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Contents

The primary aim of ALBERTIANA is to promote the interdisciplinary collaboration and understanding among members of the I.U.G.S. Subcommission on Triassic stratigraphy. Within this scope ALBERTIANA serves as the newsletter for the announcement of general information and as a platform for discussion of developments in the field of Triassic stratigraphy. ALBERTIANA thus encourages the publication of anouncements, literature reviews, progress reports, preliminary notes etc. - i. e. those contributions in which information is presented relevant to current interdisciplinary Triassic research. An electronic version of ALBERTIANA is also available in PDF format at the

ALBERTIANA website

at http://www.bio.uu.nl/~palaeo/Albertiana/Albertiana01.htm.

Cover: Participants of the field workshop on the German Triassic in the Steudnitz outcrop. See also paper by Szurlies et al pp. 60-65.

Executive Notes

From the Chair (Nov. 2005)

It has been a busy summer. It started with the very successful meeting in Chaohu, China, and ends with preparations for the New Zealand meeting next March well underway. For those who missed the *Triassic Chronostratigraphy and Biotic Recovery* meeting see the abstract volume and field guides in Albertiana 33, parts 1 and 2, and the meeting report published in *Episodes* (20:1-2). Those of you who are still contemplating whether to go to Wellington, be informed that 27 abstracts have been received to date and a good symposium on *Circum-Pacific Triassic Stratigraphy and Correlation* is shaping up; an excursion also offers the chance to see most of the type sections for New Zealand Triassic stages. Bracketed between these meeting events, your Chair had shoulder replacement surgery and now boasts a titanium-steel humeral head to enhance his conodont collecting!

The Chaohu Symposium was a spectacular event in many ways. It saw the biggest issue of Albertiana (187 pages!) ever thanks to the considerable efforts of our editor and Chinese hosts. It afforded an opportunity to see the spectacular Geopark that the P-T GSSP has become, and the excellent Lower Triassic sections in Chaohu and Guandao. Both the symposium and field excursions attracted a lot of attention from the local news media and were featured on the front pages of the local newspapers and reported on local television stations. A major outcome of the meeting was the decision to produce a special volume of *Paleo3* on the *Permo-Triassic Boundary Event and Early Triassic Biotic Recovery*; manuscripts are now in hand and we look forward to the publication next year.

Next year there are two meetings that will interest Triassic workers. Our main meeting will be in Svalbard, Norway, August 16-20, 2006. The theme will be The Boreal Triassic with Alte Mork heading the organization. The preliminary program includes a two day conference with a one day ship based excursion to see the classic high latitude successions; a conference volume in Polar Research is also planned. In July (17-21), the *First International Conodont Symposium (ICOS1)* in Leicester, England will include a special session on Triassic conodont zonations – it is hoped that the underpinning of so much of our time-scale will receive critical examination and input from conodont researchers from around the world.

This brings me to my last comments. Not for the first time, I wish to stress how we are hurtling towards the deadline for GSSP decisions: two are now complete, 5 remain to be settled. In September, the International Commission on Stratigraphy, our parent body, met in Belgium to address how the Phanerozoic time scale would be completed in time for the next IGC in Oslo, 2008. Vice-Chair Marco Balini represented STS and informs me that the schedule is firm. We must strive to complete the I-O and O-A boundary deliberations in 2006, and the L-C, C-N, and N-R in 2007-8. Each of you who are involved in these boundary task groups should consider what this means. The scientific work must be completed, the decisions made, and the proposals written: only then can the lengthy administrative process of voting and ratification take place in STS, ICS, and finally IUGS. Please get involved and help achieve these goals.

From the Chair (Sept. 2006)

As readers are aware, it has been some time since the last issue of Albertiana so this one contains reports for both 2005 and some 2006 activities. It has been a very busy year since the Chaohu meeting in May 2005. That meeting focussed on the Induan-Olenekian boundary and resulted in many communications that are herein reported collectively by the task group Chair Yuri Zacharov. Our most recent meeting, in Svalbard during August 2006, also featured considerable discussion on the I-O boundary, and research both before and since then provides diverse content for a second report from the task group. Taken together, one can appreciate the progress made. A report of this meeting will be included in the next Albertiana. Meanwhile, the full Programme and Abstracts can be downloaded from http://www.nhm.uio.no/triassic-2006/index.html. Clearly, tremendous research activity was generated by both meetings and our knowledge of this time interval has increased considerably.

The Chinese and Norwegian meetings bracketed two additional meetings co-sponsored by of STS and IGCP467, in New Zealand and in England. The first was held jointly with InterRad in Wellington during March. The 120 participants came from 19 countries, and presented a total of 71 talks and 32 posters. A symposium on *Circum-Pacific Triassic Stratigraphy & Correlation* was held, and several excellent fieldtrips afforded the opportunity to see the Notal Triassic successions. A full report of the conference and field trips, and a compendium of Triassic abstracts compiled by Hamish Campbell, can be found on the IGCP467 website (http://paleo.cortland.edu/IGCP467/.

A full Programme and Abstracts is downloadable from http://www.gns.cri.nz/interrad/. The second meeting was part of the first International Conodont Symposium (ICOS1) held in Leicester during July. A symposium on *Triassic Conodonts: Taxonomy and Time Scales* attracted about 15 talks and posters, and a full day was devoted to boundary discussions amongst a small group of Triassic researchers.

