pa		5			6	1	18		30
Branmehla inornata	Pa		2		1			8		11
Palmatolepis glabra lepta	Pa		1	1	1					3
Palmatolepis minuta schleizia	Pa		2	3						5
Palmatolepis rugosa cf. ampla	Pa		2							2
Polygnathus glaber glaber	Pa		2		1					3
Polygnathus semicostatus "Mtrend"	Pa		2						2	4
Palmatolepis gracilis sigmoidalis	Pa			8	5	24	4	24	20	85
Polygnathus perplexus	Pa			1			2	7	7	10
Branmehla bohlenana	Pa					1		1		2
Polygnathellus conditus	Pb					2				2
Polygnathus margaritatus	Pa					9	2	2	1	14
Polygnathus rhabdotus	Pa						1	21	107	129
Branmehla fissilis	Pa								11	11
Icriodus costatus darbyensis M2	Pa								4	4
Palmatolepis gracilis expansa	Pa								9	9
Palmatolepis rugosa rugosa	Pa								1	1
Polygnathellus ziegleri	Pb							1	1	2
Polygnathus styriacus	Pa								68	68
Polygnathus subirregularis	Pa							1	2	3
Al. sp. juv.	Pa							4		
Pa. perlobata maxima	Pa							1		
Total		60	49	46	20	185	22	606	399	1387

and 4.5; it is also rich in ammonoids and trilobites. It may be considered as a possible candidate stratotype section for a threefold subdivision of the Famennian (base of an upper Famennian at the base of the Lower *expansa* Zone).

The second section, Malpasso (ML), is exposed near Malpasso Hut (Perri and Spalletta, 1991; 1998) along the unsealed road to Pramosio Lake. The section is about 22 m thick, and displays the biostratigraphic interval from the Upper *trachytera* to the Lower *praesulcata* zones (Fig. 2, with the numerical distribution of conodonts, modified from Perri and Spalletta, 1998). The Upper *expansa* Zone starts in sample ML9. The zonal attribution has been based on the presence of *Bispathodus ultimus* M1 Bischoff, 1957. Sample ML9 also has the first occurrence of *Palmatolepis gracilis gonioclymeniae* Müller, 1956, and *Pseudopolygnathus marburgensis trigonicus* Ziegler, 1962. The conodont fauna is very rich and the state of preservation quite good. Data on the ammonoid fauna from the section are set forth in Korn (1998). The interval between samples ML7 and ML9 has been re-sampled because, according to Korn (1998), the Wocklumeria Stufe starts below ML9. The Malpasso section also has a rich trilobite fauna now under study (R. Feist, pers. comm.), and it has been sampled for isotopic analysis (S. Kaiser, University of Bochum). It may be considered as a possible candidate stratotype section for the fourfold subdivision of the Famennian (base of an uppermost Famennian at the base of the Upper *expansa* Zone).

Both sections needs only minor refinement of the already detailed conodont biostratigraphy, supplemented by additional study of macrofaunas. They have, moreover, the ease accessibility desired for candidate stratotypes.

Malpasso (ML)

		Late trachytera Zone				E.p.Z.	L.p.Z	E. expansa Z.			M.exp.Z		Late expansa Zone					E. praesulcata Z.			
Samples		ML1	ML2	ML3A	ML3B	ML3C	ML3D	ML4	ML5	ML6	ML7	ML8	ML9	ML10	ML11	ML12	ML13	ML14	ML15	ML16	Total
Weight (g)		1200	1425	1275	720	1350	1850	1525	800	950	875	1125	525	875	2250	2675	1575	1025	2050	1375	
Distance from the base of section (m)		0.70	6.08	10.38	10.93	13.23	14.56	14.66	15.10	15.60	16.83	17.53	18.53	19.14	19.26	19.47	21.45	22.01	22.14	22.23	
Species																					
Alternognathus beulensis	Pa	3			(1)																4
Bispathodus stabilis M1	Pa	3	5	11				1	3	10	18			6	3	2	4	4			70
Palmatolepis gracilis gracilis	Pa	3	23	1		4	42	56	26	64	70	99	11	80	73	56	33	73	14	67	795
Palmatolepis minuta minuta	Pa	1																			1
Palmatolepis perlobata schindewolfi	Pa	10	27	15	1	2	29	38	8	18	4										152
Palmatolepis rugosa trachytera	Pa	8		9																	17
Pseudopolygnathus micropunctatus	Pa	1									111	3									115
Branmehla bohlenana	Pa		1				32	35	66	2											136
Icriodus sp	Pa		3																		3
Polygnathellus typicalis	Pb		1																		1
Polygnathus marginvolutus	Pa		1						6	1											8
Polygnathus semicostatus "M trend"8	Pa		26																		26
Palmatolepis glabra lepta	Pa			(1)																	1
Palmatolepis gracilis sigmoidalis	Pa			4			10	4	2	45	32	20	5	90	98	29	15	70	11	73	508
Pseudopolygnathus granulosus	Pa			3																	3
Mehlina strigosa	Pa				2		2			1	6	1			9		1			1	23
Polygnathus communis communis	Pa				2		3	3				60	13	3			2	3		1	90
Polygnathus granulosus	Pa				5	7		6													18
Pelekysgnathus inclinatus	Pa					1															1
Pelekysgnathus inclinatus	S					2															2
Palmatolepis rugosa ampla	Pa					(1)	14		7	2											24
Palmatolepis gracilis manca	Pa						12														12
Palmatolepis perlobata maxima	Pa						1	1													2
Polygnathus margaritatus	Pa						3														3
Polygnathus semicostatus "M trend"3	Pa						1	1													2
Polygnathus styriacus	Pa						112	214	100	87											513
Palmatolepis rugosa rugosa	Pa							3			9										12
Polygnathus experplexus	Pa							3		2											5
Polygnathus extralobatus	Pa							29			128										157
Polygnathus obliquicostatus	Pa							154													154
Branmehla fissilis	Pa									46	104	10		28							188
Bispathodus costatus M1	Pa										8	18	9	18	29	108	33	175	28	134	560
Pseudopolygnathus controversus M2	Pa										9						1				10
Bispathodus jugosus	Pa											2									2
Bispathodus stabilis M2	Pa											68	5	57	25	5		15		18	193
Pseudopolygnathus brevipennatus	Pa											9									9
Pseudopolygnathus controversus M1	Pa											5									5
Pseudopolygnathus? kayseri	Pa											2									2
Bispathodus aculeatus	Pa												2								2
Bispathodus ultimus M1	Pa												1	102	73	44	27	122	23	118	510
Palmatolepis gracilis gonioclymeniae	Pa												3	2	5	12			1		23
Pseudopolygnathus marburgensis trigonica	Pa												10	6	12	35	25	40	27	30	185
Branmehla suprema	Pa													12	108	91	9	156	39	99	514
Palmatolepis gracilis expansa	Pa													5	9	7	6	2	4	4	37
Polygnathus vogesi	Pa														102	98					200
Bispathodus costatus M2	Pa															139		4		3	146
Bispathodus ultimus M2	Pa															16			1	5	22
Branmehla disparilis	Pa																4	1			5
Siphonodella praesulcata	Pa																	3	2	2	7
Total		29	87	44	11	17	261	548	218	278	499	297	59	409	546	642	160	668	150	555	5478

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THE MRAKIB SECTION (MOROCCO) AS POSSIBLE UPPER FAMENNIAN (DEVONIAN) STRATOTYPE SECTION: CONODONT DATA

Carlo Corradini[1], M. Cristina Perri[2] and Claudia Spalletta[2]

[1]*Dipartimento di Scienze della Terra (Paleontologia), Università di Modena e Reggio Emilia, via Università 4, I-41100 Modena, Italy; ccorr@unimo.it*

[2]*Dipartimento di Scienze della Terra e Geolgico Ambientali, Università di Bologna, via Zamboni 67, I-40126 Bologna, Italy; perri@geomin.unibo.it, cspal@geomin.unibo.it*

The Mrakib section is located in Morocco in the Southern Maider area, 28 Km SE of Fezzou, at Global Satellite Position N 30°45,4' W 04°42,8' (Fig. 1).

Fig. 1 - Location map of the Mrakib section

The succession is more than 100 m thick and is composed of fine siliciclastites with interbedded carbonatic levels, and was deposited under mostly poorly oxygenated conditions (Becker et al., 1999). The section is highly fossiliferous and has been proposed as a potential upper Famennian substage stratotype section. Becker et al. (1999) illustrated the sedimentary and ammonoid succession in detail, and refer also on the occurrence of bivalves, gastropods, brachiopods, ostracods, trilobites, corals, nautiloids, placoderms plates and foraminifera. According to Becker et al. (1999) the ammonoid record of the section is among the most detailed in the world for the middle and upper Famennian and allows very precise time resolution.

In the discussion within the SDS members, several levels have been proposed to define the bases of Famennian substages, all by terms of conodont zonation. The Mrakib section includes all the proposed levels. During the SDS-IGCP 421 Morocco Meeting (April 24th-May 1st 1999) some levels across the potential substage boundaries, suggested on the basis of ammonoids, have been sampled for conodonts.

Seven samples have been collected, all from the apparently most carbonatic levels or calcareous nodules within the siliciclastic succession.

Fig. 2 reproduces part of the section as sketched by Becker et al. (1999) with the location of conodont samples. The conodont data are reported in Fig. 3.

All the samples have been processed with formic acid however only some were completely dissolved (Fig. 3).

Only two samples yielded conodonts: N2 a few broken, poorly preserved, elements, and R1 a quite well preserved fauna. All the identified specimens belong to long range taxa. Sample N2 can be referred to the Upper crepida–Upper expansa zones interval and sample R1 to the Upper marginifera–Upper expansa zones.

In the same samples, vertebrate microremains, represented by fish teeth and scales, have been collected, as well as some thin, elongated, rounded simple cones. Those cones constitute the main finding in sample N2.

The low frequence of conodonts could be related to the palaeoenvironmental setting of the Mrakib section characterized mainly by siliciclastites.

As the Famennian substages should be defined on the basis of conodont biostratigraphy, the designation of the Mrakib section, as possible upper Famennian stratotype section, can not be supported by the exposed data. The search for another possible candidate section is highly recommended.

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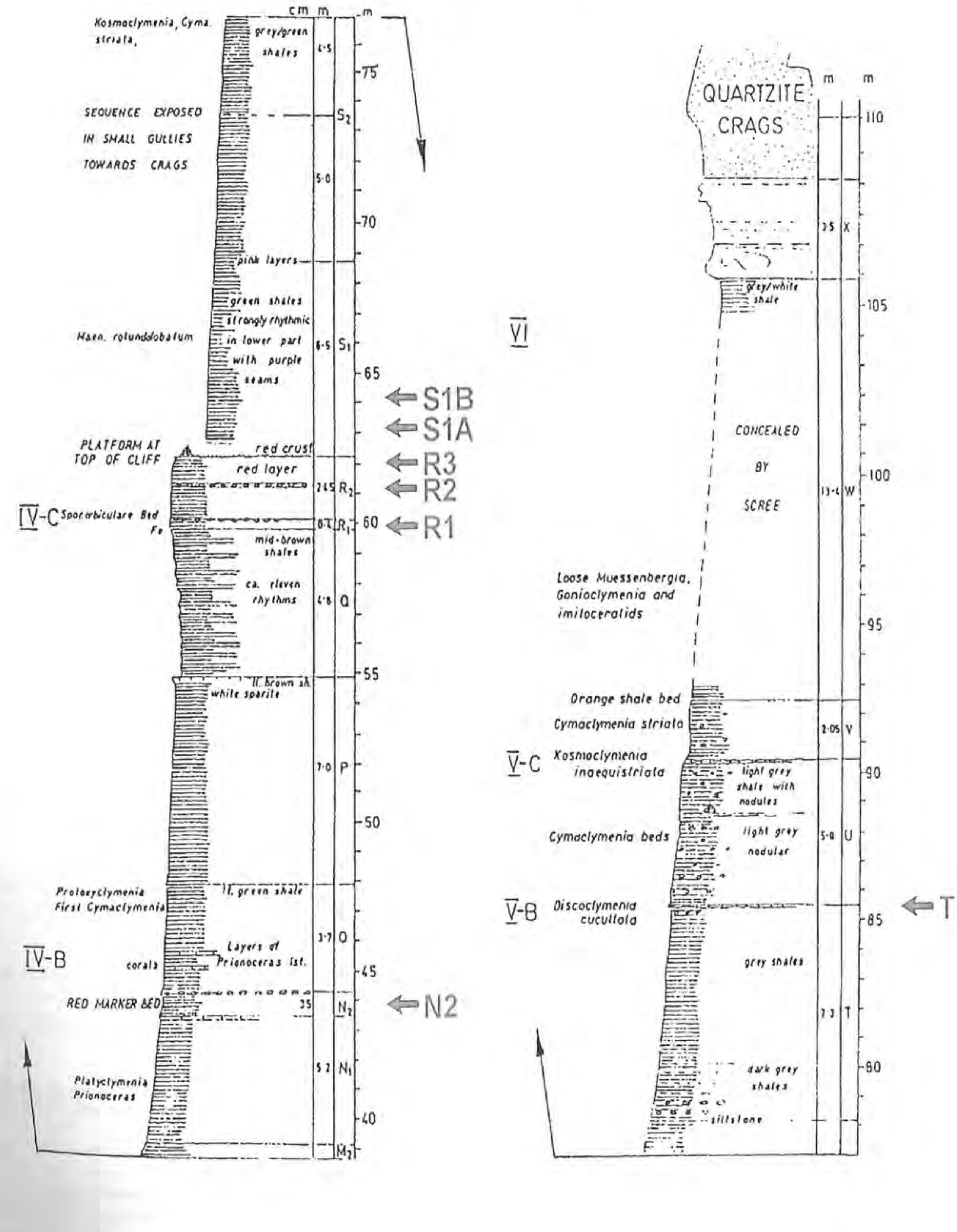

Fig. 2 – Sketch of the middle and upper part of the Mrakib section (after Becker et al., 1999). Arrows indicate conodont samples.

