

Matthew

Ordovician NEWS

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NOTES FOR CONTRIBUTORS

This will probably be the last issue that I will be editing. I would like to thank you all for the many contributions made over the past number of years; I am particularly grateful to the people who sent electronic files, which makes the job of editing **much** easier. I wish my successor the best of luck.

Because of this change, please do not send any submissions for the next issue of *Ordovician News* until we know the identity of the new editor. Thanks.

Henry Williams

EDITOR'S NOTE

The current issue is rather shorter than the last two numbers owing to fewer discussion papers. The combination of this and the invaluable assistance of my wife, Kathleen Grebneff, has finally permitted me to get *Ordovician News* printed and circulated on schedule.

Henry Williams

CHAIRMAN'S AND SECRETARY'S ADDRESSES

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CHAIRMAN'S REPORT

This year is especially important for the Ordovician Subcommission with formal balloting likely for two boundaries. The COBWG-II has approved a GSSP by a majority vote - the first appearance of *Iapetognathus* n.sp. 1 at Green Point - for the base of the Ordovician System. This GSSP proposal will now be submitted to the Ordovician Subcommission, where it must receive a majority vote before it can be considered for ratification by the ICS and IUGS. I expect a formal ballot by the Subcommission to take place before the end of 1998. By then, all titular members should become fully informed of the Green Point GSSP, which will also serve as the lower boundary of the Lower Ordovician Series and the lowest, yet to be named, Stage of the Ordovician. Roger Cooper and Godfrey Nowlan, Chairman and Secretary, respectively, of COBWG-II, will provide information on the GSSP for circulation to Subcommission titular members; no doubt, those opposed to Green Point will also volunteer information and opinions. I have all COBWG-II circulars and can provide copies, upon request.

The Subcommission should also move forward on a formal ballot on the base of the second stage of the Ordovician, i.e., the base of the *Tetragraptus approximatus* graptolite Biozone. Two stratotype sections have been proposed: the Ledge section of western Newfoundland and the Diabasbrottet section at Hunneberg, Sweden. Both are discussed and debated in great detail in *Ordovician News* No. 13 and No. 14 and in other papers cited therein. No other candidates appear forthcoming. Accordingly, I conclude that it is time to proceed with a formal ballot. By mid 1998, I will mail a circular to titular and corresponding members summarizing the debate regarding the two candidate sections, inviting final discussion and debate on the two sections, and making a final call for submission of additional candidate sections. If no additional submissions are received by August 1998, I will initiate a formal ballot.

I congratulate Tanja Koren and colleagues in St. Petersburg for the well attended and well organized WOGOGOB meeting in August 1997. It was a wonderful opportunity to meet many Russian colleagues and to visit classical Ordovician field localities. A quorum of titular members was present for an ISOS business meeting, the minutes of which can be found in this newsletter. During the week before WOGOGOB, Stig Bergström led a small group that included William Berry, Stan Finney, Barry Webby, and Jörg Maletz on an Ordovician Subcommission field excursion through southern and central Sweden inspecting key sections in Hunneberg, Scania, Östergötland, and Dalarna.

The coming year includes several important meetings. Ordovician workers will be well represented in June 1998 at the 6th International Graptolite Conference in Madrid and the 7th European Condont Symposium in Modena. IGCP Project 410 (Ordovician biodiversity) will meet in Nanjing in September 1998. And, the 8th International Symposium on the Ordovician System in Prague is scheduled for June 1999. Subcommission meetings are planned for those titular members and other interested participants in attendance at the Graptolite Conference and Project 410 meeting. The meetings will provide opportunities to discuss and solicit input on Subcommission activities, but no formal business is anticipated (it is unlikely that either meeting will

have a quorum).

During the field trip to the JCY area following the Nanjing meeting, the Darriwilian GSSP at Huangnitang will be formally dedicated. The GSSP is described in a recent article in *Episodes* (Mitchell and others, 1997). I anticipate several more GSSP dedications over the next few years.

Stan Finney

ISOS ANNUAL REPORT FOR 1997

1. Name of subcommission

Subcommission on Ordovician Stratigraphy (SOS)

2. Summary table of Ordovician subdivisions

see attachment

3. Overall objectives

The Subcommission promotes international cooperation in Ordovician Stratigraphy. Specific objectives are:

a. To delimit and subdivide the Ordovician System (and Period) as a part of the overall ICS work to elaborate the standard global stratigraphic scale. This work aims to establish the boundaries (GSSPs), the correlation of the subdivisions (Stages and Series), and the nomenclature of the subdivisions.

b. To promote regular international meetings on aspects of Ordovician geology, especially those devoted to clarifying stratigraphic procedures, nomenclature and methods for use in establishing a unified global time scale, and to prepare correlation charts with explanatory notes (this latter task now completed).

c. To encourage, promote, and support research on all aspects of Ordovician geology worldwide and to provide outlets, *Ordovician News* and international meetings, for reporting results of this research.

d. To encourage, promote, and support interdisciplinary research on the Ordovician global Earth system, addressing topics that require high-resolution, global correlation (a recent addition to the Subcommission's objectives).

4. Organization

a. Subcommission Executive

Chairperson, S.C. Finney (U.S.A.)

Vice-chairperson, Chen Xu (P.R. China)

Secretary, S.H. Williams (Canada)

17 other Voting Members

92 Corresponding Members

b. Cambrian/Ordovician Boundary Working Group:

Chairperson, R.A. Cooper (New Zealand)

- Secretary, G.S. Nowlan (Canada)
 11 other Voting Members
 57 Corresponding Members
 c. Informal intra-Ordovician Working Groups
 Conveners of these groups are as follows:
 (i) base of *approximatus* (base of second Stage of Lower Ordovician Series) - S.H. Williams, S.M. Bergström, C.R. Barnes
 (ii) base of *laevis* (base of Middle Ordovician Series) - R.J. Ross, Jr., S.C. Finney, R. Ethington
 (iii) base of *gracilis* (base of Upper Ordovician Series) - S.C. Finney, S.M. Bergström, Chen Xu, R.A. Fortey
 (iv) base of *ordovicicus* (base of upper Stage of Upper Ordovician Series) - S.M. Bergström and C.R. Barnes
 d. GOES Program - research committee
 Secretary, W.B.N. Berry (U.S.A.)
 Four other members

5. Extent of national/regional/global support for projects

Independent support for projects comes mainly from individual Ordovician workers, through their employer organizations and through individual to multidisciplinary, cooperative, team activities supported by grants from national/regional government-funded bodies. SOS receives no formal support from international organizations outside IUGS/ICS.

6. Interface with other international projects

The membership of the Subcommission both geographically and in terms of research interests effectively reflects available expertise in aspects of Ordovician stratigraphy.

The Subcommission has no formal links with other global projects, though some individual Ordovician workers are members of IGCP projects, most notably the following:

- Project 319: Global Palaeogeography of the Late Precambrian and Early Paleozoic
- Project 321: Gondwana dispersion and Asian accretion
- Project 328: Palaeozoic microvertebrate biochronology and marine/nonmarine correlation
- Project 335: Biotic Recovery from Mass Extinction events - patterns, processes and implications
- Project 351: Early Paleozoic Evolution from the nucleus to the margins in Africa and South America
- Project 386: Response of the Ocean/Atmosphere System to Past Global Changes
- Project 410: The Great Ordovician Biodiversification Event

7. Accomplishments and products generated in 1997

- a. The GSSP proposal defining the base of the Darriwilian Stage was approved by

the ICS by a 65% majority vote and ratified in January 1997 by the IUGS Executive Committee. A paper on the GSSP has been submitted for publication in *Episodes*.

b. Roger Cooper and Godfrey Nowlan, Chair and Secretary, respectively, of the Cambrian-Ordovician Boundary Working Group reported the results of the second stage of the postal ballot that reduced the GSSP candidate from two sections to one. Green Point received 7 votes; Lawson Cove received 5. The boundary would be placed at the first appearance of the conodont *Iapetognathus* s.sp. 1. A paper describing the new species of *Iapetognathus* is nearing acceptance for publication. A final postal ballot to ratify the Green Point candidate GSSP will take place shortly after the paper is published.

c. Prof. Stig Bergström led a Subcommission field excursion to central and southern Sweden in August 1997. Those participating included Stig Bergström, William Berry, Stan Finney, and Barry Webby. The excursion provided the opportunity to examine candidate global stratotype sections for the base of the second Stage of the Ordovician (the base of the *T. approximatus* graptolite Zone), for the base of the Upper Ordovician Series (the base of the *N. gracilis* graptolite Zone), and for the base of the uppermost Ordovician Stage (the base of the *A. ordovicicus* conodont zone).

d. A Subcommission business meeting was held on August 12, 1997 at the WOGOGOB-97 meeting in St. Petersburg, which was partially sponsored by the Ordovician Subcommission. 31 oral papers and 28 posters were presented on Ordovician stratigraphy and paleontology, primarily of the Baltic region; three days of field excursions provided outstanding opportunity to examine the Ordovician succession exposed near St. Petersburg.

e. A quota of titular members (9), present at the business meeting at WOGOGOB-97, voted approval of the GOES (Global Ordovician Earth Systems) Program as a major activity of the Ordovician Subcommission. The GOES Program was proposed by Stan Finney and Bill Berry at the 7th International Symposium in Las Vegas in 1995. Its purpose is to promote and coordinate research on global earth systems during the Ordovician by integrating biotic events with oceanographic, atmospheric, and lithospheric events. Such research is multidisciplinary and integrates data from such disciplines as biostratigraphy, paleoecology, paleobiogeography, sedimentology, sequence stratigraphy, geochemistry, chemostratigraphy and magnetostratigraphy. The GOES research committee, which was appointed by Stan Finney and which will promote GOES activities, was also approved at the business meeting in St. Petersburg. It consists of Bill Berry, as Secretary, Stig Bergström, Chris Barnes, Ricardo Astini, and Stan Finney (ex officio). The GOES Program has no financial support and no bureaucracy. It is envisioned as a voice for Ordovician research, especially through *Ordovician News*, international Ordovician symposia, and publicity generated by the Subcommission executive. It serves the large number of scientists who study Ordovician geology, but not the boundary issues that have been the primary activities of the Subcommission.

f. In 1997 a 108-page issue of *Ordovician News*, No. 14, was published. It was edited by S. Henry Williams.

g. A Friends of the Ordovician meeting was held on October 21, 1997 at the Annual

Meeting of the Geological Society of America in Salt Lake City, Utah. More than 40 Friends attended. Stan Finney reported on 1997 activities of the Subcommission.

8. Problems encountered in 1997

The Spencer Lucas incident seemed to spoil the ICS vote on the Darriwilian GSSP proposal.

9. Work plan for 1998

a. *Ordovician News*, No. 15, will be assembled by S. Henry Williams and published in the Spring 1998.

b. A Subcommission business meeting will be held in Nanjing in September 1998 in conjunction with IGCP 410 (The Great Ordovician Biodiversification Event) and with the expedition to the Pingliang candidate stratotype section (see below).

c. A formal vote will be taken on the Green Point GSSP proposal. If approved, it will be forwarded to the Ordovician Subcommission for a formal vote of approval.

d. Significant progress is expected in 1998 on intra-Ordovician boundaries.

(i) Two candidate sections have been proposed as the GSSP for the base of the *approximatus* Zone (the base of the second global subdivision of the Ordovician), the Ledge Section in Newfoundland and the Diabasbrottet Section in Sweden. A final call for discussion is being made. If necessary, circulars will be distributed allowing for further discussion. Once completed (target date: Spring 1998), a formal postal vote will be held to select the GSSP.

(ii) Stan Finney and Stig Bergström will join an expedition led by Chen Xu of the Nanjing Institute of Geology and Palaeontology to investigate the Pingliang section, which is a possible candidate stratotype for the base of the Upper Ordovician Series. Stan Finney will revisit the Calera, Alabama section, another candidate section, to further assess its potential, and he will visit Lund University to examine new collections that will be made in the Spring from the Fågelsang candidate section, Sweden.

e. The research committee of the GOES Program will identify and encourage research projects consistent with the program, and will plan dedicated sessions for meetings in 1999 of the Geological Society of America and the 8th International Symposium on the Ordovician System.

f. The Corresponding Membership of the Subcommission will be reviewed.

g. S. Henry Williams has indicated a desire to step down as Subcommission Secretary. A new Secretary is being recruited.