One last event remains in the busy schedule of STS-IGCP467 sponsored meetings during the term of the current Chair. This will be the meeting in Albuquerque in May 2007 (see this volume and http://museums.state.nm.us/nmmnh/globaltriassic.html). The plan is for this meeting to be a wrap up for IGCP467 and a final push for Triassic GSSPs to be concluded ahead of IGC 2008. We are clearly accelerating the process of establishing a standard Triassic time scale and I urge those of you involved in GSSP definition to continue to pursue this goal, and to attend this important meeting next year.

From the Secretary

ICS Subcommission on Triassic Stratigraphy

Minutes of joint business meeting of the STS and IGCP Project 467, International Symposium on Triassic Chronostratigraphy and Biotic Recovery, Chaohu, China, 22 May, 2005

STS Secretary: C. McRoberts

PRESENT

D. Altiner, A. Baud, T. Beatty, Chen Jun, C. Henderson, M. Horacek, T. Kolar-Jurkovsek, L. Krystyn,, D. Lehrmann, J. Marzof, C. McRoberts, M. Menning, I. Metcalf, R. Nicoll, J. Ogg, M. Orchard, R. Twitchett, Tong Jinnan, V. Vuks, B. Wardlaw, O. Weidlich, Yao Jianxin, Yin Hongfu, Yin Yugan, Y. D. Zacharov

AGENDA

1. Welcome and general STS remarks
2. Future Meetings
3. Review of present state of Triassic GSSPs
4. Discussion on Chaohu Symposium Volume
5. Closing remarks

ITEM 1.

The Chair, Michael Orchard, welcomed all those in attendance and thanked the organizers of the meeting, the leaders of the field excursions, and the editor of Albertiana for their exceptional efforts in making the meeting a success.

ITEM 2.

The Chair reviewed several forthcoming meetings that will be of interest to STS members and IGCP 467 participants:

Valencia, Spain, September, 2005.Joint meeting of the XV Congreso Nacional de Sedimentologia and IV Coloquio de Estratigrafia, Paleogeographia del Permico y Triasico.

New Zealand, March, 2006. Circum-Panthalassa Triassic Faunas and Sequences. Wellington, New Zealand. A joint meeting of InterRad XI, STS and IGCP 467, the focus of this symposium will be on Triassic stratigraphy and correlations in the circum-Pacific region.

Svalbard, August, 2006. The Boreal Triassic. This symposium will focus on all aspects of the Arctic Triassic and correlation with Tethys.

Beijing, June 2006. International Palaeontological Congress. Elaborated on by Jin Yugan.

ITEM 3

The Chairman made an announcement on the acceptance and ratification of the basal Ladinian GSSP at the appearance of *Eoprotrachyceras curionii* at the Bagolino section of Italy. Orchard also presented a brief review on the status of remaining Triassic GSSPs, of which the Induan-Olenekian and Anisian/Olenekian boundaries will likely be the next to conclude.

ITEM 4

Chairman announced the possibly of publishing a special volume on the proceedings of the conference and his discussions with David Bottjer, editor of Elsevier's Palaeogeography Palaeoclimatology Palaeoecology. There was general agreement of those in attendance that because of its international stature and on-line availability that Palaeogeography Palaeoclimatology Palaeoecology would be a better option than other potential publishing venues. Thomas Algeo, Jinnan Tong, and Daniel Lehrmann had agreed to co-edit the volume.

ITEM 5

Chairman asked if there was any other business to be discussed and no further points were raised. Chairman thanked those present for their participation and declared the meeting closed at 18:45

Duly submitted,

Christopher McRoberts
STS Secretary

Business Meeting of the Subcommission on Triassic Stratigraphy (STS)

University Centre In Svalbard (UNIS), Longyearbyen, Spitsbergen, 18 August 2006

The meeting was convened by the STS Chairman (**M. J. Orchard**, Canada) during the STS meeting '*Boreal Triassic 2006*' (16 – 19 August 2006), in Spitsbergen, Svalbard. In the absence of the STS Secretary (**C. A. McRoberts**, USA), the previous STS Secretary (**G. Warrington**, UK) was asked to keep minutes of the meeting.

Present: D. Aljinovi´, G. Bachmann, T. Beatty, A. Brayard, H. Bucher, A. Egorov, P. Gianolla, E. Gradinaru, M. Hautmann, M. Hounslow, N. Ilyina, K.-C. Käding, T. Kolar-Jurkovsek, H. Kozur, M. Menning, P. Mietto, A. Mørk, P. Olsen, M. Orchard, J. Szulc, K. Tekin, Tong Jinnan, R. Twitchett, G. Warrington, W. Weitschat, Yu. Zakharov, Zhao Laishi.

The **Chairman** opened proceedings at 11.10 and announced the agenda which covered the following matters:

1. Other STS meetings

May 2005: *Triassic Chronostratigraphy and Biotic Recovery* symposium (Chaohu, China); proceedings are *in press*.

March 2006: *Circum-Panthalassa Triassic Faunas and Sequences* (Wellington, New Zealand); held jointly with *InterRad XI* (11th meeting of the International Association of Radiolarian Paleontologists). Proceedings will appear in twin issues of *Micropaleontology* and *Stratigraphy*.

August 2006: *Boreal Triassic 2006* (Spitsbergen); proceedings of this, the current meeting, will appear in *Polar Research*, probably in 2008.

May 2007: *The Global Triassic* (Albuquerque, USA); combining an official meeting of the STS and the final meeting of IGCP Project 467 (*Triassic time and correlation*).

2. The STS Newsletter: *Albertiana*

The last issue of the newsletter (number 33) appeared in May 2005; it is hoped that the delayed issue 34 will appear this Autumn.