Mrakib section - MRK							
Samples	N2	R1	R2	R3	S1	S1B	T
weight gr	2930	1600	1150	1050	830	800	1750
dissolved gr	2920	1080	500	350	285	310	1640
% dissolved	100%	68%	43%	33%	34%	39%	94%
Conodonts							
"Belodella" sp.	12						
Branmhela sp.	1						
Palmatolepis gracilis gracilis	8	13	barren	barren	barren	barren	barren
Palmatolepis perlobata schindewõlfi		2					
Polygnathus sp.	1						
Bispathodus stabilis		37					
Branmehla inornata		14					
Ramiforms	*	*					
Simple cones	1368	62					
Fish teeth and scales	*	*					

Fig. 3 – Conodont data from the Mrakib section

MEMBER NEWS

CM G.K.M. ALBERTI (GROßHANSDORF)

Because the author had to undergo a hard operation and further operations with long stays in hospitals in 2001 the planed studies of planctonic tentaculitids and of trilobites for the most part were not possible to realize. Only in the period of time before these events such studies on a small scale (concerning especially taxa from the Pragian/Emsian boundary interval and from the Zlichovian/Dalejan boundary interval) have been continued. A further object of investigation were several trilobite taxa from the Lower and Middle Devonian of North Africa (particularly of SSW-Algeria and of Germany). Apart from that a critical comment on the recent paper (2000) by CHLUPAC, I., FEIST, R. & Morzadec, P., on "Trilobites and standard Devonian stage boundaries" has been prepared.

CM A. R. ASHOURI (MASHHAD, IRAN)

Since completing my PhD research on the conodonts of Middle Devonian – Early Carboniferous of Khoshyeilagh Formation (Alborz Mountains, north Iran) and Late Devonian - Carboniferous of Shishtu Formation (Tabas area, east Iran) in the University of Hull (UK, 1900), further research has been undertaken and extended to other fields in collaboration with some colleagues and students. Several papers have been published. Whilst spending sabbatical leave (February – September) 2001) at Macquarie University, Australia, results of further research have been prepared for publication.

I take this opportunity to express my great appreciation to both Prof. Michael House (Southampton University, UK) and Prof. John Talent (Macquarie University, Australia) for their generous encouragement. Prof. House organized excellent facilities during my candidature PhD and continuously encouraged my research activity. Prof. Talent, since1998 has encouraged my research and contributions to IGCP 421 Meetings. During my stay in Macquarie University he critically and carefully read manuscripts in order to improve them for publication.

The outcome of the research has led to the documentation of more than 120 conodont species and subspecies. The following new species have been described: *Bispathodus tabasensis, Icriodus alborzensis, I. ariaei, I. housei, I. jaafari, I. khoshyeilaghensis, I. rhodesi, I. talenti, I. walliseri, Pelekysgnathus housei, Pe. talenti, Polygnathus klapperianus, Protognathodus eftekhari, Pr. Ruttneri* and *Pseudopolygnathus shotorensis.*

Conodont zones recognized are as follows: in the Tabas area, Shotori Range, Late *rhenana, triangularis, crepida*, Late *crepida* - Early *rhomboidea, rhomboidea*, Early *marginifera*, Middle *expansa, anchoralis - latus* and *texanus* conodont zones have been recognized in the Howz-e-Dorah area (south of the Shotori Range) and Late *rhenana- linguiformis*, Late *triangularis* - Latest *crepid*, Late *crepida*- Latest *crepida, marginifera*, Latest *marginifera – trachytera* , Middle *expansa* - Middle *praesulcata* conodont zones have been recognized in the Niaz area (western flank of the Shotori Range). In Ozback - Kuh Mountains, north of Tabas area Early - Late *crepida*, Middle - Late *crepida, crepida*, Middle *crepida* - Early *rhomboidea*, Early *rhomboidea*, Early *marginifera*, Latest *marginifera - trachytera, anchoralis - latus* and *texanus* conodont zones have been recognized. In the Khoshyeilagh area *falsiovalis*, Late *rhomboidea* - Early *marginifera*, Latest *marginifera - trachytera* and Middle *expansa* - Middle *praesulcata, bouckaerti* and *anchoralis - latus* conodont zones have been recognized.

At the last SDS Meeting in Frankfurt, May 2001, on behalf of Ferdowsi University of Mashhad, Iran, I invited the SDS 2003 Meeting to be held in Iran. Fortunately as I have been informed by the secretary of the SDS (Dr. Thomas Becker) via an e-mail, 13. Aug. 2001, that the invitation has been accepted; the 2003 Meeting will be held in Iran. As a member of the SDS, I am pleased to invite all colleagues to attend this meeting.

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TM R. THOMAS BECKER (MÜNSTER)

The last year has been both exciting and tiresome because Münster University eventually offered me the vacant chair in Palaeontology which previously was held by Prof. Strauch (who had conducted some Devonian work, jointly with U. Jux some decades ago). After succesful negotiations with university and the research ministery of North Rhine Westphalia, I started the new position on first October. It means many new tasks such as a lot teaching, administration and, in the first year, a complete rebuilding of the palaeontology branch, including new laboratories, computing services and offices. This currently takes most of my time but on the other hand it offers the chance to found a new Devonian research team and to continue „Devonian university education" in Germany now that the former active groups at Göttingen, Marburg, Braunschweig and Bonn universities are on the decline. There are already eager students with interests in Devonian bivalves, ichnofossils and reef environments.

In 2001 a number of smaller projects has been finished. These include a study of a few new Frasnian goniatites from the Boulonnais made available by CM Denise Brice (Becker 2002 in press), a paper on the Annulata Event in Iran, jointly with CM M. Yazdi and CM A.R. Ashouri (Becker et al. 2002 in press), the description of buchiolinid bivalves from the Canning Basin (Grimm & Becker 2002 in press), and a joint description of Moroccan Upper Devonian crinoids, mostly collected by V. Ebbighausen and J. Bockwinkel (Webster et al. in prep.). Field work was carried out in spring in Morocco and, in the frame of a DFG project on oxygen isotopes in conodonts (jointly with T. Steuber & S. Kaiser, both Ruhr University Bochum), concentrated on the Devonian/Carboniferous boundary. New Moroccan discoveries include haematitic late Frasnian and early Famennian goniatites from the Meseta and previosly completely unknown rich middle to late Frasnian goniatites from the Tata region of the Dra Valley. A cooperation project with our Moroccan colleagues, especially with TM El Hassani, hopefully will commence in 2002.

Sarah Aboussalam is busily finalizing her Ph.D. on the Taghanic Events and first results have been published or have been submitted to the IGCP 421 Courier Senckenberg volume. Goniatite studies continue with Michael House concerning the Canning Basin and the Pharciceras Stufe of Morocco. Moroccan Famennian ammonoid faunas are subject of a joint effort by Michael, Volker Ebbighausen, Jürgen Bockwinkel, and myself. Denise Brice sent an interesting goniatite from Afghanistan from where no material has been properly described so far. Another Ph.D. student at Berlin, Anton Sprey (Free University), is about to submit his Ph.D. on ammonoid morphological evolution in relation to major extinctions. This project involves both the Kellwasser and Hangenberg Crises. A morphometric study of Phoenixites frechi, the main Kellwasser opportunist, will soon be completed by Anton and myself. In September CM Claudia Spaletta and Susanne Pohler from Cologne University led our small D/C boundary group to the marvellous sections of the Carnic Alps. Whilst our trip was overshadowed on 11th September, I was impressed with the quality of the Carnic Alps Famennian sections which should play a significant role in our current substage discussions. It was also interesting to see how well the Annulata

Event is regionally developed, with a goniatite bloom in the basalmost post-event bed, just as in Thuringia.

NEW ADDRESS:

Geologisch-Paläontologisches Institut
Westfälische Wilhelms-Universität Münster
Corrensstr. 24
D-48149 Münster
-49-(0)251-83 339 51 phone
-49-(0)251-83 339 74 secretary
-49-(0)251-83 339 68 fax
rbecker@uni-muenster.de

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CM ALAIN BLIECK & TM SUSAN TURNER

A. Blieck has been mainly continuing work initiated under the auspices of IGCP 406 on Mid-Palaeozoic vertebrates of the Circum-Arctic regions. IGCP 406 was extended into 2001, allowing French-Lithuanian collaboration on the Devonian vertebrates of the Severnaya Zemlya archipelago (Russia) to go on. A paper on the stratigraphical distribution of the pteraspidomorph vertebrates in the uppermost Silurian and the Lower to Upper Devonian is in press in the collective volume on the stratigraphy of the archipelago (to be published by Geodiversitas, Paris: Blieck & Karatajute-Talimaa, in press a). A first monographic paper on new corvaspid material from the Lochkovian of the series was presented to the 9th International Meeting on Early/Lower Vertebrates (Flagstaff, Arizona, USA; May 15-19, 2000), and will be published in a special issue of the Journal of Vertebrate Paleontology (Blieck & Karatajute-Talimaa, in press b). Revision of the known material of Protopteraspis from the Lochkovian of the Anglo-Welsh borderland (UK), and description of new material collected over years by the local palaeontologist Peter R. Tarrant has resulted in synonymising the taxa from UK (P. leathensis) and N. France (P. gosseleti); this reanalysis thus strengthens the biostratigraphical correlation between the Lochkovian series of both regions (Blieck & Tarrant, 2001). Protopteraspis is also a classical heterostracan pteraspidomorph from the Arctic regions, where it is known in the Canadian and the North European series. The work on the Russian Arctic series will continue in 2002 with a study of the tesseraspid material from the Lower Devonian of Severnaya Zemlya, which will probably be presented at the 5th Baltic Stratigraphic Conference (Vilnius, Lithuania, 22-29 Sept. 2002).

S. Turner has this last year begun work on a review of the significance of bonebeds in Gondwana. For IGCP 406 (Circum-Arctic Mid-Palaeozoic vertebrates) collaborative work with Carole Burrow, Tom Uyeno and Ray Thorsteinsson continues on the Devonian microvertebrates (thelodonts, sharks, acanthodians, actinopts and sarcopts) of the Canadian Arctic. Contributing to IGCP 421 (North Gondwana Biodynamics) she is making a study of Middle to Upper Devonian bonebeds of central USA (Ohio, Wisconsin) as well as a Late Devonian microfauna from Iran (with H. Gholamalian, M. Yazdi, Esfahan and C. Burrow, paper submitted to Memoirs AAP from the Orange Symposium). A poster on the USA bonebeds, with detailed work on the Givetian shark, Omalodus, was presented at the 15th Senckenberg Conference in May 2001 (Turner et al., 2001); papers with Dale Sparling (Minnesota) and Paul Mayer (Milwaukee Public Museum) are in preparation. There was a successful exhibition on the Wisconsin Devonian sharks held at the latter museum in 2001. Other work in the Late Devonian (late Famennian) includes a study of fish microfossils from the Louisiana Limestone of Missouri (Karl Chauffe coll.) and microvertebrates as well as gyracanth acanthodian macroremains from the non-marine tetrapod-bearing site at Red Hill, Pennsylvania (Ted Daeschler coll.). Ph.D. student Carole J. Burrow (Univ. Qld) successfully defended her thesis in May 2001 on Lower Devonian gnathostome microvertebrates of eastern Australia; it is available to interested parties on CD-Rom (contact CBurrow@zoology.uq.edu.au). With Sally Young (NHM, London) Susan is working on a review of UK Palaeozoic microvertebrates and is concentrating herself on the Devonian thelodonts of the Welsh Borderland.

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TM PIERRE BULTYNCK (BRUSSELS)

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GOUWY, S., BENFRIKA, E.M., HELSEN, S & BULTYNCK, P. (2000): Late Emsian to early Givetian conodont succession in the Tiflet area (northern-western Meseta, Central Morocco). In Tahiri & A. El Hassani (eds): Proceedings of the Subcommission on Devonian Stratigraphy (SDS)-IGCP 421 Morocco Meeting. Trav. Inst. Sci. Rabat, Série Geol. & Géogr. Phys., 20: 1-10.

