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COMMISSION ON STRATIGRAPHY

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SUBCOMMISSION ON DEVONIAN STRATIGRAPHY

NEWSLETTER No. 16

December 1999

I. U. G. S Subcommission on Devonian Stratigraphy

***Newsletter No. 16*, December 1999**

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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 102 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

I regret the delay in producing the Newsletter, especially because it contains time-sensitive material for 2000 meetings. The arrival of the important missing document conflicted with manuscript deadlines and fieldwork in Morocco.

TM Yu Chang Min informed SDS that since his retirement it is difficult to remain active enough to justify his position as titular member and wishes to resign as a TM and continue as a CM. He hopes to nominate a successor in the near future.

The SDS should commend the New York State Geological Survey/State Museum for the move to bolster the paleontology/ stratigraphy program by adding two stratigraphers. The existence of the very strong program in stratigrapher at the Survey/State Museum is due in very large part to the efforts of Dr. Ed Landing, a Cambrian stratigrapher with very impressive international credentials. We should also thank the Survey/State Museum for hiring CM Ver Straaten to fill the position of Devonian stratigrapher.

MESSAGE FROM THE CHAIRMAN

Part I and II of the SDS publication on World-wide correlation with Devonian GSSP's will be published in a Courier volume of the Forschungsinstitut Senckenberg this spring. In part I the formerly established seven Devonian GSSP's and the Devonian-Carboniferous boundary GSSP are reviewed, updated and discussed. The twenty-four contributions of part II deal with the recognition of Devonian Series and Stage boundaries in England, Wales and Scotland, the Ardennes, Germany, France, Spain, Poland, the Czech Republic, Austria, the Baltic area, Greenland and Svalbard, the Moroccan Meseta and Anti-Atlas, the East European (Russian) Platform, Belarus, the southern Transcaucasus, the Urals, the East Siberian Platform, Severnoya Zemlya, Novaya Zemlya, western Siberia, Mongolia, the Russian Far East, the South Tien Shan, northeastern Asia, south China, eastern Australia and the Appalachian Bassin. Part III on "Fossil Groups important for boundary definition" will be published next year. Manuscripts for these SDS publications started to come in from the end of 1995 on, but until June 1998 a number of relevant contributions were still missing.

However, the delay in the publication does not corrode the intrinsic value of the two volumes. At the beginning of a new century they summarize and will make available to the geological community the scientific work accomplished during thirty years of SDS activities. The formal definition of the seven Devonian GSSP's will bring more uniformity and stability in the world-wide use of these stages. Moreover, it should be stressed that SDS together with the Subcommission on Silurian Stratigraphy are the only two subcommissions that completed their primary task: the definition of all stage boundaries.

The SDS-IGC P 421 Morocco Meeting (April 23rd- May 1st 1999) was attended by more than fifty participants and twenty-four talks were presented at the scientific session in Er Rachidia.

The field trip in the Tafilalt, Maider and the north-western Meseta was documented by a guidebook with many new data en very well edited by A. ELHASSANI and A. TAHIRI. This guidebook will also be published in a special volume of the Notes et Mémoires du Service Géologique du Maroc and A. ELHASSANI recently informed me that it is going to press. On the other hand it was also decided at this meeting to publish the contributions presented at the Er Rachidia scientific session in another volume of the Notes et Mém. Serv. géol. du Maroc.

Therefore I invite SDS members and others who announced a contribution to this volume to send as soon as possible and before February 29, 2000 their manuscript to Prof. Dr. ELHASSANI, Département de Géologie, Institut Scientifique, B.P. 703 RABAT-AGDAL, 10106 RABAT - Maroc. e-mail: elhassani@israbat.ac.ma

At the meeting in Morocco SDS decided to set up working groups for the Subdivision of the Emsian. Givetian, Frasnian and Famennian. A leader has been designated for each working group:

Subdivision of the Emsian: Ruth MAWSON

Subdivision of the Givetian: Pierre BULTYNCK

Subdivision of the Frasnian: Jeffrey OVER

Subdivision of the Famennian: Thomas BECKER

More information from these working groups is included in the present Newsletter.

In conclusion of our Morocco meeting and on behalf of the SDS members attending this meeting I thank Ahmed ELHASSANI, leader of the organizing Committee and all other co-organizers from the Institut Scientific (Rabat), the Faculté des Sciences & Techniques (Er Rachidia) and the Centre Régional de Géologie (Midelt) for this successful and most pleasant meeting.

SDS participates in the General Symposium on Stratigraphy (topic: Devonian Paleogeography and Paleoclimatology of Western Gondwana) organized during the 31st IGC in Rio de Janeiro from August 6 to 17, 2000. In response to an earlier circular I received 24 abstracts of contributions. All accepted papers will be presented at a poster session and 5 of them will be selected for oral presentation. The 3 conveners for the Devonian session sent their comments to the Scientific Program Committee that will made the final decision.

During the IGC SDS will also held his annual business meeting. All SDS members are invited to complete the attached form in order to organize our business meeting.

P. BULTYNCK

REGISTRATION FORM FOR SDS BUSINESS MEETING

IGC - RIO DE JANEIRO AUGUST 6-17, 2000

First name:

Surname:

e-mail address:

Fax:

I will attend the SDS business meeting in Rio	**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 June 1st 2000) to the SDS secretary or chairman.

Minutes of the SDS Business Meeting, 25th April, Erfoud and 1st May, Rabat

The annual business meeting was held in conjunction with the SDS and IGCP 421 Meeting in Errachidia, followed by excursions to the Anti-Atlas (Tafilalt and Maider) and to the Moroccan Meseta. Since the 24th April was fully occupied by the symposium programme, it was decided to divide the meeting into two sessions, held in the evenings after dinner or in the afternoon. The first session commenced on the 25th at 9.20 in the Hotel El Ati, the second took place on the 1st May at 15.15 in the Institute Scientifique. The whole meeting was superbly organized by CM Prof. Ahmed El Hassani, by Dr. Abdelfatah Tahiri and their co-workers. For the symposium 52 participants from 15 countries were registered who presented 33 talks and posters with some emphasis on Moroccan palaeontology and geology. The excursions visited the sections at Bou Tchrafine, Hamar Laghdad, Jebel Amelane, Jebel Mech Irdane (GSSP), Jebel Issimour and Mrakib in the Anti-Atlas, and Bou Ounabdou/Gara d´Mrirt, Tibouda, Oued Tiflet, Bou Regreg, Oued Cherrat, Ain Dakhla, and Ain Khira in the Meseta. The excursion was overshadowed by a serious travel accident on the way from Errachidia to Azrou which completely wrecked one of the landrovers. With a lot of luck, none of the SDS and IGCP 421 members was seriously hurt.

PRESENT: Chairman P. Bultynck, Secretary R. Thomas Becker; TMs: J.A. Talent, R. Feist, P. Morzadec, CMs: C. Ver Straeten, C. Brett, J. Over, J. Le Menn, M. Ginter, A. El Hassani, M.R. House, E. Schindler; guests: V. Ebbighausen (Odenthal, Germany), J. Bockwinkel (Leverkusen, Germany), S. Aboussalam (Berlin, Germany), G. Schraut (Frankfurt, Germany), P. Buchholz (Braunschweig, Germany), U. Jansen (Frankfurt, Germany), G. Plodowski (Frankfurt, Germany), H. Hüneke (Greifswald, Germany), M. Yazdi (Isfahan, Iran), M. F. Perret (Toulouse, France), M. Legrand (Bordeux, France), J.P. Nicollin (Bordeaux, France), L. Slavik (Prague, Czechia), M. C. Perri (Bologna, Italy), C. Spaletta (Bologna, Italy), C. Corradini (Modena, Italy), M. Ponshelli (Bologna, Italy), L. Baidder (Casablanca, Morocco), R. Youssef (Midelt, Morocco), L. Kabiri (Errachidia, Morocco), L. Boudad (Errachidia, Morocco), E.M. Benfrika (Casablanca, Morocco), F. Rabbi Khan (Peshawar, Pakistan), Chen Xiu-Qin (Nanjing, China), B. Ellwood (Arlington, U.S.A); total = 38. The attendance of TMs and CMs was unfortunately rather low but the guests and newly elected CMs allowed a regular meeting to take place.

1. Introduction and apologies

The Chairman opened the meeting and thanked CM El Hassani and his collaborators for the smooth organization of the symposium and for hosting SDS. He also welcomed as guests the numerous participants of IGCP 421 who showed their interest in SDS matters by attending. With respect to the late start and rather tiring stay in the field during the day, it was anounced that the programme will be continued on a different evening when time proceeds.

Formal apologies were recorded as follows: Vice-Chairman R. Crick; TMs: I. Chlupac, C. Hartkopf-Fröder, Hou Hong-fei, W.T. Kirchgasser, G. Klapper, V. Menner, N. Ovnatanova, S. Turner, K. Weddige, E.A. Yolkin, W. Ziegler; CMs: G.K.B. Alberti, A.R. Ashouri, A. Blieck, H.-P. Carls, J. Day, J. Ebert, J. Hladil, H. Leliévre, R. Mawson, G. Racki, M. Rzhonsnitskaya, G. Young, O.H. Walliser, Wang Cheng-Yuan, Zhu Min.

For the various topics of the agenda, five documents were presented; one of them is included in the first part of the Anti-Atlas field guide. According to their topics, documents were placed in the following order:

Document 1: Carls, P. & Valenzuela-Rios, J.I.: Early substage of Emsian, GSSP; SDS ballots. 1 p.

Document 2: Bultynck, P., Lardeux, H. & Walliser, O.H.: On the Correlation of middle-Emsian Conodonts, Dacryoconarids, and Goniatites. 3 pp.

Document 3: Yolkin, E.A.: Comments on Proposed Emsian, Frasnian and Famennian Substages. 6 pp.

Document 4: Ziegler, W. & Sandberg, C.A.: untitled [conodont correlation chart]. 1 p.

Document 5: Becker, R.T., Bockwinkel, J., Ebbighausen, V. & House, M.R.: Jebel Mrakib, Anti-Atlas (Morocco), a potential Upper Famennian substage boundary stratotype section. 17 pp. (field guide, part I: 91-107).

2. Minutes of the Bologna Meeting 1998

The 1998 Minutes were accepted unanimously.

3. Chairman´s Business

The Chairman reported the results of the provisional ballot distributed in autumn 1998. The results have been reported in a circular to all SDS members in early Summer 1999. In brief, these were as follows:

Number of ballots sent out: 104, number of ballots returned: 37 (16 of 21 TMs but only 19 of 83 CMs).

Emsian: 34 votes for a twofold subdivision, preferably to be named (22 votes) as Lower and Upper Emsian. 24 votes for a boundary level near the entries of *Po. inversus, Po. laticostatus, Now. cancellata* and *Gyro. gracilis*.

Frasnian: 28 votes for a threefold subdivision, preferably (27 votes) to be named as Lower, Middle and Upper Frasnian. 24 votes for the base of the *punctata* Zone (L./M.), 13 votes for the *semichatovae* transgression (M./U.), 7 votes vor a level near the base of the Lower Kellwasser Limestone (M./U.). This gives a preference for the first proposal but no absolute majority in relation to the total number of returned ballots.

Famennian: 25 votes for a threefold subdivision, 8 votes for a fourfold subdivision, preferably (23 votes) to be named Lower, Middle and Upper (or Uppermost) Famennian. There were 13 votes for the base of the *marginifera* Zone (L./M.) and 13 votes for the base of the *expansa* Zone (M./U.) giving small majorities for these opinions.

CM Schindler commented that the ballot has been intensively discussed in the German Subcommission but many members decided that it was too early to have a well founded opinion to be expressed in a ballot. The Secretary complained about the low return rate of the CMs and interpreted this as an ununderstandable lack of interest. This may reflect that a large number of CMs has lost contact with the ongoing work. Both CM Schindler and TM Feist remarked that not all members felt competent enough and that the discussion needs to be continued by specialists. The Chairman answered that similar problems applied to the past decisions on series and substages, and the Secretary stated that every SDS member should feel competent at least in one or in a few substage boundary discussions. CM House proposed to resolve the problem by establishing working groups on the Emsian, Givetian, Frasnian, and Famennian and this was accepted unanimously by a formal vote of present members. The tasks of working groups and the election of working group leaders were outlined in the summer circular mentioned above. This can be summarized as follows:

Working Group Leaders

Emsian: CM R. Mawson (who accepted after her nomination at the meeting)

Givetian: Chairman P. Bultynck

Frasnian: CM J. Over

Famennian: Secretary R.T. Becker

Tasks

The Working Groups and their members are supposed to make proposals on substage boundary levels, defining fossil groups, and on potential stratotype sections. Data of different groups and non-biostratigraphical methods have to be considered. The leaders are asked to consult specialists (not only SDS members) concerning specific questions, e.g., taxonomy, pelagic-neritic-terrestrial correlation, sequence stratigraphy etc. In the working group discussions, special emphasis has to lie on results of the provisional ballot. Leaders shall submit a report to the annual SDS meetings and shall open a homepage.

Success of the working groups will rely on acitive participation of SDS members. They were therefore asked to register formally with the working group leaders and to contribute by written (e-mail, documents) statements.

4. Stages and Substage Subdivisions

Aprt from the decision to found working groups, submitted documents on stages and stage subdivisions were discussed. In Document 1, CM Carls and J.I. Valenzuela-Rios call for a revision of the base of the Emsian. The last GSSP was approved by ICS in 1996. Therefore, a revision will not be possible before 2006. The Chairman commented that apart from the taxonomic discussions around *Po. kitabicus* and *Po. dehiscens*, there are also different concepts of *Po. gronbergi* which should be addressed by specialists. Guest L. Slavik announced that a specimen of *Po. kitabicus* reported by J. Kalvoda has been questioned and that the *kitabicus* boundary still has not been recognized in the Barrandian. The Koneprusy Limestone goes up to ca. the middle Pragian.

The Chairman introduced Document 2 and drew attention to the fact that *Po. laticostatus* enters later in the La Grange Limestone than *Po. inversus*. However, according to Yolkin et al. (see also Document 3), *laticostatus* is already present in the older *nothoperbonus* Zone. It was emphasized that the polygnathid succession has to be revised in several regions before a substage boundary level can be decided. The Secretary demanded that in no case it should be accepted that *Anetoceras* faunas range into an Upper Emsian.

The Chairman briefly introduced Document 3 by TM Yolkin and stated that it disagrees with the provisional ballot by suggesting a threefold Emsian and a twofold Frasnian. It was unfortunate that TM Yolkin was unable to explain his conclusions himself. The Secretary wondered that TM Yolkin did not consider the correlative potential of the basal Domanik transgression of the northern Russian platform which correlates with the base of the *punctata* Zone or with the base of MN Zone 5.

The Secretary explained that Document 4 repeats the substage proposals of TMs Ziegler & Sandberg of the previous year. He remarked that the *Annulata* Event at the base of Upper Devonian IV has been dated as Late *trachytera* Zone not as Late *postera* Zone as suggested in the table. The German Wocklum Stufe includes a post-extinction interval spanning the main part of the Middle and the Upper *praesulcata* Zones. CM Schindler reported on the activities by a German working group, led by M. Piecha (Krefeld) that tries to revise the classical German Oberdevon-Stufen. The working group has visited major and classical Upper Devonian outcrop regions and has started intensive research on sections that are possibly helpful for a formal definition of the Nehden-, Hemberg, Dasberg- and Wocklum-Stufen. The Chairman criticized that the guidelines do not support regionally different chronostratigraphic units but the Secretary answered that these terms are widely spread in the literature and that the German group is trying to make past usages understandable and that it is working for a clear correlation with the future international substages.

The Secretary gave a brief summary of Document 5 and pointed out that it will be possible for a smaller interested group to visit the Mrakib section during the field trip. This was made possible by kind on-the-spot arrangements by CM El Hassani. B. Ellwood has visited the section in order to conduct detailed studies on magnetic susceptibility. Shale samples were taken for palynological work (for CM Hartkopf-Fröder who has received the samples in the meantime). Conodont specialists were asked to collect at the Mrakib section during the forthcoming visit. Work on other groups such as brachiopods (CM Sartenaer), crinoids (G. Webster), placoderms (M. Otto) and trilobites (TM R. Feist) is also under way. At a worldwide scale, the section has one of the most detailed ammonoid record in the interval from the UD III to V.

The Chairman recommended to subdivide the Givetian at a level near the base of the Fromelennes Formation of the Ardennes which is characterized by a major change in coral and brachiopod faunas. The secretary argued that the initial discussion should include somewhat higher levels such as the bases of the Upper *varcus* and *hermanni* Zones. TM Feist favoured to start reviews from the Upper *pumilio* Bed on. CM Ginter reported that no changes in fish faunas are currently known that could help in the discussion. CM House suggested to pay attention to the coral work which is currently done by CMs Pedder and Oliver. CM Brett reported on the re-appearances of typical Hamilton faunal groups (brachiopods, homalonotid and other trilobites) in the Upper *varcus* Zone of New York (upper Tully Limestone). The more significant break in New York appears to lie at the base of the Genesee Group which correlates with the base of the *hermanni* Zone.

5. Marine-Nonmarine Correlation

The Secretary stated that work on marine-nonmarine correlation, unfortunately, seems to have slowed down. No official report was supplied. The IGCP Courier on microvertebrates has not yet been published but it will include several contributions that are important for the topic. All specialists working in the nonmarine realm are asked to contribute with their knowledge to the current substage discussion and to consider attempts to establish nonmarine auxiliary stratotypes of all boundaries.

6. IUGS Matters

The Chairman reported that SDS has been quoted as a positive example of subcommissions. The attempts to establish stage subdivisions was acknowledged without criticism. He drew attention to the nature of IUGS which exists between succesive IGCs. Therefore, elections will have to take place in conjunction with the 2000 Rio congress. Nominations for SDS elections are needed until the 6th of August and, therefore, a nomination committee was elected, consisting of chairman CM House and of TMs Feist and Talent. [Until the 21st of July, the committee had finished its work and a proposal for re-election of the current SDS officers, signed by a majority of the TMs, has been put forward to ICS for ratification. No other nominations and no contrary votes were received by the committee.]

7. Membership

7A. Withdrawals

The Secretary reported the sad news that our long-lasting CM Ruan Yi-Ping had died a few months ago. Present members were asked to stand up in silence for a minute of memory. CM Ruan has contributed significantly to the knowledge of Chinese Devonian ammonoids and tentaculitoids and the loss of him will be felt for a long time.

The Secretary continued by repeating his view that a large number of members seems to have lost interest in SDS activities which is reflected by the lack of any communication, neither in the form of attendance to meetings, nor by the submission of documents, reports or membership news to the Newsletter. On the other hand, there are younger and active Devonian specialists, for example among those contributing actively to IGCP 421, whose experience and acitivities are of great importance for SDS. In order to re-juvenate SDS and to increase its activities it was formerly proposed (supported by TM Talent) to ask all CMs who have not communicated since three years whether they are interest to continue their membership or not. All those who do not respond will be regarded as having lost interest. TMs that do not contribute actively to SDS for three years will be asked to consider to step down and to adopt corresponding membership. The proposal was accepted unanimously and a call to re-confirm interest in SDS was attached to the summer circular. [As a result, several members have declared to step down since. Sadly, this includes several CMs who have made important contributions to SDS in the past and who had not stopped for a long time to communicate. Revision of the membership list will take place at the next annual meeting.]

7B. Election of CMs

In agreement with the intention to re-juvenate SDS, a rather high number (ten) of new CMs was elected, all unanimously. In each case, written proposals by two current members were submitted. New CMs are as follows (full addresses see address list):

Prof. Dr. B. Ellwood, Department of Geology and Geophysiscs, Louisiana State University, Baton Rouge, USA (magneto-stratigraphy)

Dr. I. Bardashev, Institute of Geology, Academy of Sciences, Dushanbe, Tadzhikistan

Dr. M. El Benfrika, Université Hassan II-Mohammedia, Casablanca, Morocco (conodonts)

Dr. Chen, Xiu-qin, Nanjing Institute of Geology and Palaeontology, Nanjing, China (brachiopods)

Dr. M. C. Perri, University of Bologna, Italy (conodonts)

Dr. F. Rabbi Khan, National Centre of Excellences in Geology, Peshawar University, Pakistan

Dr. L. Slavik, Institute of Geology, Academy of Sciences, Prag, Czechia (conodonts)

Dr. C. Spaletta, University of Bologna, Italy (conodonts)

Dr. V. S. Tsyganko, Institute of Geology, Syktivkar, Russia (rugose corals, regional stratigraphy)

Dr. M. Yazdi, Department of Geology, University of Esfahan, Iran (conodonts, regional stratigraphy)

Apart from Dr. Bardashev, all new members were present; they accepted their election and expressed their interest in active participation.