3. Membership of the STS Executive

The present Chairman (**Orchard**) and one Vice-Chairman (**Yin Hongfu**, China) will retire from the Executive in 2008. A new Chair and Vice Chair will be elected during 2007.

4. Stage Boundary (GSSP) working groups

The STS is responsible for the selection of GSSPs for seven stage boundaries. The GSSPs for the base Induan (also base of the Triassic) and the base Ladinian have been selected and ratified. Chairman requested short progress reports on the remaining stages (Olenekian, Anisian, Carnian, Norian and Rhaetian). These were given by the working group conveners, or a deputy, as follows:

OLENEKIAN (**Zakharov**): **Tozer** has now retired and **Bucher** will be a new member. The best candidates are at Chaohu and Spiti; new information continues to appear.

Olsen asked whether any of the candidate sections have a low thermal maturity. **Kozur** said that Chaohu is low, and **Orchard** said the conodont CAI is 5 at Spiti. **Olsen** commented that this would be a problem with C-isotope and magnetostratigraphic studies. **Orchard** asked **Olsen** what he regarded as 'low'; **Olsen** said 'below the oil window'. **Weitschat** commented that it is important to have good ammonites; **Kozur** said that this is the case at Spiti. **Weitschat** asked about Choahu; **Tong** said that conodonts are better there than the ammonites. **Bucher** said that there is a problem with the Chaohu ammonite record, which is poorer than at Spiti. **Hounslow** said that magnetostratigraphy has potential at Chaohu but studies should be carried out in several sections to establish whether the record can be replicated.

ANISIAN (**Gradinaru**): The Desli Ciara section (Romania) is a potential GSSP; others are in the Primyorie and Nevada. Desli Ciara has been a candidate since 1991 and has been studied by an international group, with good results from ammonoids and nautiloids; he referred listeners to his poster display. Some of the ammonites are cosmopolitan, though most are Tethyan. Conodonts are also good in this section, though there are taxonomic issues to address: conodont researchers plan to collectively produce clarification of *Chiosella timorensis* and related species. The ammonite and conodont successions have been well correlated. Foraminifera are also present, and magneto- and chemo-stratigraphic work has been carried out. **Orchard** asked whether the group is ready to make a proposal. **Gradinaru** suggested this could be done in the Autumn (2006); **Orchard** concluded that the group is ready to present a proposal. **Bucher** advocated the use of various types of zone, rather than first occurrences, for marking the boundary.

CARNIAN (**Mietto**, deputising for **Gaetani**): The base of the stage has traditionally been placed at the base of the *Trachyceras aon* zone of Mojsisovics. The Stuores Wiessen section is a candidate GSSP. Recently, a 200m-thick succession with *Trachyceras* older than *T. aon* has been recognised above the *regoledanus* zone and below the *aon* zone. Magnetostratigraphy and palynology have been studied at Stuores Wiessen, which is a unique section. The boundary could be placed at the appearance of *Daxatina canadensis*. **Balini** has a possible candidate section in Spiti.

Ilyina raised issues concerning the palynomorph succession around the base Carnian. **Orchard** advised her to direct comments to the working group Chair, and also suggested that more discussion needs to take place within the working groups generally.

NORIAN (**Orchard**): Pizzo Modello in Italy and Williston Lake in Canada are primary candidates. Correlation of conodont faunas is problematic at the level of the Macrolobatus and basal Kerri zones, but the FAD of *Epigondolella quadrata*, which appear high in the Kerri Zone, is now agreed by many conodont workers as a globally recognizable datum. Work continues on the candidate sections.

RHAETIAN (**Kozur**, deputising for **Krystyn**): Historically, the base of the stage was defined, by Gümbel, at the appearance of *Rhaetavicula contorta*, and was the only Triassic stage not based on ammonites. Proposals for the boundary have been made by Tozer & Orchard, Kozur and Krystyn. Possibilities involve the use of *Cochloceras suessi* or *Paracochloceras amoenum* and *Misikella posthernsteini*. Problems arising from provincialism and latitudinal variations affect the palynology. It is not possible to make long range correlations across latitudes. It is difficult to find a section that is stable. **Olsen** commented that if a GSSP were to be established now, there is a scarcity of proxies to support extended correlations.

TRIASSIC-JURASSIC BOUNDARY (**Warrington**): the top of the Trias is defined by the base of the Hettangian Stage, the lowest stage of the Jurassic. Although of direct relevance to the Triassic, selection of a GSSP for the Hettangian is the responsibility of the Triassic-Jurassic Boundary (Hettangian) Working Group (TJBWG) of the International Subcommission on Jurassic Stratigraphy. The TJBWG Convener (**Warrington**) reviewed the work of that group in an oral presentation in the *Boreal Triassic 2006* programme on 18 August (see Abstract volume, available at http://www.nhm.uio.no/triassic-2006/index.html).

5. Other business

Weitschat had mentioned to **Warrington** that **Hans Rieber** (Zurich, Switzerland), a former member of the STS Executive, remained physically impaired following a stroke. **Warrington** suggested to the **Chairman** that an expression of good wishes, to which participants could add their signatures, should be sent to **Rieber** from the *Boreal Triassic 2006* meeting. A sheet of signatures was collected and placed in a copy of the *Boreal Triassic 2006* abstracts volume which **Bucher** undertook to deliver to **Rieber**.

The **Chairman** declared the meeting closed at 12.05.