CM PETER CARLS (BRAUNSCHWEIG, GERMANY)

Together with Nacho Valenzuela-Rios preparing ECOS VIII field trip to sections in Eastern Iberian Chains, Spain with emphasize on early Emsian with conodonts and shelly faunas. Claudia Dojen prepares a PhD thesis on Early Devonian shallow water benthic ostracods and Falk Lehnhoff has begun his PhD thesis on Phacopidae (mainly Emsian to Eifelian) and Homalonotidae (Ludlow, Lochkovian to Emsian) in the same region. Comments on the "steps" of development of various faunal groups, of which conodonts, Acastavinae and Asteropyginae (after Gandl, 1972), and turbidicolous Spiriferacea have been listed already in the first edition of the Devonian correlation chart (Weddige, ed., 1996) and in Carls (1999) are in progress and shall be applied for a calibration of the Lochkovian through Early Emsian interval and stages and zones comprised therein.

Mark-Kurik & Carls describe a long-snouted pelagic late Eifelian arthrodire from Spain.

Critical inspection of the plate kinematics postulated in context with Tornquist's Sea and Rheic Ocean reveals that the corresponding scenarios are not tenable (Carls, 2001; in press).

PUBLICATIONS

Carls, P. (1999): El Devonico de Celtiberia y sus fosiles. - In: Gomez-Vintaned, J.A. & Lion, E: Memorias de las VI Jornadas Aragonesas de Paleontolog¡a <25 anos de Paleontolog¡a Aragonesa>, Homenaje al Prof. Leandro Sequeiros: 101-164; Zaragoza (Inst. Fernando el Catoligo).

Carls, P. (2001): Kritik der Plattenkinematik um das Rhenohercynicum bis zum frühen Devon. - Braunschweiger geowiss. Arb., 24, Horst Wachendorf Festschrift, 27-108; Braunschweig.

Carls, P. (in press): Tornquist's Sea and Rheic Ocean are unwarranted. - Cour. Forsch.-Inst. Senckenberg; frankfurt

Mark-Kurik, E. & Carls, P. (in press): Along-snouted late Eifelian Arthrodire from Aragon, Spain. - Revista Espanola de Paleontolog¡a; Madrid.

CM CARLTON E. BRETT (CINCINNATI, OHIO, USA)

e-mail: carlton.brett@uc.edu

DEVONIAN RESEARCH IN 2000-2001 BY BRETT AND COLLEAGUES INVOLVED THREE MAJOR AREAS:

a) Gordon Baird (SUNY College at Fredonia) and I continued study of eastern clastic equivalents of the Tully Formation (late Givetian) in eastern New York State and central Pennsylvania. We have now documented nearly continuous sections from the Hamilton Group into the Tully and have determined the precise position of major faunal turnovers. In addition, we have traced three major depositional sequences and subsequences throughout the north central Appalachian basin region. As a result of high resolution correlations we can more precisely locate the subsiding basin axis and probable forebulges. General patterns are summarized in a manuscript submitted for publication (BAIRD AND BRETT, 2001, in review).

b) Collaborative research with Hans Peter Schönlaub and Susanne Pohler (Austrian Geological Survey) was expanded during 2000-2001. We are making comparative studies of the sequence and event stratigraphy of the Lower and Middle Devonian of the Appalachian Basin and the Carnic Alps in Austria. Preliminary results, presented at the SDS meeting in Frankfurt, indicate some remarkable similarities of pattern, particularly of dysoxic black shale facies in the Eifelian- Givetian interval; these suggest that such intervals may represent oceanic anoxic events akin to OAEs recognized in the Cretaceous (BRETT, POHLER AND SCHONLAUB, 2001).

c) I am also working with students Alan Turner, Patrick McLaughlin and with D. Jeffrey Over (SUNY College at Geneseo) and Glen Storrs (Cincinnati Museum Center) on documentation of sedimentology, taphonomy, and biostratigraphy of Upper Devonian bone beds in central Kentucky. these beds provide an excellent case study of event condensations: they display evidence for amalgamation of distinct events of erosion, reworking and deposition during prolonged intervals (spanning two to four conodonts). A manuscript has been submitted for the SDS proceedings volume (see BRETT et al., 2001).

PUBLICATIONS

BAIRD, G.C., BRETT, C.E. AND VER STRAETEN, C. A., 2000, Facies and fossils of the lower Hamilton Group (Middle Devonian) in the Livingston County-Onondaga County region. New York State Geological Association **72nd** Annual Meeting Guidebook, p. 155-175.

BAIRD, G.C. & BRETT, C. E., 2001, Eustatic and flexural events recorded in the late Middle Devonian Tully Formation, New York State and Pennsylvania. -- Geological Society of America, Abstracts with Programs **33**(1): 3, Burlington, VT.

BRETT, C. E. , POHLER, S., AND SCHÖNLAUB, H.-P., 2001, Sequence and event stratigraphy of the Middle Devonian (Upper Emsian to Early Givetian) of the Carnic Alps. 15th Annual Senckenberg Conference; Mid-Palaeozoic Bio- and Geodynamics, The North Gondwana-Laurussia Interactions; Abstracts, p. 19; Frankfurt am Main.

BRETT, C. E. AND VER STRAETEN, C. A. 2000, Anatomy of a composite sequence boundary: The Silurian-Devonian contact in western New York State. New York State Geological Association Meeting **72nd** Annual Meeting Guidebook, p. 39-74.

BRETT, C.E., TURNER, A., McLAUGHLIN, P., OVER, D.J. AND STORRS, G. W., 2001, Middle-Upper Devonian (Givetian-Famennian) conodont beds from central Kentucky: Reworking events and biostratigraphic condensation in the distal Acadian foreland basin. 15th Annual Senckenberg Conference; Mid-Palaeozoic Bio- and Geodynamics, The North Gondwana-Laurussia Interactions; Abstracts, p. 20; Frankfurt am Main.

VER STRAETEN, C. A. AND BRETT, C. E., 2000, Bulge migration and pinnacle reef development, Middle Devonian Appalachian foreland basin. Journal of Geology 108, 339-352.

CM CHEN XIUQIN (BEJING)

Research over the recent months has been focused dominantly on brachiopod extinction and recovery from South China and northern Xinjiang.

Firstly, a study of Late Devonian brachiopod extinction and recovery in South China. This program is funded by the Major Basic Research Projects of Ministry of Sciences and Technology, China (G2000077700). From March to the beginning of April, my colleagues and I had a field work on Devonian sections in Guangxi and central Hunan. I have finished the manuscript of Late Devonian (F/F) brachiopod extinction and recovery in South China. In which, there are 13 orders, 43 families and 87 brachiopod genus collected from Frasnian to Famennian in South China. Three orders, like Orthida, Pentamerida and Atrypida, extincted at the end of Frasnian. There are 14 families extincted in F/F event and occupied 32.6% of all Late Devonian families. They are Douvillinidae, Leptostrophiidae, Monticuliferidae, Rhipidomellidae,Schizophoriidae,Pentameridae,Hypothyridinidae,Septa- lariidae, Atrypidae, Spinellidae, Echinospiriferidae, Theodossiidae, Ambocoeliidae, Reticulariidae. There are 30 genus extincted in F/F event, occupied about 35% of all Late Devonian genus and about 73.2% of all 41 Frasnian genus. There are 36 brachiopod genus recoveried during late Late Devonian and occupied about 41.2% of all Late Devonian genus.

Secondly, I'm working on late Middle Devonian brachiopod extinction in South China. There are 104 brachiopod genera collected from Middle Devonian in South China. In which, 76 genus extincted at the end of Givetian from South China and occupied 73.1% of all Middle Devonian genus. I will finish manuscript at the beginning 2002.

Third, I have been working on Late Devonian brachiopod faunas from North Xinjiang. This program is funded by National Natural and Science Fundation of China (49972005). I have finished one manuscript of "first record of First record of the Devonian brachiopod Yunnanella Grabau 1923 in the Junggar Basin, northern Xinjiang, China". Now I still continue working on Late Devonian brachiopod faunas from North Xinjiang.

RECENT PUBLICATIONS:

Chen Xiuqin & Xu Hankui, 2000: Brachiopod fauna of the Shashishan Formation(mid-Famennian) in Kruktag, South Tianshan. Records of the Western Australian Museum Supplement No.58: 37-57.

Chen Xiuqin, Liao Zhuoting & Xu Hankui, 2001: Study of the Devonian brachiopod genera Yunnanella and Nayunnella. Acta Palaeontologica Sinica,40(2):229-238.

FINISHED MANUSCRIPTS:

Chen Xiuqin & Jun-ichi Tazawa, 2000: Middle Devonian brachiopods from the southern Kitakami Mountains, northeast Japan. (Submitted to Journal of Paleontology)

Chen Xiuqin, Jin Yugan & Zhang Zixin, 2000: First record of First record of the Devonian brachiopod Yunnanella Grabau 1923 in the Junggar Basin, northern Xinjiang, China. (Submitted to Alcheringa)

Chen Xiuqin,2000: Study of Late Devonian brachiopod extinction and recovery in South China.

TM IVO CHLUPÁČ (PRAHA)

The main activities were concentrated in the finishing the comprehensive book Geological History of the Czech Republic (in Czech), now in press.

The research of the Middle Paleozoic of the Barrandian area continued in the following items:

1. The project of sedimentology research of the stratotype and reference sections continued in study of the Ludlovian-Pridolian (P. Cap), Silurian-Devonian (F. Vacek) and Lochkovian-Pragian (T. Vorel) boundary sections and intervals. The diploma theses of all named students of the Charles University were finished (under the leadership of Chlupáč) and the project will continue in terms of the research program of the Institute of Geology and Palaeontology, Charles University, Prague.
2. The study of the Lower Devonian Reef Complex at Koneprusy continued with regard to quarrying in this area (collaboration with the National Museum, Prague).
3. A surprising discovery of homalonotid trilobites in the Devonian of the Barrandian was made by Mr. P. Kolar. A joint report with description of Parahomalonotus novaki sp. n. was published together with evaluation of the "exotic" immigrants within the lower Zlichovian.
4. In terms of the international cooperation, the excursion of participants of the 15th International Senckenberg Conference (Mid-Palaeozoic Bio-and Geodynamics: The North Gondwana-Laurussia Interaction) was realized on May 19-20, 2001. Sections starting with the upper Ashgillian and ending in the Givetian were visited (including the original stratotype of the Pragian/Zlichovian boundary as defined in 1958).
5. The celebrations of the 15Oth birth anniversary of Otomar Pravoslav Novak (1851-1892) - the only direct disciple and successor of Joachim Barrande and active paleontologist particularly in research of trilobites and other arthropods, hyolithids and Devonian tentaculitids, were realized. A special exhibition was opened in the National Museum, Prague and a representative publication by R. Horny was published.
6. The occurrences of Middle and Upper Devonian trilobites in Moravia-Silesia and at some localities in Poland were summarized in a joint paper with G. Schraut (Montpellier). Presented in terms of the Devonian Correlation Tables (K. Weddige, ed.).

RECENT PUBLICATIONS

Chlupáč I., Hladil J. (2000): The global stratotype section and point of the Silurian-Devonian boundary. Cour. Forsch.-Inst. Senckenberg, 225, 1-7. Please, note the Announcement in this SDS Newsletter!

Chlupáč I. (2000): The global stratotype section and point of the lower Pragian boundary. Cour. Forsch.-Inst. Senckenberg., 225, 9-15 See announcement in this SDS Newsletter!

Chlupáč I., Galle A., Hladil J., Kalvoda J. (2000): Series and stage boundaries in the Devonian of the Czech Republic. Cour. Forsch.-Inst. Senckenberg, 225, 159-172.

Crick R. E., Ellwood B. B., Hladil J., El Hassani A., Hrouda F., Chlupáč I. (2001): Magnetostratigraphy susceptibility of the Pøídolian-Lochkovian (Silurian-Devonian) GSSP (Klonk, Czech Republic) and coeval sequence in Anti-Atlas Morocco. PALAEO (Palaeogeography etc.), 167, 73-100. Elsevier, Amsterdam.

Chlupáč I., Kolar P. (2001): First homalonotid trilobites in the Devonian of Bohemia and their significance. Bull. Czech Geol. Surv. 76, 3, 179-186. Praha.

ANNOUNCEMENT TO READERS OF THE COURIER FORSCHUNGSINSTITUT SENCKENBERG CFS 225: SUBCOMMISSION ON DEVONIAN STRATIGRAPHY. RECOGNITION OF DEVONIAN SERIES AND STAGE BOUNDARIES IN GEOLOGICAL AREAS (P. BULTYNCK, ED.)

In the first two papers on the global stratotype sections and points of the Silurian-Devonian boundary (Chlupáč, Hladil) and lower Pragian boundary (Chlupáč) all the text-figures of both articles were changed and placed incorrectly during the press. Consequently, the captions do not correspond to presented schemes. Owing to this serious print error, new and corrected reprints of both two papers were distributed at the SDS Meeting in Frankfurt a.M. in May, 2001. They can be also obtained from I. Chlupáè on request (as far as the store suffices). As most world libraries obtained the CFS Courier No. 225 without the corrected reprints (especially without that on Pragian GSSP), the author(s) ask all SDS members to make attention of librarians of their institutions on this affair which could seriously mislead the readers of the CFS Courier 225 which summarizes the SDS work of many years.