7c. Election of TMs

The Chairman recalled the problem with finding a new Canadian TM. Since the last meeting, and because of the lack of any other candidate, CM T. Uyeno had agreed to stand for vote and he was elected unanimously.

8. Reports

8a. Financial Report

The Finacial Report for 1999 was given by the Chairman as was as follows in August 1998:

Income for 1999	in US $
- carried forward from 1998	297.66
- IUGS subvention for 1999	1,100.00
Total	1,397.66
Expenditure for 1999	
- Secretary expences	150.00
- Support for attendance Morocco Meeting	390.00
- Newsletter allocation for No. 16	250.00
- Bank commission	8.71
Total	798.71
Balance	598.95

8b. German Subcomission

A brief report on activities was given in conjunction with the substage subdivision (see above). The planned review volume of the German Devonian in the Courier Forschungs-Institut Senckenberg series has not yet appeared but most manuscripts have been submitted. Attention was drawn to new columns of the Devonian Correlation Chart which are printed in Senckenbergiana lethaea. New columns are welcomed but it is recommended to attach an explanatory text that gives justification for the placing of boundaries between zones and formations. Examples for such commented columns were published in the last issues.

9. Devonian Correlation Volume

All manuscripts have been submitted but the editors at Senckenberg will return those who have been submitted long ago in order to allow updating and revision. Authors will be asked to return manuscripts by the end of May. There will be two volumes, one with GSSPs and regional descriptions, one dealing with the various fossil groups. Authors will receive a free volume but no free reprints – it will be possible to order the latter. [In the meantime, all contributions are beeing prepared for printing and the volume(s) should be out in spring 2000.]

10. Future Meetings

10a. 2000

During the IGC in Rio de Janeiro, SDS will hold a General Symposium (No. 1-8) on "Palaeogeography and Palaeoclimatology of Western Gondwana". This includes both South America and North Africa. A call for contributions was included in the summer circular. [As a response, eight papers were announced.] All that are interested and who have not received the 2nd Circular can find more details on the website (www.31igc.org). Excursions to the Devonian of Bolivia (Bft 27, led by E. Diaz-Martinez & R. Suárez-Soruco) and of the Paraná Basin (Aft 03 and 04) should find the interest of SDS members. The originally announced excursion to the Amazon Basin, unfortunately, has been cancelled.

10b. 2001

The 2001 annual meeting will be held at the Forschungsinstitut Senckenberg and will focus on the substage boundaries. The Secretary proposed to organize a field trip that visits the Fromelennes Formation and other Rhenish locations that are of importance for substage definitions.

10c. 2002

There were two proposals to hold the 2002 annual meeting:

1. In conjunction with the next ECOS in Tolouse, which will include a field trip to Spain.
2. In association with the planned 1st International Paleontological Congress, to be held in Sydney.

It was decided that SDS should be present at both occassions.

11. Any other business

The Secretary remarked that the paper by Tucker et al. on Devonian radiometric ages has appeared in the meantime. TM Talent noted that further new dates are to be expected in the near future. The Chairman expressed once again his warmest thanks to CM El Hassani and his co-organizers for enabling this successful meeting, the symposium and the excursions.

WORKING GROUP ON FAMENNIAN SUBSTAGES

Leader: R. Thomas Becker

Following the call for registration with the newly established working groups on Devonian substages, the following SDS members and other specialists have registered for the Famennian or have indicated their interest to take part in the future discussion:

1. CM D. Brice
2. C. Derycke-Khatir
3. TM R. Feist
4. CM M. Ginter
5. CM C. Hartkopf-Fröder
6. TM Hou Hong-fei
7. Ma Xue-ping (Beijing)
8. TM V. Menner
9. CM N. Ovnatanova
10. CM M.C. Perri
11. M. Piecha (Krefeld)
12. TM J.B. Richardson
13. CM S. Spaletta
14. CM M. Streel
15. CM V. Tsyganko
16. CM M. Yazdi
17. TM W. Ziegler

News will also be distributed to those who have indicated their interest by submitting documents in relation to the topic. Other interested SDS members can contact the working group leader at any time in order to be added to the list.

Following the provisional ballot and the summer circular, CM Streel has started an initiative in order to find additional support for a fourfold rather than threefold stage subdivision. The line of his arguments focusses on two points:

1. Considering the much longer duration of the Famennian (considered to be up to twice as long as the Frasnian), a higher number of substages as in the Frasnian seems reasonable.
2. A fourfold Famennian would allow to recognize a conodont-based time-equivalent of the Strunian in a revised, more accurate sense.

The new call for support of a fourfold Famennian has found a rather high positive resonance among specialists working in Famennian nearshore environments. Apart from 19 co-authors who had signed the original proposal (see SDS Newsletter 15), written statements were received by B. Owens (Sheffield), L. Tadilha de Quadros (Petrobras, Brasil), J.H.G. Melo (Petrobras, Brasil), K.T. Higgs (Cork, Ireland), K.V. Simakov (Magadan, Russia), J.T. Oliveira (Portugal), Z. M. Pereira (Portugal), T.G. Obukhovskaya (Russia), N.S. Nekryata (Russia), T.V. Strelchenko (Russia), and G. Playford (Brisbane, Australia). With respect to the so far restricted number of preliminary votes (25) for a threefold subdivision, it seems justified to let the debate about substage numbers open for continuing discussion.

The following levels have so far been proposed as potential substage boundary levels:

1. Base of the *rhomboidea* Zone (Lower/Middle in afourfold system; hardly supported in the ballot)
2. Base of the *marginifera* Zone (Lower/Middle in a threefold system; well supported in the ballot)
3. Base of the Upper *marginifera* Zone (Lower/Middle in a threefold system; almost no support in the ballot)
4. Base of the *velifer* Zone (Lower/Middle in a threefold system; hardly supported in the ballot; also Middle/Upper in a fourfold system)
5. Around the *Annulata* Event or at the base of the *postera* (*styriacus*) Zone (Middle/Upper in a fourfold system; so far only briefly mentioned in Newsletter 15, p. 4)
6. Base of the *expansa* Zone (Middle/Upper in a threefold system; well supported in the ballot)

7. Base of the Upper *expansa* Zone (Upper/Uppermost in a fourfold system)

K.V. Simakov has stretched an even further subdivision of the Strunian or of a Strunian time equivalent, based on the global Hangenberg Event, but such detail will not be dealt with in the working group, at least not in the near future.

In order to make progress, the SDS membership, and especially the working group members, are asked to contribute to the following points:

a. A review of the use of the Strunian in different regions, if possible, with respect to the conodont zonation, but also giving reference to miospore, foraminifer, brachiopod zones etc.
b. Documentation or review of conodont evolution around proposed substage levels. This should include brief overviews of regions where the levels can be recognized.
c. Description and review of important sections that could serve as boundary stratotype candidates. Documentation of several faunal groups is recommended.
d. Reviews of major Famennian evolutionary changes in various fossil groups which could assist a substage subdivision.
e. Correlation of proposed conodont boundary levels into the neritic and terrestrial realms.
f. Correlation using non-biostratigraphical methods around proposed boundary levels. This should include a review of sealevel changes.

Apart from detailed documents, brief summaries of published knowledge and simple opinions are welcomed. These will be e-mailed or sent to the other working group members. Eventually, such contributions are needed for an annual report. It seems clear, that first a decision on the number of substages is needed, before boundary levels can be decided. However, good documentation of proposed levels will play an important role in the future primary decision.

Minutes for the German SDS

Last year's meeting of the German SDS brought together 44 members out of 63 on February 13, 1999 at the Senckenberg Museum in Frankfurt. Additionally, 6 guests have been present, among them TM Susan Turner from Brisbane, Australia. Among the non-commission affairs, the activities of the two working groups (subdivisions of the Emsian stage and the Late Devonian stages – for coordinators see previous SDS Newsletters) covered most of the time.

Ulrich Jansen gave a short report about the activities of the Emsian working group. Afterwards, the majority of participants answered to requests about the future names of possible Early and Late Emsian substages, that an informal 'Early' and 'Late' Emsian is preferred at present (detailed results of straw votes have been forwarded to Pierre Bultynck). This fall, he and CM Peter Carls visited the Spanish colleagues in Oviedo and were guided to the Cantabrian Mountains by TM Jenaro Garcia-Alcalde and CM Montserrat Truyols-Massoni. Focus within the sections has been set on the inner-Emsian interval around the *elegans-cancellata* transition. A similar trip will be arranged with the Czech colleagues.

Matthias Piecha gave an overview about the activities of the working group for the Late Devonian stages. Investigations of selected sections are continuing by collaboration of specialists for different faunal groups. In one section – 'Kahlleite E' in the Thüringisches Schiefergebirge – a Diplom thesis started on the Famennian part of that cephalopod limestone sequence (carried out by M. Gereke from Marburg University). At the meeting of the national SDS group, a majority of participants agreed to investigate the classical German 'Stufen' boundaries and their position with respect to a possible threefold subdivision (Early, Middle, Late) of the Famennian stage. An international threefold subdivision of the Frasnian has also been favoured by the majority of members present. Detailed results of 'straw votes' concerning possible boundary positions within both Late Devonian stages have been forwarded to Pierre Bultynck, too. The Late Devonian working group gathered for one 'theory meeting' on February 12, 1999 (at Marburg University) and met for a field trip to the Frankenwald area on August 28/29, 1999. At least one of the sections seen during this trip shall be considered in future investigations of this working group (i.e., the abandoned quarry 'Köstenhof' often referred to as 'Schübelhammer' in the literature). The limestone sequence of the quarry covers middle and upper Famennian strata. Some members of the Late Devonian working group gathered at the section at 'Beringhauser Tunnel' on May 29, 1999. This section – being one of the key-sections in the Late Devonian subdivisions in the German Upper Devonian – allows calibrations of zonations based on goniatites and on conodonts (the latter are very well preserved and abundant); moreover, sedimentological features here are of great interest, too.

A large number of German Devonian workers contributed to the IGCP 421/SDS Meeting in Morocco in late April 1999. They gave oral presentations, showed posters, and guided the excursion party in some of the sections in the Anti-Atlas (Tafilalt, Maïder), in the Meseta, and in the Rabat/Tiflet area.

For addresses, phone/fax numbers, and e-mail addresses of persons mentioned above see previous SDS Newsletters.

Eberhard Schindler (Frankfurt)

Report on IGCP421 meeting, Peshawar (Pakistan)

20-21 September 1999 and associated excursions

The sixth international meeting of IGCP 421 Project on *North Gondwana bioevent/biogeography patterns in relation to crustal dynamics*, consisted of a formal presentation of some 40 scientific reports at the University of Peshawar, 20-21 September. The pre-conference program consisted of two excursions:

1. **Palaeozoics of northernmost Pakistan, especially in the watershed of the Yarkhun River and in the vicinity of the Baroghil Pass** with access to the principal sections being obtained by jeep, yak and horse with some support from mule trains (21 August- 7 September; 30 participants; Leader: John Talent). This group continued by jeep to Gilgit en route to Kashi/Kashgar in far western China meeting up with participants for the more formal pre-conference excursion,
2. **Palaeozoics of a transect of the Tarim Block across the Karakorum Collision Zone and Karakorum Block to Gilgit and the mid-Palaeozoics of central Chitral** (8-19 September; 30 participants; Leaders: Sun Dong-jiang, and Chen Xiu-qin for the portion in China and John Talent for the portion in Pakistan).

The principal focus for these excursions was a recent publication by Talent et al. (1999, Rivista Italiana di Paleontologia I Stratigrafia 105: 201-230) and publications by the Milano group led by Prof. Maurizio Gaetani. We were fortunate to have Professor Gaetani with us in the Baroghil area during Excursion 1.

The post-conference program (22-26 September; Leaders: various) consisted of examination of the Proterozoic to mid Palaeozoic succession of the Cherat Range, Nowshera area, a visit to the superb Geoscience Laboratory at the Geological Survey of Pakistan, Islamabad, examination of the famous Salt Range Permian-Triassic sequence, a structural-stratigraphic transect from Kohat to Peshawar and, finally, examination of the Devono-Carboniferous sequence at Gundhai Sar and on-site discussion of ages of stratigraphic units along the Khyber Road between Shaghai Fort and the Afghan border at Torkham.

The opening session of the conference, attended by 190 delegates, was opened by His Excellency, the Governor of Northwest Frontier Province, Major-General Aurangzeb and the Vice-Chancellor of Peshawar University, Professor M. Qasem Jan. Some 40 presentations were made; many concerned Devonian themes. Highlights of the conference were extended exposés on application of expert systems to handling biogeographic data (V.N Yolkina et al.), Phanerozoic climate in relation to biogeography (A.J. Boucot et al.), Mid-Palaeozoic event-stratigraphy in relation to isotopic data (A.S. Andrew and others), transgression-regression patterns in the mid Palaeozoics of the Italian Alps (C. Perri & C. Spalletta), charophyte biostratigraphy (M. Feist) CAI analysis in relation to metamorphic overprint in the Carnic Alps (M. Pondreli), transition from diagenesis to metamorphism—CAI versus IC data—in the Townsville hinterland of NE Australia (C. Brime et al.), a group of four papers on conodont biostratigraphy in relation to tectonics in Turkey (Y. Goncuoglu & H. Kozur), quantitative palaeobiogeographic implications of the silicified brachiopod faunas of the Garra Limestone of NSW (G.A. Brock & J.A. Talent), Middle Devonian trilobites from NE Australia and Late Devonian trilobites from Iran (R. Feist et al.), Devonian plants from the northern Gondwana margin (B. Meyer-Berthaud et al.) and a flock of about dozen other papers from Australian participants.

Conjoined with the conference was the First Pakistan Palaeontologic Convention (FPPC), an initiative suggested by us in order to increase viability of the meeting and to showcase the role of biostratigraphy in structural interpretations and, in the case of the FPPC, in hydrocarbon exploration. The conference and attendant excursions highlighted the paucity of biostratigraphically well-constrained ages throughout the mountainous region of Pakistan north of the Salt Range.

In addition to participants from Pakistan, 35 conference delegates represented 11 other countries. The Australian contingent was the largest (13); others came from France (5), USA (3), Italy (2), Spain (2), India (2), Russia (2), Iran (2), China (2), Morocco (1), Germany (1) and Hungary (1). Pivotal for the success of the conference were the enthusiasm and energies of Vice-Chancellor Qasem Jan, head of the National Centre of Excellence in Geology, Prof. Hamidullah, and staff members Fazl-i-Rabbi Khan, Mohammed Riaz, Barkat Ullah, Amjad Ali and many more who seemed to be everywhere at all times, looking after conference participants. Noteworthy was participation of two delegates from India, Drs O.N. Bhargava and A.D. Ahluwalia, both from Panjab University, Chandigarh. That they were able to take part in the conference was due to remarkable perseverance with bureaucracy by our Peshawar University friends at a time of acute border tension between Pakistan and India.

John Talent

WORKING GROUPS

EMSIAN WORKING PARTY

To date, the following have indicated an interest in contributing to the deliberations of the working Party:

Alain BLIECK, Jean LE MENN, Pierre BULTYNCK, Alyosha KIM, Raimund FEIST, Thomas BECKER, Pierre MORZADEC, Peter CARLS, El Mostafa BENFRIKA, Chen–yuan WANG, Jenaro GARCIA–ALCALDE, Ivo CHLUPÁC, Igor BARDASHEV, Eberhard SCHINDLER, Chuck VER STRAETEN, Karsten WEDDIGE, Uli JANSEN, Zhenya YOLKIN , Nadia IZOKH.

If anyone else would like to join the group, please e-mail: rmawson@laurel.ocs.mq.edu.au

A Web site has been established for the group at:

http://www.es.mq.edu.au/MUCEP/emsian/index.htm

All submissions sent to Ruth will be scanned in and placed on the Web. To date a large submission has been faxed from Peter Carls and Nacho Valenzuela-Ríos - we are awaiting a hard copy of it to scan for the Web page. Two comments made in the SDS Newsletter No. 14 by Ivo Chlupac, Uli Jansen and Eberhard Schindler have also been posted as well as a comparison of the conodont zonal schemes for most of the Emsian.

The task of the Working Party is to decide on the level for the division of the Emsian and then find appropriately name the substages. To begin discussion, the Group is referring informally to the subdivisions as "the lower subdivision" and "the upper subdivision" using inverted commas to make it clear that the formal naming of the subdivisions has not yet been considered.

We welcome any proposals or data that you think might be useful. Proposals should be based on:

1.events related to the boundary proposed,

2.correlation between biostratigraphic data of different groups, and

3.non-biostratigraphic information.

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Australia

WORKING GROUP FOR SUBDIVISION OF THE GIVETIAN STAGE

P. BULTYNCK

Review of potential levels for subdivision of the Givetian

At the annual meeting in Morocco (April 23rd - May 1st, 1999) SDS initiated the discussion on the formal subdivision of the Givetian and in conclusion recommended a division into an early and late Givetian substage. The main argument for subdividing the Givetian was that in accordance with the definition of the GSSP for the base of the Frasnian (KLAPPER, FEIST & HOUSE 1987) the characteristic stratigraphic interval dominated by the Pharciceratidae is included in the late Givetian, whereas goniatite specialists consider this interval as the inception of the Upper Devonian goniatite radiation. At the same meeting it was also recommended that further discussions on the subdivision of the Givetian preferably should concentrate on a stratigraphic interval between the Upper *pumilio* horizon (LOTTMANN 1990) and the radiation of the multilobate Pharciceratidae. In this interval, ranging from the middle *Polygnathus varcus* Zone (ZIEGLER, KLAPPER & JOHNSON 1976) = *Polygnathus ansatus* Zone (BULTYNCK 1987 (1), several bio- and sedimentary events with global correlation potential occur.

Review of most important events

1. Upper *pumilio* horizon (LOTTMANN 1990)

The *pumilio*-events were studied in detail by LOTTMANN (1990). They are composed of small "terebratulid" brachiopods, representing tsunami events and they were recognized in several Western European sections and in Morocco and Algeria. LOTTMANN assigned the Upper *pumilio* horizon to the middle part of the Middle *varcus* Zone, whereas according to BULTYNCK (1987) in Southern Morocco (Tafilalt, Bou Tchrafine Section) this horizon is close to the base of the *ansatus* Zone. This level seems not very appropriate for defining a globally recognizable boundary as its geographical extension is limited to Western Europe and NW Africa and moreover it does not correspond to drastic faunal changes.

2. Thaganic Onlap JOHNSON (1970) - Base of T-R cycle II a (JOHNSON, KLAPPER & SANDBERG 1985) - Thaganic Event House (1985)

JOHNSON *et al.* (1985) stated that this level represents a significant transgression that can be recognized in North America and Western Europe. However they also mention that "the initial deepening event is either diachronous or obscured in some offshore facies". In New York the inception of this T-R cycle occurs at the base of the Tully Limestone relatively low in the Middle *varcus*

vel *ansatus* Zone. According to HOUSE (1985) the Thaganic Event is marked by the extinction of the Agoniatitidae, Pinacitidae and most of the Anarcestidae.

3. Base of the Fromelennes Formation

JOHNSON *et al.* (1985) correlate the base of T-R cycle II a with the base of the Fromelennes Formation (Ardennes, S Belgium - N France). The lower member of the Fromelennes Fm, the Flohimont Mbr, corresponds to a transgressive pulse that stops the biostromal facies of the underlying Mont d'Haurs Fm. *P. ansatus* (= *P.* aff. *ansatus* in BULTYNCK 1987, pl. 8, fig. 9) occurs between 8 and 9 m above the base of the Flohimont Mbr and also P. *denisbriceae* (= senior synonym of *P. dubius frons* HUDDLE 1981, ranging in New York from the Leicester Marcasite Mbr into the Geneseo Shale Member). *Bipennatus bipennatus bipennatus* ranges into the lower part of the Flohimont Mbr (additional sampling since BULTYNCK 1987); in the Broken River region (Australia) this taxon has its last occurrence in the Middle *varcus* Zone (MAWSON & TALENT 1989). The Flohimont Mbr contains rich atrypid (GODEFROID & JACOBS 1986) and cyrtospiriferid faunas. *Stringocephalus* also present in this member disappears in the lowermost part of the overlying biostromal Moulin Boreux Member (COEN & COEN-AUBERT 1971).