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES

INTERNATIONAL COMMISSION ON STRATIGRAPHY

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24 August 2006

Dear Mike,

A year ago, in Leuven, each of the subcommissions made an estimate of when their remaining GSSPs might be submitted for formalization. Since that meeting, the Ordovician and Cambrian subcommissions have remained “on track”, and the Jurassic subcommission is preparing a set of four GSSPs for voting during late September.

In the “Leuven” completion schedule, the Triassic subcommission was planning to submit the Olenekian GSSP, which was partially the topic of a field meeting a year ago. At that time, the Chaohu city had prepared a simple geo-park for the proposed site. In addition, the Anisian and Carnian GSSPs have been very advanced by recent publications. The Triassic subcommission working groups have been very active!

In October, each subcommission must submit its annual report. It would be ideal if one or all three of these Triassic GSSPs can be submitted during September for formal voting by ICS.

As with all GSSP proposals, we (mainly Jim Ogg) will undertake a quick initial reading to see if the contents adequately cover the GSSP criteria and that the main justification and placement can be understood by non-specialists. It is also recommended that the abstract of the submission follow the same format of the voting statement (that boxed summary) in the concise statement of location and the association with known correlation methods.

If you wish, we (the ICS Executive) can directly contact the chair/secretary of these Working Groups to send them an example of past GSSP voting documents and to emphasize the importance of finalizing their documents as soon as possible for subcommission/commission voting. The 20-year saga of GSSP selection will finally attain completion!

Thank you,

The ICS Executive:
Felix Gradstein — ICS Chair
Stan Finney — ICS Vice-Chair
James Ogg — ICS Secretary

Meeting Reports

Notes on the business meeting of the Induan/Olenekian Boundary Working Group (24 May 2005, Chaohu)

Yuri D. Zakharov

The next persons were present at our last meeting: (1) Zakharov, Y.D. (Far Eastern Geological Institute RAS, Russia), chairman; (2) Baud, A. (Lausanne University, Switzerland), (3) Bernecker, M. (Institute of Paleontology, Germany); (4) Bottjer, D.J. (University of southern California, USA); (5) Chen Jun Jingxun (Nanjing Institute of Geology and Palaeontology, China); (6) Chen Zhongqiang (The University of Western Australia); (7) Davydov, V. (Boise State University, USA); (8) Gu Songzhu (China University of Geosciences, Wuhan, China); (9) Henderson, Ch.M. (University of Calgary, Canada); (10) Horacek, M. (Environmental Research UU, Germany); (11) Jin Yugan Shuzhong (Nanjing Institute of Geology and Palaeontology, China); (12) Krystyn, L. (Vienna University, Austria); (13) McRoberts, Ch.A. (State University of New York, USA); (14) Menning, M. (Potsdam University, Germany); (15) Metacalf, I. (University of New England, Australia); (16) Nicoll, R.S. (Australian National University, Australia); (17) Ogg, J. (Purdue University, USA); (18) Orchard, M.J. (Geological Survey of Canada, Canada); (19) Qi Yuping Shuzhong (Nanjing Institute of Geology and Palaeontology, China); (20) Shen Shuzhong (Nanjing Institute of Geology and Palaeontology, China); (21) Tong Jinnan (China University of Geosciences, Wuhan, China); (22) Vuks, V. (All Russian Geological research Institute, Russia); (23) Wang Chunjiang (China University of Petroleum, China); (24) Wang Yue Shuzhong (Nanjing Institute of Geology and Palaeontology, China); (25) Wardlaw, B.R. (US Geological Survey, USA); (26) Weidlich, O. (University of London); (27) Yao Jianxin (Geological Institute of Geological Academy, China); (28) Yin Hongfu (China University of Geosciences, Wuhan, China); (29) Zhao Laishi (China University of Geosciences, Wuhan, China); (30) Zuo Jingxun (Nanjing Institute of Geology and Palaeontology, China

Yuri D. Zakharov:

First of all I would like to inform you that Prof. L. Krystyn kindly agreed to be a member of the Induan/Olenekian Working Group, and I am sorry that we did not offer him to do it early. Taking into account that Prof. I. Dobruskina (Izrail) retired on a pension, our group consists of 21 members now, nine of them are present here.

Our working group exists during nine years and we have certain progress in our work now. Discussion on the Induan/Olenekian boundary have been published in many numbers of Albertiana (Baud and Gaetani, 1992; Zakharov, 1994a, 1995, 1997a,b,c, 1999a,b; 2004; Zakharov and Popov, 1999; Zakharov et al., 1999, 2000, 2002a,b,c; Dagys, 1999; Tong et al., 2001, 2002, 2004, 2005; Tong and Zhao, 2005; Chinese Lower TriassicWorking Group, 2002; Kozur, 2003; Kozur and Bachmann, 2004; Bhargava et al., 2004; Zhao et al., 2004; Krystyn et al., 2004, 2005; Krystyn, 2005) and some other journals (Dagys, 1997; Zakharov, Y.D., 1994b, 1996, 1997d; Tong et al., 2003; Tong et al., 2004; Markevich, P.V. and Zakharov, Y.D., 2004).As a result, the four candidates for global stratotype of the Induan/ Olenekian boundary have been offered: Tri Kamnya Cape and Abrek Bay sections in South Primorye (Zakharov, 1996; Zakharov et al. 2001), Chaohu section in South China (Tong et al., 2003), and Muth section (Spiti), Himalayas (Krystyn et al., 2004, 2005).