Anticipated work plan for 1997-2000

a. The Executive will continue to focus on defining boundary stratotypes for all Stage and Series subdivisions of the Ordovician System. Considerable progress is planned for 1998 and 1999. Goals for formal ballots by the Subcommission are early 1998 for the base of the *approximatus* Zone, late 1998 for the base of the *gracilis* Zone, and late 1999 to early 2000 for the base of the *laevis* and *ordovicicus* zones.

b. The Eighth International Symposium on the Ordovician System will be held in Prague, Czech Republic in June 1999. There are plans for a pre-sessional field trip to Morocco and a post-sessional excursion to Spain to study the cooler, peri-Gondwana successions.

c. There will be additional field meetings to examine potential candidate sections for stratotype boundaries.

10. Potential funding sources outside IUGS

The Subcommission has no regular funding sources outside IUGS. Individual members of the executive, Voting Members and Corresponding Members must find their own financial support to carry out their research activities on boundary stratotypes and to attend various meetings (GSA-Friends of Ordovician, 8th ISOS-Prague). The Chair, who is also Chair and Professor of the Department of Geological Sciences at California State University, Long Beach, is able to obtain travel support from his university and from his research grants; yet his travel expenses necessary to develop proposals for boundary stratotypes and to conduct meetings of the Subcommission far exceed available funds. Thus, he has requested partial supplementation in the 1998 budget request for his travel to examine the Pingliang candidate stratotype section in China and important new graptolite collections from the Fagelsang section in Sweden.

Stan Finney

MINUTES OF ISOS MEETING, AUGUST 1997

Minutes of the meeting of the Ordovician Subcommission held in St. Petersburg, Russia, on Tuesday 12. August 1997 at 17.20hrs.

Chairman: S.C. Finney

In opening the meeting, the Chairman asked for the name of a secretary for the meeting. S.M. Bergström proposed, seconded by C.R. Barnes and D.L. Bruton accepted.

1. The agenda was read and accepted.

2. The Chairman said that 9 titular members of the Subcommission were present at the meeting. These were: Finney, Huff and Bergström (USA), Barnes (Canada), Bruton (Norway), Paris (France), Popov and Apollonov (Russia) and Fakta (Czech Republic).

3. The Chairman remarked that the Subcommission was very active; important voting had been made on global sections, one of which had been approved and others were soon to be approved by the Stratigraphic Commission of IUGS.

4. Subcommission Secretary.

Henry Williams has asked to be replaced as Secretary and it is hoped that this will be as

soon as possible. The delay in publishing the latest issue of *Ordovician News* was regrettable.

5. The VIII ISOS meeting in Prague, 1999

Olda Fatka presented details of the meeting to be held in June 1999 (later accepted to be latter half of June), and organised in connection with the Charles University and The National Museum and held at the time of the 200th anniversary of the birth of Barrande. A two day Barrande Symposium would be held before the ISOS meeting and local excursions lasting 5 days. Pre- and Post symposium excursions were planned for Thuringia, Portugal, Spain and Morocco; details would be sent out in the first circular in November 1997. A full social programme was being planned, sponsorship from a bank and a brewery had been obtained and this would allow some financial support for participants from countries in which travel money was lacking.

6. Corresponding members

A circular would be sent in the New Year asking old members if they wished to continue and also inviting new members to join.

7. Ordovician classification

Agreement had been reached on dividing the Ordovician System into 3 series each with 2 stages. To date the Darriwilian Stage (second stage of the Middle Ordovician Series) had been accepted and the global stratotype for the base at the *U. austrodentatus* graptolite Zone selected at Huangnitang, China. The type section is to be presented in a future edition of *Episodes*.

The proposed base of the Ordovician System at the *Iapetognathus* n.sp.1 conodont Zone, now hinged on a formal vote between the two remaining boundary stratotype sections at Green Point (7 votes) and Lawson Cove (5 votes). Voting will continue until the end of 1997 in the hope of receiving 60% or more votes for Green Point. In the meantime, refinement work at the Green Point section had been made, a manuscript on *Iapetognathus* was being prepared for publication and thoughts were being given to a name for the Lower series.

Two candidate sections have been proposed for defining the base of the second stage of the Lower Ordovician Series at the *T. approximatus* graptolite Zone. These are the Ledge, Newfoundland and at Hunneberg, Sweden. Details will appear in the forthcoming *Ordovician News*, and a decision made after voting sometime in 1998.

Selection of a type section for the base of the second series at the *T. laevis* conodont Zone was still a long way off, but work by Ethington and Finney in Nevada was encouraging. Views on further sections were invited.

Sections in the southern Appalachians, the Tarim Basin, China, and at Fögelsång, Sweden were being considered in connection with the *N. gracilis* graptolite Zone forming the base of the upper series.

8. The Global Ordovician Earth System (GOES) programme.

This programme, proposed by Finney and Berry, addresses the valuable part palaeontology has to play in solving geological problems and calls on the integrated effort of all geoscientists. The GOES research programme for the Ordovician System was set up in 1996, with Bill Bery as Secretary. It encourages inter-disciplinary effort and invites scientists to identify work they are doing that would be valuable for those interested in all things Ordovician. Such interdisciplinary efforts (e.g., IGCP 410, Bergström et al. bentonite project) sells well and is the best way of attracting funding.

The GOES programme for the Ordovician was unanimously accepted by the 9 titular members present as an important Subcommission effort.

The meeting ended at 18.20hrs. There were approximately 35 persons present.

David Bruton

CAMBRIAN-ORDOVICIAN BOUNDARY CHOSEN

The International Working Group on the Cambrian-Ordovician Boundary (COBWG) has completed its voting procedure for choosing the global stratotype section and point (GSSP) for the boundary. As reported in the last issue of *Ordovician News*, the section and point had been proposed as follows:

"The first appearance datum of the conodont *Iapetognathus* n.sp.1 in the Green Point section of western Newfoundland. This point lies in Bed 23".

The final vote was to confirm this decision; this was made in December, 1997. A 60% vote in favour of the choice was necessary before the Working Group could make its recommendation to the Subcommission.

The result gave 10 votes in favour and 3 against. One member did not reply. With 14 Voting members, a 10 to 3 result in favour gives a majority of 71%. However, the Guidelines of the Subcommission state that a "no reply" is to be counted as a "yes" vote. The official approval for the decision is therefore 11 to 3, or 79%. Either way, the decision has been approved by a clear majority.

No doubt readers of *Ordovician News* will heave a sigh of relief that after 23 years, a decision has been reached. But it is not all over yet. Early on it became obvious that there was no single section and level that clearly stood out as an obvious choice. As investigation continued, great advances were made in subdivision and correlation of the boundary interval in sections around the world, but the lack of a single outstanding candidate led to much debate and discussion. In particular, it was difficult to find a satisfactory candidate that would enable the two best groups for correlation (graptolites and conodonts) to be used directly in its correlation. The issue became increasingly controversial and this has continued to the present time. Interestingly, the difficulty in correlation that has emerged is not one of correlating between continents, biogeographic provinces or paleolatitudinal zones, but between shallow and deep water facies, even in the one region. The most abundant and diverse conodont assemblages are found on the shelf and craton rather than in slope and oceanic facies, whereas the reverse is true for the

graptolites.

We will not review here the history of the two groups, COBWG I and its successor COBWG II (this will be done in the final submission). No doubt there will be those who feel duty-bound to point out the deficiencies of the chosen GSSP and attempt to reverse the decision. It is still to be approved by the Subcommission and by the Commission on Stratigraphy. All we can say is that the Voting Members of the working group are well aware of its deficiencies but feel that, overall, the deficiencies of its rivals are greater. The final choice was necessarily a compromise. Voting Members had to take the hard decision - to live with a less than ideal section and point or to reject it. To have rejected it (by failing to give it a 60% majority approval) would have meant that the whole issue had to be opened up again, new candidates called for, and the whole procedure delayed by at least a further 5 years. As it is, we have a level that can be used, at least for the next 10 years when the decision is open to reconsideration. This is about the time it takes to demonstrate to the scientific community that the chosen GSSP is unworkable and that there is a significantly superior alternative candidate available.

The Green Point GSSP lies close to the traditional base for the Ordovician System in many parts of the world - the base of the Tremadoc Series - and thus to the first appearance of planktic graptolites. It will enable both conodont and graptolite biostratigraphic successions to be directly used in correlating the boundary interval. A full review of the genus *Iapetognathus*, with a description of the defining species, has been submitted for publication (Nicoll, Miller, Nowlan, Repetski and Ethington, submitted) and a full review of early Tremadoc graptolites is due to be published in the first issue for 1998 of *Norsk Geologisk Tidsskrift* (Cooper, Maletz, Wang and Erdmann).

Roger Cooper, Chair
Godfrey Nowlan, Secretary

NAME FOR THE EARLIEST DIVISION OF THE ORDOVICIAN

The new GSSP for the base of the Ordovician System, once it is ratified, automatically becomes the base of the earliest Ordovician subdivision (probably to be called a stage) of the System. In response to a request in 1996 from Barry Webby, then Chair of the Subcommission, I invited members of the International Working Group on the Cambrian-Ordovician Boundary (COBWG) to give their opinion on an appropriate name. So far, no opinions have been received. Members were clearly preoccupied with the more difficult issue of choosing a GSSP, which was, after all, their primary task.

I suggested that the name Tremadoc is appropriate, as the boundaries of this earliest division are close to those widely used for the Tremadoc (Fortey et al. 1995). The base will lie close to the first appearance of planktic graptolites and the top will be at the first appearance of *Tetragraptus approximatus*, assuming that both levels are ratified.

For the above reasons, this suggestion cannot come as a recommendation from the COBWG. However, I would like to remove my hat, as Chair of that group, and offer it as an individual.

Reference

Fortey, R.A., and D.T. Harper, Ingham, J.K., Owen, A.W. and Rushton, A.W.A. 1995. A revision of the Ordovician series and stages from the historical type area. *Geological Magazine* 132, 15-30.

Roger Cooper

ORDOVICIAN OF THE SIBERIAN PLATFORM

Since the late 1980's and early 1990's, a group of paleontologists and stratigraphers including A.G. Yadrenkina (brachiopods), G.P. Abaimova (Lower Ordovician conodonts) and O.V. Sychev (sedimentology) from SNIIGG&MS, and A.V. Kanygin (ostracodes), T.A. Moskalenko (Middle and Upper Ordovician conodonts) and A.V. Timokhin (trilobites) from OIGG&M SB RAS have been studying the Ordovician sections penetrated in numerous wells within the Tunguska and Vilyui synclinoria and their rims. The Ordovician is represented in cores from a great number of wells.

Very complete Ordovician sections have been revealed for the first time in many regions of poor outcrop on the northern and eastern Siberian Platform, allowing improved understanding of the geological structure of these areas.

Based on core data, type sections for different structural-facies zones have been chosen and correlated; ages and thicknesses of many formations were refined as well as their lateral boundaries; breaks and their stratigraphic range were determined. In some regions facies zone configuration was traced. The transitional Ordovician sections occurring in border areas between adjacent facies zones were differentiated. The examination of fresh core material combined with data from previously drilled wells made it possible to introduce refinements for the hitherto existing division and correlation of the Ordovician strata.

The regional correlation chart for the Siberian Platform Ordovician has been elaborated. The Ordovician strata are subdivided into 13 horizons and local zones (litas) based on trilobites, brachiopods and conodonts. N.V. Sennikov was the first to identify graptolite-containing beds. Correlation of the Ordovician strata for each structural-facies zone is given. Comprehensive characteristics of formations and correlation of the most complete sections are presented for each zone. Lithofacies charts are constructed for individual Ordovician sections.

Using the findings of the investigation, a paper on the Ordovician stratigraphy of the Tunguska and Vilyui synclinoria and their rims (from drilling data) has been prepared for publication. It includes the following sections:

1. General characteristics and a state of knowledge.
2. Zonation.
3. Global stratigraphic scale.
4. Regional stratigraphic scale and its paleontological evidence.
 - 4.1. Regional stratigraphic units.
 - 4.2. Zonal sequence.

5. Local stratigraphic units in structural-facies zones.
6. Section correlation.
7. Facies.
8. Description of brachiopods, trilobites and conodonts.

G.P. Abaimova and A.G. Yadrenkina

PROBLEMS RELATED TO THE CAMBRIAN-ORDOVICIAN BOUNDARY ON THE SIBERIAN PLATFORM

The problem of the Cambrian-Ordovician boundary is complicated on its own. The international working team has been solving it during the third decade and has not finished it yet. The reasons are well known and need no repetition here.