4. *Pharciceras* Stufe (HOUSE 1985)

The *Pharciceras* Stufe corresponds to the period of radiation of the Pharciceratidae and its base was defined by the earliest occurrence of *Ph. amplexum* in New York in the middle part of the Tully Limestone. The conodont species *Polygnathus semialternans* appears at the same level (uppermost part of the Middle *varcus* Zone) and *P. latifossatus* slightly above (= base of the Upper *varcus* Zone) (KLAPPER 1981). Thus, the base of the *Pharciceras* Stufe is slightly younger than the beginning of the Thaganic Onlap. In the Bou Tchrafine section *P. semialternans* and specimens transitional to *P. latifossatus* appear just below or together with the most primitive pharciceratids (BULTYNCK & JACOBS 1981, bed 32, BENSAÏD, BULTYNCK, SARTENAER, WALLISER & ZIEGLER 1985; BULTYNCK & WALLISER 1999; BECKER & HOUSE 1999).

5. Late Givetian Event (WALLISER 1995)

According to WALLISER's definition "it is the level at or prior to which the typical Givetian goniatites became extinct and at which multilobate pharciceratids occurred". In the Bou Tchrafine section this event starts within the lower part of the *Schmidtognathus hermanni - Polygnathus cristatus* Zone (BENSAÏD *et al.* 1985).

Conclusions and call for contributions

The conodont and goniatite succession of the recommended interval for defining an Early-Late Givetian substage boundary are well documented in the Bou Tchrafine ridge, situated in the northern Tafilalt and belonging to the hemipelagic facies. However, the different specialists studying the area do not completely agree on the taxonomy and stratigraphic ranges of the earliest pharciceratids and on the correlation between the goniatite and conodont zonation. The latter discrepancy may be due to the condensed nature of the succession and the lateral discontinuity of some beds. The Bou Tchrafine section also show clear-cut sedimentary changes, which one corresponds to the base of TR cycle IIa and the correlations with the different pulses of this cycle are still a matter of discussion. Moreover, the authors working on this topic also disagree on which is the most important and appropriate event for global correlation.

The Fromelennes Formation in the Southern Ardennes may be a suitable succession for recognizing the above discussed events in an inner shelf facies.

Everyone who has comments on this contribution or can propose other relevant successions is invited to e-mail his comments and proposals to bultynck@kbinirsnb.be. In the near future all data will be put on a website.

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(1) Bultynck (1987) proposed to replace the Lower, Middle and Upper *varcus* zones by the *timorensis, varcus/rhenanus, ansatus* and *latifossatus/semialternans* zones. The latter zonal names refer directly to the characteristic taxa, increase the resolution of the zonation and permit further subdivision of this interval.

FRASNIAN SUBDIVISIONS WORKING GROUP AS OF 12/99

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(No communication received, but materials will be sent to: Rzhonsnitskaya, Yolkin. Please contact me if you would like to be added to this list.)

The goal of the working group is to delineate substages for the Frasnian. Proposals for globally recognized and useful subdivisions will be discussed toward the goal of presentation and vote to the whole of the Subcommission on Devonian Stratigraphy (SDS). The substage boundaries should be recognized by conodonts, additional flora and fauna, as well as related geochemical, magnetic susceptibility, and sequence stratigraphic changes. The criteria for a global standard stratotype section and point (GSSP) should be followed (see Remane et al., 1996 - Episodes). A three-fold substage division was favored in a preliminary SDS vote, but this should not limit consideration of proposals that support other configurations.

A Frasnian web site is under construction to post proposals, reference sections, and notes from contributors. The address will be linked to the SDS Homepage when operational. Notification will be sent by post and e-mail.

Four substage proposals have been submitted in 1997 and 1998. Three of the proposals recognize the eustatic rise associated with the widespread distribution of *Palmatolepis semichatovae* as a recognizable mid-upper Frasnian boundary in the lower portion of MN Zone 11 (*jamieae* or Lower *rhenana* Zone):

Upper Frasnian substage defined by the eustatic sea level rise associated with widespread *Palmatolepis semichatovae* near base of MN Zone 11 (Lower *rhenana* Zone).

Ziegler, W., and Sandberg, C.A., 1997, Proposal of boundaries for a Late Frasnian Substage and for subdivision of the Famennian Stage into three Substages: SDS Newsletter No. 14, p. 11.

Base of Middle Frasnian substage defined by first occurrence of *Palmatolepis punctata* (base of MN Zone 5 and base of *punctata* Zone). Base of Upper Frasnian substage defined by the traditional German separation of do I delta, near the base of the Lower Kellwasser Horizon, or utilizing the eustatic rise associated with *Palmatolepis semichatovae* near base of MN Zone 11.

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.

Base of Upper Frasnian substage defined by the base of Lower *gigas* (*rhenana*) Zone.

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.

Two Frasnian substages are recognized in West Siberia, divided near the base of the *rhenana* Zone.

Yolkin, E.A., 1998, Devonian substages in West Siberia sequences: SDS Newsletter No. 15, p. 62.

Notes:

Based on the dates of Tucker et al. (1998) the Frasnian is approximately 6 Ma in duration. Zircons from the Center Hill Ash Bed in the Chattanooga Shale, close to the Frasnian-Famennian boundary, are currently at MIT for dating. This should lead to a more precise age for the Frasnian. There is some confusion in Tucker et al. (1998) about the ash bed dated from Little War Gap. The ash is identified as the Center Hill Ash, but the ash bed dated 380.8 Ma is the lowest ash in the Belpre Ash suite, which consists of six discrete ash beds at Little War Gap. The occurrence of *Ancyrognathus barba* in between ash 5 and ash 6 indicate MN Zone 8 (within Lower *hassi* Zone). The Center Hill Ash is present much higher in the Little War Gap section.

Klapper (see Klapper , 1997) subdivided the Frasnian into 34.5 composite standard units (csu) using graphic correlation. Subdivision of the Frasnian using *Pa. semichatovae* and *Pa. punctata* will result in three substages of 22.1 csu (upper), 6.3 csu (middle), and 6.1 csu (lower), respectively.

The holotype of *Palmatolepis punctata* is a specimen of Hinde (1879), collected from the Genesee Shale at North Evans, New York, along Eighteenmile Creek (reillustrated by Branson and Mehl, 1933; Ziegler, 1973). This is probably from the Rhinestreet Shale. *Palmatolepis punctata* has not been recovered with certainty from the Middlesex Shale; *P. punctata* is abundant in the basal Rhinestreet, and has been reported from the underlying Cashequa Shale. Specimens of *P. punctata* illustrated by Ulrich and Bassler (1926) and reillustrated by Huddle (1968) are from the basal Rhinestreet at Weyer (Shaleton), New York. The morphotype of the conodont used to define a substage boundary must be clearly defined, illustrated, and its occurrence well documented.

Taxonomic problems and range interpretations of key taxa need to be resolved before a final decision is reached.

Document submitted to the International Subcommission on Devonian Stratigraphy
Field Meeting in Morocco, April 1999

JEBEL MRAKIB, ANTI-ATLAS (MOROCCO), A POTENTIAL UPPER FAMENNIAN SUBSTAGE BOUNDARY STRATOTYPE SECTION

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1. Locality and previous work

Jebel Mrakib (formerly Merakeb), in the southern Maïder, lies 60 km SE by S of Msissi and forms an east-west ridge of Lower and Middle Devonian rocks; the ridge includes, on the northern side, the mudmound of Aferdou el Mrakib described by KAUFFMANN (1998).The section Mrakib described here is of Famennian age and is in a detached ridge, 28 km SE of Fezzou and 2.5 km north of Madène el Mrakib. Our locality, at Global Satellite Position N 30° 45,4' W 04° 42,8' (Fig. 1), is best approached by passing SE from the western end of Msissi towards the E end of Irhfelt n'Tissalt and on to the NE end of the Aguelmous ridge, then skirting the hills to the W to beyond Rich Chouiref and turning W to the valley leading to Madène el Mrakib after the reef mound of Aferdou el Mrakib is seen.

WENDT & BELKA (1991: Loc. 5, Fig. 7) illustrated a Frasnian/Famennian boundary section from around Madède el Mrakib (sheet NH-30-XIV Fezzou, x = 566, y = 414.5) which has not yet been studied by us. Loose ammonoid faunas (mostly leg. EBBIGHAUSEN & BOCKWINKEL) were included in a study on Famennian tornoceratids by BECKER (1995). Since, the sedimentary and faunal succession has been investigated in detail (Fig. 2). It represents the best exposed, fossil-rich and thick sequence through the middle and upper Famennian (Upper Devonian III to V) of the area and has been regarded as potential stratotype candidate for the definition of a Middle/Upper Famennian substage boundary (BECKER 1998). The succession is composed of thick fine-grained siliciclastics with intercalated micritic limestones and was deposited under mostly poorly oxygenated conditions which led to widespread haematitic preservation of faunas. Low diverse benthos is present throughout the sequence showing that the seafloor was dysoxic, not anoxic. For example, SARTENAER (1998) has recently described *Hadyrhyncha meridionalis* from the section.

Independent research on the Famennian of the Mrakib area has been carried out by a Tübingen group but their results (KORN 1999 in press) are not included here. The majority of haematitic faunas was collected from the surface of weathered shale units. Repeated sampling, avoiding small gullies with occasional water flow, produced generally the same assemblages suggesting that the material was in most cases sitting next to the place where it has weathered out. However, a few specimens were obviously washed downslope and these are recorded here in [brackets].

2. Sedimentary and faunal succession

The sedimentary and faunal succession in detail, from old to young and with respect to a new regional ammonoid zonation (see early results in BECKER 1996), is as follows (Fig. 2):

***Planitornoceras euryomphalum* Zone (UD III-A/B)**

Bed A	110 cm alternation of green shales and reddish to grey limestones, at top with small cliff:
	Plani. eurymphalum (WEDEKIND) n.ssp. (with ventral constrictions)
	orthocones indet., *Guerichia* sp. (from limestone)
Bed B	Ca. 140 cm poorly exposed green shale, no fauna.
Bed C	85-90 cm green shales, with nodular limestone at the base, mostly concealed:
	Buchiola sp.
Bed D[1]	80 cm green shales and limestones, with bivalve-rich platy limestone at the base, thin nodule layer in the lower part, and brown nodular limestone at the top:
	Buchiola sp., *Myalina* sp., *Guerichia* sp. (in limestone)
Bed D	240 cm green shale, with thin limestone at the top, no fauna.
Bed D[2]	105 cm green shale, with thin limestone at the top, poorly fossiliferous:
[3]	*Myalina* sp.

Bed D_4 55 cm green shale, with limestone at the top:

Plani. euryomphalum euryomphalum

"Sporadoceras" varicatum varicatum WEDEKIND (with evolute early whorls)

orthocones indet., rhynchonellid indet.

Bed E_1 30 cm fossiliferous shale, with red rubbly limestone at the top:

Plani. euryomphalum euryomphalum (including strongly ribbed juvenile morphotypes)

Plani. euryomphalum n.ssp. (including ribbed morphotypes)

"Sp." varicatum varicatum

Gundolficeras n.sp.1 (compressed, with strong ventrolateral furrows, A-lobes asymmetrically rounded)

?Lobobactrites paucesinuatus CLAUSEN

orthocones indet

"Terebratula" rotundata MÜNSTER (resembling *Pugnaria plana* BIERNAT)

Loxopteria radiata SCHINDEWOLF

Bed E_2 ca. 440 cm green shale, with platy brown limestone nodules at the top; from the lower part:

Plani. euryomphalum euryomphalum

Plani. euryomphalum n.ssp.

"Sp." varicatum cf. *humile* LANGE

Sp. n.sp. aff. *heterolobatum* LANGE (much more compressed, faster expanding, umbilical wall concave)

Gundolficeras n.sp.1

"Maeneceras" spiriferum (LANGE) (relative thick, without constrictions, early stages open umbilicate and with rounded first adventitious lobe, with spiral ornament)

Palaeoneilo sp., *Myalina oviforme* BORN, *Buchiola* sp., rhynchonellid

From the upper part:

"Sp." varicatum Group

"Maene." spiriferum (with coarse spiral ornament)

[*Sulcoclymenia sulcata* (SCHINDEWOLF), one specimen]

Bed F 65 cm alternation of shales and platy, planar bedded limestones:

"Sp." varicatum varicatum

"Sp." varicatum humile

Bed G 100 cm green shales with two thin limestones in the middle part and with a pink nodular limestone forming a little cliff at the top; fauna from lower part:

Plani. euryomphalum n.ssp.

"Maene." spiriferum

Fauna from upper part:

Plani. euryomphalum euryomphalum (juvenile with umbilical nodes)

Plani. euryomphalum n.ssp.

Sp. n.sp. aff. *heterolobatum*

"Sp." varicatum varicatum

"Maene." spiriferum

Bed H_1 440 cm green shales with platy brown limestone nodules at the top:

Plani. euryomphalum euryomphalum

Plani. euryomphalum n.ssp.

Sp. n.sp. aff. *heterolobatum*

Sp. n.sp. aff. *heterolobatum* var. (with ventral constrictions)

"Sp." varicatum varicatum

"Sp." varicatum ssp.

"Maene." spiriferum

Gundolficeras n.sp.2 (resembling *bicaniculatum* PETTER, but with closed umbilicus and wider, asymmetric A-lobes; with ventrolateral furrows, flank saddle very narrow and high, relative thick)

Falcitornoceras aff. *falcatum* (FRECH) (with extensively wide lateral lobes)

[*Cymaclymenia* n.sp. sensu BECKER 1992, one specimen]

[*Platy. (Platyclymenia) subnautilina* WEDEKIND, one specimen]

[*Sulco. sulcata*, one specimen]

Lobobac. paucesinuatus

orthocones indet.

Buchiola sp., *Palaeoneilo* sp., *Guerichia* sp.

Loxo. radiata, other bivalves

Bellerophon sp., other gastropods

rhynchonellid

N.Gen. aff. *Prolobites* n.sp. Zone (UD III-C$_1$)

Bed H$_2$ 55 cm green shale with thin red nodular limestone at the top:

N.Gen. aff. *Prolobites* n.sp. (without flank lobe, dorsal suture simple with median dorsal lobe only, early stages evolute, adult stages with closed umbilicus and prolobitid constriction, septa very widely spaced as in *Raymondiceras* s.str.)

Platyclymenia (Varioclymenia) sp. (rather evolute, whorl coss-section subcircular, with concave ribs)

Plani. euryomphalum euryomphalum

Plani. euryomphalum n.ssp.

"Sp." varicatum varicatum

"Sp." varicatum humile

Sp. n.sp. aff. *heterolobatum*

Sp. n.sp. aff. *heterolobatum* var. (with ventral constrictions)

"Maene." spiriferum

Gundolficeras n.sp.1

Gundolficeras n.sp.2

Posttornoceras aff. *contiguum* (MÜNSTER)

Lobobactrites sp.

[*Platy. (Platy.) subnautilina*, one specimen]

[*Protactoclymenia "crassa"* (PETTER non WEDEKIND)]

Buchiola sp., *Leptodesma* sp., *Loxo. laevis*

Bellerophon sp., other gastropods, crinoid ossicles

"Terebrat." rotundata, other rhynchonellid

Bed H$_3$ 140 cm green shale forming a steep cliff, with limestone bed at the top, no fauna.

Bed I$_1$ Ca. 250 -300 cm green shale with limestone bed at the top, poorly fossiliferous.

Bed I$_2$ Ca. 660 cm green shale, limestone at the top, only squashed fauna:

Plani. euryomphalum euryomphalum

Plani. euryomphalum n.ssp.

"Sp." varicatum ssp. indet.

Sp. n.sp. aff. *heterolobatum*

Gundolficeras n.sp.1

Lobobac. paucesinuatus

Loxo. radiata, Buchiola sp.

Bed J$_1$ 256 cm green shale with two layers of nodular limestone in the middle and with red to purple nodular limestone at the top:

"Sp." varicatum ssp.

"Maene." spiriferum (with coarse spiral ornament and open umbilicate early stages)

Gundolficeras sp. indet.

Post. aff. *contiguum* juv. (with ventrolateral furrows)

[*Sulco. sulcata*]

Loxo. radiata

***Sulcoclymenia sulcata* Zone (UD III-C$_2$)**

Bed J$_2$ Ca. 140 cm green shale, with pink haematitic crust at the top:

Sulco. sulcata

Sp. n.sp. aff. *heterolobatum*

"Sp." varicatum ssp. (abundant)

"Maene." aff. *spiriferum* (early stages with somewhat open umbilicus, rather thick, no constrictions, coarse spiral ornament, A lobes remain rounded)

"Maene." spiriferum

Loxo. radiata

Bed J_3 50 cm green shale (J_{3a}), with yellow weathering platy *Sulcoclymenia* Bed (J_{3b}) on top which forms a marked platform in the sequence; fauna from shale (mixed J_2 /J_3)

Sulco. sulcata

"Sp." varicatum varicatum (abundant, many open umbilicate juveniles)

Sp. n.sp. aff. *heterolobatum*

"Maene." spiriferum

"Maene." aff. *spiriferum* (A remains rounded)

Gundolficeras n.sp.2

Posttornoceras aff. *contiguum* (with extended L-lobe as illustrated in BECKER 1995)

orthocones indet., *Loxo. radiata*

Sulcoclymenia Bed:

mass occurence of *Sulco. sulcata*

entomozoid ostracods (*Richterina*)

Bed K 60 cm poorly fossiliferous green shale, with a pink limestone layer in the middle and with a thin brown marker limestone at the top which forms a platform.

Bed L_1 65 cm green shale:

Sulco. sulcata (rare)

Plani. euryomphalum euryomphalum (rare)

"Sp." varicatum varicatum

Sp. n.sp. aff. *heterolobatum*

"Maene." spiriferum

"Maene." aff. *spiriferum*

Gundolficeras n.sp.1

Gundolficeras aff. *delepinei* (PETTER) (more compressed, flank saddle wider than in n.sp. 2, no furrows)

Lobobac. paucesinuatus

orthocones indet., breviconic nautiloid

rhynchonellids, crinoid stems

Buchiola sp., *Loxo. radiata*, gastropod

Bed L_2 125 cm green, poorly fossiliferous shale, with solid limestone bed (9 cm) at the top, forming the top of a ledge; the haematitic fauna is squashed:

"Sp." varicatum ssp.

"Maene." spiriferum

rhynchonellids

Bed M Bed M^1_2 110 cm green shale with limestone bed at the top, poorly fossiliferous.

45 cm green shale with limestone bed at the top, only poor and squashed fauna:

sporadoceratids indet., rhynchonellid

***Prionoceras divisum* Zone (UD IV-A)**

Bed N_1 520 cm thick package of poorly fossiliferous green shale, followed by a reddish interval with squashed fauna which seems to represent the global *Annulata* Event. By downslope transport, the allochthonous fauna is heavily mixed with haematitic and limestone fauna from beds (N /O_2) above; squashed fauna:

Platyclymenia (Platy.) pseudoflexuosa (RZEHAK)

Platy. (Platy.) cf. *annulata* (MÜNSTER)

Prionoceras sp.

Plani. euryomphalum n.ssp.

Haematitic fauna from Beds N$_1$, probably contaminated from above:

[*Cyma.* n.sp. sensu BECKER (1992)]

Platy. (Platy.) annulata richteri WEDEKIND (forma *bicostata* WEDEKIND)

Platy. (Platy.) subnautilina SANDBERGER (= *ruedemanni* WEDEKIND)

Platy. (Platy.) cf. *pseudoflexuosa*

Platy. (Trigonoclymenia) protacta crassicosta WEDEKIND

Priono. divisum (MÜNSTER) (including *Priono. sulcatum* (MÜNSTER))

Priono. frechi (WEDEKIND) (only thick morphotypes)

Rectimitoceras felix (KORN) (rare)

Post. contiguum

Plani. euryomphalum ssp.