As I said, two candidates were offered by me in South Primorye. We obtained very important data on Early Triassic ammonoid succession in South Primorye, but we have many problems with paleomagnetic there because of remagnetization. We asked Prof. K Kodama from Japan to check up our paleomagnetic results, making additional maleomagnetic analyses of Lower Triassic rocks taken by us from the Abrek and Tri Kamnya Cape sections. Recently I received his confirmation that it is impossible to obtained reliable paleomagnetic data from the mentioned sections because of strong remagnetization Triassic rocks both in South Primorye. Similar results have been obtained by him for Permian and Triassic rocks in Japan.

Mainly on this reason I concentrated my attention to the Chaohu (Western Pingdingshan) section, offered by Prof. Tong as a candidate in South China. Now I consider that it is best candidate for global stratotype of the Induan/ Olenekian boundary. I like this section not only because of my participation in its investigation together with Prof. Hansen from Copenhagen and Chinese colleagues during two seasons, but because the large complex of different works was made there and excellent results on magneto- bio and hemostratigraphy have been obtained.

H. Hansen informed me that before his work in the Anhui Province he was invited to make preliminary paleomagnetic work in the Meishan section, but obtained negative result and therefore refused to continue paleomagnetic work there. But his paleomagnetic results on the Chaohu section he was very glad. He used folded control and some other controls and also obtained excellent results on this topic. Ammonoids very abundant in Induan and Lower Olenekian shales of the Chaohu section, they discovered also in the Upper Changhsingian. Most of ammonoid shells are bad preserved, flattened, but there is possibility to find there small phosphate ammonoid shells with well preserved suturelines. A lot of *Claraia* bivalves present in the lower part of the Induan. The Chaohu section is very good place for detail investigation of the Early

Triassic conodonts succession because a lot of lenses of limestone present there. I was very surprised when learn that in many lenses more than 200 conodonts were discovered in small samples; besides, in layers of mudstone between lenses of limestone conodonts are also present. Chinese workers obtained good results on carbon isotopic composition of Induan-Lower Olenekian limestone of the Chaohu section. H. Hansen took mudstone samples from every ten cm of the Induan-Lower Olenekian interval and also obtained very good results on ˜ ^{13}C org. It is very important also that several volcanic clay beds with zircon grains have been discovered near the Induan-Olenekian boundary of the Western Pingdingshan section, which may be used for chronological purpose.

Prof. L. Krystyn offered the Spity (Muth) section in the Himalayas as a candidate for global stratotype of the Induan/Olenekian boundary during IGC in Florence last year and gave additional information on this topic in the Chaohu meeting. It is a classic section with well preserved ammonoids and abundant of conodonts. Excellent results on carbon isotopic composition of limestone obtained there. A single defect of the Muth section is a strong remagnitization of Triassic rocks, therefore it is impossible to obtain positive paleomagnetic results there. I would like to use both the Western Pingdingshan (South China) and the Muth section (Himalayas) as the stratotype and parastratotype for the Induan-Olenekian boundary, correspondingly (I incline in favour of the Chaohu section in this stage of our investigation), but it is impossible, if conform to the going rule. According it, we must have a single type for the Induan-Olenekian boundary.

I would like to learn your opinion on the offered candidates, your comments and proposals are very important. I invite to take part in our discussion both members of IOBWG and other persons presented here.

Leopold Krystyn:

The Muth section (Spiti) in Himalayas is well exposed and it looks like a good section from the perspective of ammonoids. I have nothing against the Western Pingdingshan section, but full information on it must be published. We must to learn the interests of the IOBWG in this topic, but we need to have all information on both the Western Pingdingshan and the Muth sections in the next number of Albertiana.

Robert S. Nicoll:

I believe that the West Pingdingshan section at Chaohuhas several advantages over other alternative sites: 1) The section can be reached through Nanjing by a couple of hours. Alternative (Muth), take a over of 2 to 3 days. 2) Chaohu can be visited at any time of the year. Other sites, especially Muth, would be difficult to visit and work during winter months. 3) Chaohu and West Pingdingshan could be easily visited by researchers with physical mobility problems and those less physically fit. Muth by its location and elevation would be restricted to the physically fit. 4) The ash beds located just above the proposal boundary, in Bed 25, at West Pingdingshan are very important in their potential to obtain a zircon/Ar-Ar data on the Induan-Olenekian boundary. Where such ash beds and data are available, this should be a prime GSSP section.

Ian Metcalfe:

I comment that it is important to choose a GSSP section that has robust magnetostratigraphy and also if possible volcanic ash layers that may provide radio-isotopic geochronological calibration. This is important for potential correlation between GSSP in marine environment with non-marine sections and also between sections located in northern and southern hemispheres.

Yin Hongfu:

To promote the procedure to meet the deadline of 2008, with the support of Prof. Krystyn I suggest taking a questionnaire (straw vote) immediately to ask the majority opinion on the definition of IOB and the preference of the suggested candidate sections.

Charles M. Henderson:

It is my view that we should proceed with a formal proposal to establish a GSSP at the West Pingdingshan section, Chaohu, China. My reasons are that considerable paleontology has been done both on conodonts and ammonoids.Conodonts are most suitable for GSSP because of the opportunity to do continuous sampling – the FAD of *Neospathodus waageni* sensu lato is very distinct and precise. The Chaohu section is also the best choice because of the other work on paleomagnetism and carbon isotope geochemistry. There is also the possibility of radioisotopic ages for near boundary position based on sampling on May 24 / 2005 by Drs. Davydov and Nicoll.