The development of the Siberian epicontinental basin at the Cambrian-Ordovician boundary is characterized by a number of peculiarities which in turn complicate the problem solution even for the given territory.

Over most of the Siberian Platform, exclusive of its northern portion, the Middle and Upper Cambrian is represented by terrigenous and terrigenous-carbonate, sandy-silty-argillites (with dolomite and marl interbeds), which are mottled, essentially red-colored and poorly fossiliferous, belonging to the Evenkiiskaya, Verkholskaya, Kholomolokhskaya and Morkokitskaya formations.

Grey carbonates, mainly dolomite and dolomite-marl strata of the Iltykskaya, Proletarskaya, Ustkutskaya, Tochilninskaya, Balyktakhskaya and Oldondinskaya formations occur above these levels. The nature of the contact nature is variable: it may be accompanied by erosion, sometimes it is sharp, but without distinct unconformity, occasionally it is gradational.

The lower portions of the above formations are poorly characterized by macrofauna, including trilobites, graptolites and brachiopods which are essentially endemic, and referred to the Mansi and Lopari horizons of the Ordovician (Decisions..., 1983; Kanygin et al., 1982, 1984, 1989, and others).

The conodont research done on these strata during the last decades (Abaimova and Markov, 1977; Abaimova, 1986, 1990, 1994; Abaimova et al., 1990), show the Mansi and Lopari horizons to be characterised by conodonts of the *Proconodontus* and *Eoconodontus* zones. Conodont occurrences are few in number and stratigraphically separated; nevertheless, all species are typical of the standard Upper Cambrian North American conodont sequence, including *Proconodontus tenuiseratus*, *P. postero-costatus*, *P. muelleri* and *Eoconodontus notchpeakensis*. The uppermost subdivision of the Upper Cambrian is indicated by individual occurrences of *Cambroistodus cambricus* and *Cordylodus andresi*. The findings are spaced apart through the section: thin intercalations containing fauna are usually separated by multimeter beds of barren dolomite being occasionally sulphatized.

The higher stratigraphic level is also represented in these formations by numerous occurrences of the partially endemic complex *Cordylodus proavus* (*sensu lato*) Zone.

Within the interval it is impossible to differentiate smaller subdivisions due to the absence of the zonal species *Fryxellodontus inornatus*, *Hirsutodontus hirsutus*, *Clavohamulus elongatus*, *C. hintzei* and *Cordylodus lindstroemi*.

The most paleontologically complete sections are: the 4-2 well section at the Appainskaya area and the section along Dyukte R. (Kanygin et al., 1989, p.38-47, Fig.9). Based on data from conodonts and inarticulate brachiopod remains, Stefan Ebneth performed stable isotope analysis for the Dyukte section. From Sr⁸⁷/Sr⁸⁶ ratio he (personal communication) established the existence of the eustatic event (LREE) near the upper part of the *Eoconodontus* Zone. The graptolites *Dictyonema ex gr. flabelliforme*, *D. inexpectatum*, *D. kulumbeense*, *Anisograptus aff. richardsoni*, *Callograptus staufferi*, *Airograptus furciferus*, *Dendrograptus aff. communis*, *Idiotubus* sp. and *Cysticamara* sp., of Upper Cambrian-Tremadoc age, are found in some outcrops and wells of the eastern Siberian Platform, including those in well 4-2 and near the Aikhal settlement at the Mansi-Lopari level (Sennikov, 1992, 1996).

The *Cordylodus proavus* Zone level appears to belong to the overlying Nyaya horizon and represents its lower zone. Above, in the Nyaya horizon, the *Loxodus bransoni* - *Acanthodus* and *Rossodus manitouensis* zones are recognised in almost the entire study area. Thus, the Mansi and Lopari horizons should be considered as Upper Cambrian (Rozova, 1968).

In this case the Nyaya horizon is composed of three conodont zones, *C. proavus*, *Loxodus bransoni* - *Acanthodus* and *Rossodus manitouensis* belonging to both the late Cambrian and early Ordovician. However, the final solution of the problem is hampered by the occurrence of rather young, thick, paleontologically barren intervals below and above the level with the *C. proavus* Zone complex. Another solution may be that the *C. proavus* Zone is the upper zone of the Lopari horizon. In terms of practicality, this version is favoured, with the Nyaya horizon, being completely included within the Lower Ordovician as is common in many Siberian geological practices.

During the whole of the late Cambrian and part of the early Ordovician, the Siberian epicontinental basin constituted a closed or semi-enclosed lagoon usually having no connection to other basins. Only short-term episodes of connection give the possibility of dating deposits and making intraregional and interregional correlations. Hence, a precise determination of the position of the Cambrian-Ordovician boundary on the Siberian Platform is presently impossible.

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G.P. Abaimova

THE HIRNANTIAN BOUNDARY STRATOTYPE

The Hirnantian Stage records the late Ordovician mass extinction accompanied by major climatic, sea-level and oceanographic changes. A reliable stratigraphy is therefore essential for establishing the sequence of events on a global scale. At the recent Geological Association of America Meeting in Salt Lake City (October, 1997), there was a Symposium, "Late Ordovician Mass Extinction - Silurian Recovery and Associated Perturbations of Global Earth Systems", with an accompanying field excursion. Although our hosts wished to relate their work to the Hirnantian stage, they expressed considerable frustration about the poorly defined stratotype. This is something that many working at this interval will have been aware of for many years. Furthermore the recognition of a

widespread carbon isotope excursion in approximately the lower Hirnantian should allow high resolution chemostratigraphic and potentially chronostratigraphic correlation, but as yet cannot be related to a satisfactory stratotype. I suggest that a new stratotype needs to be established in the near future to aid international integration of studies of late Ordovician events.

I suggest that the stratotype should have the following attributes:

- 1) It should be based on a section with a shelly fauna, as envisaged when the term Hirnantian was first established.
- 2) The base of the Hirnantian should be established somewhere between the disappearance of the Rawtheyan fauna and the appearance of a *Hirnantia* fauna. In practice these two levels are commonly rather widely separated.
- 3) The facies change reflecting the start of the glacio-eustatic regression should be recognisable and might be one attribute of the boundary. This facies change has in practice commonly been used to locate the base of the Hirnantian.
- 4) The strongly positive late Ordovician carbon excursion should be preserved in the section, preferably in $\delta^{13}\text{C}$ carbonate from brachiopod shell material or micrites. This would allow correlation with graptolitic sequences where a $\delta^{13}\text{C}_{\text{org}}$ is preserved.

In my experience the sections that best contain these attributes, including a *Hirnantia* fauna close to a level that might be considered base Hirnantian, are those in the Oslofjord nearby the city of Oslo. There is a substantial amount of published work on the stratigraphy, sedimentology and biostratigraphy of the sections. There is a large carbon isotope excursion recorded, though its exact extent could be further refined. The start of the excursion is close to the facies change that marks the initiation of the glacio-eustatic regression. The sequence thus yields biostratigraphic, chemostratigraphic and sequence stratigraphic information that would aid global correlation of a suitably chosen boundary stratotype.

I suggest that an Oslo section should be considered as a leading candidate for a new Hirnantian boundary stratotype but would welcome any opinions from others interested in this part of the Ordovician.

Pat. Brenchley

IGCP PROJECT No 410: THE GREAT ORDOVICIAN BIODIVERSIFICATION EVENT - Circular No 1, October 1997

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The Board of the International Geological Correlation Program approved Project 410 at their meeting last January. The project will run for five years (1997-2001). This is the first newsletter for Project 410 and is being circulated to all those who have expressed interest in the project during the planning phase and, in the first instance to, those having electronic mail services (a postal mail delivery will be provided to others). This issue includes details of our main objectives, and a set of Minutes of our recent (August 11) inaugural meeting, held in St Petersburg, Russia, in association with the 5th Meeting of the Working Group on Ordovician Geology of Baltoscandia (WOGOGOB), post-sessional field trips in the St Petersburg area from August 13-16. Included in the Minutes is a brief outline of our future meetings, and our work program. If you are able to actively participate in the work program, please contact one of the co-leaders or a regional coordinator.

A. Main objectives

The project aims to: (1) develop an improved, globally integrated zonation of graptolites, conodonts, organic-walled microfossils and shelly fossils using selected, wide-ranging bioevents and graphic correlation methods; (2) extend onshore-offshore community analyses to profiles in all latitudinal zones; (3) identify patterns of biotic response to climatic change (greenhouse to icehouse); (4) assess the physical factors (e.g., plate movements, volcanicity, climate, sea level change) that may have been responsible for promoting the major biodiversification; and (5) compare the economically significant, organic-matter assemblages of contrasting deeper, pelagic and shallow, intracratonic oil-shale deposits.

The benefits to society lie in an increased understanding of the factors controlling biotic diversity, as well as applying better time frames and facies analysis to oil shale habitats. The additions to biological understanding have application in managing marine communities. The project builds on a large existing database, and its spread of interest is global.

B. Minutes of inaugural meeting, August 11, 1997, VSEGEI lecture room, St. Petersburg, Russia

1. Attendance: 49 persons were present (see separate list). [Documents including an agenda and an outline of the IGCP project no. 410 were circulated to participants attending the meeting].

Barry WEBBY opened the meeting with a short presentation about the aims and scope of IGCP 410. He noted that it was the first IGCP project to deal specifically with an Ordovician topic. The project had been accepted by the IGCP Board in January 1997; it had received a "good" evaluation rating (one of the 8 approved projects among the 19 submitted), and granted a "medium/high" level of funding support (5400 \$US in 1997), much lower than normal because of recent withdrawal of US and UK funding support.

2. Outline of Main Objectives & Duration: A brief outline of aims and overall plans

were presented, and it was noted that the project was expected to continue over the next five years, to end of 2001.

3. Proposed Activities: Details of proposed activities were indicated in the document circulated to members attending the meeting, as follows:

1997 - In addition to the inaugural St Petersburg meeting, three other meetings were planned:

1) The first IGCP meeting for the North America regional team at the Annual Meeting of the Geological Society of America in Salt Lake City, Utah, October 20-23 (contact: Mary DROSER)

2) The first IGCP meeting of the Europe-North Africa regional team during the APF/SGF (French Paleontological Association/ Geological Society of France) meeting on "Biostratigraphy and Palaeogeography" in Lyon, 27-28 November (contact: Florentin, PARIS)

3) The first IGCP meeting of the Australasia regional team, in conjunction with the AAP conference on "Palaeobiogeography of Australasian faunas and floras", Wollongong, 8-10 December (contact: Barry WEBBY).

1998 - Two IGCP meetings have been scheduled:

1) The first meeting will be associated with the International Symposium "Palaeodiversifications - Land and Sea compared", in Lyon, France, 6-8 July (contact: Mireille GAYET, UFR des Sciences de la Terre, Université Claude Bernard, 69622 Villeurbanne cedex, France; Fax: 33 04 72 44 84 36; E-mail: gayet@univ-lyon.fr).

2) The second, will be a major IGCP 410 program of field meetings and workshops in China and Korea (co-ordinators: Profs. RONG Jia-yu, CHEN Xu, ZHOU Zhi-yi, WANG Xiao-feng and Duck K. CHOI) during September, 1998. The itinerary involves focus: (a) field trip and meeting in South Korea (6-11 September); (b) field trip to the Yichang area (successions on the Yangtze Platform - 12-16 September); (c) indoor meeting in Nanjing (17-18 September); and (d) field trip to Zhejiang-Jiangxi area of SE China (platform and slope successions - 19-23 September);

1999 - The 8th International Symposium on Ordovician System in Prague, Czech Republic, will give an opportunity for a major activity, with a session reserved for IGCP 410 presentations, and with field trips to the Barrandian region near Prague, and to Spain and Morocco. The dates of the Prague symposium have not yet been firmly fixed.

2000 - The next IGC to be held in Brazil, will provide the opportunity for a first significant major meeting of IGCP no 410 in South America.

Questions/replies:

-M. APOLLONOV: will details of the program of IGCP n° 410 be published in some journal?

- B. WEBBY: for the immediate future, news information about our work program will be circulated via the e-mail, and will be made available in regular updates to the Web

page of the Centre for Ecostratigraphy & Palaeobiology at Macquarie University, North Ryde, N.S.W., Australia (<http://www.es.mq.edu.au/MUCEP>). A full description of the project has been included in *Ordovician News* (No. 14, for 1997) but this issue has not yet been distributed. This point will be developed later.