"Maene." ungeri ungeri (MÜNSTER) (compressed, with ventral constrictions)

"Maene." ungeri rotundolobatum (SCHINDEWOLF) (with constrictions, moderately thick)

Bed N$_2$ 35 cm, alternation of three marly units and of three limestone nodule beds; with haematitic fauna from shale and limestone fauna from nodules; haematitic fauna, mixed with fauna from above:

Priono. divisum

Priono. frechi

Platy. (Platy.) subnautilina (rather evolute)

[*Cyma.* n.sp. sensu BECKER (1992)]

Limestone fauna:

Platy. (Platy.) subnautilina (rather evolute morphotypes as *glabra* CZARNOCKI)

Platy. (Platy.) quiringi MÜLLER (smooth, umbilical widths > 50 % diameter)

Platy. (Platy.) cf. *intracostata* (FRECH) (very large, with adult umbilical nodes)

Platy. (Platy.) pseudoflexuosa

Platy. (Platy.) annulata annulata

?Stenoclymenia sp. (relative thick for the genus; shallow ventral lobe present)

Priono. divisum (mostly *sulcatum* morphotypes)

Priono. frechi (rare)

"Maene." ungeri ungeri

"Maene." ungeri rotundolobatum

Loxopteria sp., *Guerichia* sp., other bivalves

Planovatirostrum sp.

Loose fauna from UD IV limestone:

Priono. divisum (abundant)

Platy. (Platy.) subnautilina

trilobite pygidia, *Guerichia* sp., *Loxo. radiata*

***Cymaclymenia* n.sp. Zone (UD IV-B)**

Bed O Ca. 370 cm green shale, in the lower part with lenticular *Prionoceras* limestones which may not yet belong to the zone with *Cymaclymenia*; haematitic fauna (often squashed):

Priono. divisum (including *Priono. sulcatum*)

Priono. frechi

Platy. (Platy.) annulata annulata

Platy. (Platy.) annulata richteri

Platy. (Platy.) annulata nodosa (MÜNSTER) (rather involute, around 40 % diameter)

Platy. (Platy.) subnautilina

Platy. (Platy.) aff. *subnautilina* (with ribbed earliest whorls)

Platy. (Platy.) quiringi

Platy. (Platy.) semiornata PETTER (with much finer ribs than *annulata* from early stages on)

Platy. (Trigono.) protacta crassicosta

Protacto. "crassa"

Protacto. aff. *enkebergensis* WEDEKIND (stronger ribs, no ventrolateral edges as in *pseudarietina* RZEHAK)

Carinoclymenia beuelensis (LANGE) (rare, leg. JB)

Cyma. n.sp. sensu BECKER (1992) (abundant)

[*Cyma. costellata*, one specimen]

Protoxyclymenia cf. *primaeva* CZARNOCKI

"Maene." n.sp. (A$_2$ very deep and asymmetric, biconvex constrictions, early whorls evolute)

"Maene." ungeri ungeri (compressed and with constrictions)

"Maene." ungeri rotundolobatum

large colonial rugose coral (phylogenetically important form, under study by D. WEYER)

gastropod

Prionoceras Limestone:

Priono. divisum (thick morphotypes only, mass occurence)

Platy. (Platy.) annulata ssp. (rare)

Loose limestone fauna:

Cyma. n.sp. sensu BECKER (1992)

Platy. (Platy.) subnautilina

Platy. (Platy.) quiringi

[*Cyrto. ventriosa* (PETTER) (very large-sized, broad whorls, flanks flattened at maturity, growth lines concavo-convex with very broad and prorsiradiate flank salient)]

Planovatirostrum sp.

Bed P Ca. 700 cm green shale, with thin lenses of crinoidal limestone in the upper part, with a white sparitic marker layer near the top and with brown shales at the top:

Priono. divisum (including *Priono. sulcatum*)

Priono. frechi (thick morphotype)

Cyma. n.sp. sensu BECKER (1992)

Platy. (Platy.) annulata

Platy. (Platy.)subnautilina

Platy. (Platy.) semiornata

Platy. (Platy.) rotundata WEDEKIND (rare, whorls well rounded)

Platy. (Platy.) quiringi MÜLLER (very evolute and smooth, rare)

Protacto. euryomphala WEDEKIND

Protacto. tenuicostata PETTER

Protacto. "crassa"

"Maene." ungeri ungeri

"Maene." cf. *ungeri* (with very low A$_2$-E saddle as in some *Lagowites*)

"Maene." ungeri rotundolobatum

Maene. n.sp. aff. *milleri* (with deep and rounded A$_2$ and low ventral saddle, without constrictions, compressed, early whorls obviously involute, rare)

Gund. cf. *delepinei* (PETTER)

crinoid stems, ossicles and calyces, placoderm plates

Bed Q Ca. 480 cm green and brown shale forming eleven rhythms in small cliffs, at the top with an iron-enriched orange marker unit:

Priono. divisum (including *Priono. sulcatum*)

Platy. (Platy.) aff. *subnautilina*

Cyma. n.sp. sensu BECKER (1992)

Protacto. euryomphala

"Maene." ungeri

"Maene." rotundolobatum

gastropod

***Sporadoceras orbiculare* Zone (UD I-C)**

Bed R_1 Ca. 40 cm green shales (R_{1a}), followed by the nodular *orbiculare* Bed (R_{1b}); the last has:

Sp. orbiculare orbiculare (MÜNSTER)

Sp. orbiculare longilobum (PETTER)

"Maene." ungeri ungeri

"Maene." ungeri rotundolobatum

Cyrto. ventriosa

Platy. (Platy.) ?subnautilina

Bed R_2 Ca. 180 cm green shales, forming a small cliff in the lower part (R_{2a}), with the yellowish weathering, somewhat nodular and platy *Protoxyclymenia* Bed (R_{2b}) which forms a bench at the top; squashed haematitic fauna from R_{2a}:

Sp. orbiculare ssp.

"Maene." ungeri rotundolobatum

Prionoceras sp.

Protoxyclymenia Bed; platy, fossiliferous dark grey micrite:

Protoxyclymenia n.sp. (mass occurence, growth lines somewhat prorsiradiate and with wide and low flank salient, compressed, at maturity with apertural constriction and keel)

Priono. divisum

"Maene." ungeri rotundolobatum

Guerichia sp. (frequent)

Bed R_3 Ca. 65 cm green shale, followed by a red marker limestoneon the flat above the lower main cliff.

***Endosiphonites muensteri* Zone (UD V-A)**

Bed S_1 Ca. 650 cm green shales, strongly rhythmic, in the lower part with purple seams that have fauna, at the top with a red marker limestone:

Endosiph. muensteri ANSTED (rare)

N.Gen. aff. *Platyclymenia teicherti* JENKINS (very evolute, flank lobe simple and shallow, with very widely spaced rursiradiate constrictions, smooth, rare)

"Maene." ungeri ungeri (rare)

"Maene." ungeri rotundolobatum (mass occurence)

Priono. divisum or *Mimimitoceras* sp. (A-lobes rather symmetrical)

Bed S_2 Ca. 950 cm mostly poorly fossiliferous green shale, exposed in small gullies along the steep upper cliff, fauna from the upper part:

N.Gen. aff. *Platyclymenia teicherti*

Kosmoclymenia inaequistriata lamellosa (WEDEKIND)

Cyma. striata (rare)

Mimimitoceras sp. (rare)

Bed T Ca. 730 cm green and dark grey shales (in the middle part), with thin limestone beds and nodules towards the top, closing with a marker limestone:

fauna from the basal part

Kosmo. (Kosmo.) inaequistriata lamellosa (moderately abundant)

"Maene." ungeri rotundolobatum (abundant)

"Maene." ungeri ungeri

Gund. cf. *escoti* (FRECH) (with strong ventrolateral furrows of early stages, squashed)

Mimimitoceras sp.

orthocones, brachiopod

Loose fauna from the upper part:

Cyma. striata (abundant)

"Maene" ungeri ungeri

"Maene." ungeri rotundolobatum

Exotornoceras fezzouense BECKER

***Gonioclymenia hoevelensis* Zone (UD V-B)**

Bed U Ca. 500 cm green shales with many limestone nodules and thin limestone intercalations, very fossiliferous; fauna from nodular limestones at the base, possibly including specimens from the topmost part of Bed T:

Gonio. hoevelensis WEDEKIND

Gonio. subcarinata (MÜNSTER)

Kosmo. (Kosmo.) inaequistriata lamellosa

Kosmo. (Muessenbiaergia) diversa (MÜNSTER)

Cyma. striata (abundant)

Rectim. lineare

Rectim. cf. *lineare* (mostly lacking the otherwise typical mould constrictions)

Rectim. cf. *pompeckji* (SCHINDEWOLF)

Discoclymenia cucullata (v. BUCH)

Guerichia sp., large-eyed proetids, bundles of tabulate corals overgrowing ammonoids from the umbilicus

Often squashed haematite fauna from the main part of the bed:

Kosmo. (Kosmo.) inaequistriata lamellosa

Endosiph. muensteri

Cyrtoclymenia cf. *angustiseptata* (MÜNSTER)

"Maene." ungeri ungeri (rare)

"Maene." ungeri rotundolobatum (abundant)

Mimimitoceras sp. indet.

brachiopods, orthocone indet.

Limestone fauna from the higher part of the unit:

Cyma. striata (abundant)

Rectim. lineare

large bivalves

Bed V — 205 cm green shales with few nodules and with an orange marker shale bed at the top; preliminary small fauna from the transitional interval between Beds U and V:

Cyma. striata

Kosmo. (Muess.) diversa

Gonio. ?subcarinata

Fauna from main part of the unit (small sample):

Cyma. striata (abundant)

Upper part of UD V and UD VI (locally still unzoned)

Bed W — Ca. 1340 cm shales and siltstones, mostly covered, at the top with white and grey shale (not yet properly sampled); according to KORN (1999 in press) *Wocklumeria sphaeroides* (RICHTER) is present in the upper part of this unit.

Bed X — Ca. 350 cm grey sand- and siltstones, followed by massive quartzites higher up (not yet sampled for fauna); probably an equivalent of the German Hangenberg Sandstones and quartzites.

3. Comments on the ammonoid zonation

The Mrakib section enables for the first time in the Anti-Atlas, the distinction of faunal levels in Upper Devonian III. The basal level is dominated by *Planitornoceras* and the *"Sporadoceras" varicatum* Group (representing a new genus with evolute early stages) seems to be widespread and it has also been recognized in the Tafilalt (Seheb el Rhassal) and further east in southern Algeria (PETTER 1959). There is no evidence for pseudoclymenids which allow a distinction between UD III-A and III-B in Germany and in Australia. The presence of prolobitids in North Africa has so far been based on the record of a single specimen by TERMIER & TERMIER (1950). Two specimens from Mrakib (leg. JB) not only belong to a new genus but also show that an equivalent of the German *delphinus* Zone can be locally recognized although the marker form, unfortunately, is rather rare. *Sulcoclymenia* was originally described by SCHINDEWOLF (1923) from the classical IIIß (= UD III-C) of the Fichtelgebirge. At Mrakib, this species, which is rare elsewhere, turned out to be an abundant marker form that locally defines an upper subdivision of III-C. Since PETTER (1960) recorded *Sulco. sulcata* from southern Algeria, it can be assumed that the *sulcata* Zone is useful on a wider regional scale. However, Tafilalt Platform sections have not yielded the genus so far.

The base of Upper Devonian IV is not only easy recognizable by the entry of *Prionoceras* and various *Platyclymenia (Platyclymenia),* but also by a change in associated Sporadoceratidae and by the regional appearance of *Protactoclymenia.* Older, still rather simple-lobed *Cymaclymenia* allow the recognition of UD IV-B. Rare associated *Protoxyclymenia* prove that this level can be correlated with the *Protoxy. dunkeri* Zone of Germany. *Carinoclymenia* is also recognized in this unit and this is the first North African record for the thinly oxyconic genus. Higher up, the *Sp. orbiculare* Marker

Bed, characterized by subglobular sporadoceratids and giant-sized clymenids (Cyrtoclymeniidae) in association with last platyclymenids, gives a third zone within Upper Devonian IV. The *orbiculare* Bed is widespread in the Famennian all over the Tafilalt. The subsequent *Protoxyclymenia* Bed has only been recognized in the southern Maïder but may be used for establishing a local upper subdivision of UD III-C. The low diversity of the bed is distinctive but the lack of platyclymenids leaves some doubt whether it should be assigned to UD IV.

The change from *Platyclymenia* to *Clymenia* Stufen (UD IV/V transition) lies within a relatively thick interval that has macrofauna in some but not in all units. Around the base of UD V, *Endosiph. muensteri* (= *Costaclymenia limata* CZARNOCKI) is an important marker that has been found in the same position in several localities of the Tafilalt Platform (Jebel Erfoud, Bou Tchrafine, Hamar Laghdad, Ouidane Chebbi). A corresponding *Endosiph.* [= *Costaclymenia*] *binodosa* Zone, still lacking *Gonioclymenia*, has been recognized by LANGE (1929: do Va) in the Rhenish Massive (Melschede) and is also present in Poland (CZARNOCKI 1989, BECKER 1993: Fig. 7.2.). Oldest *Kosmoclymenia* and *Cyma. striata* are diagnostic for UD V-A but appear at Mrakib slightly above *Endosiphonites*. At least this level is thought to correlate with the *Clymenia laevigata* (MÜNSTER) Zone (= *Progonioclymenia acuticostata* Zone of KORN 1981) of Germany although both German index genera have not been found so far in the southern Maider.

The next zone up, UD V-B, is characterized in southern Morocco by *Gonio. hoevelensis, Cyma. camerata* and oldest *Kosmo. (Muess.) diversa*. Due to the lack of the marker genus, a correlation with the German *Ornatoclymenia ornata* (MÜNSTER) Zone (KORN 1981) is only tentative. In the Tafilalt (Bou Tchrafine, Hamar Laghdad), N.Gen. aff. *Gonioclymenia* aff. *kiense* appears in the upper part of UD V-B. Collecting at Mrakib is not yet detailed enough to confirm this or to establish a local succession. The same applies to the first appearance of *Kalloclymenia*, still in association with *Gonioclymenia* (e.g., at Djebel Erfoud, Jebel Ihrs and Ouidane Chebbi), and to Wocklum-Stufen (UD VI) zones which, judging from loose assemblages, seem to be well developed in the northern Maider (Jebel Aguelmous) and at Djebel Erfoud. According to KORN (1999 in press), the *Wo. sphaeroides* Zone (UD VI-D) is present at Mrakib.

4. Potential Substage boundary levels

In the current discussion of SDS (ZIEGLER & SANDBERG 1997, BECKER 1998, STREEL et al. 1998), several levels have been proposed which might define the bases of Upper and Uppermost Famennian substages. Since the Mrakib succession is both highly fossiliferous, thick and complete, all proposed levels within the UD III to V interval should be recognizable. A wide range of fossil groups is present: ammonoids, ostracods, conodonts, trilobites, crinoids, rhynchonellid and other brachiopods, rugose and tabulate corals, placoderms, pelecypods, gastropods, agglutinating foraminifers. The ammonoid record is among the most detailed in the world for the middle and upper Famennian and allows very precise time resolution. The rhynchonellid sequence is much more detailed than given in the faunal list and includes new genera and species; it is currently under study by P. SARTENAER. Conodont work is still in an initial stage but detailed investigations, concentrated around potential substage boundaries as indicated by ammonoid levels, are under way. The dominance of shales might be seen as disadvantage of the section but in relation to condensed pure limestone successions of Germany and of the Tafilalt Platform, these ensure that time is well represented by sediment. Fine siliciclastics give hope for succesful palynological studies and are suitable for detailed magnetostratigraphy which is in preparation by R. CRICK & B. ELWOOD. Potential substage boundary levels are placed as follows:

4.1. Potential base of an Upper Famennian near the global *Annulata* Event (base of *posterior* Zone)

The *Annulata* Event, represented by one or two black shales in Germany, forms the base of the *Platy. (Platy.) annulata* or *Priono. divisum* Zone (base of UD IV; KORN & LUPPOLD 1987, BECKER 1992a, 1998). The base of the *posterior* Zone (formerly base of the *styriacus* Zone) lies in limestones just or a little above the hypoxic sediments but has not been placed with precision in most sections. In the Tafilalt, the *Annulata* Event has been recognized by BECKER (1992b) at Bine Jebilet where it is represented by extremely clymenid-rich green marls intercalating red cephalopod limestones. Facies conditions strongly resemble the seamount section at Beul in the Rhenish Slate Mountains (LANGE 1929). At Mrakib, the *Annulata* Event led to the deposition of haematite (originally pyrite) rich red shales in the upper part of Bed N_2. The base of the *posterior* Zone should be sought in the limestone sequence of Bed N_2 which fall in the upper part of the *Priono. divisum* Zone.

4.2. Potential base of an Upper Famennian near the traditional base of the Dasberg-Stufe or near the base of the Lower *expansa* Zone

BECKER (1998) has proposed to follow the traditional German Famennian subdivision and to place the base of an Upper Famennian substage near the base of the Dasberg or *Gonioclymenia* Stufe (do V = Upper Devonian V, = *Clymenia* Stufe). Since the precise faunal sequence around the UD IV/V transition has never been properly documented in the type region, there have been arguments whether the poorly documented German level (zone) with *Franconiclymenia serpentina* (MÜNSTER) should be assigned to the basal UD V (KORN 1981) or to the top part of UD IV (BECKER 1992a, 1993). KORN & LUPPOLD (1987) correlated the base of the *serpentina* Zone with the base of the *expansa* Zone (base of Upper *styriacus* Zone).

ANNUAL MEETING OF THE PALÄONTOLOGISCHE GESELLSCHAFT

The 1999 annual meeting took place at the Paleontological Institute and Museum of the University of Zürich in Switzerland. It was perfectly organized by Prof. Hans RIEBER and Karin HÄNNI. In accord with the location of the conference, excursions led to the Mesozoic and Cenozoic of the Alps and of the Jura Mountains. As usual, abstracts and the excursion guides were published in Terra Nostra (vols. 99/8 and 99/). The following talks and posters dealt with Devonian topics:

Talks

BECKER, R.T.: Zur Paläobiogeographie oberdevonischer Ammonoidea.

GRIMM, M.C.: Funktionsmorphologische Untersuchungen der Buchiolinae (Lamellibranchiata/Devon).

KLUG, C.: Biometrie devonischer Ammonoideen und globale Events – vorläufige Ergebnisse.

NOSE, M., LEINFELDER, R. & SCHMID, D.: Devonische und jurassische Riffsysteme: Ein Vergleich.

SALERNO, C. & SCHRÖDER, S.: Korallenfauna unsd Fazies givetischer Kalksteinfolgen (Cürten-/Dreimühlen-Formation) der Dollendorfer Mulde (Devon, Rheinisches Schiefergebirge/Eifel).

SCHRAUT, G.: Korrelationsmöglichkeiten mit Hilfe von Phacopiden (Trilobita) am Beispiel von *Phacops sparsinodosus* STRUVE 1970.

SCHÜLKE, I.: Conodonten: Eine Fallstudie über die Habitate der Organismen und die Funktion ihrer Apparate aus der frühen Famenne-Stufe.

Posters

KLUG, C., DÖRING, S. & KORN, D.: Sukzession devonischer Ammonoideen in Nordwest-Afrika.

REICH, M. & HÜNEKE, H.: Muellerisphaerida (incertae sedis) aus dem Devon des Harzes.

ROGALLA, N.S. & AMLER, M.W.: Life position in new anomalodesmatan bivalves from the Rhenish Devonian (Germany).

EARLY PALAEOZOIC PALAEOGEOGRAPHIES AND BIOGEOGRAPHIES OF WESTERN EUROPE AND NORTH AFRICA

Paléogéographies et Biogéographies de l'Europe de l'Ouest et de l'Afrique du Nord au Paléozoïque inférieur

FIRST CIRCULAR

After a successful meeting on the topic *Palaeozoic Palaeogeography and Palaeobiogeography of Western Europe*, held at Lille in 1992, the Laboratory of Palaeontology of Lille invites you to participate and contribute to a conference on early Palaeozoic Palaeogeography which will take place at Lille in September 2001. A pre-conference field trip to visit the Lower Palaeozoic of Belgium and a post-conference field-trip to the southern Montagne Noire (Languedoc, southern France) will be organized.

The conference topics are designed to address various subjects related to the Lower Palaeozoic palaeogeography and palaeobiogeography of Western Europe and North Africa, and include:

1-The geodynamic and tectonostratigraphic framework of Western Europe and North Africa during early Palaeozoic times.

2-Relationships between the northwestern Gondwana margin, Baltica and related terranes (Ossa-Morena, Armorica, Perunica, Avalonia, etc.).