CM JAMES EBERT (ONEONTA, NEW YORK)

Continued fieldwork in portions of the Helderberg Group (PÍRdolRan – Lochkovian) in New York has further clarified the significance of three cryptic, regionally angular unconformities. In ascending order, we have designated these surfaces as the Terrace Mountain Unconformity (lowest), the Howe Cave Unconformity and the Punch Kill Unconformity. The Terrace Mountain Unconformity separates the Thacher Member of the Manlius Formation from the overlying Olney Member (Manlius Formation) and Dayville Member (Coeymans Formation). The Jamesville, Clark Reservation, and Elmwood members (Manlius Formation) and the Dayville Member (Coeymans Formation) are truncated beneath the Howe Cave Unconformity, which is overlain by the Coeymans Formation (Deansboro and Ravena members). The Punch Kill Unconformity bevels portions of the Coeymans Formation and is overlain by the Kalkberg Formation. These relationships suggest that the Dayville Member, currently a part of the Coeymans Formation, should be reassigned to the Manlius Formation. The presence of these unconformities invalidates previous correlations (Rickard, 1962; Laporte, 1969), which had interpreted the Helderberg sequence as a spectrum of gradually migrating, coeval facies.

This significant revision of stratigraphic relationships within the Helderberg Group is supported by previously published biostratigraphic work and new studies, which are currently in progress. Barnett (1971) and Rickard (1975) placed the Silurian – Devonian boundary within the Helderberg Group, but discounted the significance of the entry of Icriodus woschmidti at the base of the Coeymans Formation (Ravena and Deansboro members) because they felt the distribution of this important taxon was restricted by facies. Such facies dependence has not been recognized in other areas. The first appearance of I. woschmidti at the base of the Coeymans Formation is reinterpreted as a delayed first appearance, which coincided with the resumption of deposition following the period of erosion marked by the Howe Cave Unconformity. Equally significant is the occurrence of the Silurian (PÍRdolR) forms Ozarkodina remscheidensis eosteinhornensis and O. confluens in the units immediately below the Howe Cave Unconformity. It now seems clear that in New York, the Silurian – Devonian boundary occurs within the erosional vacuity of the Howe Cave Unconformity. This placement necessitates removal of all members of the Manlius Formation and the Dayville Member of the Coeymans Formation from the Lochkovian Stage; these units should now be considered PÍRdolRan.

To further strengthen these interpretations, a parallel study of a sparse icthyolith fauna from several Helderberg units is under way in collaboration with Sue Turner and Carole Burrow. Some preliminary studies of chitinozoans have also begun.

Summaries of these litho- and biostratigraphic investigations have been presented at the 15th Annual Senckenberg Conference and at the Annual Meeting of the Geological Society of America. A more thorough consideration of the tectonic causes of the Helderberg unconformities has been submitted to CFS for the proceedings volume of the Senckenberg Conference. Details of the litho- and biostratigraphic revisions are in preparation for submission to the Geological Society of America Bulletin. Damon Matteson and I also presented a poster session, which included a minor re-description of the Lochkovian cystoid Lepocrinites gebhardi and the description of a new PÍRdolRan species (currently un-named) of the same genus at the Boston GSA Conference.

I am also participating in a study of the impact of early land plants on the global cycling of carbon that is being conducted by Ulrich Mann and Ulrich Herten (Forschungszentrum, Jülich, Germany). Sections within the Helderberg group that are suitable for this study are being identified and will be sampled. A preliminary report of this project was published in Terra Nostra.

RECENT PUBLICATIONS

Ebert, J.R. and Matteson, D.K., in review. Distal Stratigraphic Effects of the Laurentia – Avalon Collision: a Record of Early Acadian (PÍRdolR-Lochkovian) Tectonism in the Helderberg Group of New York State, USA: submitted to Courier Forschungsinstitut Senckenberg.

Mann, U., Herten, U., Kranendonck, O., Poelchau, H.S., Stroetmann, J., Vos, H., Wilkes, H., Suchy, V., Brocke, R., Wilde, V., Muller, A., Ebert, J., Bozdogan, N., Soylu, C., El-Hassani, A, and Yalcin, M.N., 2001, Dynamics of the Silurian/Devonian-Boundary Sequence: Sedimentary Cycles vs. Organic Matter Variation: Terra Nostra, 4, p. 44-48.

Ebert, J.R., Matteson, D.K., and Natel, E.M., 2001, Early Acadian Tectonism and PÍRdolR-Lochkovian Eustasy in the Helderberg Group of New York State, USA: 15th International Senckenberg Conference/Joint Meeting IGCP 421/SDS May, 2001: Abstracts, p. 34.

Ebert, J.R., Matteson, D.K. and Natel, E.M., 2001, Parting the Helderberg Sea: Cryptic Unconformities and the Silurian-Devonian Boundary in the Classic Epeiric Sea Sequence of New York: Geological Society of America Abstracts with Programs, v. 33, n. 6, p. A321-322.

Matteson, D.K. and Ebert, J.R., 2001, Cystoids of the Coeymans Formation, Helderberg Group, New York State: A new Species of *Lepocrinites* and *Lepocrinites gebhardi* Revisited: Geological Society of America Abstracts with Programs, v. 33, n. 6, p. A10-11.

TM AHMED EL HASSANI (RABAT, MOROCCO)

RESEARCH:

My research tasks were concentrated this year on two fields the Western Anti Atlas (Dra Valley) and the north western Moroccan Meseta (Oulmes and Tiflet area) with the following topics: Devonian stratigraphy, sedimentology and stable isotopes.

NATIONAL PROGRAM:

Continuation of investigations with my Ph.D students:

1. Rehamna (Mr. Fouad EL KAMEL): In the carbonated platform of Upper Emsian to Givetian age, the reef edification is previous to, and contemporaneous with, a tilted block tectonic that has favored the bioconstruction in its upper part. The tectonic expression is illustrated by several instability marks, such as tension faults, progressive unconformity and the resulting landslide, observed in both the reef development zone and the external platform. This Ph.D will be defended early 2002 in Casablanca University.

2. Western Meseta Coastal Block (Ph-D of Assia MOHSINE). This thesis will be defended end of this year under the following topic: tectonic and volcanic activity in the Paleozoic of Coastal Block and Rehama: petrographic approach, geochemistry and structural petrology.

3. Tiflet: A Ph.D on The Devonian sedimentology was started this year in the Tiflet and Oulmes area. (Mr. Abdelkader RAZOUANI). This program should be in cooperation with Prof. Thomas BECKER (University of Munster) under incoming research collaboration.

4. Eastern Anti Atlas: Mr. Youssef RADDI is starting a new Ph-D on the following topic: Late Devonian Formations: sedimentary environment, water resources and porosity.

INTERNATIONAL COOPERATION:

First investigations in Western Anti Atlas in co-operation and coordination with colleagues from the Free University of Berlin (Prof. Thomas BECKER) and The University of Buchum (Prof. Thomas STUBER):

1. Stratigraphy & paleontology of several sections in the Area of Torkoz, Assa and South of Tata (Oued Mzerreb).
2. Investigation in the area of Oulmès: Souk Jema and Moulay Hassane sections (Central Western Meseta)

MEETING:

Frankfurt (Germany) May 10 –June 2nd 2001:

On invitation of Dr. Raimund (IGCP 421 Co-Director) I participated in the 15th International Senckenberg conference: Mid-Paleozoic Bio- and Geodynamics, the North Gondwana-Laurussia Interaction. It's also the opportunity of SDS Annual Meeting.

During the conference I presented a lecture on the following topic: The Variscan Crust between Gondwana and Laurasia. This lecture was in collaboration with Prof. Otto WALLISER (Goettingen, Germany) and Prof. Abdelfatah TAHIRI (Rabat, Morocco).

I was also invited to participate to the Thuringian-Barrandian excursion, wonderfully showed by our friend Prof. Ivo CHLUPAC.

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Ellwood, B., Crick R., J.L. GARCIA-ALCALDE, F.M. SOTO, M. TRUYOLS-MASSONI, El Hassani A., & E.J. KOVAS, (2001): Global correlation using Magnetic sceptibility dat from Lower Devonian rocks. Geology: Vol. 29, No. 7, pp. 583-586.

MANN, U.; HERTEN, U. ; KRANENDONK, ... EL HASSANI, A.; YALCIN, M.N. (2001).- Dynamics of the Silurian/Devonian – boundary sequence: sedimentary cycles vs. organic matter variation. Terra Nostra , N°4, pp:44-48.

MANN, U.; BOZDONAN, N. BROCKE, R.; EBERT, J. ; EL HASSANI, A.; HERTEN, U. ; KRANENDONK, & YALCIN, M.N. (2001).- High Bioproductivity at the Silurian/Devonian boundary – A global event? Margins Meeting, Kiel, October 2-6 2001, Schriftenreihe der Deutschen Geologischen Gesellschaft, Heft 14, pp:128-129.

EL HASSANI, A. (2000)- The Rabat-Tiflet zone: late Devonian -Early Carboniferous of Tiflet and Lower and Middle Devonian of Rabat. In SDS-IGCP Morocco Meeting Excursion guidebook. Notes & Mém. Serv. Géol. Maroc, 399, pp: 115-122

EL HASSANI A. (2000).- The Cambrian Sehoul Block, a Caledonian terrane in northern Moroccan Meseta. 1 Congresso Iberico de Paleontologia/XVI Jornadas de la Sociedad Espanola de Paleontologia , VIII International Meeting of IGCP 421, pp :212-213

EL HASSANI, A. & BENFRIKA, EM. (2000).- The Devonian of the Moroccan Meseta: biostratigraphy and correlations. Cour. Forsch.-Inst. Senckenberg, 225, pp:195-209.

EL HASSANI, A. & TAHIRI, A. (2000).- The eastern part of central Morocco (western Meseta). In SDS-IGCP Morocco Meeting Excursion guidebook. Notes & Mém. Serv. Géol. Maroc, 399, pp:89-92.

EL HASSANI, A. EL KAMEL, F., (2000).-Tectonic control of Devonian reef building in Mechra ben Abbou area (northern Rehamna, Morocco). Trav. Inst. Sci. Rabat, Série Géol. & géogr. Phys., 20, pp:25-30

CRICK R.E., ELLWOOD B.B., EL HASSANI A., and FeisT R. (2000).- Proposed Magnetostratigraphy Susceptibility Magnetostratotype for the Eifelian–Givetian GSSP (Anti-Atlas, Morocco), Episodes, 23, pp: 93-101

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WALLISER, O.H., EL HASSANI, A. & TAHIRI, A. (2000).- Mrirt: a key area for the variscan Meseta of Morocco. In SDS-IGCP Morocco Meeting Excursion guidebook. Notes & Mém. Serv. Géol. Maroc, 399, pp:93-108

ZAHRAOUI, M. , EL HASSANI, A. & TAHIRI, A. (2000).- Devonian outcrops of the oued Cherrat shear zone. In SDS-IGCP Morocco Meeting Excursion guidebook. Notes & Mém. Serv. Géol. Maroc, 399, pp:123-128.

CM ULRICH JANSEN (FRANKFURT)

Research in 2001 has been focused on Lower Devonian brachiopods from the Rheinisches Schiefergebirge (Germany) and the Dra Plains (Morocco). A monograph was published in "Abhandlungen der Senckenbergischen naturforschenden Gesellschaft" (Vol. 554).

An interdisciplinary research programme of the Senckenberg group and colleagues from other institutions concerns facies, sedimentology, palaeontology, and palaeoenvironment of the Rhenish Emsian. In 2001, the work concentrated on Lower Emsian strata near Koblenz, which were deposited under intertidal conditions.

Lower Devonian ("Siegenian") sections along the new railway construction site from Frankfurt to Köln (near Neuwied/ Rhein and in the "Siebengebirge" near Bonn) have been studied in co-operation with M. Poschmann (Mainz) and T. Schindler (Bayerfeld-Steckweiler). One section has yielded a very interesting arthropod fauna including phalangiotarbids (the oldest known representatives), chasmataspidids, arthropleurids, eurypterids, and trigonotarbid spiders; additionally bivalves, brachiopods, fishes, and land plants have been found (Poschmann & Jansen, 2001, in prep.). In another section, very rich and well preserved brachiopod faunas including orthids, strophomenids, and spiriferids have been discovered. The brachiopod material certainly will open new biostratigraphic possibilities.

Finally, I participated in the organisation of the IGCP 421-SDS Meeting/15th Senckenberg Conference in Frankfurt.

PUBLICATIONS 1999-2001

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TM G. KLAPPER (GLENCOE, ILLINOIS)

Change of addresses: Gilbert Klapper, 1010 Eastwood Road, Glencoe, Illinois 60022 (g-klapper@northwestern.edu)

Research on Frasnian and lower Famennian conodont taxonomy and biostratigraphy is continuing at retirement pace. I would like to take this opportunity to support the statement by Jeff Over and Kristina Rotondo in this issue of the Newsletter. Their research demonstrates that ash bed 61 at Little War Gap, Tennessee cannot be the Tioga Bentonite as was claimed by Maurice Streel in the 2000 SDS Newsletter (No. 17, p. 59). This is the ash bed dated by Tucker et al. (1998, p. 181) as 381.1 Ma (with a 1.3 Ma analytical error), approximately 10 million years younger than the Eifelian Tioga ash beds in Virginia and Pennsylvania analyzed by two different radiometric-dating laboratories. As Over and Rotondo show (their Figure 1), ash bed 61 at Little War Gap is directly overlain by middle Frasnian conodonts in bed 62 (including *Palmatolepis punctata* identified by Anita Harris and in further collections that Anita has kindly provided for my study) and Frasnian MN Zone 8 conodonts in bed 66 (less than 0.4 m above bed 61). Furthermore, the Little War Gap ash bed 61, dated by Tucker et al. (1998), is directly underlain by the unequivocal late Givetian conodonts *Klapperina disparilis* and *K. disparalvea* (see Over and Rotondo, Figure 1, figs. 6 and 7-9, respectively). These species identify the penultimate conodont zone of the late Givetian, the *disparilis* Zone.