4. Work program (especially 1997-99, inclusive): a well defined management structure has been defined under general direction of the three co-leaders, Barry WEBBY, Mary DROSER and Florentin PARIS. The necessity of REGIONAL TEAMS for the coordination of the work became apparent from the beginning. Seven teams with invited co-ordinators have been proposed:

- Australasia Barry WEBBY (chair), Bob NICOLL, Roger COOPER, Fons VANDENBERG, Ian PERCIVAL (co-ordinators)
- Balticscandia: Lars HOLMER, David BRUTON, Dim KALJO, Leonid POPOV, Sven STOUGE (co-ordinators)
- China/Korea: RONG Jia-yu (chair), CHEN Xu, WANG Xia-feng, ZHOU Zhi-yi, Duck K. CHOI (co-ordinators)
- Europe-North Africa: Florentin PARIS (chair), Alan W. OWEN, Naïma HAMOUMI, Juan Carlos GUTIERREZ-MARCO, Berni ERDTMANN, Olga FATKA (co-ordinators)
- Kazakhstan-Middle Asia-Siberia : Mischa K. APOLLONOV (chair), Igor NIKITIN, Alexei I. KIM, Alexandr V. KANYGIN (co-ordinators)
- North America: Ray L. ETHINGTON (CHAIR), Mary DROSER, Chris BARNES, Peter SHEEHAN, Bill BERRY (co-ordinators)
- South America : F. Gilberto ACENOLAZA (chair), Juan L. BENEDETTO, Ramiro SUAREZ-SORUCO (co-ordinators)

We are inviting ALL persons who wish to participate in the project to coordinate their work through their particular regional co-ordinators, and/or one of the co-leaders.

In the initial stages of the project work of each major region, it is recommended that focus be given to smaller, tectonically and/or palaeogeographically discrete AREAS of the REGION (e.g., the fold belts, continental platform and basinal areas of their region) - for individual WORKING GROUPS to be established in each AREA for the initial collection of data, where possible with a wide range of support from general geologists, and specialists such as, sedimentologists, geochemists and structural geologists. For example, in North America there would be a number of working groups, e.g., one for the Great Basin, one for the Appalachians, and so on.

Each AREA working group would encompass the rock successions of the Ordovician, with overlap downwards into the latest Cambrian and up into the earliest Silurian (to the top of the Rhuddanian = Lower Llandovery), in accord with suggestions of the IGCP Board.

5. Guidelines for the IGCP 410 Regional Work Program: Barry WEBBY gave a brief outline of an approach to be undertaken in the REGIONAL work program over the next

two or three years of the project. This outline was presented using a series of overhead diagrams and figures.

A set of four major tasks (A to D) were proposed for the REGIONAL work program over the next few years of the project:

TASK A. - "To plot the taxonomic ranges in time" [WORK IN LOCAL AREAS]

Work would commence in each AREA using a diagram with the regional time scale linked to the global Ordovician series and stages already accepted or under discussion by the Ordovician Subcommission on the left-hand margins.

A.1 - Group-by-group entries of taxonomic data would be made on these diagrams for each AREA of, say, China and other parts of E Asia.

A.2 - It was suggested that the Ordovician correlation charts published by IUGS, where available, could be used to provide the basis for plotting the full range of lithological and biotic information for each formation in the given AREA.

A.3 - Using separate diagrams with a regional time scale, list the ranges of species, genera, families... (depending of the taxonomic refinement possible) of each group, for each given AREA.

A.4 - Compile a bibliography of relevant papers for each AREA, especially keyed to each fossils group recognized.

TASK B - "To differentiate the biofacies" [WORK MAINLY IN LOCAL AREAS]

This includes:

B.1 - depicting the associations of organisms with regard to the different lithologies, and giving information on their abundance, diversity, mode of life. This data must be extended to all localities in the AREA with different faunal and/or different lithological patterns.

B.2 - documenting all the physical and chemical characters of the associated sediments, e.g.; ash layers, changes in substrates, oxygen and carbon isotope ratios.

B.3 - attempting to prepare local sea level curves that can be added to the compilations of local taxonomic range charts.

TASK C - "To establish intra-regional correlation" [REGIONAL SYNTHESIS]

This involves integrating the local data into the whole regional picture, a task undertaken by each regional team. This will allow local signals (e.g., tectonic and/or environmental) to be separated from those having wider (regional or global) significance.

TASK D - "To achieve a global synthesis" [GLOBAL SYNTHESIS]

The region-to-region syntheses aim mainly to identify globally significant events, to provide full documentation of the radiation and extinction events, and to depict the role of physical and chemical factors in shaping these major changes to the biotas.

In addition to the different "regional" objectives stated above, Barry WEBBY indicated the establishment of several other activities:

CLADE TEAMS: Groups of experts to check what is significant in the patterns of development of their particular group during Ordovician time, and the relationships with other groups.

DATABASES: Some selective databases already exist but the proposal by Alan

OWEN, University of Glasgow, Scotland, to establish a piece of software to evaluate British Ordovician biodiversity down to species level will provide the basis for its use for comprehensive analyses of our global records.

OIL SHALES: This part of the project will involve representatives of the oil industry as well as geochemists and palaeontologists. For the present the work program of this aspect of the project is under review.

Questions/ replies/comments

-Chris Barnes: such projects take much longer than we wish, especially when there is little or no funding. The major challenge is to get a positive result within a 5 year work program. The risk is that we make a compilation, but never complete the database and so to fail to achieve worthwhile conclusions. Chris suggests: 1) that we limit the number of sections to be investigated and 2) that we aim to arrive at a balance between the data collected from the different regions.

Barry WEBBY: our main problem is the limited number of people actively working on Ordovician and, moreover, this number is gradually becoming smaller. However, much data is already available: e.g., for the conodonts. The most urgent need is to collect the available information from each region in order to make it more accessible to the global audience, and allow the overall patterns of diversity change to be more clearly seen. I recognize that project has a very wide scope, but I still believe we can produce some significant results in the 5 year time frame.

Chris Barnes added: it is of prime importance to give very well defined guidelines in order to prevent a dispersal of effort.

6. Networking: information about our activities we continue to circulate once a year when *Ordovician News* is published, but we will supplement these reports with a more regular and rapid circulation of news by electronic mail. This means that all people participating to the project should advise us of their e-mail address. In addition, a Web site at Macquarie University (<http://www.es.mq.edu.au/MUCEP>) will give similar, regular updates of our activities.

Comments

Florentin PARIS : this Web site should serve as a good place to store the regional references. This reference list, with free access, must be regarded as a collective tool for the benefit of all the contributors to the project.

7. Linkages: the main linkage is with the Subcommission on Ordovician Stratigraphy, especially because IGCP no. 410 needs for its final conclusions a well defined time scale, with all stage boundaries accepted. On the other hand, the IGCP work program in the first years may help to identify potential candidate sections for GSSPs.

Additional linkages are with several other IGCP projects such as IGCP n° 335 including that includes focus end-Ordovician extinction (but the project concludes at the

end of 1997), IGCP n°406 on circum-Arctic Palaeozoic vertebrates (M. WILSON & T. MARSS) and the newly accepted IGCP n°421 focusing on "North Gondwanan Mid-Paleozoic biodynamics" (leaders Raimund FEIST and John TALENT). For the latter project, the IGCP board recommended a slight overlap between the two projects through latest Ordovician to early Llandovery time interval. Local and/or national projects may also be linked to IGCP no.410.

The GOES Program ("Global Ordovician Earth Systems"), being established by Stan FINNEY and Bill BERRY, has broader aims than IGCP no 410. It is not a specific research project but a broader initiative, of collaborative research involving a wide range of scientific disciplines, aimed at achieving a better understanding of the "complex interactions among earth's physical, chemical and biological processes during the Ordovician". The dramatic sea level changes, the climatic shifts from greenhouse to icehouse to greenhouse, the plate motions, and the widespread volcanicity are some of the other major issues requiring attention. The scope of the GOES program is therefore much broader than that of IGCP no 410, with its primary focus of documentation and analysis of Ordovician biodiversity change.

8. Finances: the funding of IGCP no. 410 is rather limited, in spite of gaining a "good" evaluation rating among recently accepted projects. Consequently, we can only provide minimum financial support, and then mainly only to support participants from non-convertible currency areas.

Comments

Florentin PARIS reminds people participating to IGCP n°410 project that the IGCP label may help for getting funding from their National IGCP committees. They are invited to make in time funding application for IGCP-sponsored meetings.

9. Publications: it is stressed that publications are of prime importance - if you like, a measure of the "health" of the project, particularly of the scientific quality and productivity of our work. We hope you will be able to contribute significantly to the project, and will acknowledge IGCP no 410 in all your relevant publications. Where possible the IGCP logo should be included in the heading of the publication. Details of all publications of participants must be included in the Annual Report of IGCP no. 410 (the first list will be submitted in October 1998).

Comments

Florentin PARIS asks all IGCP participants to submit to one of co-leaders of the project, details of the title and abstract of papers they are submitting for publication with an IGCP label. This will help us in our task of compiling an accurate and up-to-date list of IGCP no. 410 publications for the annual report.

10. Assessment: the first annual report must be submitted by 15 October 1998 with a list

of publications (published or accepted), and the major results and data compiled, based on the work of the seven regional teams and our other activities.

11. Membership: all colleagues wishing to work on any aspect of Ordovician biodiversification studies will be warmly welcomed to joint the IGCP project, and to contact one of the co-leaders for further information.

12. Additional Remarks:

Chris BARNES : what databases will you use for storing the data from various regions and what link do you see with the database project being developed in Glasgow.

Barry WEBBY: we have been invited by Alan OWEN to collaborate in the database project being established at Glasgow University. This database seems well adapted to our purposes. The alternative is to try to use some other, existing database.

Chris BARNES: each computerising program has its specific purposes and it may be not well adapted to the specific goals of IGCP 410.

Barry WEBBY: we do not want to develop a specific database for our project; we would prefer to use one that already exists, or is being developed, for our use.

Warren D. HUFF: I recommend to select a format for collecting the data and then to establish a group that agree on a software for processing the stored data.

Dick ALDRIDGE: is somebody designated as a local co-ordinator for South Africa? Prof. THERON may be the suitable person.

Barry WEBBY and Florentin PARIS: we agree fully with this choice; South Africa will be included in the South American regional group.

Barry WEBBY in closing this inaugural IGCP 410 meeting, thanked the large group of Ordovician workers for their attendance.

Minutes contributed by Florentin PARIS

C. Publications arising from IGCP-sponsored WOGOGOB meeting

KOREN, Tatjana N. (editor), 1997. Programme and Abstracts. Meeting of Working Group on Ordovician Geology of Baltoscandia, 63 pp. [The abstracts in this volume covering a wide range of Ordovician topics, including many aspects of biodiversity, were contributed by a total of 95 authors (31 separate oral communications and 28 posters) mainly from Baltic countries (Sweden, Norway, Denmark, Estonia, Poland) and Russia, but also from Ordovician workers elsewhere in Europe (France, U.K., Czech Republic, Germany, Italy) and from Belarus and Kazakhstan, as well as the United States, Canada and Australia. For copies of the volume contact: T.N. Koren, VSEGEI, Srednii pr.74, 199026, St Petersburg, Russia]

POPOV, Leonid E. (editor), 1997. WOGOGOB Excursion Guide, St. Petersburg, Russia, 1997. Uppsala University, Department of Historical Geology and Palaeontology, 24 pp., 25 figs. [This work prepared by L.E. Popov, A.V. Dronov, A.Ju Ivantsov, T.Ju Tolmacheva, L.M. Melnikova and P.V. Fedorov, for the 4-day post-sessional excursion, includes an Introduction, an Outline of Geology & Stratigraphy, and Excursion Guide to

the flat-lying Cambrian and Ordovician successions near St. Petersburg. For copies of the contribution contact: L.E. Popov or L. Holmer, Dept of Historical Geology & Palaeontology, Uppsala University, Box 558, S-751 22 Uppsala, Sweden]

Circular assembled by Barry Webby, October 1, 1997

GLOBAL ORDOVICIAN EARTH SYSTEMS

The Global Ordovician Earth Systems (GOES) program was accepted unanimously by titular members of the Ordovician Subcommission present at the meeting in St. Petersburg during August 1997 as a part of the mission of the Ordovician Subcommission.