3-Palaeomagnetic versus palaeobiogeographical data.

4-Biostratigraphic improvements of the Proterozoic-Cambrian transition and the Lower Palaeozoic (Cambrian to Silurian).

5-Lower Palaeozoic geochemical anomalies and palaeoclimatology.

6-Palaeogeographical controls on biodiversity patterns.

7-Volcanoclastic events and geochronological framework.

8-Evolutionary trends in early Palaeozoic ecosystems.

9-Event stratigraphy and radiation/extinction turnovers.

10-Sea-level changes, cyclicity and palaeo-environments.

The organizers welcome additional topics that participants wish to have included.

Dates and places:

Conference: (3 days)

Université des Sciences et Technologies de Lille, Villeneuve d'Ascq: September 24-26, 2001

Pre-conference excursion: (2 days)

Lower Palaeozoic of Belgium (Brabant, Condroz): September 22-23, 2001

Post-conference excursion: (3 days)

Lower Palaeozoic of the southern Montagne Noire: September 27-29, 2001

Organizers:

José Javier ALVARO, Villeneuve d'Ascq

Thomas SERVAIS, Villeneuve d'Ascq

Field trips:

Pre-conference field trip organization:

Alain HERBOSCH, Brussels & Jacques VERNIERS, Ghent

Post-conference field trip organization:

Daniel VIZCAINO, Carcassonne

Scientific committee:

Alain BLIECK, Villeneuve d'Ascq

Bernd-Dietrich ERDTMANN, Berlin

Oldrich FATKA, Prague

Naima HAMOUMI, Rabat

Alain LE HERISSE, Brest

Florentin PARIS, Rennes

Gian-Luigi PILLOLA, Cagliari

Jean VANNIER, Lyon

Enrique VILLAS, Zaragoza

Mark WILLIAMS, Keyworth-Nottingham

Organizing institutions:

Université des Sciences et Technologies de Lille (USTL)

Centre National de la Recherche Scientifique (CNRS): UPRESA 8014

Groupe Français du Paléozoïque

Société Géologique du Nord

Société Géologique de France

Geologica Belgica

IGCP 410 and 421

Conference proceedings:

Bulletin de la Société Géologique de France

Field-Trip Guide-books:

Annales de la Société Géologique du Nord

Important Dates:

May 2000: First circular

October 2000: Second circular - Call for papers May 2001: Deadline for Abstracts and registration

July 2001: Third circular - Programme and final arrangements

Please send correspondence to:

José Javier Alvaro or *Thomas Servais*
USTL - Sciences de la Terre
UPRESA 8014 CNRS
Cité Scientifique SN5
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(FRANCE)
Tel: (+33) (0)3 20 33 63 92
or (+33) (0)3 20 33 72 20
Fax:(+33) (0)3 20 43 69 00
e-mail: Jose-Javier.Alvaro@univ-lille1.fr
or Thomas.Servais@univ-lille1.fr

Registration Form

Please send this part before October 1st, 2000 to:

José Javier Alvaro or *Thomas Servais*
USTL - Sciences de la Terre- UPRESA 8014 CNRS
Cité Scientifique SN5, F-59655 Villeneuve d'Ascq cedex (FRANCE)

NAME: .....
ADDRESS: .....
Phone: .....
Fax: .....
E-mail: .....

I am interested in attending the meeting on Lower Palaeozoic Palaeogeography, and I will

definitely plan to attend
yes/no
probably plan to attend
yes/no
possibly plan to attend
yes/no

I plan to present (or co-author)

..... Talk(s)
..... Poster(s)
about .....

I am interested in attending the

+ Pre-conference excursion to the Lower Palaeozoic of Belgium (September 22-23, 2001)
yes/no
+ Post-conference excursion to the Lower Palaeozoic of the Montagne Noire (September 27-29, 2001)
yes/no

15th International Senckenberg Conference

Mid-Palaeozoic bio- and geodynamics: The North Gondwana – Laurussia interaction

Joint meeting of the 'International Geological Correlation Program (IGCP) 421' and the 'Subcommission on Devonian Stratigraphy (SDS)' hosted by the 'Senckenbergische Naturforschende Gesellschaft', Frankfurt am Main at the 'Forschungsinstitut und Naturmuseum Senckenberg' Frankfurt am Main (Germany)

May 11 – 21, 2001

First circular and preliminary registration

Close to the end of IGCP 421, there will be again a joint meeting of IGCP 421 and SDS as has been successfully arranged during the past years (Bologna/Modena, Morocco). The participants will be hosted by the 'Senckenbergische Naturforschende Gesellschaft' in Frankfurt am Main, Germany; the meeting will take place as the '15th International Senckenberg Conference'. Besides the technical sessions that will be held at the 'Naturmuseum Senckenberg' from May 15 – 17, 2001, there will be two pre-symposium field trips and one post-symposium field trip. Field trips prior to the lectures will lead to the Belgian Ardennes (organized by P. Bultynck, Bruxelles), May 11 – 12, 2001 and to the Rheinisches Schiefergebirge (organized by the Senckenberg group), May 13 – 14, 2001. After the lectures, a field trip will lead via the Thüringisches Schiefergebirge (May 18 – 19, 2001) – organized in cooperation with our Thuringian colleagues – to the Barrandian area (May 20 – 21) where our Czech colleagues will guide the participants. During these trips, a variety of rocks generated in different facies realms can be visited, i.e. from coastal to pelagic facies of mainly Devonian as well as Carboniferous and Silurian. The oral presentations shall be arranged in different sessions; topics like biogeography of different faunal and floral groups, biogeographical methods and databases, biofacies belts, bioevents, plate tectonics, palaeomagnetism, map reconstructions, etc. are prospected. Sessions of the IGCP 421 and SDS groups will be arranged during the meeting as well.

Program overview

May 11 – 12, 2001: Pre-conference field trip (V1), starting from Bruxelles and ending in Frankfurt, organized by P. Bultynck: Belgian Ardennes.

May 13 – 14, 2001: Pre-conference field trip (V2), starting from Frankfurt (overnight stay in Frankfurt as well on May 13, 2001), organized by the Senckenberg group: Rheinisches Schiefergebirge.

May 14, 2001 (evening): Icebreaker party at the Naturmuseum Senckenberg.

May 15 – 17, 2001: Technical sessions at the Naturmuseum Senckenberg, Frankfurt.

Registration: May 15, 2001, from 8.00 to 9.00 a.m.

May 18 – 21, 2001: Post-conference field trip (N), starting from Frankfurt with overnight stay in Thuringia on May 18, 2001 (organized by the Thuringian colleagues), and leading to Praha (organization by the Czech colleagues), where the excursion ends on May 21, 2001: Thüringisches Schiefergebirge and Barrandian area.

Remark: For those who will be heading back to Frankfurt transportation by coach will be possible on May 22, 2001.

Registration fees: Because of the early date for this first circular, all costs can be announced only in the 2nd circular.

Second circular: Will be sent in June 2000 to those people who reply to this circular, also available on the website which will be arranged (at least in February 2000). Please, find a link to this via the Senckenberg homepage (http://www.senckenberg.uni-frankfurt.de).

Presentations: Oral presentations (one oral presentation per participant, please) will be 15 minutes + 5 minutes for discussion.

Conference language: English.

Publications: All abstracts will be published in a special volume received by each participant; excursion guides will be distributed to participants of excursions; papers of the conference contributions will be refereed and published in a volume of the 'Cour. Forsch.-Inst. Senckenberg' (details will be given in the 2nd circular).

Accomodation: We shall try to get allocations in hotels of different classification (first class, medium, 'cheap'). Hotels then can be booked by yourselves until a certain date which will be indicated in the 2nd circular; names of the hotels will also follow in the 2nd circular.

Letter of invitation: If an official document is needed to confirm participation or help arrange funds for travel and attendance, please write or contact the organizers.

Insurance: All participants should note that they must have valid health and travel insurance; in case, please purchase prior to your departure.

Visa: Those who want to take part in the post-conference field trip to the Barrandian area, please check if you need visa for entering the Czech Republic.

Funding: It will be tried to achieve limited funding for some participants from developing countries.

Social events: To be announced in the 2nd circular.

Deadlines:

March 1, 2000: Return of 1st circular.

November 1, 2000: Return of 2nd circular (sent to those who reply to the first circular, 3rd circular with scientific program will be sent to those people who reply to the 2nd circular in March 2001).

November 1, 2000: Submission of abstracts.

August 1, 2001: Submission of manuscripts for the proceedings volume.

November 1, 2000: Payments (conference and excursions); after this date, 20% more until January 1, 2001.

Until March 1, 2001: Refunding possible (with cancellation fee of 20%); after March 1, 2001 no refunding will be possible.

Organization: Please, contact one of the following persons (mailing address for all of them is: Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt am Main):

G. Plodowski (phone: ++49-69-97075127, fax: ++49-69-97075137,
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e-mail: eschindl@sngkw.uni-frankfurt.de

15th International Senckenberg Conference

Mid-Palaeozoic bio- and geodynamics: The North Gondwana – Laurussia confrontation

Registration form IGCP421/SDS Meeting; May 11 – 21, 2001

(please print clearly and indicate wishes by circles, please, send back until March 1, 2000)

Last name:

First name:

Degree:

Address:
Institution:
Street:
Zip code:
City:
Country:

Phone:
Fax:
e-mail, website:

Attendance:

Technical sessions:	yes	no	probably
Excursion V1:	yes	no	probably
Excursion V2:	yes	no	probably
Excursion N:	yes	no	probably

Presentation of oral lecture (intention; 15 minutes + 5 minutes discussion):

yes no probably (if yes or probably, please give tentative title below)

Presentation of poster (intention):

yes no probably (if yes or probably, please give tentative title below)

Publication of contribution in proceedings volume (intention): yes no probably

Tentative wish for accomodation: First class hotel (250,- to 300,- DM), medium class hotel (120,- to 200,- DM), 'cheap' hotel (80,- to 120,- DM)

I agree with putting my name onto a publicly accessible electronic list of participants (WWW)

Date, Signature:

REPORTS FROM THE MEMBERSHIP

TM R. Thomas Becker (Berlin)

In 1999 detailed ammonoid work continued with emphasis on faunas from Morocco, the Canning Basin and from the Rhenish Slate Mountains. Moroccan results were presented in six joint contributions (with M.R. House, J. Bockwinkel and V. Ebbighausen) to the two field guides produced in conjunction with the SDS and IGCP 421 meeting in Errachidia in April/May. Our Moroccan regional zonations are more detailed than the different successions published by D. Korn (Tübingen) and co-authors. Two morphometric studies of lower Famennian single bed assemblages (*Acrimeroceras, Maeneceras*) have been submitted to a volume of the Geologische Bundesanstalt that includes contributions to the International Cephalopod Symposium held in September in Vienna. During fieldwork conducted in the Anti-Atlas prior to the SDS meeting, important new late Givetian to upper Famennian collections have been made. It has become clear that pharciceratid faunas include a wide range of new genera and species. The proposed Upper Famennian substage boundary stratotype candidate at Mrakib in the southern Maider has been sampled for conodonts (C. Corradinia, C. Spaletta, M.C. Perri) and palynomorphs (for C. Hartkopf-Fröder). In the southern Tafilalt, first diverse clymenid-goniatite faunas of the Upper Devonian III (including *Sulcoclymenia*) could be collected and these will enable a correlation with contemporaneous assemblages from the Maider. Roughly of the same age is a new thin level with abundant branching rugose corals and thamnoporoid tabulates from the Tafilalt Platform (to be studied by D. Weyer and others). Gary Webster and co-authors will soon publish southern Maider Famennian crinoids.

Together with Michael House, work has progressed on the very rich Canning Basin ammonoids which will be treated in a future Bulletin of the Geological Survey of Australia. New samples provided by P.E. Playford from the basinal Gogo Formation includes several new species which are lacking in contemporaneous sections of shallower marginal slope settings. The joint work with M.C. Grimm (Mainz) on Buchiolinae from the region is continuing. Biogeographic relationships of ammonoid faunas are in print in the IGCP 421 volume to be published in the Records of the Western Australian Museum.

During the IGCP 421 field trip to Iran (December 1998), important goniatite and clymenid faunas have been collected in the Shotori Range near Tabas from where O.H. Walliser (1966) first described Famennian faunas. Faunas are much more diverse than previously thought and include many species known from Morocco and Germany. A forthcoming joint paper with M. Yazdi and A.R. Ashouri will deal with the *Annulata* Event near Niaz. New Famennian trilobites will be described by R. Feist. Of special importance is the discovery of Devonopronoritidae in a thin middle Frasnian bed with many brachiopods and gastropods; this group was formerly supposed to be endemic to the Rudnyi Altai. Such palaeobiogeographic problems were addressed in a talk at the annnual meeting of the Paläontologische Gesellschaft.

In the Rhenish Massive detailed joint work together with M. Piecha (conodonts) on the middle Famennian (UD III-IV) Nie Brickwork Quarry is under way. A master thesis on the pathology of lower Famennain goniatites has made progress; faunas from Bergisch Gladbach provided by V. Ebbighausen include more than a dozen new species.

Sarah Aboussalam has continued her Ph.D. on the Taghanic Event by sampling late Givetian successions of the Sauerland, Montagne Noire and of Morocco. In the Montagne Noire, beds with early pharciceratids have been discovered for the first time and at Col de Tribes *Maenioceras* and *Pharciceras* occur together with various trilobites in one bed. The Taghanic Event is clearly composed of different phases with extinctions pulses in the late Middle *varcus* and near the end of the Upper *varcus* Zones. The global conodont record around the event has been put in an extensive data base. Within another Ph.D. study, Anton Sprey (Free University Berlin) will look into the morphometry of goniatites around the Frasnian-Famennian boundary.

Prof. Tong-Dzuy has sent the first Devonian ammonoids from styliolinid-rich shales of Vietnam but these are so poorly preserved that no identification can be given so far. It is hoped that better material can be collected in future. Joint papers on the Frasnian facies development and on goniatites of the Timan have been submitted.

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BECKER, R.T.: Phylogeny and systematics of the Wocklumeriina (Ammonoidea, Clymeniida, middle to late Famennian). – V Internat. Symp., Cephalopods – Present and Past, Vienna, 6 – 9th September 1999, Abstr. Vol. (K. HISTON, Ed.), 19.

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HOUSE, M.R. & BECKER, R.T.: The phylogeny of pharciceratids and their relatives (Ammonoidea, Anarcestida; late Givetian to middle Frasnian). - V Internat. Symp., Cephalopods – Present and Past, Vienna, 6 – 9th September 1999, Abstr. Vol. (K. HISTON, Ed.), 51.

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KLAPPER, G. & BECKER, R.T. : Comparison of Frasnian (Upper Devonian) Conodont Zonations. – Boll. Soc. Paleont. Ital., 37 (2-3): 338-348.

CM Alain BLIECK (Paris)

Activities

Mostly devoted to Devonian vertebrates.

1) Field work

Lower Devonian (Emsian) of the western Rhenish Slate Massif (RSM) of Germany with a team of the Forschungsinstitut Senckenberg, Frankfurt-am-Main and Wilhelmshaven, and the Naturmuseum, Humboldt Universitaet, Berlin (Plodowski G. coord., Schindler E., Wilde V., Brocke R., Jansen U., Wehrmann A., Schultka S., Koenigshof P., etc.; sequence stratigraphy, sedimentology, palaeontology of Lower Devonian sections of the RSM);

Upper Devonian (Famennian) of the Ardenne Massif, Belgium (with G. Clément, Ph.D. student Paris; H. Lelièvre and G.C. Young (invited professor), Paris; A. Ivanov (CNRS associated scientist), Villeneuve d'Ascq).

2) Meetings and workshops

Workshop of the French National Program on Coastal Oceanography (J.-C. Dauvin conven.), at the Marine Biology Station, Wimereux, Pas-de-Calais, France;

Symposium of the «Palynologists and plant micropalaeontologists of Belgium» working group (T. Servais conven.), at the Univ. Sci. Technol. Lille, Villeneuve d'Ascq, France;

Symposium «Major events in early vertebrate evolution» (P. Ahlberg conven.), London, UK;

Third meeting of the European Elasmobranch Association (B. Seret conven.), in Nausicaa, Boulogne-sur-Mer, Pas-de-Calais, France;

Second National Meeting on Geological Heritage, Lille, France;

4th Baltic Stratigraphic Conference and IGCP 406 joint meeting, Jurmala (Riga), Latvia;

IGCP 406 workshop in Vilnius, Lithuania, with V.N. Karatajute-Talimaa: Silurian-Devonian heterostracans of Severnaya Zemlya and the Timan-Pechora Province, Russian Arctic; Upper Ordovician-Lower Silurian vertebrate microremains of Tuva (Russia) and western Mongolia; Lower Devonian heterostracans of Predobroudja (Moldavia), Podolia and the Lvov region (Ukraine).

Publications 1998-99

Papers

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MARK-KURIK E., **BLIECK A.**, LOBOZIAK S. & CANDILIER A.-M. (1999).- Miospore assemblage from the Lode Member (Gauja Formation) in Estonia, and the Middle-Upper Devonian boundary problem.- *Proc. Eston. Acad. Sci., Geol.*, 48 (2): 86-98, 2 fig., 1 pl.; Tallinn [with Estonian and Russian abstracts].

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BLIECK A., TURNER S., YOUNG G.C., with contributions of LUKSEVICS E., MARK-KURIK E., TALIMAA V.N. & VALIUKEVICIUS J.J. (in press).- Devonian vertebrate biochronology and global marine/non-marine correlation.- In: BULTYNCK P. (ed.), International Devonian Correlations. Volume II. *Cour. Forsch.-Inst. Senckenberg*; Frankfurt a.M. (submitted, accepted).

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STREEL M., BRICE D., DÉGARDIN J.-M., DERYCKE C., DREESEN R., GROESSENS E., HANCE L., LEGRAND-BLAIN M., LETHIERS F., LOBOZIAK S., MAZIANE N., MILHAU B., MISTIAEN B., POTY E., ROHART J.-C., SARTENAER P., THOREZ J., VACHARD D. & BLIECK A. (1998).- Proposal for a Strunian Substage and a subdivision of the Famennian Stage into four Substages.- In: I.U.G.S./Subcommission on Devonian Stratigraphy, Annual Business Meeting (Bologna, June 23, 1998) (Document submitted to the SDS).- *Subcomm. Devon. Stratigr. Newsletter*, 15 : 47-52, 4 fig.; Arlington, Texas (USA).

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CM Carlton E. Brett (Cincinnati)

Co-workers: Gordon C. Baird SUNY College at Fredonia

Charles Ver Straeten, University of Wisconsin at Oshkosh

During the summer of 1999 we continued mapping of Devonian bedrock in the eastern Finger Lakes area, completing a preliminary bedrock map of the Skaneateles 7.5' Quadrangle as a part of the STATEMAP program. This mapping aided in delineating trends along the southeast margin of the Devonian foreland basin. In particular, we confirmed an earlier suspected pattern of very rapid northwest-ward facies change, especially within the Centerfield Formation and Otisco Shale.

As an extension of this work, we also completed detailed correlations of the Skaneateles Formation across western New York, by successfully tying the capping beds of all of the coarsening upward cycles (lower and upper Delphi Station, lower and upper Pompey, and Butternut members) of the Onondaga County area into thin concretionary limestones that extend into western New York. The detailed correlation of beds within the Mottville Member near its type area also slightly modify earlier correlations into the Stafford Limestone of western New York. Baird et al. (1999) summarized results of this work to date.

In addition, we extended research on the detailed stratigraphy of the upper Moscow and Tully formations. We have discovered and documented the highest known Hamilton beds in the area of Shedds, NY. These beds are virtually conformable with the basal Tully units (this contact is disconformable nearly everyhere else in the basin). Despite the conformable relationship of the upper Hamilton with the Tully at Shedds, the faunal transition remains sharp. The highest Hamilton "Shedds beds" carry a diverse and typical Hamilton fauna, which gives way abruptly to the unusual lower Tully (Emmanuella-Hypothyridina) fauna across a single bed.

Together with our colleagues Brad Sageman and Adam Murphy (Northwestern University), Rex Crick (University of Texas at Arlington) and Brooks Elwood (Louisiana State University), we sampled the uppermost Hamilton and complete Tully interval in central New York, at decimeter intervals, for geochemical and magnetic susceptibility (MS) analyses. In conjunction with work already completed on the AKZO drill cores, these analyses will provide a nearly unbroken record of geochemical and MS fluctuations through the late Eifelian through early Famennian in New York State.