All of this means that the Eifelian brachiopods cited by Streel (2000, p. 59), which lie more than 3 m below ash bed 61 (Denison and Boucot, 1974, p. 98), are irrelevant to the correlation of this ash bed, since late Givetian conodonts intervene above the brachiopod horizon. It is reasonable to assume as Over and Rotondo infer, that ash bed 61 is likely to be in the same zone as the directly overlying middle Frasnian conodonts. [All references cited here can be found in Over and Rotondo's contribution].

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CM TANJA KOREN

Currently I am working jointly with Dr. A. Kim and Prof. O. H. Walliser on the Lochkovian-Praguian boundary beds at the sections of the Northern Urals, the Alaj and Turkestan Ranges of the South Tien Shan. The goal of this work is to date the *falcarius* graptolite Zone in terms of the conodont and dacrioconarid biostratigraphy.

CM ELGA MARK-KURIK (TALLINN, ESTONIA)

kurik@gi.ee

In the paper by Mark-Kurik & Young (in press) a new Early Devonian buchanosteid arthrodire from the Urals (Bashkortostan) is described and the other related forms from the family Buchanosteidae are discussed. The best known buchanosteids (*Buchanosteus*, *Errolosteus*) were so far discovered in Australia. The new genus from Urals (Takata and Vyazovaya Formations, Emsian) is significant as its material contains both of macroremains and scales, belonging to the same individual. One of the plates from the Taemas Limestone, referred earlier to the genus *Errolosteus* belongs according to Young to the new buchanosteid found in Urals. Mark-Kurik (1991) reported several buchanosteids from the other regions of the Northern Hemisphere: Siberian Arctic, Spitsbergen, Central Asia (Kazahstan, Uzbekistan). The earliest buchanosteid is *Buchanosteus* sp. from the Lochkovian of South China (Wang et al., 1998). But in general, buchanosteid arthrodires are characteristic of the Emsian, late Early Devonian.

A new representative of Rhenanida was discovered in the Razvedochnyj Formation (Pragian-Emsian) of the NW of the Siberian Platform (Mark-Kurik, 2001). Rhenanids, though rather poorly known placoderm fishes, are quite widely distributed. They are known mostly from the Early and Middle Devonian of several regions: Ohio (North America), Bolivia and probably also Colombia (South America), Germany and Turkey (Europe), and Saudi Arabia. Microremains of these fishes (*Ohioaspis*, *Asterosteus*?) are reported from the eastern states of USA, Victoria and New South Wales, Australia, Germany and Turkey. The Siberian rhenanid is closest to the Middle Devonian *Asterosteus* from Ohio.

The arthrodires, discovered in the Devonian of Spain are fairly rare. Mark-Kurik & Carls (in press) described an extraordinary long-snouted form, coming from the Eifelian of Aragon. The Spanish arthrodire has such a specific combination of characters, which does not make it possible to establish any relationship to the other long-snouted arthrodires known from Germany, Morocco and Australia. The large pelagic arthrodire inhabited the waters of the Palaeotethys.

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CM J. LE MENN (BREST, FRANCE)

A collaboration program initiated a few years ago between Portuguese geologists of the Instituto Geologico e Mineiro (J.T. Oliveira, J.M. Piçarra, J. Romao , Z. Pereira) and Armorican searchers (R.Gourvennec, Univ. Brest; M. Robardet, Univ. Rennes) on the Upper Silurian and Lower Devonian in Portugal is still going on. Field studies have been carried out in two structural zones of Ossa Morena and Central Iberian.

The Ossa Morena succession has been investigated in the three units of the Barrancos area: Terena syncline, Faixa das Mercês folded belt and the Russianas syncline. New data collected on palynomorphs and macrofossils (graptolites, crinoid columnals, brachiopods, tabulate corals) modify considerably the stratigraphical scheme in this region. Formerly the upper Silurian-lower Devonian succession was considered to be composed of the Xistos Raiados Formation, followed by the Monte das Russianas Formation which was overlaid unconformably by the Terena Formation assigned to the Upper Devonian-Carboniferous. The correlations based on the new biostratigraphical data are summarized on the figure (see following page).

The record of the Xistos Raiados Formation is poor in macrofossils. Nevertheless in situ reworked columnals of scyphocrinitids are indicative of open shelf paleoenvironnement. North Gondwanan affinities has been pointed out for the benthic faunal association in the Monte das Russianas Formation (Pragian). The presence of pebbles containing scyphocrinitid columnals to lower Silurian graptolites, olistolites in the top of the Xistos Raiados Formation and flat pebbles, iron crust, erosional surfaces in the Monte das Russianas Formation shows that instability occurs in the Barrancos area along the Lower Devonian. The succession seems to end with the Lower

Emsian which is the youngest stratigraphic level dated in this region. These results have been presented during the field session of the VIII International Meeting of the IGCP 421 and First Congresso Iberico de Paleontologia in Evora (8-14 October 2000).

In the Central Iberian Zone, the upper Silurian and Devonian successions have been investigated in the Portalegre, Dornes-Maçao and Valongo synclines. The macrofauna more frequent better preserved and diversified than in Barrancos area is suitable for detailed studies. A synthesis on the widespread dimerocrinitid level which may use to trace the base of the Devonian throughout the Ibero-Armorican domain is in progress.

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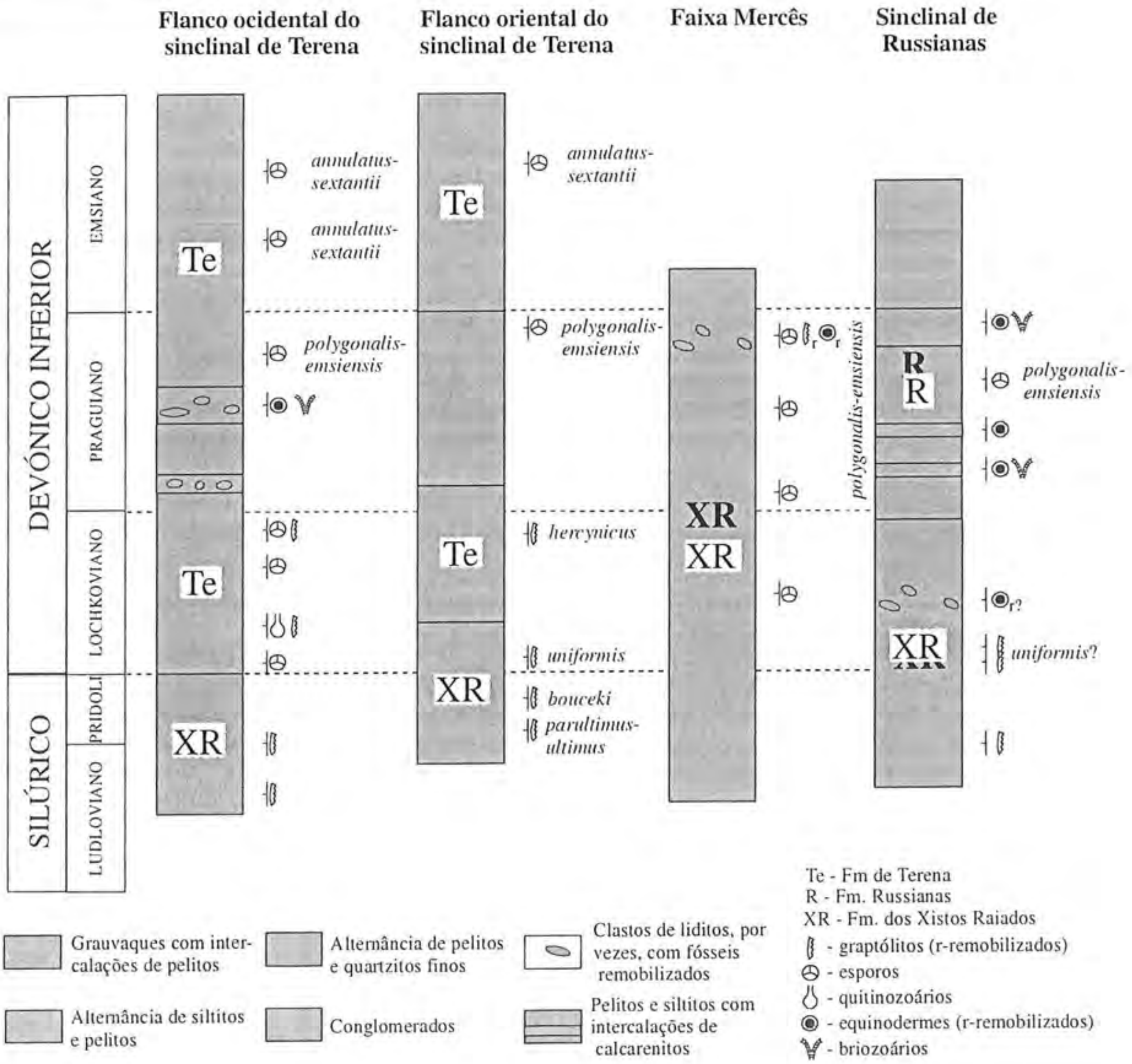
Flanco ocidental do sinclinal de Terena
Flanco oriental do sinclinal de Terena
Faixa Mercês
Sinclinal de Russianas
DEVÓNICO INFERIOR
SILÚRICO
EMSIANO
PRAGUIANO
LOCHKOVIANO
PRIDOLI
LUDLOVIANO
Te
XR
R
annulatus-sextantii
polygonalis-emsiensis
hercynicus
uniformis
bouceki
parultimus-ultimus
uniformis?
Grauvaques com intercalações de pelitos
Alternância de siltitos e pelitos
Alternância de pelitos e quartzitos finos
Conglomerados
Clastos de liditos, por vezes, com fósseis remobilizados
Pelitos e siltitos com intercalações de calcarenitos
Te - Fm de Terena
R - Fm. Russianas
XR - Fm. dos Xistos Raiados
- graptólitos (r-remobilizados)
- esporos
- quitinozoários
- equinodermes (r-remobilizados)
- briozoários

CM JEFFREY OVER (GENESEO, NEW YORK)

I continue to work on stratigraphic problems in the clastic dominated Upper Devonian basins of eastern North America. Students and I are investigating the timing of the start of black shale deposition in the upper Frasnian and lowest Famennian; conodont and brachiopod faunas across the Frasnain-Famennian boundary, and the conodont stratigraphy of the Chattanooga Shale.

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Vacco, D.I., Sheldon, A.L., and Over, D.J., 2001, Geochemistry of a modern anoxic environment and implications for ancient anoxic environments: Geological Society of America, Abstracts with Programs, v. 33(1), p. A7.

TM FLORENTIN PARIS, (RENNES, FRANCE)

florentin.paris@univ-rennes1.fr

At present, I am mainly involved in the activities of IGCP n° 410 dealing with Ordovician biodiversity. Nevertheless, I had some activities on Devonian material, including field work with sedimentologists and palynologists from the SONATRACH (National Algerian Oil Company) leaded by Dr K. BOUMENDJEL in the splendid Devonian sequences of the Tassili area and of the Illizi basin, in south-eastern Saharan Algeria. Macrofossils and palynological samples have been extensively collected in this area. The study of the palynomorphs (chitinozoans) from the Devonian of Bolivia (sub-surface and outcrops) is also reactivated in collaboration with A. LE HÉRISSÉ (Brest) and P. RACHEBOEUF (Lyon).

LIST OF THE RECENT PUBLICATIONS RELATED TO DEVONIAN TOPICS

Montenari M., Servais T. & Paris F. 2000. Palynological dating (acritarchs and chitinozoans) of Lower Paleozoic phyllites from the Black Forest/ southern Germany. *C. R. Acad. Sci. Paris, 330: 1-8.*

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TM JOHN B. RICHARDSON (UK)

PAPERS & ABSTRACTS PUBLISHED

Richardson, J.B., Rodriguez, R.M. and Sutherland, S.J.E. 2001. Palynological zonation of mid-Palaeozoic sequences from the Cantabrian Mountains, NW Spain: implications for inter-regional and interfacies correlation of the Ludford/ Přídolí and Silurian/Devonian boundaries, and plant dispersal patterns. Bull nat. Hist. Mus. Lond. (Geol.) **57** (2), pp. 115-162

------------ 2001 (Abstract) Spore species distribution patterns, environments and palaeogeography. Were there floristic regions in Laurussia and Gondwana in the Upper Silurian and Lower Devonian? Abstracts from the 15th International Conference, Frankfurt. IGCP 421 & SDS p. 106

WORK IN PROGRESS:

UPPER DEVONIAN SPORE FLORAS FROM NEW YORK STATE & PENNSYLVANIA, U.S.A.