The GOES Mission Statement - handed out at St. Petersburg - states:

"A program to stimulate research among Ordovician specialists is proposed. That research initiative is the Global Ordovician Earth Systems (GOES) research program. Research under the GOES program is designed to integrate the physical, chemical and biological processes that collectively comprise an event, an episode or a change in coupled earth-life systems during the Ordovician. The GOES research program is meant to promote integrative research among specialists in many organismal groups and in relevant physical and chemical processes. GOES is proposed to be an integrative programmatic approach to the analysis of a wide range of coupled physical-chemical-biological processes that took place during the Ordovician because the Ordovician System provides many unique opportunities to investigate linked physical-biological earth systems. For example, what are the consequences/causes of: 1) extensive mid-Ordovician vertical and lateral plate motions; 2) the rapid greenhouse-icehouse-greenhouse changes in the Late Ordovician within an otherwise long, 300 Ma. interval, of greenhouse conditions on earth; 3) widespread mid-Ordovician volcanic activity with some of the largest ash outfalls recorded in the Phanerozoic; 4) the mid-Ordovician organismal radiation with the dramatic replacement of the Cambrian evolutionary faunas with the Paleozoic Evolutionary fauna; or 5) extensive mid-Ordovician relative sea level changes that are the most extensive in the Phanerozoic? It is evident that the Ordovician is a pivotal interval to many critical events and changes in processes in earth history. GOES will stimulate inquiry into answers to these and many similar questions."

The intent is to make the primary activity of GOES the promotion of a wide range of collaborative research efforts in many areas where specialists in the study of the Ordovician identify with earth-life system issues.

Chairman Finney appointed a small committee that will attempt to provide advice to those who desire to become involved in a GOES type project. The committee will coordinate research efforts once they have been initiated. Progress reports of integrative research projects may be published in *Ordovician News* and other forums. Special theme sessions and symposia at regularly scheduled meetings will be organized to promote the collaborative aspects of this program. Chairman Finney has proposed one such

symposium be organized for the next International Geological Congress.. The steering committee for the GOES project is: Ricardo Astini, Christopher Barnes, Stig Bergström, William Berry (secretary) and Stanley Finney (ex officio).

We are anxious to make specialists aware of the need for and value in collaborative research and will make such suggestions, comments, etc. that may be helpful as we can.

Bill Berry

IGCP PROJECT No. 410: THE GREAT ORDOVICIAN BIODIVERSIFICATION EVENT: ORDOVICIAN FIELD MEETING - S KOREA & CHINA, 7-23 September 1998. 2nd Meeting Circular

PART I.- FIELD MEETING TO KOREA

7-11 September 1998, Seoul, Korea

PROGRAM. - The Korea meeting consists of a one-day indoor meeting and three-day field trip. The indoor meeting will be held at the Hoam Faculty House on the campus of Seoul National University, where meals and accommodations will be provided. We welcome oral presentations on all aspects of Ordovician geology and paleontology. The field trips will provide an overview of Lower and Middle Ordovician rocks and fossils of Korea, with emphasis on trilobites and sedimentologic features. Most stops will examine exposures at road cuts or on river beds and participants are asked to bring their own sturdy field boots. We will prepare a few spare geological hammers for those participants who do not want to carry hammers in their luggage.

Sept. 7 (Mon.): Arrive in Seoul

Sept. 8 (Tue.): Indoor Meeting

Sept. 9 (Wed.): Seoul-Taebaeg (5-hour drive); Lower-Middle Ordovician sequence at Gumunso area.

Sept. 10 (Thu.): Lower-Middle Ordovician sequence at Hyeolri area.

Taebaeg-Yeongweol (2-hour drive)

Lower Ordovician sequence at Garam area.

Sept. 11 (Fri.): Middle Ordovician sequence at Namgyo area.

Yeongweol-Seoul (3-hour drive), Korean Folk Village

Sept. 12 (Sat.): Depart Seoul to Wuhan.

CLIMATE. - September in Korea is in general quite pleasant: it would be warm to hot, ranging from 20°C to 30°C and occasionally we may have heavy rains. Light clothing is suitable during daytime, although a long-sleeved shirt and pants would be needed during evening or early morning. We also advise to bring a wide-brimmed hat, sunglasses, and raincoat.

GETTING TO SEOUL. - Many international airlines maintain a regular flight service

between Seoul and major cities around the world. The Kimpo International Airport, the main gateway to Seoul, is located at the western part of Seoul. Transportation from Kimpo International Airport to Seoul National University will be arranged by the Organizing Committee and thus all the participants are expected to meet at the arrival level of the airport terminal building. Please send your flight schedule to Duck K. Choi (dkchoi@plaza.snu.ac.kr).

ABSTRACTS. - The abstract should be written in English and a lengthy or extended abstract is preferred. The title of paper is followed by author's name and organization with mailing address. In the case of papers with more than one author, please indicate who will present the paper. The author is encouraged to send the abstract via e-mail. Participants who are not able to access to e-mail should send a print-out of the abstract. The abstract should be sent no later than 30 May 1998 to Duck K. Choi (address below).

REGISTRATION. - The registration fee for the meeting is US\$400 which includes shared accommodation, all meals, transportation from Seoul to field trip stops, abstract volume and excursion guidebook. [Participants will make their own flight arrangements to be in Seoul by September 7th to get from Seoul to Wuhan on September 12th] Please complete the attached registration form together with your payment and send to Duck K. Choi (address below) before 30 May 1998.

Duck K. Choi

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PART II

PROGRAM. - This part of the IGCP 410 meeting includes a two day indoor meeting in the Nanjing Institute of Geology and Palaeontology, preceded by a two-day field trip to the Yangtze area, near Yichang, and succeeded by a two-day field trip to the JCY area, near Changshan.

Sept. 12. (Sat). Arrive in Wuhan. Wang Xiao-feng will meet you at the Wuhan international airport. You may stay overnight at Wuhan and may get some time for sightseeing in Wuhan city.

Sept. 13. (Sun.) Wuhan to Yichang by coach (half day).

Sept. 14. (Mon.) Examine Ordovician sections in north of Yichang. Mainly shelly carbonates interbedded with graptolite beds from Tremadoc to early Ashgill and Ashgill graptolite black shale and cherts, and mudstone with Hirnantia fauna.

Sept. 15. (Tues.) Examine Early Paleozoic strata and tour in the East Yangtze Gorges.

Sept. 16. (Wed.) Morning: Yichang to Nanjing by air. Chen Xu will meet you at the Nanjing international airport. Afternoon: Indoor meeting and workshop at Nanjing Institute of Geology and Palaeontology. Evening reception held by the Institute.

Sept. 17. (Thurs.) Indoor meeting and workshop continues at Nanjing Institute of Geology and Palaeontology.

Sept. 18. (Fri.) Morning: Workshop session continues, then leave for Anhui in afternoon by coach. Stay overnight in Jingxian County Town.

Sept 19. (Sat.) Arriving Changshan County Town by coach.

Sept 20. (Sun.) Morning: Examine the Huangnitang Darriwilian GSSP section. Opening ceremony of the Darriwilian GSSP monument. The Huangnitang section includes lower Ordovician shelly carbonates and shales, middle Ordovician graptolite shale and conodont limestone lenses (Darriwilian) and upper Ordovician shelly carbonates and flysch deposits.

Afternoon: Examine the Songfan Ashgill carbonate mud mound. Evening reception will be held by Changshan County Government and Nanjing Institute.

Sept 21. (Mon.) Morning: Examine the Zhusai (Yushan) section with Ashgill carbonates and shales, reef deposits and brachiopod communities. Afternoon: Drive to Jiande County town.

Sept. 22. (Tues) Leave Jiande for Shanghai. Arrive Shanghai by the dinner time.

Sept 23 or later. Participants leave from Shanghai.

GETTING TO WUHAN. - Please send a message of your flight number and arrival time on 12 September at Wuhan international airport to Wang Xiao-feng and Chen Xu. Some participants are expected to fly directly from Seoul (via Beijing or Shanghai) to Wuhan that day.

ABSTRACTS.- All participants are requested to offer a talk at the Nanjing indoor meeting and workshop. Please send a one page abstract by diskette to Chen Xu before the end of June. We use Microsoft Word 6.0.

PAYMENTS.-

1. Yichang Pre-conference trip (Sept.12-Sept.15):

US\$60 per day for participants, US\$40 per day for accompanying members. US\$35 for coach between Wuhan and Yichang. Around 650 Yuan (about US\$80) for airfare from Yichang to Nanjing. Total: US\$355 per participant, US\$ 275 for each accompanying member.

2. Nanjing in-door meeting and workshop (Sept.16 and Sept.17):

US\$60 per day (total US\$120) for participants and US\$40 per day (total US\$80) for accompanying members.

3. JCY area Post-conference trip (Sept.18-Sept.22):

US\$60 per day for participant and US\$40 for accompanying members. The transportation (coach) between Nanjing - JCY area - Shanghai will be US\$40 for each person. The total payment for participant is US\$340 and US\$240 for accompanying members.

Wang's address:

Yichang Institute of Geology and Mineral Resources
P.O.Box 502, Yichang, Hubei Province, P.R.China.
Fax. 0086-717-6331867

Chen's address:

Laboratory of Palaeobiology & Stratigraphy, Nanjing Institute of Geology & Palaeontology, Academia Sinica, 39 East Beijing Road, Nanjing, P.R. China
Tel: 0086-25-7714443 (Office); Tel. & Fax: 0086-25-7713239 (home)
Email (2 choices): LPSNIGP@NANJING.JSPTA.CHINAMAIL.SPRINT.COM
or: rongjy@pub.jlonline.com

THOMAS E. BOLTON—IN MEMORIUM

Thomas Elwood Bolton, eminent paleontologist, biostratigrapher, and Past President of the Paleontological Society, passed away in Ottawa on November 21st, 1997 at the age of 73. Tom was born and raised in Kirkland Lake, part of the mining area of northern Ontario. He began his undergraduate studies in geology at the University of Toronto in 1941, but interrupted them to join the Canadian army in July of 1943. As a Gunner with the 12th Field Regiment at the Normandy landings, he sustained injuries and returned home for convalescence. He went back to the University of Toronto to complete his BA (Geology) in 1947, then subsequently completed a Masters and eventually a Ph.D. program at the University of Toronto under the guidance of Professor Madeleine Fritz.

His lifelong career with the Geological Survey of Canada (GSC) began in 1952. He remained active in his paleontological pursuits well into retirement and was an Emeritus Scientist with the GSC until his death. Over his career, he expanded his knowledge to include Ordovician and Silurian rocks from across Canada, especially the classic sections on Anticosti Island and elsewhere in eastern Canada. His research covered a remarkable diversity of organisms including trilobites, eurypterids, corals, brachiopods, crinoids, cystoids, bryozoans, sponges, nautiloids, gastropods and pelecypods. He published over 80 papers in his career and was working on at least 5 additional papers at the time of his death.

Not only was Tom an acknowledged authority in his field, his career was characterized by distinguished and sustained service to the discipline and he provided vital leadership to those entering the field. His long, distinguished career in paleontology was acknowledged by his receipt of the Billings Medal of the Paleontology Division of the Geological Association of Canada (GAC) in September of 1997. The hallmarks of Tom's work were cheerful involvement, modesty, effectiveness and a willingness to involve others. His style was characterized by common sense, generosity, a sharp wit and personal humility that was never meek. His enthusiasm for paleontology was contagious, and he delighted in talking to those who shared his passion whether they were "professional" paleontologists or not. If you liked fossils, Tom would share his knowledge with you.

His happy, enthusiastic presence will be missed by all who knew him and had the pleasure and honour to work with him.

Godfrey S. Nowlan

GEOLOGY AND MINERAL RESOURCES OF ESTONIA

The monograph "Geology and Mineral Resources of Estonia", edited by A. Raukas and A. Teedumägi, was published in December 1997. This lengthy volume (436 pages, A4-format) provides overall coverage of the essential mineral resources (oil shale and black shale, phosphorite, peat, construction materials, etc.) and geological formations in Estonia. It also deals with the hydrogeology, tectonic structure and evolution of the territory from the Precambrian up to the present, evolution of life in the Phanerozoic and with geological monuments in Estonia. The book includes numerous illustrations. The monograph costs \$95 (plus postage) and can be ordered from the Estonian Academy Publishers.