We have also extended correlations of Middle Devonian units into the central Appalachian region. In August, we discovered correlatives of all but the highest Moscow units and much of the Tully in eastern Pennsylvania, near Bowmanstown. Despite considerable deformation, these rocks display facies quite similar to those in the Windom Shale of central New York. This suggests that a strong eastward embayment in t;he paleoshoreline carried facies patterns considerably east of their positions in New York.

Work with Chuck Ver Straeten on regional relationships within the lower Onondaga Formation resulted in establishment of detailed correlation of meter-scale cycles using marker beds including two previously unrecognized K-bentonites. This work corroborated our earlier interpretation of a subsiding "back bulge basin" west of the Cayuga Lake meridian.

Finally, I must acknowledge Prof. Ahmed El Hassanl and his colleagues in Morocco for organizing a splendid field conference for SDS. Needless to say, we were very intrigued by similarities of patterns of facies cyclicity relative to those of the Appalchian Basin for portions of the Eifelian-Givetian succession. This suggests the possibility comparative studies of patterns of facies change and bioevents in the Devonian. I look forward to collaborative projects with international as well as American colleagues.

PUBLICATIONS RELATING TO DEVONIAN GEOLOGY

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Brett, C.E., Goodman, W.M., LoDuca, S.T. and Tetreault, D.K., 1999, Silurian-Early Devonian sequence stratigraphy, events, and paleoenvironments of western New York and Ontario, Canada. New York State Geological Association 71st Annual Meeting, Field Trip Guidebook, Fredonia, NY, p. B1-B58.

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Frest, T.J.. Brett, C.E., and Witzke, B.J., 1999. Caradocian to Gedinnian echinoderm associations of central and eastern North America. In Boucot, A.J. and Lawson, J.D., eds., Paleocommunities: A Case Study from the Silurian and Lower Devonian. Cambridge University Press, p. 638-783.

TM Rex Crick (Dallas) and CM Brooks Ellwood (Baton Rouge)

The year has brought some major changes. First, Brooks accepted the position of department chair at Louisiana State University (Baton Rouge). Second, we have reworked, revised, and rethought the use of MSEC data and decided to present the data in the form of qualified magnetostratigraphy susceptibility (please do not confuse magnetostratigraphy susceptibility with the more common magnetostratigraphy polarity). This move allows the formal proposal of magnetostratotypes to codify the work and hopefully this will make our work more palatable to those who have by slow in adopting MSEC. Brooks is at this moment completing an insightful paper addressing every conceivable (we hope) argument against magnetic susceptibility as a viable tool for chronostratigraphy and chonocorrelation. I have appended at the end of the references some earlier comments regarding why magnetic susceptibility works.

The Eifelian- Givetian GSSP boundary sequence has been reworked into a magnetostratigraphy susceptibility magnetostratotype and this will appear shortly in Episodes. We have just completed conversion of the Pridoli- Lochkovian GSSP boundary sequence plus a nearby core sequence to a magnetostratigraphy susceptibility magnetostratotype. Its fate now rests in the hands of the editors at Palaeogeography, Palaeoclimatology, and Palaeoecology. We have now turned our attention to the Frasnian- Famennian boundary sequences in the Montagne Noire area and that paper should be to EPSL before the end of May.

Publications

Ellwood, B.B., Crick, R.E. and El Hassani, A., 1999. The MagnetoSusceptibility Event and Cyclostratigraphy (MSEC) method used in geological correlation of Devonian rocks from Anti-Atlas Morocco. American Association of Petroleum Geologists Bulletin, 83(7): 1119-1134.

Crick, R.E., Ellwood, B.B. El Hassani, A., and Feist, Raimund, in press. Proposed Magnetostratigraphy Susceptibility Magnetostratotype for the Eifelian–Givetian GSSP (Anti-Atlas, Morocco). Episodes

Crick, R.E., Ellwood, B.B. Hladil, Jindrich, El Hassani, A., Hrouda, Frantisek, and Chlupác, I., in review. Magnetostratigraphy Susceptibility of the Přídolian–Lochkovian (Silurian–Devonian) GSSP (Klonk, Czech Republic) and a Coeval Sequence in Anti-Atlas Morocco. Palaeogeography, Palaeoclimatology, and Palaeoecology.

Ellwood, B.B. and Crick, R.E., 2000. The MagnetoSusceptibility Event and Cyclostratigraphy (MSEC) Method Used in High-Resolution Chronocorrelation, Annual AAPG Meeting, New Orleans, Louisiana, p. A46.

MagnetoSusceptibility Event and Cyclostratigraphy (MSEC) in Marine Rocks and the Question of Detrital Input Versus Carbonate Productivity (in prep.)

Some Comments on MSEC in Marine Sediments - B. Ellwood

There are two sources of sediment in marine limestones and shales, and these are marine and non-marine. MSEC researchers must first ask the question, "Is the marine component diluting the non-marine in these samples, or is the non-marine component diluting the marine?" I think the answer is quite clear. In marine sediments, the non-marine component is diluting the marine and the MS reflects this dilution. A good example of this is given by Figure 4 in our recent AAPG paper (July 1999; please note the photo on the cover of the journal!), where MS is linearly related (at >99.9% significance level) to the residual (non-marine detrital/ diluting component) that results from dissolving large limestone samples. If the non-marine component originates as a result of sea-level changes or climate, and if this signal is global, then a direct measurement of the diluting material, such as the magnetic susceptibility (MS) or stable element analyses, should provide global correlation tools.

On the other hand, others have argued that the marine component is diluting the non-marine and that any measure of the non-marine component must be corrected to account for dilution by the marine component. One way this is done is by measuring the calcium carbonate percentage in a sample and then adjusting (changing) the MS to account for the dilution. I believe that this argument and approach is incorrect.

There are several problems with the 'marine diluting the non-marine' approach. (1) There are siliceous as well as carbonate marine components in marine sediments and an adjustment for the carbonate alone does not account for the entire marine component. Therefore the MS results that have been adjusted for carbonate content are skewed depending on the percentage of the siliceous component present. (2) Calcium carbonate and quartz are diamagnetic minerals that are significantly lower in their contribution to the MS than either paramagnetic or ferrimagnetic components. To correct the MS based on the carbonate percentage, without factoring in the dramatic difference between diamagnetic and paramagnetic/ferrimagnetic components, skews the relative MS and creates a signature of its own. (3) Empirical raw MS measurements, at multiple sites known to be the same age and where there is good biostratigraphic control and varying lithologies, indicate that MS values without adjustments can be correlated. However, adjusting for the carbonate percentage destroys these correlations.

In the final analysis, if raw MS measurements are considered to reflect dilution by non-marine elements then it is possible to correlate between sections using MS. On the other hand, if the marine component is considered to be a diluting element and methods are used to adjust for such dilution, then it will never be possible to correlate sections using recalculated MS values.

It is now clear that there are some stage boundaries in the Devonian that are not well defined in terms of their MSEC signature, but they do show very slight, but distinguishable changes (i.e., Loch/Prag). Some boundaries are very distinct (Eif/Giv). Some GSSP's have erosional, weathering, serious alteration effects, and other problems so when sampling these it is difficult to get a good signature. It then becomes necessary to sample many sections to establish the MSEC character. An example is the F/F

boundary where we now think we finally have enough data points from various sections to understand the MSEC character. In fact, we have compared the GSSP in France to the equivalent Woodford Shale section in Oklahoma. In Oklahoma we measured the MSEC, established the boundary based on these results in comparison to the French GSSP, and then asked Jeff Over to check it using conodonts. He said that based on the biostrat that we had picked the F/F boundary correctly.

A second issue that has been raised is my ability to measure MS. I have worked in the area of MS for over thirty years and have published many papers on the subject. Most of the active MS workers in the world are familiar with my work and while some may disagree with some of my interpretations they respect the fact that I am a careful instrumentalist and know what I am doing. In addition, in the two major MSEC papers we have published in the reviewed literature (Episodes 97 and AAPG 99) we have reported data from two different instruments, the instrument in my lab and a commercially available instrument. I have also compared measurements against Czech Kappa Bridges. The MSEC results are essentially identical, so even if some would argue that I don't know what I am doing, the commercially developed numbers are reported (Episodes and AAPG) exactly as they came from the instrument (without any corrections to the numbers) and they give the same results as my instrument. The results using both instruments show correlations between sections. I have a lot of experience with MS having measured approximately 40,000 samples that are currently in my laboratory and have measured another >10,000 samples from deep-sea sedimentary cores and on other projects for which the samples had to be returned. I have published results from cross calibration research where multiple instruments were used. I have used most of the major types of instruments going back to the early 1960's and have compared these. As an international expert on the subject of MS, Dr. Frantisek Hrouda of Agico, the manufacturer of the Czech Kappa Bridges, KLY 2 and KLY 3, can vouch for my integrity and ability as a scientist using MS (as can many others).

So, assuming that my numbers and my integrity are not in question, then in the final analysis, it comes down to the basic assumptions as to how to treat the MS results. In our work, we report the results as measured, without adjustments, because we believe that the MS measurements reflect dilution by non-marine elements, and that the dilution is the important correlatable indicator. This then makes it possible to correlate between sections using MSEC methods. On the other hand, if the marine component is considered to be a diluting element, and MS values are changed to account for such a 'dilution' effect, then it is my view that it will never be possible to correlate sections using MSEC methods.

CM Ahmed EL HASSANI (Rabat, Morocco)

I. SDS-IGCP Meeting:

The first half of 1999 was concentrated on the organization of The SDS Annual Meeting in connection with The fifth international meeting of IGCP 421 held in Errachidia, Morocco, 23 April- 1 May 1999.

This Meeting consisted of :

* one-day scientific meeting (24 April) during which 36 scientific papers were presented orally

* An excursion (25 April-1 May) with 60 participants (20 Moroccans and 40 other Nations) during which colleagues from various institutions in Morocco and Europe demonstrated sequences of regional and global significance in the Tafilalt and Meseta regions of Morocco. (See publications)

Two publications were produced for the conference:

1. R. Feist, J.A. Talent & B. Orth (eds), Abstract Book Errachidia Meeting SDS-IGCP 421 (April 23rd -May 1st 1999), 48 pp. Institut des Sciences de l'Evolution, Université de Montpellier II, France.

2. A. El Hassani & A. Tahiri (eds), Excursion Handbook, Part I: Tafilalt and Maïder (eastern Anti Atlas) (p. 1- 107); Part II: The northwestern Moroccan Meseta, (p. 107-15 8).. Institut Scientifique (Rabat), Faculté des Sciences et Techniques (Errachidia) & Centre Régional de Géologie (Midelt), Morocco.

A Special Issue of the Moroccan "Notes et Mémoires du Service Géologique de Maroc" is in press.

Another special Issue of the same Bulletin is scheduled to publish refereed papers from the conference soon. The deadline to send contributions to me is end of next February 2000.

II. RESEARCH

My work was concentrated on various continuing projects on the Paleozoic series of Morocco.

1. In the Western Meseta : **several investigations in the Silurian and Devonian series allows to publish first results with Dr. Fouad El Kamel on the part of distensional tectonic in reef edification into the Rehamna Massif, and also for the structure of the Eastern Rehamna.**

In the carbonated platform of Upper Emsian to Givetian age, the reef edification is previous and contemporaneous of a tilted block tectonic, that has favoured the bioconstruction in its upper part and which was at the origin of the controlled in both the tectonic instability, especially tension faults, progressive unconformity and resulting landslide observed in the reef development zone and the external platform.

2. In collaboration with Prof. Walliser we publish our results on Mrirt area (Eastern part of Central Morocco Massif). The Mrirt Nappe is situated in the tectonic unit of Khenifra-Azrou at the eastern margin of the Moroccan Western Meseta. The sedimentary history of the nappe offers strong indications for the complex tectonical history of this Variscan Central Massif. Block tectonics prevail since the middle Famennian until the assumably late Visean compressive tectonics and the subsequent gravitational emplacement of the nappe. The beginning of block tectonics is indicated by chaotically embedded Frasnian blocks within middle Famennian nodular limestones. The emplacement of the nappe caused an overthrust of the Upper Devonian upon the Devonian-Carboniferous sequence and a melange at the base of the overthrust. The latter did not reach the westernmost section within the Mrirt Nappe.

3. In the Tafilalet and Maider (Anti Atlas) the MSEC method was developed and confirmed to correlate Devonian series. One of the last paper was published into the AAPG Bulletin (See also report of TM Crick).

III. REFERENCES

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Late Devonian Glaciation in Gondwana: Setting the Stage for Carboniferous Eustasy

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ABSTRACT

It has recently been shown that Gondwana's well-known Carboniferous glaciations began in Late Devonian time. The Devonian glaciation event occurred over a broad area, including much of Brazil (Parnaíba, Amazonas, and Solimões basins), Bolivia (Madre de Díos and Altiplano areas of the Paleozoic foreland basin), and Africa. This initial glaciation continued into earliest Carboniferous (Tournaisian) time. It is dated within at least the LE, LN and VI palynozones. In North America, central Europe and southern China there is a coeval sea-level fall that exhumed and eroded carbonate platforms, deposited siliciclastics, and generated lacunae in the Famennian record. The lowstand resulted in extensive carbonate breccias, shoal-deposits and evaporites in western U.S.A. Lowstand clastic-wedges were deposited in a major forced regression (eastern U.S.A.) with widespread black shales. The glaciation was apparently responsible for lacunae in the Famennian rock-record in many regions. In Moravia, Famennian physil and siliclastic influx increased as a result of weathering in newly-emergent highs that resulted from sea-level drop. Partial sea level drops were manifested by ferruginous oolites, which developed in nearshore environments and were subsequently dispersed onto adjacent slopes by storm resedimentation. In southern China, aggradation, siliciclastic influx, dolomitization from evaporation, and shallow-water carbonates resulted from Famennian sea-level lowering. The coupling of glacial and lowstand events explains the sudden appearance of shallow-marine, as well as subaerially-affected features within a generally transgressive sea that breached the North American craton during Late Devonian (Frasnian) time.

INTRODUCTION

Isaacson et al. (1999) have suggested that with new evidence supporting a Devonian age for initiation of Gondwanan glaciation (Caputo 1985), many Famennian events can be explained by short-term sea-level fluctuations, and a general drawdown. The late Paleozoic (Carboniferous and Permian) Gondwanan glaciation has been well-documented in Brazil and elsewhere in South America (Caputo and Crowell 1985). It is generally well-accepted that this glaciation caused short-term sea-level fluctuations (cyclothems) in North America (Veevers and Powell 1987). The glaciation commenced in the Late Devonian in South America over a broad area, including much of Brazil (Parnaíba, Amazonas, and Solimões basins) and Bolivia (Madre de Dios and western foreland basins), and it continued into Early Carboniferous (Tournaisian) time and beyond. Its earliest deposits are dated within the late Famennian Stage (Vavrdová *et al.* 1993), although it affected sea-levels before this time. Evidence for the glaciation is discussed more extensively by Díaz-Martínez et al. (1999) and includes striated clasts within palynomorph-dated, poorly-bedded diamictites and glacial pavements. Famennian rocks in North America show evidence of a very rapid sea-level fall that exhumed carbonate platforms and resulted in extensive carbonate breccias and shoals. Lacunae punctuate the rock record, and lowstand clastic wedges and black shales were deposited during and after the major forced Famennian regression. This coupling of events explains the sudden appearance of shallow-marine, as well as subaerially-produced features, indicating 100 m to 140 m sea-level drop. A revision of Famennian transgressive and regressive cycles in a framework of the expanded (i.e., 10my long) duration of the Famennian Age (Gradstein and Ogg 1996) is required.

The eustatic drawdown effects of the Late Devonian glaciation are manifest on many present-day continents (Veevers and Powell 1987); nevertheless, the stratigraphic record in North America needs re-examination. Response to very rapid sea-level drop and the sea's episodic withdrawal from the craton is a dominant feature during Famennian time. Effects include: 1) subaerial exposure of Famennian- and Frasnian-age (and possibly older) carbonate rocks commonly resulting in their karstification and phreatic zone brecciation; 2) deposition of evaporites in some basins as sea-level fell; 3) clastic-wedge progradation as a result of forced regression manifested by black shale; 4) an extensive (temporally and areally) lacuna within the Famennian and part of the Tournaisian, punctuated by thin units of clastic rocks, carbonates, and evaporites deposited during interglacial events during the lowstand (Handford and Loucks 1993).

FAMENNIAN GLACIATION OF GONDWANA

Caputo (1985) has not only described diamictites/dropstones of glacial origin across the Parnaíba, Amazonas, and Solimões basins of Brazil, but he also demonstrated that these include faceted and striated pebbles as clasts and are accompanied by glacially striated pavements. The diamictites are up to 350 m thick, although their thickness varies greatly, as is to be expected in the peri-glacial sedimentary record. Further evidence for this Devonian glaciation was recently found in Bolivia (Díaz and Isaacson 1994; Díaz-Martínez et al. 1999), in outcrop in the Lake Titicaca region, as well as in the subsurface of the Madre de Dios Basin (Isaacson *et al.* 1995). The Brazilian glaciations extended 3500 km in an east-west direction. When Bolivia and Africa are added, the dimension increases to more than 5500 km. North-south dimensions of the glaciated area(s) are uncertain.

The timing of glacial deposition is relatively well-constrained by palynomorphs (Vavrdová *et al.* 1993; Isaacson *et al.* 1995). It generally begins within the Late Devonian (Famennian) *pusillites - lepidophyta* Palynozone and continues into the Carboniferous. A relative decrease in the abundance of marine acritarchs and associated increase of megaspores in the rocks, corresponding to the transition from the Devonian to the Carboniferous, suggest a significant coeval lowering of sea-level.

Much evidence has now been found in Bolivia for this early glaciation of Gondwanaland (Vavrdová *et al.* 1993; Díaz and Isaacson 1994; Isaacson *et al.* 1995). Large granite boulders, and faceted and striated clasts within unbedded and poorly-bedded diamictites indicate a glacial source. The Cumaná Formation (Lake Titicaca area) has a well-constrained late Famennian age (Vavrdová *et al.* 1993). In contrast to the Brazilian evidence for a large ice cap, the interpretation of the Bolivian data indicates a major glacial advance and retreat from glaciated highlands related to southwestern Gondwanaland's convergent margin (Isaacson and Díaz-Martinez 1995), with possible earlier advances. The Brazilian succession suggests two discrete glacial events during the Late Devonian, as evidenced from both surface and subsurface data (Caputo 1985). The distal periglacial character of the preserved record, both in Bolivia and Brazil, may have masked the influence of previous glacial advances and retreats. Recently, dropstones have also been discovered in the Colpacucho Formation, of late Frasnian and early Famennian age (Racheboeuf *et al.* 1993), thereby suggesting the possibility that the glaciation event(s) began much before the better-known late Famennian deposition. Also, Lang *et al.* (1991) and Censier *et al.* (1995) have presented evidence for the Devonian glaciation in equatorial Africa. Therefore, its influence in global sea-level changes needs to be considered. Given that glacial deposition represents ice-sheet maxima and the beginning of withdrawals, ice formation (and consequential sea level drop) would antedate biostratigraphically-derived ages yielded by the deposits (Buggisch 1991). With the recent revision of the Phanerozoic timescale (Gradstein and Ogg 1996) and our modified interpretations of Famennian Stage rocks (Díaz and Isaacson 1994; Isaacson *et al.* 1995) in South America, the likely presence of lacunae caused by eustatic regressions within a longer (10 m.y.) Famennian Age are compelling.

EFFECTS OF THE FAMENNIAN GLACIATION

Phreatic Zone Weathering and Evaporite Solution Breccias

We suggest that there has been a Devonian glacio-eustatic overprint of the tectonically adjusted western margin of Laurussia. Evidence of Late Devonian, Antler-associated tectonics extends across the Laurussian platform and shelf from the Nevadan Roberts Mountains allochthon to the coeval Ellesmerian orogen in Arctic Canada (McNicoll *et al.* 1995). Paleogeographic reconstructions of foreland stratigraphy using subtidal to supratidal facies associations and isopach patterns show the existence of arches and basins of various orientations. Migrating lithospheric flexural profiles, intra-plate stresses, reactivated brittle failure of pre-existing rifted Precambrian structural grain and basin inversion are commonly used to explain variations in Famennian stratigraphy.