1. The variation and stratigraphical distribution of variants of the species *Vallatisporites "pusillites"* in New York State and Pennsylvania is being studied from its first appearance within the Cattaraugus Formation and through the overlying Oswayo & Kushequa Formations. Although most of the variants occur throughout the sequence, the range and abun-

dance of the variants is different especially in the in the three formations. *Vallatisporites "pusillites"* was a widespread and important element of Upper Devonian (Strunian) spore floras and the genus persists into the Carboniferous. This follows earlier work reported in the SDS Newsletter. The work is in collaboration with Dr. V. Avkhimovich (as previously) & Dr. E. Turnau Polish Academy of Sciences, Kracow. Both co-authors have worked on Strunian deposits in Eastern Europe.

2. Dating the widespread diamictite event in the Upper Devonian of New York State, Pennsylvania, & Maryland. with Woodrow, D. L. (Hobart College, New York State) and Don Sevon (Pennsylvania Geological Survey). Further samples are being prepared for study from Pennsylvania. Continuation of the work reported at the Moscow Conference (SDS 1994).

3. Continuation of systematic and biostratigraphical studies of cryptospore and miospore assemblages from the Lower Old Red Sandstone of England and Wales.

CM EBERHARD SCHINDLER (FRANKFURT)

The major work of last year has been the organization of the 15th International Senckenberg Conference (joint meeting of IGCP 421 and SDS) together with colleagues and staff of the Forschungsinstitut Senckenberg at the Senckenberg Museum in Frankfurt. 130 participants out of 25 countries from all over the world gathered in May 2001 when during three days 42 talks and more than 50 posters were presented. Two pre-conference field trips (to the Belgian Ardenne Mountains and to the German Rheinisches Schiefergebirge) and one post-conference field trip (beginning in the German Thueringer Schiefergebirge and ending in the Barrandian area of the Czech Republic) took place. A conference report can be found in the September 2001 issue of *Episodes* (see reference below) or on the Senckenberg website (address see below). An abstract volume and a field trips guidebook had been put together – a limited number is still available and may be purchased from me (Euro 10,- + postage / Euro 13,- + postage). The editorial work on the proceedings volume of the meeting (to be issued as a 'Courier Forschungsinstitut Senckenberg' (CFS) next year) has started some time after the conference together with the other organizers. Further information (such as lists of participants, photographs, etc.) can be found on the Senckenberg website (http://www.senckenberg.uni-frankfurt.de).Research on the clastic Lower Devonian rocks in the Rhein/Mosel area of the Rheinisches Schiefergebirge has been ongoing together with other colleagues from the Senckenberg and from other institutions. A paper on a key section at Alken, situated close to the river Mosel south of Koblenz, has been submitted. An oral presentation was given on details concerning two outstanding fossiliferous horizons from that section at the annual meeting of the 'Palaeontologische Gesellschaft' in Oldenburg (see reference below).

In connection with plans of a revival of the *Nahecaris* Project (i.e., a project targetting the Lower Devonian Hunsrueck-Schiefer of the Rheinisches Schiefergebirge, now under the leadership of W. OSCHMANN, Frankfurt University), investigations have started together with other Senckenberg workers and with colleagues from other institutions.Work on material from trenches in the Eifel Hills area (Lower and Middle Devonian of the Eifel-Kalkmulden) that had been opened in connection with a Trans-European gas pipeline (TENP) has been pushed forward together with other colleagues at the Senckenberg.Further research activities – although with some reduction due to the 15th International Senckenberg Conference – have been on Upper Devonian sections of the Russian western Urals (see reference below), on Lower Devonian sections in the Moroccan Anti Atlas (see reference below), on central Asian sections, and on the section Cisarska Rokle (Barrandian), the latter in connection with joint research activities with other members at the Senckenberg and Czech workers included in the working group of the subdivision of the Emsian stage.Conodont material was sent to M. JOACHIMSKI from Erlangen University to investigate oxygen isotopes with the aim to get informations about the temperatures e.g., across the F/F boundary and the Kellwasser Event.Zircon samples for radiometric dating of Middle and Upper Devonian settings had been sent to Bob TUCKER (St. Louis) already last year– but no results have been received yet.Contacts with the MSEC workers TM R. CRICK and CM B. ELLWOOD are ongoing.Together with TM K. Weddige and CM U. Jansen work on a chart of main Devonian rocks from different areas in Germany has started.Participation in the working groups of the German SDS for the subdivision of the Emsian and the Late Devonian stages continued.

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HANS PETER SCHÖNLAUB AND SUSANNE M.L. POHLER (AUSTRIA)

The project on *Sequence stratigraphy, platform evolution and paleoecology of Devonian carbonates in the Central Carnic Alps (Austria)* funded by the FWF (Fonds zur Förderung der wissenschaftlichen Forschung) continued this year at the Geological Survey of Austria. Project leader H.P. Schönlaub contributed numerous conodont samples from various Devonian sections to the study; additional samples were collected this summer from sections at Pal Piccolo, Gamspitz, Creta di Timau, Freikofel, and the southern reaches of Mt. Seewarte. Lithological samples from different shallow water sequences will be investigated with respect to their algal flora by B. Hubmann, Graz. Rugose corals will be studied by S. Schröder, Cologne. The carbonate sedimentology is still being investigated by S. Pohler. Four mapping projects in the area between Plöcken Pass and Creta di Timau were conducted by students from the University of Cologne.

Preliminary results of the study were presented at the SDS meeting in Frankfurt (May 2001), at the GAC/MAC Meeting in St. John's (Nfld., Canada 2001) and at the Workshop on "Paleozoic Studies in Austria" (St. Pankrazen, 2001).

Two publications connected with IGCP 421 "North Gondwana mid-Paleozoic bioevent/biogeography patterns in relation to crustal dynamics" (Coordinated by Raimund Feist and John Talent) were published this year, a third one is scheduled for April 2002.

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TONY WRIGHT (WOLLONGONG NW, AUSTRALIA

The last year or so have seen two major publications appear, both resulting from the PAFF conference held in my university in late 1997. The first of these is the AAP Memoir 23, all 516 pages of Australasian palaeobiogeography (except for the Triassic, which did not make the final deadline); although the published date is 2000, it actually did not appear until 2001. A similar publication situation affected the special issue (vol. 15, 191 pp.) of *Historical Biology*, which is a collection of papers by delegates to the PAFF conference; I understand this volume is being reprinted due to printing problems.

My research falls into two main categories. One consists of collaborative studies of NSW Silurian (and one Devonian) and Iranian Ordovician-Silurian graptolites, all with Barrie Rickards; we are now studying the large faunas from Four Mile Creek, NSW, along with Gordon Packham and Amanda Chapman. One large MS on Llandovery dendroids is in preparation; after its (imminent as I write) submission, the focus of this Four Mile Creek project will move to the graptoloids and other dendroids. Several recent papers on graptolites are listed. During late March-early July I was in Cambridge working with Barrie, getting this new project off the ground.

The other focus is Devonian faunas, especially corals of NSW and Iran. I have described a new genus of Early Devonian calceoloid (operculate) tetracoral - *Chakeola* – from NSW, Queensland and Vietnam. As part of this theme I attended the Frankfurt IGCP conference in July, and went on the post-conference field trip to Thuringia and the Barrandian. I am currently working up my final (?) effort on *Calceola* and its close relatives, based on lots of Eifel material plus important, mostly Australian silicified material.

For my sins, I am also now editing *Alcheringa*. Enough said about the onerous and time-consuming nature of this chore. Thank heavens for email!

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CM MEHDI YAZDI (ISFAHAN, ISLAMIC REPUBLIC OF IRAN)

E-mail: m.yazdi@ sci.ui.ac.ir or Mehdi_my@hotmail.com

I completed my research on Carboniferous-Permian Boundary in Central and East of Iran. Interesting point that I should mention about CPB in eastern part of Iran (Shotori Range) is: a bed (20 Cm thick) with all reworked and redeposits Early Permian fauna. The presence of this bed confirmed that, similar biota to western Australia lived at the time of Early Asselian in the Shotori Range close to CPB.

Regarding to Devonian: my PhD student Mr. Gholamalian is going to complete his thesis on the Conodont biostratigraphy (Frasnian/Famennian Boundary) in Chahriseh (Isfahan) and Shotori Range. He did a good job on the phylogeny of *Polygnathus communis* group.

Miss. Rabiey submitted her thesis on Darchaleh area (south of Isfahan). She found a crinoidal bed similar to the Shotori Range. Based on conodonts out of this bed the age of crinoidal bed in Darchaleh area can be reported as: late Namurian.

Miss. Shirani submitted her thesis on Permian-Triassic transitional boundary. New data out of her thesis will be published in China in future.

Two weeks ago I found a bed with reworked goniatite close to the base of a section (Frasnian in age) in Zefreh area (north of Isfahan). The goniatite out of this level are unknown. I will contact Prof. Thomas Becker in near future.

Miss Bagheri, one of my Msc students started her research in Chahriseh (Permian in age). Miss Hosseine is going to work on a sequence between Devonian to Permian in north of Isfahan of (Soh). She will complete a research on Carboniferous and Permian flora related Soh area. The plant remains from this area can be used for international correlation in future.

TM E.A. YOLKIN (NOVOSIBERISK)

My attention at present year was concentrated mostly on two long-term projects and on preparation of the 410/421 IGCP field meeting in Siberia. The first one concerns of the West Siberian Lowland Subsurface Paleozoic stratigraphy and paleogeography. Proofs of the book "Paleozoic of Western Siberia" are already checked and the book will appear at the end of this year. Apart from clarification of the Regional stratigraphic chart for the Paleozoic of this region, there are proposed two sketch maps showing paleogeographic environments on western margin of the Siberian continent during the first half of the Cambrian and Ordovician times. Paleogeographic reconstructions, at least for time-slices of marine sedimentation (Silurian – Lower Carboniferous), will be continued. Much time was devoted to the biogeographic project (Talent J.A., Gratsianova R.T., Yolkin E.A.). The first computer calculation of accumulated brachiopod data on species taxonomic level from regions of Asia-Australia hemisphere was made and special paper ("small monster" by John's definition) is appeared. The special attention was paid to preparation of the 410/421 IGCP field meeting in Siberia. Its participants visited many sections within Gorny Altai, Salair and Kuznetsk Basin from the base of the Ordovician to top of Lower Carboniferous. This trip was slightly long, about 4000 km.

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BIOSTRATIGRAPHIC CONTROL ON THE BELPRE ASH, LITTLE WAR GAP AND ITS BEARING ON THE DEVONIAN TIME SCALE OF TUCKER ET AL. (1998)

CM D. Jeffrey Over (Geneseo, New York) and Kristina A. Rotondo (Baton Rouge, Louisiana)

In the 2000 SDS Newsletter (No. 17, p. 59) and in Earth-Science Reviews (2000, v. 52, p. 129) CM Maurice Streel has questioned the biostratigraphic control on the middle Frasnian 381.1 +/- 1.3 Ma. date of the Belpre Ash by Tucker et al. (1998). We would like to take this chance to clarify the name of the ash dated by Tucker et al. at Little War Gap, Tennessee, and present data that has only appeared in abstract form on the biostratigraphic age of the Belpre Ash (Rotondo and Over, 2000).