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<http://gaia.gi.ee/eap/>

CORRELATION CHART AND BIOSTRATIGRAPHY OF THE SILURIAN ROCKS OF CANADA

By B. S. Norford and 38 other contributors. This IUGS publication (No. 33), with 79 pages, 7 figures and 123 stratigraphic columns representing specific localities throughout Canada, is available from the IUGS Secretariat, P.O. Box 3006, Lade, N-7002, Trondheim, Norway, or from IUGS, c/o Geological Survey of Canada, 3303 33rd. St. NW., Calgary, Alberta, T2L 2A7, Canada. Tel: (403) 292-7097; Fax. (403) 292-6014. Price CN\$19.50 or US\$14.00, including postage and taxes; by cheque, Visa or MasterCard.

CHARLES DOOLITTLE WALCOTT, PALEONTOLOGIST

This book by Ellis Yochelson is an in-depth biography documenting Charles Doolittle Walcott's (1850-1927) career and life from birth to retirement. He is one of the most important and highly respected figures in the history of geology. There is a fair amount in the book on the "Taconic System", which would be of interest to US and Canadian workers, and also includes some information on Newfoundland. The price is US\$49.00 plus \$4.00 for shipping and handling. It is available at a pre-publication price of US\$44.00 before July 31 1998 and will also be available at a slightly lower price at the regional GSA meetings. It is available from the Kent State University Press, P.O. Box 5190, Kent, OH 44242-0001, USA. Tel: (330) 672-7913; Fax: (330) 672-3104) or EUROSPAN, 3 Henrietta Street, Covent Garden, London WC2E 8LU, UK.

CURRENT RESEARCH

LEHO AINSAAR (Estonia) is currently working on sedimentology and isotope stratigraphy of late Middle Ordovician environmental events in Baltoscandia (in cooperation with Tõnu Meidla and Tõnu Martma). The results suggest that the extinction event in the middle-late Caradoc is associated with sea-level change, stable isotopic shift, and changes in carbonate sedimentation. Another project is dealing the Arenig sea-level changes in East Baltic area (with Tõnu Meidla).

DICK ALDRIDGE (UK) continues to hunt for exciting soft-bodied fossils in the Soom Shale of South Africa with Sarah Gabbott and Hannes Theron. Papers in press on the chitinozoans and the taphonomy of the Soom will appear in 1998, and a paper on the orthocones and their epibionts has been submitted; immediate work will concentrate on the brachiopods, eurypterids, agnathans, enigmatic fossils and geochemistry of the deposit. Conodont work on the Ordovician of Estonia continues with Viive Viira and Stephanie Barrett.

MIKHAIL APOLLONOV (Kazakhstan) reports that last year was not particularly successful in terms of Ordovician work in Kazakhstan. Nothing was published, Damir Tsai retired and went to live to Russia, Aidar Zhilkaidarov went from our Institute to the Ministry and will be engaged in administrative work, related to economic geology in Akmola City.

HOWARD ARMSTRONG (UK) is currently involved in studies on the palaeobiology of Upper Ordovician conodonts, chert REE geochemistry, and cryptic terranes in the British Caledonides (both with Alan Owen).

CLAUDE BABIN (France) is continuing his work on bivalves from the Ordovician, including the Arenig from southern France (with Daniel Vizcaíno) and Arenig, Llanvirn and Caradoc from Spain (with Juan Carlos Gutiérrez-Marco). He is preparing a paper with John Cope examining radiations of the bivalves from Ordovician to present for the Symposium on "Paleodiversifications" in Lyons (July, 1998).

STEPHANIE BARRETT (UK) has been working on the functional morphology of prioniodontid conodonts (supervised by Dick Aldridge); she went to Estonia last summer and had a successful field season working with Viive Viira and Peppe Mannik. The material collected has helped in the studies of feeding apparatus reconstructions and the function of individual conodont elements. The study of functional morphology, considered in collaboration with histological and ontogenetic studies, will help to understand the relationships between feeding adaptations and the evolutionary patterns of the Ordovician prioniodontid radiation. This work will also be used to try to clarify the enigmatic relationship between the last Ordovician and early Silurian prioniodontids. She is especially interested in any bedding plane assemblages of

prionodontid apparatuses and is at present working on a collection of *Phragmodus* assemblages with **Mark Purnell**.

RICHARD BETTLEY (UK) is currently working on a Ph.D. project with **Richard Fortey** and **Derek Siveter** on the Middle Ordovician stratigraphy of the Anglo-Welsh area. Topics which are directly relevant to his research includes the recent discussions on the viability of the base the *N. gracilis* Zone as a sub-system boundary.

PAT BRENCHLEY (UK), with colleagues **Jim Marshall** and **Charlie Underwood** are still working on high resolution studies of the late Ordovician isotope excursion. **Paul Mason** has completed his PhD thesis on the isotopic content of extractable bitumen in late Ordovician organic matter from the Baltic region and has identified probable photosynthetic biomarkers, which may help estimates of levels of productivity and/or atmospheric CO₂. Work has started on karstified limestones filling the lower part of a large channel of Hirnantian age which incised late Ordovician facies on the eastern side of the Welsh basin. This should provide a further estimate of the magnitude of late Ordovician sea-level fall.

ROBIN COCKS (UK) has been working on: (a) Ordovician and Silurian palaeobiogeography, with papers completed on the Margins of Avalonia (with **Stuart McKerrow**) and Baltica (with **Richard Fortey**) and more work in progress on the various terranes which make up Gondwana; (b) Late Ordovician brachiopods and ecology from South China and Burma (with **Zhan Renbin**); and, (c) An early Devonian brachiopod fauna from Thailand (with **Art Boucot** and **Patrick Racheboeuf**).

JOHN COOPER (USA) is working (with **Martin Keller**) on detailing the sequence stratigraphy of the Lower-Middle Ordovician Pogonip Group, and overlying middle-Upper(?) Ordovician Eureka Quartzite in a regional transect south of the Las Vegas Valley shear zone (southern and dolomitic equivalents of many of the rocks examined on the pre-meeting Great Basin transect for the Las Vegas Ordovician meeting). They have some spectacular paleokarst features in these rocks that relate to multiple sea-level drawdown and exposure events across this part of the platform. During the next two years, **Oli Lehnert** will be doing some high-resolution conodont biostratigraphy for their project. One of his senior thesis students is working on the sequence stratigraphy of the Eureka Quartzite and has pulled some conodonts out of the Eureka from the Montgomery Mountains, NV. Two of his students are working on an unusual occurrence of paleokarst breccia within the Eureka Quartzite - sourced from the overlying Ely Springs Dolomite! He has also been working with **Stan Finney**, **Bill Berry**, **Walt Sweet**, and **Rob Ripperdan** on the Ordovician-Silurian boundary interval in the Eureka, NV district, focusing primarily on the sequence stratigraphic expression of the sea-level drawdown accompanying the Hirnantian glaciation. They ran a pre-meeting GSA field trip (guidebook paper published in *BYU Studies in Geology*, v. 42, Pt. 1, p. 79-103) last

October and took part in a GSA meeting symposium on late Ordovician perturbations and crises, which used their project as the centerpiece. Presently we are working on manuscripts for *Geology* and *Science* and hope to put all this into a *GSA Special Paper* during the next year or so.

ROGER COOPER (New Zealand) has completed an analysis of the species longevity of Ordovician graptolites which found that deep water species have an average duration (2.26 m.y.) that is less than half that of shallow water species (5.48 m.y.). A calibration of Ordovician graptolite and conodont zones, required for the previous study, will probably be published separately. The ecostratigraphy, zonation and correlation of Tremadoc graptolite sequences has just been submitted for publication. Most other work relates to the Early Paleozoic terranes of New Zealand, and to the development of a refined time scale. For the latter work we are collaborating with **Pete Sadler**, author of CONOP, and with **Felix Gradstein**, author of RASC, in developing a quantitative approach. A conference and workshop on quantitative stratigraphy will be held in Lower Hutt in the first week of August, 1998. With the voting for the Cambrian-Ordovician Boundary over, the next task will be preparing the submission for the Subcommission on the Ordovician System.

JOHN COPE (UK) is finishing off a paper on Middle Ordovician bivalves from mid-Wales and the Welsh Borderland. He and **Steve Tunnicliff** are going to work together on Upper Ordovician Anglo-Welsh bivalves and are hoping to rediscover some long lost localities in North Wales. He continues to work on his South Wales Ediacaran Fauna and has been asked to coordinate a second edition of the Geological Society's Jurassic Correlation Charts.

PAUL COPPER (Canada) In a recently published paper (Jisuo Jin and Copper, 1997: *Journal of Paleontology*) we include a new map and section of the O/S boundary around Ellis Bay on Anticosti: aficionados should note especially that we have changed the old interpretation of the upper contact of the Vaureal Fm. (Richmondian: Rawtheyan) and base of the Ellis Bay Fm. (Hirnantian) to match the new Hirnantian faunas exposed there. The contact is some 15m lower than previously suspected (Petryk, Barnes, etc). The Schmitt Creek Mbr. is exposed at Anse aux Fraises, and this fauna comes in directly above: this also coincides with a major increase in abundance of *Gamachignathus*, understood earlier to have been in the 'upper Vaureal'. Copper and Jin gave two papers, one at the GSA Salt Lake City, the other at the IGCP 'Biotic Recoveries' meeting in Prague, showing that the Anticosti O/S mass extinction events are two fold, one top Richmondian and the second top Ellis Bay Fm., and that the intervening oscillating sea level low and highstands mark the Hirnantian primarily as an interglacial episode, with biodiversity higher than either the preceding Ordovician or overlying Silurian strata. Finally, he is scribbling with **Darrel Long** in order to complete a Columbia University Press book on the O/S extinctions by the end of the year (part of the mass extinction

series).

JAN OVE R. EBBESTAD (Sweden) is continuing his Ph.D. in Uppsala, Sweden, on Baltic Upper Ordovician gastropods. Various aspects of the fauna are treated besides taxonomy, including palaeogeography and ecology. The latter has so far covered a discussion on shell repair in Lower Palaeozoic gastropods. Last year Jan collaborated with **Mare Isakar** in Tartu, Estonia, and they will continue their joint research on Baltic gastropods during 1998. Otherwise, the monographic treatment of the Lower Ordovician Ceratopyge trilobites is now in press for *Fossils and Strata*.

SVEN EGENHOFF (Germany) continues with his Ph.D., dealing with Upper Cambrian to Upper Ordovician clastic coastal to basin successions in southern Bolivia. Additionally, he just started work on trace fossils which occur in great variety in the shelf strata together with **Bernd Weber**. The work is supported by the German NSF (DFG)-Special Research Programm 267 "Deformation Processes in the Andes".

BOB ELIAS (Canada) is studying various aspects of corals and environmental change during the Ordovician radiation, mass extinction, and Early Silurian recovery. Research with **Graham Young** focuses on the diversity, ecology, and provincial structure of late Ordovician to earliest Silurian coral faunas. The paleobiology of Ordovician tabulate corals is being examined with **Dong-Jin Lee**. A postdoctoral fellow, **Xu Shaochun**, is continuing to work on late Ordovician corals of south China. M.Sc. and Ph.D. projects are available; see http://www.umanitoba.ca/faculties/science/geological_sciences/faculty/elias/elias.html for information.

BERND ERDTMANN (Germany) is now writing up a new graptolite biostratigraphy for the 5.5 km thick Lower Ordovician sequence in southern Bolivia - especially for the 500-700 m thick "Hunnebergian" (at least 4 graptolite zones between *Araneograptus murrayi* (with *Aorograptus* beneath!) and *Paratetrograptus approximatus* on top. He has two complete sections which were measured and sampled in detail.

ANNALISA FERRETTI (Italy) continues her work on Upper Ordovician conodonts. She is deeply involved in preparation for the conodont meeting ECOS VII (June 1998, Italy). A new section in the Italian Carnic Alps has been investigated with **Gabriella Bagnoli** and **Enrico Serpagli**. A global report with Enrico on several Upper Ordovician conodont faunas from Sardinia and their facies relationship is almost completed. A study on some Ashgill conodonts from Bohemia is in press in the ECOS VI congress volume.