In the U.S.A., the Famennian subsidence curve for east-central Idaho is taken from Grandview Canyon and the Tendoy Mountains (Dorobek *et al.* 1991, Dorobek 1995). The upper part of the Jefferson Formation of the Lemhi Range records 580 m of shallow-marine carbonates (mostly mudstone), quartz arenites, mostly stratiform carbonate breccias, and disconformities. These mostly unfossiliferous beds occur above a cyclic succession of Givetian and Frasnian rocks which contain organic buildups, lagoon facies and sporadic siliciclastics sourced from the craton to the east (Isaacson *et al.* 1999). The uppermost 168+ m of the Jefferson Formation comprises a limestone evaporite solution breccia and shows marked contrast to much of the unit below. Recognizable dark and light carbonate and rare red shale clasts float in a matrix of silty and sandy limestone. Extreme brecciation in the upper Jefferson Formation is well-known over a large area of NW and SW Montana (M'Gonigle 1982; Blount 1986), and coeval units have evaporites. Original environments of deposition suggest a shift to hypersalinity in a restricted basin. Early phreatic zone dissolution (Mylroie and Carew 1995) may have played a part, analogous to similar processes forming breccias of the Mississippian Mission Canyon Formation (Vice and Utgaard 1996).

Central and coastal parts of carbonate platforms in Central Europe characteristically have significant breaks in their Famennian and Tournaisian sedimentary successions (Hladil and Kalvoda 1989). Drill-hole informa-

tion, moreover, shows numerous paleokarst levels as well as diagenetic brecciation (Hladil *et al.* 1994). Sporadic onlaps of Famennian carbonates are separated by lacunae; these sediments consist of lithoclastic carbonate-sand and foralgal bioclastics. Swarms of filled fissures (Neptunian dykes) occur in the Frasnian reefs and formed during occasional sedimentary onlaps during the Famennian or Tournaisian.

In Moravia, Frasnian reef areas covered by an uninterrupted Famennnian succession represent only 5% of the carbonate surface; sporadically-flooded areas comprise 65%, and the continuously-subaerally-exposed areas 30%. Karstification of emergent islands resulted in development of cave systems. Some of the caves have very late sedimentary fills (late Tournaisian to Namurian A; Hladil *et al.* 1994). Drowning of marginal reef blocks was explained by their tilting in a transpressional system (Dvorak *et al.* 1976). At other localities, downdropping blocks in a transtensional setting has been suggested (Hladil 1988, 1994; Babek 1996). Thus, as in many regions, Late Devonian glacioeustasy was superimposed over tectonic controls of sedimentation.

In South China, the Famennian Xiangzhou-facies platform-sediments contain numerous syn-sedimentary exposure and solution surfaces that constitute good correlation markers, as follows (Isaacson *et al.* 1999): 1) Conformable karst surfaces resulting from slight karstification of the underlying beds; clay-parting laminae that sporadically drape these solution-weathered surfaces. 2) Numerous fossil molds (occluded by calcite orthospar) within dolomitic boundstone/framestone (biolithite) that culminates each cyclothem. These cavities originated during subaerial exposure and freshwater solution. Undulating surfaces at the top of these thick and massive dolomitic layers are recognizable widely in the platform facies. 3) Strongly dolomitized subaerial desiccation-fill products of stagnant-water: mainly reddish silts or marl, and gravels; these occlude solution fissures and drape bedding planes. Phosphatic and/or ferricrusts commonly cover this residue. 4) Accumulations of paleokarst breccia on bank margins, and calcarenite debris on the marginal slopes.

Craton-Derived Sand

Grader (1998) has described significant contributions of mature, craton-derived sand into the carbonate depositional systems represented by the Givetian-Famennian Jefferson Formation in Idaho (U.S.A.). It is similarly well-known that the age-equivalent Bierdneau Formation, in southeastern Idaho has quartz arenite units and mixed siliciclastic-carbonate units (Beus 1968). We emphasize that this sand is mineralogically distinct from Antler chert and lithoclast-dominated highland-sourced lithologies seen in the Famennian Pilot Shale, Nevada and the Picabo Sandstone of Idaho.

In Europe, physil and coarser-grained siliclastic influx increased as early as late Frasnian time. Partial sea-level drops were mostly accompanied by formation of ferruginous oolites that developed near the shoreline and were subsequently dispersed on the narrow shelf and slope by storm resedimentation. This concept was explored by Dreesen *et al.* (1988), and Dreesen (1989), and the phenomenon was narrowed to the Frasnian/ Famennian boundary (Hladil *et al.* 1991). Middle to late Famennian sedimentary ironstones of the Ardennes region correlate with Rhenish red shales of the Nehden, Hemberg and Dasberg intervals (Dreesen 1989). We suggest that the occurrence of these red shales manifests emergence of continents, and better oxygenation of the sea floor.

Black Shales - Organic Enrichment

In Canada, initial Famennian siliciclastics and silty argillaceous carbonates of sub-tidal to peritidal environment (Morrow and Geldsetzer 1988), are followed by a carbonate ramp and bank facies of the southwestern cratonic-shelf Palliser Formation (subsurface - Wabamun Group). The 200 m thick Sassenach Formation), which thins to the east, is feldspathic and is interpreted as filling a western basin (Savoy and Mountjoy 1995). At this time, the inner-shelf Besa River Formation accumulated over a hiatal surface; the coeval outer-shelf Earn succession constitutes part of a poorly understood western tectonic assemblage (Moore 1988). It is important to note that the model (Savoy and Mounjoy 1995) of convergent Antler tectonism associated with a foreland basin, differential subsidence (including sedimentary loading) and periodic western clastic influx also includes the Exshaw Formation and Mississippian lower Banff Formation. In this model, correlative Famennian western-margin black shales, such as the Exshaw Formation are interpreted as deep-water deposits. However, Richards *et al.* (1991) included the Exshaw in the Banff assemblage, because of its

shallow- water sedimentary structures to supratidal siliciclastic association. Overall, Moore (1988) concluded that the Famennian interval in Canada was mainly regressive. Conversely, Savoy and Mountjoy (1995) suggested that the Exshaw Formation shale was deposited at depths greater than 50m. They also infer that the Sappington Member of the Three Forks Formation and parts of the Pilot Shale represent transgressive drowning and intrusion of the oceanic oxygen-minimum zone. Using an alternative approach, we stress the possibility of paleoenvironments from 1 m to 50 m deep for many globally extant black shales. In our view, shales in the formations discussed above can also be construed in part or in whole as shallow-water deposits that are unrelated to the effects of Antler uplift and/or subsidence.

Halbertsma (1994) suggested an affinity between the Exshaw and Costigan/Big Valley strata (Upper Palliser Formation), calling upon an alternative lowstand interpretation: instead of deposition during highstand transgression, Halbertsma envisaged the pyritic black shales to have been deposited in anoxic environments on a confined shelf during lowstand condition. These rocks are characterized by shales, pyritic argillaceous carbonates, laminated limestone, limestone breccia, major disconformities and intervals of normal fossiliferous limestone deposited in a shallow subtidal setting (Halbertsma 1994). This interpretation contradicts the placement of deposits within the third and fourth Famennian transgressive events above a major faunal lacuna (Johnson *et al.* 1985, Sandberg *et al.* 1988).

Zeigler (1988) questioned glacio-eustatic influence on Upper Devonian strata at the scale of the Old Red Continent. Zeigler, and Witzke and Heckel (1988) have suggested that epicontinental seas and marginal seaways led to initial Gondwanan Laurussian contacts and cosmopolitan biotas, variable stratigraphy in widely separated basins and major lithologic shifts. In the Great Lakes region analogous Devonian black shale and brecciated deposits of the Thiensville Formation, and Famennian Antrim Shale, suggest restricted water circulation, slow sedimentation and disconformity (Kluessendorf *et al.* 1988).

Throughout Late Devonian time in eastern North America, the accumulation of black shales with progradational siliciclastic units manifested Acadian uplift to the east. Westward migration of the ultimate, Late Famennian lowstand wedge has been attributed by Pashin and Ettensohn (1995) to glacial-forcing, which is consistent with the shallow, eustatic-lowstand origin of black shales proposed here, and embodied in a revised sea-level model for the Famennian and lowermost Tournaisian.

It is now well-known that the latest Devonian units throughout Andean and intracratonic South American basins are very high in total organic carbon (TOC) values (Peters *et al.* 1996). Peterson (1993) similarly demonstrated a high primary production recorded in the Bakken-Exshaw facies. We suggest that the combination of low sealevels and increased nutrient supply engendered a significant increase in primary production which was subsequently preserved in shallow ocean basins, thereby affording high organic contents. This correlates with the significant drop in atmospheric CO_2 reported by Cox *et al.* (1999).

Evaporites

Late Devonian evaporites have been reported in western North America and elsewhere. Sandberg (1962) reported extensive avaporites in the Trident Member, Three Forks Formation. Evaporites also occur in the Stettler Formation (Wabamum Group), western Canada (Morrow and Geldsetzer 1988), and in the Dneiper-Donetz Basin, Belorus (Avkhimovich and Demidenko 1985).

The middle Famennian is dominated by regression. The widespread occurrence of evaporites is reported from Montana (Sandberg *et al.* 1983), and from the Pripyat Depression and the Dnieper - Donetz Basin (Manukalova-Grebenjuk 1974, Avkhimovich and Demidenko 1985). The middle Famennian sea-level lowstand, traced both in the western part of Laurussia (Johnson *et al.* 1985) and in Moravia (Kalvoda 1987), in Poland (Matyja 1993) as well as in Eastern Europe (accompanied by the widespread evaporite occurrence), seems to be compatible with another glacial event. Other occurrences have been reported, and this will be the subject of further documentation and research.

Lacunae

In Nevada there is a significant lacuna above Frasnian-age carbonates (Sandberg *et al.* 1988). Because tectonic-induced subsidence and paleohigh emergence rates are generally stronger than predicted glacio-

eustatic variations (Giles & Dickinson 1995), lacunae and shallow/deep lithotopes have been attributed to early Antler tectonic pulses. We do not contend the reality of Late Devonian Antler tectonics, but we propose an additional glacio-eustatic overprint at this time; purely eustatic regressions were of substantial influence. Widespread hiatuses of extra-basinal origin in conjunction with alternative reading of carbonate and siliciclastic rocks along the North American margin have lead to this interpretation.

In the southern Roberts Mountains, the shallow-water part of the Devils Gate Limestone is separated by an unconformity below Mississippian strata. Although a sea-level rise could have caused slump breccias in the upper Devils Gate Fm., we suggest alternatively they manifest the Famennian lowstand subaerial-weathering brecciation event. Episodic flooding events, accompanying interglacial times, would be responsible for the Pilot and other siliciclastic and mixed carbonate units that are bounded by erosional disconformities.

It has been suggested (Fig. 1 of Giles and Dickinson 1995) that in Nevada there are five unconformity-bound syntectonic sequences occupying the upper Frasnian and Famennian and these are attributed to changes in accommodation space in conjunction with lithospheric flexure and eustacy. Following initial thrusting of the Roberts Mountains allochthon, and the establishment of flexural topography (first sequence), the following four sequences (mostly Famennian) suggest congruous accommodation trends in coeval stratigraphic sections. Eustasy and sediment-supply have been interpreted as the primary controls on accommodation space at this time. Non-migration of the flexural features throughout the Famennian in Nevada, which otherwise would have led to inversions of topography, major Famennian hiatus, and subaerial exposure, parallel the Idaho succession (where effects of allochthon loading are not obvious), and this suggests common extrabasinal causes in marginally different tectonic environments. Lacunas separate the Trident and Sappington members of the Famennian Three Forks Formation (Idaho and Montana), further suggesting subaerial exposure with marine onlap events of short duration (interglacials) punctuating the gaps. Furthermore, it has been suggested that eustatic cyclicity in Frasnian-age units in Idaho and Montana may have manifest incipient stages of the Gondwanan glaciation (Dorobek 1995).

The inability of a deeper-water depositional model to explain Famennian events in Moravia was first suggested by Dvorak *et al.* (1986) who reassessed the region's paleogeography with its synsedimentary tectonics (Dvorak 1986). Late Devonian paleogeographic development of Moravia used to be interpreted as uninterrupted deepening from carbonate buildups (reefs) to cephalopod limestone occurring in some tectonically downdropped blocks, which rimmed the platform at Hranice and Jedovnice, Moravia. On the other hand, localities more distant from these margins typically show larger stratigraphic gaps between the end of the Frasnian reef development and Famennian sediments (e.g., Miedzianka quarry, Holy Cross Mts., Poland; central block of the Mokra quarry, Moravia; Cejchan and Hladil 1996). Central and coastal parts of carbonate platforms characteristically have significant breaks in their Famennian and Tournaisian sedimentary successions (Hladil and Kalvoda 1989).

Other Features

F. Paris (written commun. via Y. Grahn, 1997) reports several horizons of ferruginous oolites and emersion surfaces in the North African Famennian. Such has included erosion and progradation of siliciclastics. It appears that a distinction must be made between the tectonically-active Moroccan depositional systems (Wendt 1988) and the Illizi and Mourzouk basins of Algeria and Libya, respectively. In the latter, Van Houten and Karasek (1981) report several Late Devonian ferruginous oolitic horizons, suggesting cyclic shallow water deposition and subaerial exposure.

BIOGEOGRAPHY

Worldwide onset of sedimentation of Late Devonian cephalopod facies on the carbonate-platform margins mentioned above can be explained by causes other than global eustatic rise. In Famennian time, a significant lowering of sea-level and marine regression on shelves suggest a lowstand scenario of oceanic circulation; the stratified oceans of Givetian and Frasnian highstands changed to mixed-water oceans of the Famennian lowstands. Famennian coastlines appeared near former Frasnian shelfbreaks (Hladil *et al.* 1994, Isaacson *et al.* 1999). Marginal slopes located adjacent to former carbonate-platforms were reshaped into

inclined ramps, on which accumulated lime-mud sediments; and breccia slide deposits and calciturbidite fills formed in tectonic sags. Width reduction of Famennian shelves caused a shift of pelagic environments towards the coast (Hladil 1994; Hladikova *et al.* 1997). Characteristic features of the Famennian included depletion of the shelf benthic organisms, increased manganese content of the sediments, and enhanced uptake of the ^{18}O isotope in the sedimentary carbonates (Hladikova *et al.* 1997).

The middle *praesulcata* Chronozone (latest Famennian) regression is perhaps the most characteristic event. It can be traced worldwide, including the Rheinische Schiefergebirge, Belgium, Montagne Noire, Urals, China, Omolon, and North America (Kalvoda 1989), and it is more easily identifiable than the early *praesulcata* Chronozone anoxic event. This worldwide event correlates well with extended glaciation on South American continental precursors (Streel 1986). Data from many shelves show that the LE - LN Palynozone (late Famennian) sea level fall manifested a very significant glaciation peak occurring within a longer glaciation period (larger sea level lowering on continental margins of the world).

Another important event is the *sulcata* event (Kalvoda and Kukal 1987). In Moravia, as in other parts of the world, *sulcata* Biozone (earliest Tournaisian) sediments commonly unconformably overlie regressive facies of the *praesulcata* Biozone (Kalvoda 1986). In some places, the erosion that produced the unconformity also removed part or all of the *sulcata* Biozone record, and sediments of the *praesulcata* or *expansa* Biozones are overlain by sediments of the *duplicata* Biozone (early Tournaisian) or even younger zones. Even though the sea-level at this time was in a relatively lowstand mode, the *sulcata - sandbergi* interval is relatively transgressive, following the preceding middle and upper *praesulcata* regression (Bless *et al.* 1993).

The *sulcata* event was marked by a considerable change in the character of carbonate sedimentation. During the *sulcata - sandbergi* interval muddy carbonate facies were widespread. They contain abundant radiolarians, thin-shelled ostracodes and primitive foraminifera (Kalvoda 1991). In general, modeled water temperatures show that seas were generally warmer during the Famennian than during the Tournaisian (Brand 1993).

Restoration of high-diversity foraminiferan assemblages in the middle Tournaisian occurred mainly in the Paleotethyan Realm and is compatible with climatic warming in this realm. The middle Tournaisian transgression was worldwide. It is recognized in North America and Europe (Kalvoda 1989, Becker 1993), China (Muchez *et al.* 1996), as well as Siberia's Omolon Massif (Simakov *et al.* 1983). The middle - upper Tournaisian boundary is characterized by a considerable decline in foraminiferan diversity and the extinction of the *Chernyshinella* fauna (Kalvoda 1991). The onset of this interval, accompanied by the decline of this fauna, appears to be connected with the occurrence of time-specific euxinic black-shale facies along the southern European margin of Laurussia ("Calcschiste de Maurenne" in Belgium, and black shales in Moravia) and the development of widespread unconformities in North America, the Urals and in Siberia. In addition, facies with low-diversity faunas have been recognized both in Eastern and Western Europe and in North America (Kalvoda 1991).

A low diversity and widespread occurrence of calcareous foraminifera with inclusions of agglutinated grains characterize the foraminiferan fauna corresponding to the upper *crenulata - isosticha* and lower *G. typicus* Biozones. The occurrence of some taxa, such as *Paraendothyra* and *Latiendothyranopsis* in the high paleo-latitudes of the Siberian Realm and boundary regions (e.g., Tien Shan), as well as in North America, may be compatible with a high-latitude origin of the calcareous forms with agglutinated grains (caused by the availability of $CaCO$ in cold water) and migration to lower latitudes. At the middle - upper Tournaisian boundary this correlates with the reduced diversity of calcareous foraminifera. For comparison, there is a corresponding minimal effect on small agglutinated foraminifera during anoxic events during the Mesozoic (Brasier and Young 1988). The increased prevalence of shaley facies on the Tournaisian shelves evidently manifests a decline of carbonate sedimentation during a cooler climatic episode.

In the upper Tournaisian there is a transgression and widespread migration of the Paleotethyan biotic elements in the Siberian and North American Realms. This represents the Tournaisian warming climax (Kalvoda 1989). This conclusion is supported by the coral faunas (Fedorowski 1981). The upper part of the

G. typicus Biozone is characterized by diversification and widespread occurrence of "upper Kizel fauna" (especially by loeblichiids), which is typical of the Kizel Cycle of Lipina (1963) in the Paleotethyan Realm. This fauna is relatively scarce in the Siberian Realm. There is a massive migration of the Paleotethyan foraminifera fauna, which can be traced into the Kolyma region and the Omolon Massif (Yuferev 1973; Shilo *et al.* 1984) areas in Siberia.

An important aspect of the development of and changes within foraminiferan biogeography compatible with the global eustatic curve is a certain periodicity of climatic oscillations. Thus the faunal patterns in the upper parts of the stages (i.e., upper Frasnian, uppermost Famennian, upper Tournaisian) suggest the acme of climatic amelioration connected with the widespread migration of Paleotethyan tropical and subtropical organisms to the higher latitudes. This was followed by climatic deterioration at stage boundaries resulting in the immigration of taxa to the Paleotethys area from higher latitudes. The lower parts of the stages are characterized by evidence of further cooling that resulted even in the decline or retreat of the Paleotethyan fauna from high latitudes. It is partly supported by data of Streel (1986) that most glacigenic sediments of South America correspond in age to the uppermost Famennian, Tournaisian and Visean. This agrees well with Famennian and lower Visean tillites recently reported from Niger (Lang *et al.* 1991). Additional support comes from the data of Bruckschen and Veizer (1994), who report that both oxygen and strontium isotopic curves show cyclic 4th-order fluctuations with a periodicity of 10^6 years that are superimposed on the 3rd-order (10^7 year) trends. Concurrently, both curves correlate with smaller-scale sea- level changes. Since ice-volume fluctuation is the only presently-known mechanism that could have produced such sea-level changes, the 4th-order ^{18}O oscillations appear to reflect combined ice-mass and temperature effects.

Vavrdová and Isaacson (1999) report that acritarchs and prasinophyte cysts reveal a distinct provincialism in Famennian time. Recognition of provinces, based on selected temperature-sensitive morphotypes, help define paleocontinent positions and paleolatitudes. Distribution of the Late Devonian acritarch, *Umbellasphaeridium saharicum*, has been used to distinguish a high-latitude microplankton community in Frasnian and Famennian time. *Umbellasphaeridium saharicum* is dominant in Peruvian and Bolivian Late Devonian palynospectra and present in numerous western Gondwana localities, as well as in the presumed southernmost parts of Laurussia. When compared with the ubiquitous distribution of *Retispora lepidophyta*, a spore from a land plant, restriction of marine acritarchs by shallow seas is a distinct possibility.