I agree with Dr. Krystyn that the Muth section is well exposed and it looks like a good section from the perspective of ammonoids, but ammonoids should not be the defining group because the occurrence are not continuous. Furthermore, the preliminary work indicated in Dr. Krystyn’s talk suggests that the potential boundary is either identical or nearly identical. I encourage additional work on that section, but I don’t think it is necessary in order to establish the GSSP.

Furthermore, the Chaohu section is ideal because the site is easily accessible and there is considerable interest by the local government to protect this site as a very special location. I agree with the proposal of Prof.Yin Hongfu that a straw vote be conducted immediately to determine the interests of the entire working group. This straw vote should ask: 1) Do you prefer the Chaohu or Muth section? 2) Do you prefer the FAD of *N. waageni* sensu lato (n. subsp. A)? Yes or No. If no, what would your preference be? I urge the working group try to prepare this straw note immediately so that we can make rapid progress. There are two other things that should be done before a formal proposal is initiated, but I do not believe these are necessary to do the straw vote. These include: 1) formal definition in publication of *N. waageni* subsp. A and 2) results of geochronology samples.

Aymon Baud:

The Muth section, provided perfect and long distance stratigraphical exposures, is highly fossifliferous and exhibits favorable facies with continuous and expanded deposition across theboundary; a potential boundary datum is controlled by conodonts and ammonoids. Krystyn demonstrated that the Muth section is more complete than the Chaohu section in therm of ammonoid zones. We must find a solution that we need in a next Albertiana the presentation of two formal proposals and a discussion of the advantages and disadvantages of two candidate sections. After that a formal vote will be organized among the working group members and forwarded to the chairman of STS.

Bruce R. Wardlaw:

In my opinion, the Chaohu (Western Pingdingshan) section is best.

Vladimir Davydov:

I offer to accept a resolution.

Yuri D. Zakharov:

We must move hastily but not excessively quickly now, I think, it is better to move step by step. I agree with Dr. Aymon Baud's proposal that our next step must be concentration of our attention on the two best candidates: Western Pingdingshan and Muth. Additional information on both of them with elements of discussion will be given in the next number of Albertiana. According to other proposals, a straw vote will be conducted just before the formal voting to determine the interests of the entire working group. As you can see, the most participants agree with such arrangement. Thank you for your productive work.

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Appendix: Additional comments to the joint business meeting of the STS and IGCP Project 467

Aymon Baud

During the Chaohu meeting, advances on the proposal, made by Tong et al. *in* Albertiana 29 (2004) of the West Pingdingshan Section in Chaohu, as the GSSP Candidate of the Induan-Olenekian Boundary, have been presented to the participants and a half day field trip gave the opportunity to every one to examine the proposed outcrop.

During the meeting an other section candidate has been presented by L. Krystyn: it concern the Muth locality in Spiti India as a potential GSSP for the Induan/Olenekian boundary. Krystyn outlined recent field-based research activities in Spiti. Krystyn also noted that, although the section was high (about 4000 meters), it provided perfect and long distance stratigraphic exposures, is highly fossiliferous, and exhibits favorable facies with continuous and expanded deposition across the boundary. A potential boundary datum is controlled by conodonts and the ammonoid *Flemengites*. Krystyn demonstrate that the Muth section is more complete than the Chaohu sections in term of ammonoid zones.

After the presentation by the chairman and a general discussion, some of the participants wanted an immediate vote. But finally the solution chosen was that we need in a next Albertiana the presentation of the two formal proposal and a discussion of the advantages and disadvantages of the two candidate sections. After that a formal vote will be organized among the working group members and forwarded to the chairman of the STS.

2. Prompting a questionnaire on the Induan/ Olenekian boundary

Yin Hongfu

With the mandate for completion of all Phanerozoic GSSPs in 2008, it becomes urgent to take essential steps toward the establishment of the GSSP of Induan/ Olenekian boundary (IOB). During the International Symposium on Triassic Chronostratigraphy and Biotic Recovery (23-25 May 2005-Chaohu City, Anhui Province, China), nearly 80 participants visited the suggested GSSP of IOB, the West Pingdingshan Section (WPS, Tong et al., 2003). The Task Force of IOB met at the evening of 24 May, and the majority agreed to take this section as the candidate of the GSSP of IOB based on the following facts.

By definition, the IOB is suggested to locate at the FAD of *Neospathodus waageni eowaageni* (*Neospathodus waageni* n. subsp. A, in Tong et al., 2005) within the lineage of *N. dieneri—N. waageni eowaageni—N. waageni waageni*. The West Pingdingshan Section meets this requirement (Zhao et al., 2004; Tong et al., 2005). The FAD horizon is at the base of Bed 24, Subbed 16 (Bed 24-16). This marks an evolutionary phase of *Neospathodus* and can be correlated intercontinentally.

Auxiliary markers:

The FAD of ammonoids *Flemingites* and *Euflemingites* is located 2-3 decimeters above the suggested GSSP (Tong and Zakharov, 2004, Tong et al., 2005). This biomarker helps in correlation with ammonoid-bearing sections.

A positive high of the δ^{13}Ccarb exists at the IOB (an increase of about 6 $^{0}/_{00}$ at WPS, Tong et al., 2005). This can be correlated throughout South China (Lower Yangtze, Guangxi and Guizhou Provinces) and probably also Iran and Austria (Horacek, 2005). Biostratigraphic controls of the latter are less certain, and a correlation with South China will be well established if the IOB there could be lowered a little.

Magnetostratigraphy has been established in WPC (Hansen and Tong, 2005) and can be correlated with that of the German Basin (Manning, 2005).