Tucker et al. (1998) collected four ash beds at Little War Gap. In reference to the section measured by Dennison and Boucot (1974) these are beds 59 (lowest), 61, 65, and 67 (highest). These ash beds occur in a 7 m thick interval, where the three highest ashes collected, and the one dated ash, are in a 0.8 meter thick interval of the lower Chattanooga Shale separated from the lowest ash by 5.6 m (Figure 1). The lowest ash bed is petrologically different from the upper ash beds, which are very rich in muscovite. These ashes were first considered to be the Tioga Bentonites by Dennison and Boucot (1974). Identification by Anita Harris, USGS, of an abundant conodont fauna, including *Palmatolepis punctata* from bed 62 (USGS Collection No. 12562-SD) and bed 66 (USGS Collection No. 12563-SD) within the upper group of ash beds indicated a Frasnian age and correlation with the Belpre Ash by Kepferle and Roen (1981). Tucker et al. (1998) made a provisional correlation of the dated ash bed with the Center Hill Ash of central Tennessee and used that designation in their figure 1. The ash bed dated by Tucker et al. (1998) is certainly the Belpre Ash of Collins (1979) which has been documented in numerous other localities in the Appalachian Basin (de Witt et al., 1993). The Belpre is distinct from the younger Center Hill Ash, which is high Frasnian based on the occurrence of *Palmatolepis winchelli* and *P. juntianensis* below the ash bed, and *P. winchelli* above the ash bed at Hurricane Bridge (Over et al., 1998). Recollection of the Little War Gap section in 1999 by our group revealed six discrete ash beds in the Belpre suite and yielded several important conodonts from below, within, and above the ash interval (Figure 1). The ash that yielded zircons dated by Tucker et al. (Bed 61 of Dennison and Boucot, 1974; our bed u02) lies on a disconformity over dark gray shale that weathers light gray. These dark gray shales (bed 60 of Dennison and Boucot, 1974; our bed u01) yielded the conodonts *Klapperina disparalvea*, *K. disparilis*, as well as numerous orbiculoid brachiopods, indicative of the high Givetian *disparilis* Zone and correlation with the lower Blocher Shale in Indiana and Kentucky, as well as the Geneseo Shale in New York State. The brachiopod *Leiorhynchus limitare* was recovered from lower in the section, bed 58 of Dennison and Boucot (1974). Dark shale beds above the lowest Belpre Ash (beds 62-68 of

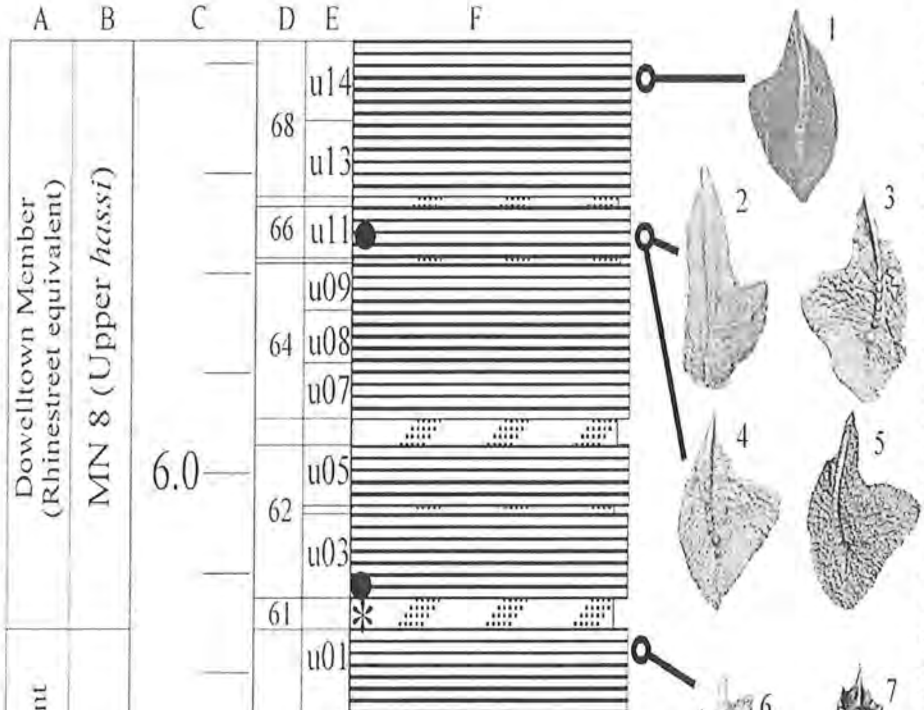

Figure 1. Stratigraphic section of basal Chattanooga Shale at Little War Gap, Tennessee, showing the ash-rich measured section collected in 1999. A - stratigraphy; B - conodont zonation; C - measured interval in meters; D - beds of Dennison and Boucot (1974); E - beds of Over; F - lithology, USGS conodont sample localities (●), dated ash (*), and selected conodonts: 1) *Palmatolepis ljaschenkoae*; 2) *Ancyrognathus barba*; 3) *P. punctata*; 4) *P.* sp. H of Over; 5) *P.* sp.; 6) *Klapperina disparilis*; 7-9) *K. disparalvea*.

Dennison and Boucot, 1974; our beds u03-u14) yielded *Palmatolepis punctata*, other palmatolepids, *Ancyrodella nodosa*, and most importantly *Ancyrognathus barba*, which is only known from MN Zone 8 (Upper *hassi* Zone). This shale and ash interval is correlative with the lower Dowelltown Member in central Tennessee and the Rhinestreet Shale in New York State. The shale above the highest recorded ash bed contains *Palmatolepis ljaschenkoae*, which first occurs at the top of MN Zone 8 and ranges to MN Zone 11. This restricts the Belpre Ash suite to MN Zone 8. The interbedded shale and ash beds are typical of the Belpre at other locations. Because the lowest Belpre ash bed lies below the middle Frasnian conodonts and rests on a disconformity at Little War Gap one of the upper ash beds will need to be dated to confirm the radiometric date assignment to MN Zone 8. Nonetheless, it seems reasonable to assume the ash beds are all in the middle Frasnian MN Zone 8 and represent related eruptions based on similar lithology and conodont fauna between beds u01 and u12. At worst the 381.1 Ma date is highest Givetian *disparilis* Zone to middle Frasnian MN Zone 8, well above the 391.4 Ma date determined for the Eifelian Tioga Ash.

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DEVONIAN EVENTS IN CENTRAL ASIA JOINT FIELD MEETING OF IGCP 421 – *North Gondwana mid-Palaeozoic bioevent/biogeography in relation to crustal dynamics*, in conjunctiom with IGCP 410 (*The Great Ordovician biodiversity event*) 4–21 August 2001, SW Siberia, Russia; and 21 August–6 September 2001, Mongolia.

SW SIBERIAN SEGMENT (21 AUGUST – 6 SEPTEMBER 2001)

The program in SW Siberia was mounted by the Institute of Petroleum Geology [IPG] of the Siberian Branch of Russian Academy of Sciences, Novosibirsk, and "Zapsibgeols'emka" of the Ministry of Natural Resources of Russia, Novokuznetsk. Co-sponsors were the Presidium of the Siberian Branch of Russian Academy of Sciences, the Russian Foundation for Basic Research, and the National IGCP Committee of Russia. The field meeting (5-19 August) focused on: 1). Ordovician–Devonian and Early Carboniferous sequences displaying major transgression/regression events (many conceivably global eustatic events), having faunas forming the basis of major monographic works (published and unpublished), and sequences displaying major extinction events during that time-interval; 2). Reef/clastic facial development and faunal associations/palaeocommunities within the shelf belt of the Siberian Continent during the Ordovician–Devonian and Early Carboniferous; and 3). Most recent views on large-scale translation of crustal blocks earlier hypothesized for some of the 10 or more major sutures in the Altai-Sayan Folded Area (ASFA). The last, though not a prime focus of the meeting, was of interest because of the suspicion that the ASFA collage may include a suspect terrane or two perhaps derived from the North Gondwana margin. Part of the AFSA extending from the Rudniy Altai through the South Mongolia Folded System (or, more specifically, the Inner Mongolian Fold System) includes various ophiolite slivers as well as terranes believed with high probability to have been derived from the North Gondwana continental margin.

The field excursion of 4000+ km by 4-wheel-drive vehicles enabled about 40 participants (from Australia, Czech Republic, France, Italy, Japan, Mongolia, Russia and the USA) to examine key Late Cambrian to Early Carboniferous sequences in the Gorniy Altai (extending into the Altai Republic), Salair and Kuznetsk Basin regions of SW Siberia. These regions constitute the western part of the Altai-Sayan Folded Area (ASFA) where a mosaic of structures was generated by several periods of tectonic activity (Early Caledonian to Variscan orogenic cycles). Gradual decrease in age of accretional and collisional geological complexes from east to west (with distance from the Siberian Craton) is apparent, related to successive accretion of terranes to the Siberian Craton, coupled with substantial, and some major strike-slip displacement during collisional and post-collisional stages. Outer and inner shelf zones are clearly defined. The former is characterized by extensive development of carbonate platforms including build-ups, the outer shelf zone by mainly clastic sedimentation. The Ordovician-Silurian sequences include graptolitic as well as shallow-water sequences with high diversity of benthic fossils. The Devonian and Early Carboniferous sequences are characterized mainly by benthic associations, though with occurrences of conodonts and ammonoids. It is believed that collisions of Mongolian terranes with the Siberian Continent at the beginning of the Devonian caused narrowing and eventually closure of seaways along which exchange of benthic faunas had been taking place between SW Siberia, Mongolia, the Heilungjiang region of China, and the Russian Far East.

The field excursion occasionally split into two groups, one concerned primarily with Ordovician-Silurian sequences, the other with Late Silurian-Early Carboniferous sequences. The excursion focused initially on sequences near Bugryshykha with Llanvirn-Ashgill-early Llandovery shelly faunas, and Kur'ya with early Ludlow, Pragian and Early Carboniferous shelly faunas including conodonts. Sequences near Ust' Chagyrka, Rossypnaya Mount, Charyshskoe and Tigerek provided insights into clastic, reef and deep water facies during Tremadoc-Wenlock times as well as, for the "Devonian group", persistent shallow marine Silurian and Devonian environments. The region about Cherny Anui near the northern boundary of the Altai Republic displays, *inter alia*, fine exposures of abundantly fossiliferous late Llandovery and Lochkovian–Pragian sequences in clastic and reef limestone facies, notably in the vicinity of Kamyshenka, and Caradoc–early Silurian clastic–reef limestones on Dietken Ck. The Gorniy Altai segment of the excursion ended with examination of the Early Devonian-Eifelian sequence along Kuvash Ck and the shallow-water Tremadoc (brachiopods, trilobites, conodonts) at Kamlak Ck.

Travel from the Gorniy Altai to the Salair and Kuznetsk Basin sequences include a stopover in Novokuznetsk with a visit to the facilities, including the palaeontological laboratories, of the superbly equipped Russian Geological Survey, "Zapsibgeols'emka", of the Ministry of Natural Resources of Russia. This large and remarkably dynamic organization is producing a profusion of wonderfully detailed maps at various scales from 1:10,000 upwards, more sophisticated than those currently being produced by Commonwealth and State surveys in Australia. The warmth and scale of hospitality extended to our IGCP group by "Zapsibgeols'emka" during our all-too-brief visit matched the amplitude and excellence of the scientific work they are producing. The Novokuznetsk experience was, arguably, the most memorable feature of the IGCP 410/421 meeting in SW Siberia!

The excursion concluded with examination of isolated Late Cambrian to Late Ordovician exposures and superbly exposed Lochkovian–Pragian, Givetian and Lower Carboniferous sequences (with abundant shelly faunas) in the vicinity of Gur'evsk, and examination of late Givetian to early Famennian sequences along the Tom' River (including reference sections for the Kuznetsk Basin), again with many intervals characterized by abundant brachiopods, corals, fish and microfaunas. Sequences demonstrated included one that is arguably the most elegant sequence globally through the Kellwasser events (especially the Upper Kellwasser Event) in extremely shallow-water contexts. Its global importance is such that a centimetric-scale study of isotopes, lithologies and biota (macrofauna and microfauna) would be justified. The centimetric-scale is emphasised because cyclicity is obvious, and presumably sub-events like those documented by conodont data for the earliest Wenlock Ireviken Event, especially in Gotland and SE Australia, and by sedimentary and conodont data for the Late Silurian Lau Event in Gotland and the Broken River region of NE Australia, need to be carefully discriminated and documented.

Overall impression? Amazement at what has been achieved regarding stratigraphic alignments from 40 years or more of extraordinarily hard work in the Altai-Kuzbas-Salair region of SW Siberia, principally from admirably detailed mapping supported by a profusion of monographic studies, published and unpublished, mainly of shelly faunas (by, *inter alia*, R.T. Gratsianova, E.A. Yolkin, M.A. Rzhonsnitskaya, V.N. Dubatolov and N.P. Kul'kov), but also of graptolites (e.g. N.V. Sennikov), conodonts (E.A. Yolkin and N.G. Izokh) and, lately, of radiolarians (O.T. Obut). The region is vast, almost half the size of France, with a profusion (emphatically so) of lenses and slivers of limestones of all ages from Cambrian to Early Carboniferous. The ages of many of these have been made known solely from macrofaunas obtained by intensive work with the hammer, especially during the 1960s to 1980s. Conodont biostratigraphy, carried out intensively in recent years has produced significant improvements in stratigraphic alignments (including better underpinning of ages of macrofaunas on which correlations have traditionally been based), but most of these carbonate sheets/lenses/tectonic slivers are shallow-water, often with faunas dominated by algae, tabulate corals and stromatoporoids. The conodont data obtained from acid-leaching is thus often sparse, often lacks zonally compelling forms, and thus is not as tightly constraining age-wise as our Siberian colleagues would like. But the work goes on, vigorously and admirably.

The meeting in SW Siberia concluded with a session of oral and poster presentations on 20 August at the Institute of Petroleum Geology of the Siberian Branch of Russian Academy of Sciences in Novosibirsk. Presentations ranged widely over Ordovician to Devonian biostratigraphy, biogeography and event stratigraphy. Salient among these was a well-grounded and optimistic analysis of the future of palaeontology in the 21st century by Tanya Koren', head of palaeontology and stratigraphy at VSEGEI, the research wing of Russian Geological Survey. The hospitality extended by our Novosibirsk colleagues to the IGCP 410/421 participants was again stunning, rivaling the hospitality we had received in Novokuznetsk! IGCP 410 and 421 are extremely grateful to the numerous individuals and organizations in Novosibirsk and Novokuznetsk which so enthusiastically supported the meeting. These include Academician A.E. Kontorovich, Director of IPG, and Dr A.N. Metsner, Director of "Zapsibgeols'emka" of the Russian Ministry of Natural Resources. The numerous individuals included the excursion leaders (E.A. Yolkin, A.V. Kanygin, A.A. Bakharev, N.V. Sennikov, N.G. Izokh, O.T. Obut and A.A. Alekseenko from Novosibirsk, and Z.E. Petrunina and O.P. Mesentseva from Novoskuznetsk), and the many drivers, cooks and camp constructors who contributed hugely towards making this complex operation a stunning success!