CONCLUSIONS

While there is not direct support for early Famennian glaciation, in our opinion the sedimentological data (especially the geographical contraction of the carbonate sedimentation belt; Heckel and Witzke 1979) and paleontological data (e.g., the great impact on the stenothermal fauna), together with evidence of a worldwide regression recognized at the Frasnian - Famennian boundary (Goodfellow *et al.* 1988; Hladil *et al.* 1991) can all be construed as manifesting the effects of glaciation (Buggisch 1991).

The correlation of Gondwanan glaciation to North American marine cycles (Heckel 1977) during Carboniferous time is well-established (Veevers & Powell 1987). We submit that with increasing evidence for significant glaciation in the Late Devonian of South America, its effects in more temperate contemporary depositional systems must be studied. Several avenues of analysis are required, including: 1) timing of karstification and phreatic zone brecciation of various Late Devonian and earlier carbonates; 2) deposition of evaporites; 3) clastic wedge progradation; 4) black shales as sequential replacement lithologies for Frasnian carbonate banks; 5) the timing of Famennian hiatuses in the framework of a recently corrected timescale; and 6) further investigations of causes for significant CO decrease. Also, further study of this time interval on a global basis (e.g., ferruginous oolites in Libya) is required.

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CM D. Jeffery OVER (Geneseo)

Work has continued in investigation of Frasnian and Famennian strata and conodont biostratigraphy in the black shale dominated facies of the Appalachian Basin, as well as adjacent cratonic basins in North America. A revision of the biostratigraphy of the Chattanooga Shale is in preparation. In summary the Frasnian-Famennian boundary is at the contact of the Gassaway Member and the Dowelltown Member. The Center Hill Ash, in the upper Dowelltown Member, is in MN Zone 13. Zircons recovered from the Center Hill Ash have been sent to the lab of S. Bowring at MIT. The ash bed dated by Tucker et al. (1998) from the Chattanooga Shale at Little War Gap, and reported as the Center Hill, is the basal ash of the Belpre Ash suite. *Ancyrognathus barba* has been recovered between the ash beds of the Belpre, indicating placement in MN Zone 8 (Lower *hassi* Zone).

Conodont samples from the West River, Middlesex, Rhinestreet, Dunkirk, and Ohio shales are under investigation to resolve taxonomic, correlation, and sequence stratigraphic problems.

A web page is under construction to provide information on subdivision of the Frasnian, as decided at the SDS meeting in Morocco, 1999. The address is not yet operational.

CM Eberhard Schindler (Frankfurt)

During the past winter, I have been involved in work on trenches in the Eifel Hills area (Rohr Syncline, Blankenheim Syncline) and the surrounding strata of the Hohes Venn Anticline. These trenches have been opened in cooperation between the 'Forschungsinstitut Senckenberg' (FIS), Frankfurt, the 'Geological Survey of Nordrhein-Westfalen', Krefeld, and the 'Rheinisches Amt für Bodendenkmalpflege', Bonn, due to the construction of a gas pipeline. In the Eifel Hills, late Lower to (mainly) Middle Devonian strata have been sampled in great detail, whereas in the Hohes Venn region early Lower Devonian rocks have been trenched and sampled. Research now is under way together with the other workers of the FIS palaeontological department, including palynological investigations, and a close cooperation with Josef Winter (Frankfurt University) on bentonites from the various trenches has started.

Another big effort within the past year has been the joint work on clastic Lower Devonian rocks of the Rheinisches Schiefergebirge, namely in the Rhein/Mosel area. A big group of researchers from the FIS (located in Frankfurt are: Gerhard Plodowski, Peter Königshof, Ulrich Jansen and myself [all palaeozoologists], Volker Wilde, Rainer Brocke [both palaeobotanists]) started to work very closely and intensely together with the sedimentologists and actuopalaeontologists of the FIS department 'Senckenberg am Meer' in Wilhelmshaven (Achim Wehrmann, Günther Hertweck). Additional collaborators from other institutions are Stephan Schultka, Berlin (macro plants) and Alain Blieck, Lille (fishes). Selected sections are investigated in great detail to solve problems mainly in the fields of palaeoecology, biostratigraphy, and sedimentology.

Another main target has been the work on Upper Devonian material mainly from the western slope of the Urals. Within the framework of a joint project between the FIS and the Academic Institute in Ekaterinburg (Russia), samples are under investigation with respect to biostratigraphy and facies/sedimentology. Our Russian colleagues have been in Frankfurt last fall and we had vivid discussions completed by field work in the Rheinisches Schiefergebirge.

Work also continued within other projects. Together with a student of CM Jeff Over, granted by a Fulbright fellowship, the core of the drill hole 'Büdesheimer Bach' in the Prüm Syncline of the Eifel Hills area has been investigated.

Another ongoing research is the work within the Morocco project of the FIS. Some results on Lower Devonian strata of the Maïder area have been presented by the whole group during the IGCP 421/SDS Meeting in Morocco, where I have been involved in guiding at the Jebel Issemour section.

The project in the Albanian Palaeozoic and Triassic shows only minor progress at present. A paper on Silurian graptolites (Maletz, Königshof, Meco & Schindler), however, has been published in Senckenbergiana lethaea, vol. 78.

Finally, contributions to both working groups of the German SDS (see also 'minutes for the German SDS', this newsletter) shall be mentioned.

CM J. N. THERON (Bellville, RSA)

Research continued on the stratigraphy and depositional environment of the Lower Devonian Bokkeveld Group by Hannes Theron. In collaboration with Art Boucot publications are also in preparation on some recent new brachiopod finds in the Nardouw Subgroup (Emsian) and Bidouw Subgroup (Frasnian). With John Utting the results of a palynological investigation of the Bokkeveld Group are being assessed, and with John Almond and Owen Sutcliffe the ichnofaunas of the same are studied.

Prolonged collaboration with Maurice Streel from the University of Liege and Peter Jell from the Queensland Museum culminated in the publications listed. The former defining the enigmatic local Devonian-Carboniferous boundary, the latter representing the first comprehensive revision of the South African Devonian echinoderms since 1925.

Middle to Late Devonian fish faunas from the Bokkeveld and Witteberg Groups are under investigation by Eric Anderson, J. Almond and F. Evans in collaboration with John Long from the Western Australian Museum.

Collaboration continues with Dich Jefferies and M. Ruta from the British Museum of Natural History.

Late Devonian eustatic sea-level curves in the Witteberg Group are under investigation by Ed Cotter from Bucknell University.

RECENT PUBLICATIONS

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TM SUSAN TURNER (South Brisbane, Queensland)

DEVONIAN PUBLICATIONS

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YOUNG, G.C. & TURNER, S. 1999. East Gondwana Devonian overview. In A. Blieck & S. Turner (eds.) IGCP: 328, Final Report. Courier Forschungsinstitut Senckenberg.

See also

BLIECK A. & TURNER S. (1999).- Timing of early vertebrate evolution — Results of IGCP 328: Palaeozoic Microvertebrates project (1991-1996).- In: The Palaeozoic Microvertebrates Page: News. World Wide Web address = http://gause.biology.ualberta.ca/wilson.hp/paleozoic/IGCP328Results.html: 13 p.

CM Chuck Ver Straeten (Albany)

The first news to report is that I've been hired as Devonian stratigrapher at the New York State Geological Survey/State Museum beginning June 2000. The Survey/Museum is adding two stratigraphers to their staff in a move to bolster the paleontology/stratigraphy program and complement the regional to international focus on the Cambrian brought by Dr. Ed Landing. In addition to the Devonian position, the Museum is presently searching for an Ordovician-Silurian worker (application deadline Dec. 10, 1999). The research focus of the position will allow me more time for Devonian studies, not only in New York but also regionally and internationally.

Ongoing Devonian studies in eastern North America include analysis of mudrock depositional dynamicsand faunal change between the Middle Eifelian and Lower Famennian in the Appalachian Basin (with Brad Sageman and Carlton Brett). A part of this and other work is also focused on the record of sea level change/sequence stratigraphy between the Emsian to Lower Famennian in eastern North America, with an interest to extend this to other regions in the future. In addition, continued bentonite studies, which yielded dates for the recent Devonian time scale revision by Tucker et al. (1998), indicate the presence of bentonites thorough a broader range of facies than previously known, including the classic Middle Devonian redbed succession of the Catskill Mountains in eastern New York.

I organized a symposia for last spring's Northeastern GSA Meeting on the integration of Acadian events in the Appalachian Basin with those in the adjacent Acadian orogenic belt. The session was an attempt to open discussions toward a broader synthesis of dynamics and events in the orogenic event. Toward this, Carlton Brett and I recently submitted a manuscript utilizing small (parasequence)-scale correlations in the Eifelian Onondaga Limestone to detail the migration of a peripheral bulge-like feature across the Appalachian basin during a lull in tectonic activity. The paper also explores the implications of bulge migration and eustasy (Devonian T-R cycle Ic) for development of pinnacle reefs in deeper parts of the basin.

Recently initiated work includes conodont studies of Emsian and Eifelian strata in the Appalachian Basin. The Eifelian of New York has been the focus of previous studies; however, the lower and upper stage boundaries have not as yet been resolved. Emsian strata in the basin have received little attention in the past from conodont workers. We (myself, Gil Klapper, and possibly Jeff Over) plan to explore both carbonate and fine-grained clastics in an attempt to better resolve the conodont biostratigraphy of both stages, enabling better international correlation of significant cycles and events at that time.

In ending, I invite all to come to New York and the Appalachian Basin to study and compare the classic Devonian succession that many of you saw at the Rochester SDS Meeting two years ago. And if I can assist you in other ways (e.g., fossil loans, information), please contact me in Albany after June first.

Tucker, R.D., Bradley, D.C., Ver Straeten, C.A., Harris, A.G., Ebert, J.R., and McCutcheon, S.R., 1998, New U-Pb zircon ages and the duration and division of Devonian time: Earth and Planetary Science Letters, v. 158, p. 175-186.

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TM V. N. YOLKIN (Novosibirisk)

Current projects of my team (N.K.Bakharev, N.G.Izokh, A.G.Klets, O..A.Rodina, N.V.Sennikov) are:

(1) Subsurface Paleozoic stratigraphy of the Western Siberian Plain. There are already prepared: (a) general stratigraphic survey for the book "Geology and oil/gas potential", (b) the first version of manuscript of the separate volume "Paleozoic strarigraphy of the West Siberia" in series of books "Stratigraphy of Siberian oil and gas basins", (c) two papers are in press on a replacing dolomites from the Precambrian to Upper Devonian according to findings of forams in the core material from the South-East of region;

(2) RFBR grant "Evolution of facial environments and faunal assosiations in the Devonian on the shelf in transitional zone from the Paleoasian ocean to Siberian continent" and IGCP 421 project "North Gondwana bioivent/biogeography patterns in relation to crustal dynamics". There were carried out field works in the Gorny Altai. Clear upper Emsian ammonoids are revealed in the key Altaian section for the inner shelf zone. Results on application of data analysis methods, developed in Novosibirsk Akademgorodok, in paleobiogeography are reported, together with J.A.Talent, R.T.Gratsianova, V.N.Yolkina, T.P.Kipriyanova, A.A.Jr.Kipriyanov, on the 6th International meeting of the IGCP 421 project in Pakistan (Peshawar). For computer calculation there are used Pragian brachiopod data accumulated during more then 10 years of joint works from Asian and Australian regions. These regions were grouped into units that could be considered as faunal provinces. There is proposed the special software that after transmission into English version could be distributed by moderate payment. If somebody would be interesting, please ask additional information. I hope our report will be published soon in proceedings of the IGCP 421 meetings. Unfortunately the figure in our abstract of the Peshawar report is not complete by technical reasons.

(3) Second issue of the new edition "News of Paleontology and Stratigraphy", mentioned in the Newsletter 15, is in processing.

CM Gavin Young (Australian National University, Canberra)

I was fortunate to be able to spend 3 months in Paris March-June 1999 working with Daniel Goujet and colleagues on various fishy projects, which included description of a large Devonian fish collection from the Cravens Peak Beds of the Northern Territory and western Queensland (Georgina Basin). This contains the endemic Australian placoderm *Wuttagoonaspis* described by Alex Ritchie from western NSW many years ago. The age of the *Wuttagoonaspis* fauna, widespread in the nonmarine Devonian sequences of central Australia, has been an ongoing problem for marine-nonmarine correlation of the Australian Devonian (see Young 1993-95). A brief update of the problem is presented in Young & Turner (1999), and there have been more recent developments.

The possibility that the Cravens Peak Beds may mix two faunas (an older one in clastics, and a younger limestone assemblage) was previously contemplated, even though there was no supporting field evidence (as mapped, the stratigraphy shows the limestone beneath the clastic sequence, but faulted contacts are possible). This was an attempt to resolve confusing indications from different components of the fish fauna that it should be either younger (e.g. sharks, antiarch placoderms) or older (e.g. arthrodires) than 'Emsian-Eifelian'. Our new study (commenced in Paris, not yet finalised) has identified various widespread fish taxa supporting an older (?Pragian) age for the *Wuttagoonaspis* assemblage, consistent with latest opinions that the underlying marine assemblages in western NSW are more likely Lochkovian in age (e.g. Sherwin 1995). The question has been complicated by confusion about the significance of anomalous isotopic ages for certain Early Devonian conodont assemblages in the Lachlan Fold Belt of southeastern Australia (e.g. Colquhoun 1995), which indicate that the 410 Ma age for the S-D boundary used for the Devonian timescale in Young & Laurie (1996) was too young. My revised working calibration (Young 1997; discussed in Young & Turner, 1999) now places some stage boundaries a bit older than previously (base of Givetian at 380; Eifelian, 390; Emsian, 401; Pragian, 408; Lochkovian, 415 Ma).

The new Devonian calibration of Tucker et al. (1998), which places the S-D boundary as old as 418 Ma, has been a topic of recent discussion, in particular the discrepancies between zircon dating using the 'Sensitive High Resolution Ion Microprobe' (SHRIMP), and the method of multigrain isotope dilution used in R.D. Tucker's laboratory (see Compston & Williams 1992; Tucker & McKerrow 1995). Rationalising numbers produced by different isotopic dating methods remains a difficult problem (Claoue-Long et al. 1995). Several of the Tucker et al. (1998) ages seem too old to accommodate a range of data from the Devonian of the Lachlan Fold Belt of eastern Australia, but alternative interpretations of the isotopic data are possible (Compston, in press). Two other isotopic ages, previously relied upon for the Devonian calibration, now need re-assessment: the Laidlaw Volcanics (early Ludlow) age of Wyborn et al. (1982), and the D-C boundary age of Claoue-Long et al. (1992). Although the high experimental precision of some isotopic data are impressive, their accuracy as applied to the Phanerozoic Timescale requires caution until the reasons for discrepancies between different methods and/or different laboratories are clarified. Clearly, there is a long way to go before agreement is reached on the issue of Devonian calibrations, and a general 1% uncertainty for Palaeozoic timescale calibrations, as previously assessed for the Young & Laurie (1996) Devonian scale, seems still to apply. Some new information on Upper Devonian macrovertebrate ages for East Gondwana are discussed in Young (1999a).

Other recent publications on Devonian fishes relevant to the question of marine-nonmarine Devonian correlations of East Gondwana are listed below. These include several contributions to the forthcoming final results volume of IGCP 328 (Palaeozoic microvertebrates), to be published in the *Courier Forschungs-Institut Senckenberg*.

Recent publications, and cited references:

Basden, A., Burrow, C.J., Hocking, M., Parkes, R. & Young, G.C. 1999. Siluro-Devonian microvertebrates from southeastern Australia. (ms 42 pp., 13 text-figs.) Final results volume, IGCP 328 'Palaeozoic microvertebrates'. *Courier Forschungs-Institut Senckenberg* [in press].

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Young, G.C. 1993a. Middle Palaeozoic macrovertebrate biostratigraphy of Eastern Gondwana.- In J.A. LONG (ed.) *Palaeozoic Vertebrate Biostratigraphy and Biogeography:* 208-246; London (Belhaven Press).

Young, G.C. 1993b. IGCP 328 and SDS marine/non-marine correlation working group report: marine/non-marine correlation using vertebrates: summary of recent studies in Australia and Antarctica.- *Subcommission on Devonian Stratigraphy Newsletter* no. 10: 58-61.

Young, G.C. 1995. Timescales calibration and Development. 4. Devonian.- Australian Phanerozoic Timescales. Biostratigraphic charts and explanatory notes. Second Series. AGSO Record 1995/33: 1-47 + chart.

Young, G.C. 1997. Revision of the age of the Silurian-Devonian boundary on the AGSO Phanerozoic timescale. *AGSO Professional Opinion* 1997/01[unpublished].

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Young, G.C. & Laurie, J.R. (editors) 1996. *An Australian Phanerozoic Timescale.* Oxford University Press, 279 pp., 38 text-figs., 12 charts

Young, G.C. & Turner, S. 1999. Devonian microvertebrates and marine-nonmarine correlation in East Gondwana: Overview (ms 48 pp., 5 text-figs). Final results volume, IGCP 328 'Palaeozoic microvertebrates'. *Courier Forschungs-Institut Senckenberg* [in press].

TM K. Weddige (Frankfurt)

Special issue of Senckenbergiana lethaea „In memoriam Dr. Wolfgang Struve"

The journal „Senckenbergiana lethaea" No. 79 of 1999 is dedicated to Dr. WOLFGANG STRUVE. The two parts of this special issue have been edited by KARSTEN WEDDIGE, JOHN A. TALENT and WILLI ZIEGLER. The first part appeared at the end of November 1999, the second is scheduled for the end of February 2000.

The 34 articles focus on topics central to STRUVE's research, i.e. Devonian stratigraphy and palaeogeography. Some of these are in German, but most have been written by international authors most of whom are active in SDS and/or IGCP project 421 *North Gondwana mid-Palaeozoic bioevent\biogeography patterns in relation to crustal tectonics.*

The first part starts with papers on broad aspects of palaeogeography and general palaeontology, e.g. the *otomari* Event and STRUVE's „Great Gap". These are followed by articles on the biostratigraphy and palaeobiology of fossil groups important in the Devonian, arranged in taxonomic order, beginning with stromatoporoids and corals, and then proceeding to a broad spectrum of papers devoted to brachiopods from many regions of the globe – from Belgium to Morocco, Afghanistan, Iran, China, Australia and Alaska.

The second part concentrates on trilobites, with the addition of ostracods. The reader will be impressed by the broad temporal spectrum of the trilobite contributions ranging from Cambrian to Carboniferous.

The last contribution documents WOLFGANG STRUVE's monumental scientific life-work, specifically his 160 papers. Access to these has been facilitated by stratigraphic and palaeontologic indices, the latter enabling swift access to the specific publications within which STRUVE erected some 300 new taxa of brachiopods and trilobites.

If the journal Senckenbergiana lethaea is not available in your libraries, or you would like detailed information regarding the contents of the special STRUVE memorial issue, or if you want to order [100.- DM for each - about 300 pages thick - part of the issue, resp. 0.25 DM per page of a single reprint], please contact KARSTEN WEDDIGE [kweddige@sngkw.uni-frankfurt.de].

The editors.

INFORMATION FOR CONTRIBUTORS

There are several ways to provide contributions to the Newsletter. Listed in order of preference, they are:

1. **Computer file on disk** — Text files in any DOS, WINDOWS or MACINTOSH word processing format are acceptable (Microsoft Word is the preferred option). Graphic files are acceptable in any standard format **BUT** if the desire is to retain the image's original appearance, image files should be created with Adobe Illustrator or if created by another graphic package, they should be submitted in encapsulated postscript (eps) format.

2. **E-mail** — Text material is acceptable when contained within the body of the e-mail message. In most cases, however, this results in the loss of italics, etc. To prevent the loss of such formatting, it is suggested that contributors attach formatted text material and graphics to e-mail messages after being archived (ZIP or SIT). Check with your systems administrator or computer specialist if you are unsure how to accomplish the attachment of text or graphics.

3. **Anonymous ftp** — Contact the Editor for details.

4. **Original typewritten copy** — Please keep the number of pages to a minimum since this material will have to be either retyped into a computer file or scanned.