There are four clay beds, all within one meter's distance above the suggested IOB. Zircon grains have been found there, denoting that some or all of them are ash beds. Drs. Metcalfe and Nicoll have collected samples to investigate the isotopic age of IOB.

The accessibility of WPC is easy. It is a roadcut section within one-hour's and two-hour's drive from Hofei (capitol of Anhui Province) and Nanjing (capitol of Jiangsu Province) respectively. The municipal government of Chaohu has promised to protect this section and move the nearby cement factory away. The WPC meets all the demands of a GSSP, provided that an isotopic age can be obtained.

The Muth Section of Spiti, Kashmir has also been suggested as a candidate of the GSSP of IOB (Krystyn et al., 2004, 2005). It meets the definition of the FAD of *N. waageni eowaageni* within the above-mentioned lineage. Also *Flemingites* and *Euflemingites* show their FADs several centimeters above the suggested GSSP, and the ammonoids are not compressed as at WPC. Hopefully a δ^{13}Ccarb curve is possible and scheduled for 2005, but magnetostratigraphy is precluded by thermal overprint, and there is no ash beds for isotopic dating. Besides, the sections are located at the altitude of 4000 m+. However, they also meet the demands of a GSSP candidate, provided that a single section is chosen and described (the published data are based on a composite section combining sections M03+M04).

To promote the procedure to meet the deadline of 2008, with the support of Prof. Krystyn I suggested taking a questionnaire immediately to ask the majority opinion on the definition of IOB and the preference of the suggested candidate sections. This was accepted by the majority and will be implemented by the Task Force Chair Zakharov. After that we can proceed to the 4 time-taking runs of ballots for the formal choice of a GSSP.

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3. To the Leader of Induan-Olenekian Task Force

Michael J. Orchard

Dear Yuri,

You asked for a summery of my comments expressed during the I-O Task Group Meeting in Chaohu. I attach them herewith. These are my views as both a participating researcher and a task group member, but I am also cognitive of my position as STS Chair so in that capacity I do not take a partisan position on the choice of a GSSP. In this document I address only what I see as the scientific necessities. I received copy of the comments by Yin Hongfu. Most of his comments are factual and appear to represent both a report of the meeting and advocacy of the Chaohu section as the I-O GSSP. However, the comment about the lineage of *N. waageni* is supposition and premature. There was much vocal support for the Chaohu section from non-task group members during the meeting but I was not aware there was a poll taken so I also wonder whether a statement about "majority view" is warranted. Finally, an immediate questionnaire/ poll may be of interest but I would think it might be more meaningful when we have the completed dataset before us later this year. These are my personal views. I am not arguing against Chaohu – far from it. I do think the Chinese section has the greater number of attributes as GSSP. However, the process must be seen to be fair.

3. To Prof. Leopold Krystyn (brief report on the study of the Spiti conodonts)

Michael J. Orchard

Dear Leo,

My assessment of the present Spiti conodont materials leads to some new views on both the succession and taxonomy. Faunal change is most marked between the lowest 3 or 4 samples, all(?) of which lie within the *R. rohilla* interval. Betwe en sample 11 and 12c the fauna changes profoundly, particularly with the incoming of *nepalensis*. Between 12c and 13a, we see the incoming of *'Ns.' discreta*, *'Ns'*. ex gr. *spathi*, and *'Ns.' waageni* with a thickened cup.In 13b (M 04), 'typical' *waageni* and *Ns. spitiensis* appear. From 14a, the *waageni* group diversifies with respect to modification of the posterior denticulation. The only other additions higher up come in 14c (in both M 03 and 04) where a new *spathi*-like morphotype appears. Frankly, I have had problems applying the tripartite subdivision of *waageni* in these collections. I now consider *N. w.* subsp. B (="*posterolongatus*" as more akin to the *Ns. spitiensis* group with its posteriorly pointed basal cavity. The abbreviated *N. w.* subsp. A (="*eowaageni*") can be recognized amongst the more typical *waageni* but the basal margin is variable from straight, to upturned on one margin, to upturned on both. Typical (*w.) waageni* occurs in all collections from 13b and above. The posteriorly thickened form (with pseudo-platform) slightly predates the latter (in 13a) and is reminiscent of the similarly robust but more elongate *Ns. novaehollandiea* = "*Kashmirella*" *alberti*. One can visualize an origin in the latter and, through further reduction, a precursor to *waageni* s. s. - although this is conjectural. These observations are based on my analysis of photographed specimens taken as representative of successive collections. I need to test them further by looking at the original collections at work - I am currently still working from home. Similarly, the Chaohu succession needs to be re-examined in the light of these observations. Tentatively, one (the best?) solution for a GSSP datum may be to use the undifferentiated *N. waageni* at the base of the broader "*Flemingites* beds". I am copying this email to Yuri and our Chinese colleagues to inform them of the new developments.

3. Comments

Francis Hirsch

After reading with attention the attached comments by various researchers on the present question, I estimate that it is premature to give a positive or negative response on the spot.I suggest waiting a little longer until we have the additional publications due in Albertiana. Having not been active myself in neither field on the subject, expressing a preference would only unjustly favor one of the candidates.

Please consider my hesitation in the matter as an expression of my sense of responsibility in this important scientific decision. I look forward to receive a further quest as soon as we can make up our minds more clearly.

4. Comment

Vladlen Lozovsky

All proposed sections have no tetrapod remains which are very important for correlation with continental beds.