STAN FINNEY (US) continues to lead an integrated multi-disciplinary study of Late Ordovician basin and platform sections in central Nevada. The rest of the team includes **Bill Berry**, **John Cooper**, **Walt Sweet**, **Steve Jacobson**, **Rob Ripperdan**,

Azzedine Soufiane and **Paula Noble**. Results were presented at the Geological Society of America Annual Meeting in Salt Lake City in a symposium dedicated to the Late Ordovician extinction and Early Silurian recovery. Eight papers reported the results from the Nevada section. Other presenters in the symposium included Pat Brenchley, Paul Copper, Chuck Mitchell, Peter Sheehan, Mike Melchin, John Warne, Mark Gibbs, and Lee Kump. A pre-meeting field excursion visited the Nevada sections. Papers are now being prepared for publications due out in late 1998 and 1999. Stan continues his work in the Roberts Mountains mapping the Ordovician to Devonian stratigraphy and structure of the Roberts Mountains allochthon - a project supported by the U.S. Geological Survey Educational Mapping Program. In addition, he has teamed up with an isotope geochemist, **James Gleason**, on a project titled "High Resolution Chemostratigraphic and Biostratigraphic Correlation of Ordovician Sedimentary Sequences, Ouachita and Southern Appalachian Mountains." In this project, supported by the Petroleum Research Fund (American Chemical Society), a prominent Nd-isotope shift is being correlated with graptolite biostratigraphy between the Ouachita and Appalachian mountains in order to test the reliability of Nd-isotope stratigraphy as an indicator of provenance of Middle Ordovician strata.

RICHARD FORTEY (UK) reports that the first of the papers resulting from the post-doctoral collaboration with **Jon Adrain** has been published, the trilobites from the Tourmakeady Limestone. A second part of the trilobites and stratigraphy of the base of the type Whiterockian of Nevada has been completed. The base of the Whiterockian was a time of interesting fauna change in the Great Basin (as elsewhere) and certainly not a smooth transition as it has sometimes been portrayed. Richard and **Tim McCormick** have their first paper on free swimming trilobites in press in *Paleobiology*.

ROBERT FREY (US) is currently working with **John Catalani** on a revision of the extensive nautiloid fauna described from the Middle Ordovician (Blackriveran) Platteville Group in Illinois and Wisconsin, including the description of some new taxa. He is also finishing up the photography for a systematic study of Upper Ordovician nautiloids from SE British Columbia hopefully to be published by the Canadian Geological Survey as a Bulletin.

GERALD FRIEDMAN (US) with graduate students **Shruti Philips** and **Mossbah Kolkas** continue to work in Ordovician carbonate facies of the subsurface of western New York and surface deposits of the Mohawk Valley, New York. These studies emphasize depositional environments and diagenetic overprint.

YNGVE GRAHN (Sweden) continues his co-operation with **Jaak Nõlvak** on Ordovician type sections in Baltoscandia.

JUAN CARLOS GUTIERREZ-MARCO (Spain) is continuing his study of

Ordovician fossils and sedimentary formations of the Iberian Peninsula, with collaborators in Africa and South America. Most of his activities for 1998 are focused on the organization of the Sixth International Graptolite Conference and the 1998 Field Meeting of the Silurian Subcommission. Immediate plans for Ordovician publications include the first discovery of the Hirnantia fauna from Spain (in collaboration with **Enrique Villas**), a new Middle Ordovician bivalve from Iberia (with **Claude Babin**), the Ordovician paleogeography and Ashgill conodonts from NW Spain (with **Michel Robardet** and **Graciela Sarmiento**), the preliminary study of the Lower Arenig graptolites from the Portezuelo de las Minitas Formation, Argentina (with **Gilberto Aceñolaza**), an evaluation of the Middle Ordovician chronostratigraphy from Morocco (with **Mohamed El Bourkhissi**) and several short notes on Ordovician ichnofossils, echinoderms and graptolites from Spain and Argentina, among several other contributions with maps and invited chapters to books on regional Spanish geology. Juan Carlos is also directing or participating in several active research projects with official support, for instance: the study of the Middle Ordovician of norwestern Spain (under the direction of **Jaime Truyols**), the high resolution biostratigraphy and lithoradiometry in the Middle Ordovician-Silurian of Spain, and other projects relating to the EUROPORBE or IGCP projects. A project of bilateral cooperation between the Spanish Research Council and the Bulgarian Academy of Sciences has been aproved for the biennial 1998-1999 (under the codirection of **Slavcho Yanev**) for the study of Ordovician paleogeography of Gondwanan terranes of Bulgaria. In his remaining spare time, Juan Carlos acts as Secretary of the Geological Society of Spain, does Silurian research and teaching, organizes national meetings (two in 1997 and two in 1998), edits books, and tries to spend time with his daughters!.

JEAN-LOUIS HENRY (France) is now dealing (jointly with **Daniel Vizcaino**) with Tremadoc and Arenig Calymenina (Trilobita) from the Montagne Noire, South France, to be submitted for publication this year. He is also jointly working on a project with **Muriel Vidal** on Arenig trilobites from the Anti-Atlas, Morocco. He is retiring in December this year, but will continue to work at home.

THOMAS HEUSE (Germany) is continuing biostratigraphic work on Ordovician palynomorphs (acritarchs and chitinozoans) in the East Cordillera of S-Bolivia and N-Argentina. Additionally, together with **Ivo Paalits**, he is preparing an overview of acritarch associations across the Cambrian/Ordovician boundary of the East European Platform. Also, a taxonomic revision of selected acritarch and brachiopod species from the Early Ordovician of Germany (the latter together with **Ivar Puura**) is in progress.

LINDA HINTS' (Estonia) main task during 1997 was the preparation of a manuscript (in collaboration with **Jaak Nolvak** and **Tonu Meidla**) on Ordovician stratigraphy in Estonia for the monograph *Geology and mineral resources of Estonia*. This book was published at the end of 1997; it includes reviews of Vendian-Devonian

stratigraphy with details of the Ordovician and Silurian carbonate sedimentary basin and data on the stratigraphical distribution of several groups of fossils. Studies of the Upper Ordovician sequences in southernmost Estonia showed relative rarity of brachiopods in the transitional areas between the confacies belts. Up to now the most shallow-water Thebesia and Brevilamnulile associations of the Hirnantian (*s.l.*) have not been established in Estonia. Linda is the leader of a new project "Changes of the Ordovician biotas along the onshore-offshore transect in the Baltic Palaeobasin" (1998-2000) which was approved by the Estonian Science Foundation. The results of this project wil be integrated into the IGCP Project 410. She has also coordinated the revision of geological and palaeontological collections housed at the Institute of Geology. A new database for these collections is in preparation.

OLLE HINTS' (Estonia) current research concerns various aspects of Ordovician scolecodonts; most of the material is derived from the Baltic region. One of his projects is "Changes of the Ordovician biotas along the onshore-offshore transect in the Baltic Palaeobasin" (led by **Linda Hints**). His M.Sc. thesis is devoted to Harjuan (roughly Ashgillian) eunicid polychaetes of Estonia, the emphasis being on taxonomy, stratigraphic distribution and facies dependance. The thesis defence is in June 1998, after which he will continue his work as a Ph.D. student. In 1997, one paper on the Kinnekulle K-bentonites appeared (in cooperation with **Tarmo Kiipli**); it is hoped that some problems involving K-bentonites will be studied further. Two papers on scolecodonts have bee submitted for publication.

ANETTE HÖGSTRÖM (Sweden) is studying the problematic group Machaeridia, mainly from Ordovician and Silurian sediments, for her Ph.D.

DENNIS JACKSON (UK) is once again studying Ordovician graptolites.

DIMITRI KALJO (Estonia) continues, together with his colleagues **L. Hints**, **T. Martma**, **J. Nolvak** and **A. Oraspold**, to study the uppermost Ordovician of Estonia (Pirgu and Porkuni stages) with the aim of clarifying whether the latter stage is really pre-Hirnantian as suggested by Bruton *et al.*, 1997.

OLIVER LEHNERT (Germany) is working on Cambro-Ordovician conodont biostratigraphy in the 'forgotten dolomites' of the southern Great Basin in order to prove the sequence stratigraphic framework of John Cooper and Martin Keller. With various colleagues and friends, he is still working on Early Paleozoic conodont faunas and associated microfossil groups from western and northwestern Argentina and is mainly interested in their paleobiogeographical significance.

ALFRED LENZ (Canada) and **Dennis Jackson** are beginning the study of a thick sequence of diverse and well-preserved Tremadoc graptolites collected from northern

Yukon, primarily from the Peel River, many years ago. The fauna has important ramifications for understanding the biostratigraphic position of the genus *Psigraptus*.

PIERRE LESPERANCE (Canada) retired last May but has remained active to complete two research projects and put his collections in order. Technical support at the Département de géologie of the Université de Montréal ended in the Spring of 1997 and the department itself will cease to exist by June 1st 1998. P. J. Lesperance's library will be transferred to the Miguasha Museum in Gaspé and his brachiopod and trilobite collections to the Geological Survey of Canada in Ottawa, hopefully during the summer of 1998. One of the research project mentioned above will be published in the March issue of the *Journal of Paleontology* 1998 (Ashgill trilobites from the Percé area (Pabos Formation).

ANITA M. LÖFGREN (Sweden) is continuing work on the apparatus reconstructions of some Early Ordovician coniform conodonts; manuscripts on *Semiacontiodus cornuformis*, "Scolopodus?" *peselephantis* and *Cornuodus* are being finished, while papers on *Paroistodus* and *Paltodus* have just been published. She is also currently working on biostratigraphic problems in the upper Arenig.

DARREL LONG (Canada) is currently examining a plethora of cores and a scattering of outcrops in the Moose River sub-basin of the Hudson platform in order to determine if coastal boundary currents, storm systems or alternate bypass mechanisms had significant influence on Ordovician (Silurian and Devonian) facies segregation and interaction in this epic basin. So far (? estuarine) bypass mechanisms are winning - but watch out for an anticlockwise gyre driving the coastal boundary currents. Most of the Upper Ordovician strata in the basin (equivalent to the Bad Cache Rapids Group, Ashgillian Churchill River Group and Red Head Rapids Formation) are dominated by unfossiliferous to sparsely fossiliferous intertidal to shallow subtidal carbonates, with local development of evaporitic facies. The availability of core from more than 45 holes in the basin will allow development of a detailed sequence stratigraphic and paleogeographic framework for the basin - it would help to have more outcrops on those rivers !

SANDY MCCRACKEN (Canada) submitted a multi-authored manuscript for a *GSC Bulletin* on the Ordovician of Baffin Island. Papers are by B. Sanford and A. Grant (geology), T. Bolton (macrofossils), M. Copeland (ostracodes), J. Riva (graptolites), E. Asselin, A. Achab, A. Soufiane (chitinozoans), A. McCracken (conodonts; history of exploration).

PEEP MÄNNIK (Estonia) is studying the evolution, palaeoecology and taxonomy of Ordovician (Caradoc to Ashgill) and Silurian conodonts in the Baltic and Russian Arctic and applications to high-resolution stratigraphy.

JÖRG MALETZ (Germany) completed his Habilitation Thesis on the Ordovician of the Rügen subsurface in January. A manuscript on the graptolite faunas and biostratigraphy has been submitted to *Palaontologische Zeitschrift*. He is working together with Gerhard Katzung, Hagen Beier and Antje Niedzwiedz on the development of an Ordovician-Silurian foreland basin at the southwestern margin of Baltica. On a trip to North China in September 1997 with Wang Haifeng he collected Tremadocian graptolites from several sections. Further taxonomic work on Tremadocian graptolites from China and Newfoundland is planned, mostly on isolated material. Taxonomic work on late Tremadoc graptolites from eastern North America (with Ed Landing), Middle Cambrian rhabdopleurids from Bohemia (with Michael Steiner), and late Wenlock graptolites from Albania (with Peter Königshof and Eberhard Schindler) is in progress.

TONU MEIDL (Estonia) is continuing research on the Ordovician of Baltoscandia, stratigraphy, ostracode taxonomy and palaeoecology, Arenig faunal successions and sea levels (together with L. Ainsaar, A. Dronov and S. Stouge), mid-Caradoc faunal successions and oceanographic event (together with L. Ainsaar and T. Martma), and the latest Ordovician event (together with L. Hints and J. Marshall).

MICHAL MERGL (Czech Republic) continues to study lingulate brachiopods from the Bohemian Ordovician (papers about the genus *Paterula* and late Ordovician lingulates from Kralv Dvr Formation will be finished in early 1998). Other research is directed towards obolid brachiopods from the late Cambrian-early Ordovician of Spain. His study of Siluro-Devonian lingulate brachiopods from Barrandian is in progress.