PUBLICATION:

Yolkin, E.A., Talent, J.A. & Webby, B.D. (eds), 2001. Contributions to Siberian IGCP 410/421 joint meeting (4-21 August 2001), 110 pp. Institute of Petroleum Geology, Siberian Branch, Russian Academy of Science, Novosibirsk.

It is planned to publish refereed papers from the Novosibisk meeting as a special issue of Russian Geology and Geophysics.

MONGOLIAN SEGMENT (21 AUGUST – 6 SEPTEMBER 2001)

The field component of the Mongolian segment of the joint IGCP 410/421 expedition (23 August to 5 September) followed a day (22 August) of technical presentations at the Mongolian Technical University and visits to the Natural History Museum and Geological Museum in Ulaanbataar. There were about 45 participants (including the support team) from Argentina, Australia, Belgium, China, Canada, the Czech Republic, France, Mongolia and the USA. Transport for the field expedition was by 4-wheel-drive jeeps and minibuses; accommodation was in tents (mostly) and portable homes (*ger*) of nomads. The main excursion areas were in the vicinity of Mushgai and Shine Jinst, SSW and SW respectively of Ulaanbaatar, and Sagaan Dei and Arvaikheer, WSW of Ulaanbaatar. In all areas excellent sequences of often highly fossiliferous Ordovician, Silurian, Devonian and Early Carboniferous sediments were presented. Continuing work on these sequences is resulting in an increasingly intricate stratigraphic nomenclature and much new and important biostratigraphic data.

The sequence at Bayan Khoshuu about 30 km E of Mushgai displays interesting fossiliferous intervals of Late Ordovician (Ashgill) to Early Carboniferous, with noteworthy highly fossiliferous carbonate intervals in the Lochkovian and Famennian-Tournaisian, the latter with conodont data from above and below the D/C boundary. The sequence, as so often in southern Mongolia, is thick (>3000 m). Shorter sections were visited at Haniin Doloon (Early Silurian with diverse fauna of brachiopods, rugosans and tabulate corals) and Havtsal (Early Silurian and Lochkovian).

The region about Shine Jinst, the focus of intensive investigation by Soviet workers in the 1970s and 1980s, has excellent and picturesque outcrops of Ordovician to Devonian sequences. The Caradoc-Wenlock sequence at Shar Chuluut has several interesting and highly fossiliferous carbonate intervals, including build-ups in the Ashgill and late Wenlock. The succession continues at Ulaan Shand through the Ludlow and Lochkovian with intermittent carbonate intervals (and diverse but unpublished faunas), passing into clastics before the end of the Lochkovian. An especially interesting sequence at Tsakhir extends from Pragian to Givetian with carbonates and conodont data from Emsian, Eifelian and early Givetian horizons. Sections at Yamaan Us display richly fossiliferous Ashgill, late Llandovery-Wenlock and late Famennian-

Tournaisian, the latter with conodont data from either side of the D/C boundary. Other sections visited in the Shine Jinst region were at Daravgai (Caradoc) and Gashuun Ovoo (richly fossiliferous Ashgill-Llandovery).

The Caradoc-Ashgill sequence at Tsagaan Del in the Bayankhongor area, elaborated by Rozman and Minjin and others in the 1980s, and noteworthy for its brachiopod faunas (possibly spanning the Ordovician-Silurian boundary) was visited on the way back to Ulaanbaatar from Shine Jinst. Detailed lists of the faunas from all sections visited are given in the excellent field guide compiled by Chuulin Minjin from contributions from seven Mongolian workers (reference below).

Superb cultural asides to the expedition included: 1). Bayan Zag famed for dinosaur discoveries made in 1922-30 by the American Museum of Natural History expeditions under the leadership Roy Chapman Andrews; 2). Bulgan village near Togrogiin Shiree where fighting and baby dinosaurs were found; and 3). The ruins of the ancient Mongolian capital, Kharakorum, and Erdene Zuu monastery, built in 1586 from stone from the ruins of Kharakorum. Leaders of this enjoyable, memorable, and scientifically instructive expedition were Prof. Chuulin Minjin of the Mongolian Technical University, and Dr Baatar Tumenbayar, Director of BEMM (a geoconsulting organization), enthusiastically supported by a flock of genial and helpful colleagues from the Palaeontological Section of the Mongolian Academy of Science, the Mongolian Technical University, and the Mongolian Mineral Resources Authority. We are grateful to all of these institutions and people for their seemingly limitless kindness.

Conjunction of IGCP 421 and IGCP 410 in the ventures in SW Siberia and Mongolia proved especially felicitous.

PUBLICATION:

Webby, B.D. & Talent, J.A. (eds), Minjin, Ch. (compiler) and 7 authors, 2001. Guide book, abstracts and Ordovician-Silurian correlation chart for the joint field meeting of IGCP 410 and IGCP 421 in Mongolia (August 21-September 6, 2001), 127 pp.

DEVONIAN SYMPOSIA AND EXCURSIONS CONNECTED WITH THE FIRST INTERNATIONAL PALAEONTOLOGICAL CONGRESS (IPC 2002)

Sydney, Australia, 6-10 July 2002

The SECOND CIRCULAR for IPC 2002 can be found on the web at:

www.es.mq.edu.au/mucep/ipc2002/index.htm

A hard copy can be obtained by contacting the Organising Committee at: IPC2002@mq.edu.au

Those who replied to the First Circular will probably have received the SECOND CIRCULAR mailed in mid-November. The SECOND CIRCULAR contains details of Registration, Technical Sessions, Pre- and Post Congress Excursions, Mid-Conference Excursions, and other Meetings and Events being held in conjunction with the Congress.

Not surprisingly, in view of the credentials of most of those involved with organisation of IPC2002, there is a strong mid-Palaeozoic (especially Devonian) bias! Symposia and excursions of special interest to Devonian "groupies" are:

Sympsia (numbered according to numbers in the Circulars, with leaders indicated):

1. Global extinction events: abrupt, gradual or polyphase (Carl Brett)

2. Evolutionary palaeoecology: chronofaunas and chronofloraas: Is biogeohistory punctuated? (Brian McGowran)

3. Organic-rich facies, faunas and genesis (Carl Brett)

4. Evolution of the pelagic realm through time (Thomas Becker)

6. Palaeozoic vertebrates: phylogeny and palaeobiogeography (Gavin Young and Phillipe Janvier)

9. Palaeozoic communities revisited (Rodney Watkins)

10. High precision biostratigraphic alignments (Dick Aldridge and Theresa Winchester-Seeto)

18. Trace fossils (Barry Webby)

And two special symposia:

23. The Geoffrey Playford Symposium, celebrating Geoff's sustained contribution to palynology, including Devonian-Early Carboniferous spores and chitinozoans (Clinto Foster)

24. The Jane Gray Memorial Symposium: conquest of land – terrestrialization (Bill Shear & Greg Edgecombe)

Excursions:

Post-congress 3: Palaeozoic fish localities in SE Australia. This fish spectacular will take in the most spectacular Emsian, Middle and Late Devonian localities in E Australia, led by SDS members and fish aficionados Gavin Young and Alex Ritchie.

Post-congress 5: Palaeozoic of ME Queensland: Broken River region and Burdekin Basin. Leaders will be SDS members and brachiopod and conodont aficionados John Talent, Ruth Mawson and Glenn Brock.

These two excursions are timed so that participants can follow on with one of:

Post-congress 4. Contemporary reef dynamics on Heron Island (John Jell)

Post-congress 6. Devonian reef complexes of the Canning Basin (Phil Playford)

Among meetings associated with the IPC 2002 will be meetings of IGCP 421 and the Pander Society.

Note that, following a decision made after the European Conodont Symposium ECOS-7 in 1998, a decision was made by organisers of IPC 2002 and ECOS-8 (Oviedo, Toulouse and Montpellier) to have the meetings separated by a short break to allow determined travellers to participate in both meetings.

We look forward to meeting many SDS friends at Macquarie University in Australia in 2002.

John Talent & Ruth Mawson

For the IPC 2002 Organising Committee

LATE DEVONIAN BIO-EVENTS: SPECIAL ISSUES OF "PALAEOGEOGRAPHY, PALAEOCLIMATOLOGY, PALAEOECOLOGY" AND "ACTA PALAEONTOLOGICA POLONICA"

TM Grzegorz Racki, Sosnowiec

As announced previously, the main goal of the recently (21 November 2001) approved special issue of "Palaeogeography, Palaeoclimatology, Palaeoecology" (PPP), co-edited by me and Michael R. House, is to present integrative stratigraphical, lithofacies and geochemical approaches to the Frasnian-Famennian problems, and high-resolution results and interpretations that are currently available from different parts of the Devonian World. This volume includes finally 15 articles that highlight significant interrelated forcing mechanisms and processes in the evolution of Late Devonian ocean-climate and biological systems. Three contributions herein were the direct outgrowth of the international project realized in Poland and more fully presented in the coeval thematic issue of "Acta Palaeontologica Polonica" (APP; see below), apart from twelve articles of invited authors from Germany, USA, Belgium, Canada, England, France, China, Czech Republic, Australia, and Morocco. Some works were encompassed by IGCP Project No. 386 "Response of the Ocean/Atmosphere System to Past Global Changes".

In the issue of "Palaeogeography, Palaeoclimatology, Palaeoecology", a compendium of recent advances is given in four introductory articles, focused mostly on state-of-the-art ecostratigraphical and geochemical studies. In particular, House gives updated family extinction data related to current estimated length of stages which emphasises the severity of Givetian to Frasnian, and end Famennian extinctions. Following the several case studies on Laurussia, the last two articles present reference successions from the South Chinese and western Gondwanan continents.

The main aim of the APP thematic volume is to present refined biostratigraphical and taxonomic data and current ecological interpretations. The manifold palaeobiological results are not limited to the Kellwasser (KW) Crisis, and frequently concern survival and recovery patterns, especially for brachiopod faunas. Eight articles gather faunal data (from radiolarians to sharks) available for eastern Laurussian epeiric successions in the framework of the project "Ecosystem Aspects of Late Devonian Biotic Crisis", supported by the Committee for Scientific Research in Poland (grant no. 6 P04D 024 13). The study was realized jointly by Silesian University and Institute of Palaeobiology, Polish Academy of Sciences, in co-operation with specialists from Russia, Belgium, France and USA. The reference F-F paleontological record is derived mostly from convenient outcrops of Holy Cross Mts, but there are supplementary articles by invited authors from USA, Russia, China and France. In addition, a comprehensive paper by Jerzy Dzik on regional emergence and collapse of the Frasnian conodont (in apparatus-based taxonomic terms!) and ammonoid communities will be published in the next issue of this journal. In summary, the new taxonomic summaries in different geographical scales from three Devonian continents reveal the more precise chronostratigraphical and biogeographical control needed to understanding of the processes and events occurring within the KW Crisis (and through the F-F boundary timespan itself), as well as during other Late Devonian global events.

As an integrative stratigraphical synopsis, the both volumes certainly constrain at least some of the many causal uncertainties, exemplified by the clearly proved record of the F-F regression pulse at the end probable eutrophication to productivity-driven anoxia feedbacks of preceding KW Events. A major disturbance episode of the trophic web in the photic zone becomes apparent in the context of selective demise of the top, predatory consumers. The new refined data support a long continued, multicausal interpretation of the F-F extinctions and an Earth-bound crisis rather than a worldwide cosmic cataclysm. Unfortunately, the modern studies are limited to a low-latitude belt, even if first evidence available from a deep-slope succession of Polar Urals (Yudina et al., APP Volume) reveals many well known biotic and geochemical phenomena (positive d13Ccarb excursions of +3.5‰, icriodontid and biosiliceous acmes, etc.).

A greatly refined and time-constrained study of taxon ranges is required from the widespread Middle Devonian carbonate platforms to the total collapse of stromatoporoid-coral reef biota at the F-F boundary particularly related to the many pulses of transgression, anoxia and reef decimations known over this timespan. In fact, several fossil groups experienced only minor losses across the disastrous F-F interval, and the main compositional turnovers occur later (e.g., at the Devonian-Carboniferous boundary) or rather earlier (near the Middle-Upper Devonian boundary). The quantitative approach to estimation of the true stratigraphical end-points (cf. confidence intervals on taxon ranges) should be applied to distinguishing between sudden and gradual biotic change. In addition, this is difficult to statistically asses any bioevent so long as detailed phylogenetic relationships in many fossil groups remain somewhat misleading. Therefore, the highly improved insight into the perplexing terrestrial processes lead to several new questions, and to key unresolved Late Devonian matters for future interdisciplinary research, including, among others, climatic and weathering regimes, complex links between nutrient fluxes, bio-productivity and anoxia, magmatic and tectonic events, and comprehensive cyclostratigraphical analysis of magnetosusceptibility and sedimentary signatures, as well as – last but not least - a radiometric dating of the key Devonian boundaries.

LATE DEVONIAN BIOTIC CRISIS: ECOLOGICAL, DEPOSITIONAN AND GEOCHEMICAL RECORDS

Special Issue of "Palaeogeography, Palaeoclimatology, Palaeoecology"

Guest Editors: GRZEGORZ RACKI and Michael R. HOUSE

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