BOB NEUMAN (USA) continues work with Leonid Popov on their report of Arenig-Llanvirn brachiopods from south-central Kazakhstan. Bob is also engaged in long-deferred work on collections of Late Ordovician brachiopods from northeastern Maine, at least one of which is a Hirnantian fauna, recognized as such by Rong Jia-yu during his July 1997 visit in Washington.

JAAK NOLVAK (Estonia) continues his work on Ordovician chitinozoans and biostratigraphy from Baltoscandian sections. More detailed work is proceeding for uppermost Ordovician beds in the East Baltic together with his Estonian colleagues, and for some middle Ordovician sections from Sweden in cooperation with Yngve Grahn and Erik Sturkell.

ALAN OWEN (UK) has started work on a database to contain and analyse information on Ordovician faunas from the British Isles as part of IGCP 410 "The Great Ordovician Biodiversification Event" and has been made the Royal Society Correspondent on that project. He continues to work on Ordovician faunas from the Leinster terrane (with Matthew Parkes) and Iapetus suture zone (with Mike Romano and Dave Harper)

in Ireland and from the Southern Upland and Midland valley terranes (with, *inter alia*, **Howard Armstrong** and **Keith Ingham**) in Scotland. Work on the geochemistry of cherts from the Southern Uplands (with **Howard Armstrong** and **Jim Floyd**) and its bearing on the plate tectonic setting of the terrane is being written up for publication. A new project (largely with **Howard Armstrong**) on Ordovician faunas in clasts in Silurian and Devonian conglomerates in the Midland Valley terrane has already produced some interesting results concerning the provenance of these rudites. A Geological Conservation Review volume on British Cambrian and Ordovician sites (with **Adrian Rushton** and **Bob Owens**) is nearing completion and progress is being made on the revised Geological Society of London Ordovician correlation charts (coordinated by **Richard Fortey**).

IAN PERCIVAL (Australia) has been expanding the local Ordovician conodont zonation in central New South Wales, finding a rich Lower Ordovician fauna in allochthonous limestones overlain by siltstones bearing Bendigonian graptolites. **Yongyi Zhen** and **Barry Webby** are collaborating in a description of the majority of the conodont species; another paper is planned bringing in **Bob Nicoll** to describe *Bergstroemognathus* from this fauna. Work on a younger (late Darriwilian-Gisbornian) macrofauna from higher in the sequence, by Percival, Webby, and **John Pickett**, is well advanced. Upper Ordovician conodonts and other microfauna newly recognised in the past year from the Gulgong Belt allow precise correlation with successions on the Molong Belt to the west. Results of this work were presented at the Palaeobiology of Australasian Faunas and Floras (PAFF) conference held at the University of Wollongong in December. Ian contributed several sections to the Ordovician chapter (being co-ordinated by Barry Webby) of the proposed PAFF book.

J. KEITH RIGBY (USA) continues to work on fossil sponges from the El Paso Group in the Franklin Mountains of Texas and New Mexico with Blair Linford and David LeMone. They hope to submit a manuscript to the Journal of Palaeontology on the systematics and occurrences of the sponges in the sequence there. He is working with Paul Myrow on an assemblage of sponges out of the Ordovician Manitou Limestone from the Garden of the Gods locality in the Colorado Front Range west of Colorado Springs. In both areas the sponges are associated with stromatolite mounds. In the El Paso sequence they become part of the mound reef structure, as well as occurring in debris around the mounds, but in the Colorado locality they occur as debris between much smaller mounds in several horizons. He also continues work on the Lower and Middle Ordovician sponges from western Utah and eastern Nevada, focusing on the Ibex region in the Confusion Range in western Utah.

DAVID ROHR (USA) is completing a study of Middle Ordovician gastropods from the Table Point Formation and Cow Head Group of western Newfoundland. He plans to start looking for Lower Ordovician snails from same area in Summer 1998, as part of a

joint study with **Doug Boyce**.

NORMAN SAVAGE's (USA) work involves those rhynchonellid brachiopods that occur in the Ordovician (as part of his revision of the Paleozoic Rhynchonellida for the new Brachiopod Treatise). He is heavily committed to work on Late Devonian Russian conodont faunas. He has good photographs of his sample sites that were the source of the several new species described in his Ordovician Cliden Caves paper (*Jl. Paleontology*, 1990) and copies of these photographs can be made available to anyone who has need of them.

N.V.SENNIKOV's (Russia) latest paper considers the structural position and reports the first data on the paleontology of the Zasur'ia Formation from the sections of the Gorny-Altaï Series in the northwestern part of Gorny Altaï. Conodonts and radiolaria have been found in the siliceous rocks of this formation following chemical preparation. Under discussion are the problems of correlation of Zasur'ia Formation with strata from the western part of Altai-Sayan Folded Area, which occupy the same stratigraphical position and are similar in composition. On the basis of new paleontological data, the Upper Cambrian-Lower Ordovician stage of the active margin and the evolution of the Paleoasian Ocean have been proven.

THOMAS SERVAIS (France) has moved once again and works now as a CNRS research associate at Villeneuve d'Ascq, France. He continues studies on Ordovician acritarchs with projects in the Ordovician of Belgium and Germany and on the Cambro-Ordovician boundary beds in Algeria. He is currently reviewing data from the German Ordovician with **Bernie Erdmann** and co-workers. A paper with **Jörg Maletz** on Belgian graptolites should come out this year in *Geobios*. And the literature review of Ordovician acritarchs, submitted a couple of years ago, should finally see its publication this year in the *Annales de la Société Géologique de Belgique*.

JOHN SHERGOLD (France) has retired from the Australian Geological Survey Organisation and has relocated to France. He is currently associated with the Institut des Sciences de l'Evolution, Laboratoire de Paléontologie, Université de Montpellier II, where he is working with **Raimund Feist** on the late Cambrian trilobites of the Montagne Noire.

LAWRENCE SHERWIN (New South Wales) continues with work on mostly late Ordovician sequences from the Parkes-Forbes area of central west New South Wales and is investigating differences in graptolite assemblages from siliciclastic and volcaniclastic sequences.

NILS SPJELDNÆS (Norway) is working on Ordovician bryozoans, mainly the Caradoc ones from Baltoscandia, but also others, especially from North-Africa and SW

Europe. The main project is a large one, and will not be completed in 1998. If anybody is interested in a status report, please contact him. Minor projects related to the Ordovician are an attempt to establish a sequence stratigraphy for the Oslo Region, and to look at the Ordovician/Silurian boundary in the Oslo Region. He is busy changing Middle to Upper and Lower to Middle Ordovician in his bryozoan projects.

FONS VANDENBERG (Australia) has put the VandenBerg and Cooper Ordovician graptolite range chart into XL 5.0 (and updated it slightly); it is available to anyone who asks. It is only a small file (53 Kb) and is easily sent by e-mail.

JIRI VANEK (Czech Republic) continues work on Ordovician trilobites and biostratigraphy from the Prague Basin (Barrandian).

VILLE VIIRA (Estonia) continues work on Ordovician and Silurian conodonts in the northern East Baltic.

BEATRIZ WAISFELD (Argentina) continues to work on Ordovician trilobite faunas from western Argentina. Her studies are focused on taxonomy, paleoecology and paleobiogeography. She is also working on different aspects of the Ordovician radiations along with **Teresa Sanchez**.

WANG XIAOFENG (China) is continuing to work with **Chen Xiaohong** on the Ordovician-Silurian graptolites and chitinozoans, sequence stratigraphy and palaeobiogeography in South China. Considering that the water level in the upper reaches of the Yangtze River will rise by 170m after completion of a new dam located in the Yangtze Gorges area about 40km away from Yichang, some well-known or named sections from the Middle Archean to Jurassic currently exposed in the river-sides, will be under-water in the year 2010. As a result, he organized a team of colleagues to start a new project on the protection and collection of valuable geological records in the Yangtze Gorges area in 1997 and plans to finish in 2000. This will be in association with a selection of substitute sections and research on bio-, event- and sequence stratigraphy in reselected sections. The research emphasis is put on the Sinian, Lower Paleozoic and Permian-Triassic rocks.

BARRY WEBBY (Australia) is continuing to work on a number of Ordovician projects and with **Mary Droser**, **Florentin Paris** and many other participants in IGCP project no. 410 (The Great Ordovician Biodiversification Event). A paper (with **Zhen Yong-yo** and **Chris Barnes**) on Late Ordovician conodonts from the Bowan Park Group, central NSW was recently accepted for publication in *Geobios*. Also well advanced is a manuscript reviewing the Ordovician Biogeography of the Australasian region to be published in a volume by OUP; it has involved participation of fourteen specialists in different taxonomic groups. Barry and **Ian Percival** are coordinating this

contribution. Other cooperative studies are commencing on Australasian Ordovician biodiversity topics.

BERND WEBER (Germany) has started a paleontological research programm on ichno- and macrofossil assemblages in Ordovician sediments from SW-Gondwanan shelf deposits. He studied ichnofossils in shallow marine siliciclastic rocks in southern Bolivia together with **Sven Egenhoff**. He continues his work on probably Lower Ordovician trace fossils and arthropods from the Shackleton Range (W-Antarctica). His work is supported by the NSF (DFG).

MALCOLM WEISS (USA) reports that he has just completed a biography of Frederick W. Sardeson, to be published in 1998 by the Minnesota Geological Survey. Sardeson was an innovative student of the stratigraphy and paleontology of the Ordovician rocks of the Upper Mississippi Valley (MN, WI, and IA) from 1890 to 1940. The book concentrates on Sardeson's work and the exigencies of his professional life. He was also engaged in the stratigraphy and mapping of Pleistocene deposits over much of the state of Minnesota.

HENRY WILLIAMS (Canada) is trying (mostly in vain) to tie up some loose ends before heading off to Calgary on sabbatical this summer. His graduate and honours students are doing rather better, with **James Carter** having submitted his thesis on the structure, geochemistry and sedimentology of the Caradoc of central Newfoundland and **Lorna Clarke** having completed a preliminary study on specific variation and biostratigraphic use of Ordovician graptolite prosiculae. **Helen Gillespie** is nearing completion of her thesis on Caradoc acritarchs from western Newfoundland. Henry's paper with **Elliott Burden** on the thermal maturity of potential source rocks in western Newfoundland has finally been accepted for publication, and they are now able to begin preparation of previously confidential subsurface studies for submission. Projects in progress include Lower to Upper Ordovician graptolites from the Hamburg Klippe of Pennsylvania (with **Bob Ganis**), Ordovician-Silurian boundary graptolites and brachiopods from Yewdale Beck, UK (with **Dave Harper**) and a revision and extension of the Ordovician-Silurian boundary section at Dob's Linn (with **Mike Melchin**).

MARK WILSON (USA) and **Paul Taylor** have finished a project assessing the paleoecology, evolutionary systematics and skeletal mineralogy of the Ordovician bryozoan *Dianulites*. They continue to work on Ordovician cyclostome bryozoans, especially in regard to possible links between the stenolaemates and gymnolaemates.

XU SHAOCHUN (Canada) is continuing a postdoctoral fellowship at the University of Manitoba. Research is on late Ordovician corals of south China.

GRAHAM YOUNG (Canada) is examining several aspects of Lower Paleozoic

corals, sponges, and paleoenvironments. Research with Bob Elias is examining the diversity, ecology, and provincial structure of late Ordovician to earliest Silurian coral faunas. Collaborative work with Steve Kershaw involves comparison of growth banding phenomena in stromatoporoids and corals. Graham is also working on projects concerned with coral paleoecology, and with systematics of Ordovician tabulate corals, tetradiids, and chaetetids.

ZHOU ZHIYI (China) has been working on Ordovician trilobites from Tarim and western Yunnan, and has four relevant papers in press (two, with W.T. Dean, *Palaeontology*; the other two, with Yuan Wenwei, *Acta Palaeontologica Sinica*). As one of the China team members of the IGCP Project 410, he is going to work on the trilobite biofacies in South China from late 1998 to 2000. A further publication cooperated with his institute colleagues on the systemic stratigraphy of the Tarim Basin is now in preparation.

MICHAEL ZUYKOV (Russia) is currently working on the morphology, taxonomy and distribution of Ordovician brachiopods from the East Baltic/Northwestern Russia.

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