5. Lower Triassic Series, Stages and Substages

Yuri D. Zakharov

Many suggestions have been made regarding a stage-subdivision of the Lower Triassic (Mojsisovics, 1882; Mojsisovics et al., 1895; Lapparent, 1900; Noetling, 1901, 1905; Ichikawa, 1950, 1956; Kiparisova and Popov, 1956; Arkell et al., 1957; Mutch and Woaterhouse, 1965; Tozer, 1965, 1978; Vavilov and Lozovsky, 1970; Zakharov, 1973,1978, 1996; Kozur, 1973; Guex, 1978; Rostovcev and Dagys, 1984).

The analysis of the most popular concepts mentioned above shows that the preference may be given to the Kiparisova and Popov's (1964) project. The results of the voting of the subcommission on Triassic stratigraphy in Lausanne (October 1991) and Kyoto (August 1992) confirm this idea. The subcomission took into account the Kiparisova and Popov's (1964) argument on Brachmanian Stage problem (Brachmanian Stage was not used more than 50 years when the Induan Stage was proposed in second variant).

Stratotype of the Induan has been proposed by Kiparisova and Popov (1964) to be established in Salt Range, Indus River (in Russian maps it is indicated as Ind). The body stratotype for the Olenekian is situated at the lower reaches of the Olenek River in Arctic Siberia. But new data show that it is impossible to chose the type of Olenekian as a single section there; at the same time we have some possibility to establish the Lower (Chekanovskian and lower Ystannakh Formations in the Buur-Nyykabyt section) (Popov, 1958; Dagis, 1984; Dagys and Ermakova, 1988, 1993; Dagys and Kozakov, 1984; Dagys and Kurushin, 1985) and Upper Olenekian (upper Ystannakh Formation in the Mengilyakh section) (Mojsisovics, 1886; Kiparisova and Popov, 1956; Zakharov, 1978) stratotypes in the Olenek River basin, Arctic Siberia (Zakharov, 1996).

Lower Olenekian limestone of the upper part of the Chekanovskian Formation (*Hedenstroemia hedenstroemi* (upper part) and *Lepeskites kolymensis* Zones), overlying the Induan Ulakhan-Yuryakh Formation in the Buur-Nyykabyt section, contains abundant ammonoids *Hedenstroemia hedenstroemi*, *Clypeoceras* sp., *Anakashmirites borealis* associated with conodonts *Neogondolella waageni*, *N. mosheri*, *N. buurensis, N. dieneri*, *Xaniognasrhus expansus*, and *Enarniognathus zigleri* (Dagys, 1984).

In the evolution of the Early Triassic ammonoids, three major phases (stages) can be recognized (Zakharov,1997). During the first phase (early Early Triassic), the oldest representatives of some typical Mesozoic taxa were formed: Meekocerataceae (Ophiceratidae, Dieneroceratidae, Meekoceratidae), Proptychitaceae (Proptychitidae and Paranoritidae) and also Dieneroceratidae (*Dieneroceras*), Prosphingitidae (*Pseudoprosphingites*), Hedenstroemiidae (*Parahedenstroemia*), Inyoitidae (*Inyoites*) and Xenoceltitidae (*Preflorianites*). According to traditional point of view, the beginning of the phase seems to be determined by the first emergence of *Otoceras*, last lineage of the superfamily Otocerataceae existed manly during Wuchiapingian and Changhsingian.

The second phase in ammonoid evolution (middle Early Triassic) seem to be characterized by the appearance and development of most representatives of the Aspenitidae, L:anceolitidae, Hedenstroemiidae (*Hedenstroemia*, *Epihedenstroemia*),Ussuritidae, Xenoceltitidae, Sibiritidae (Palaeokazachstanites, Parastephanites, Stephanites, and Amphistephanites), Kashmiritidae, Tirolitidae, Dinaritidae (*Tchernyschevites*), Meekoceratinae (*Meekoceras*), Prionitidae, Flemingitidae, Palaeophyllitidae, Parananitidae, Owenitidae and some representatives Prosphingitidae (Prosphingitoides).

In the third phase (late Early Triassic) we observe the appearance and development of the Keyserlingitidae (*Olenekoceras* and *Keyserlingites*), Columbitidae (*Neocolumbites*, *Columbites*, *Subcolumbites*, *Arnautoceltites*, *Procolumbites*, *Paradinarites*, *Epiceltites*, *Protropites*, *Tunglunites), Chioceratidae,* and some representatives of the *Hedenstroemiidae* (*Metahedenstroemia* and *Beatites*), Sibiritidae (*Olenikites*, *Subolenikite*, *Parasibirites*, and *Sibirites)*, Tirolitidae (*Carniolites*, *Hololobus*, *Bittnerites*,, *?Tirolitoides* and *Diaplococeras*), Meekoceratidae (*Northophiceras*, *Arctotirolites*, *Svalbardiceras*, *Arctomeekoceras*, and *Boreomeekoceras*), Kashmiritidae (*Mangyshlakites*), Prosphingitidae (*Prosphingites* and *Zhitkovites*), Parananitidae (*Isculitoides*), Palaeophyllitidae (*Leiophyllites*, *Palaeophyllites*, *Eophyllites*, and *Schizophyllites*), Hungaritidae (*Dalmatites*), Noritidae (*Subalbanites*).

The phase 1 / phase 2 boundary time is characterized by the most sharp increase in taxonomic diversity both at the generic and familial levels, therefore it is more likely to assume that three phases in the evolution of the Early Triassic ammonoids correspond to three major stratigraphical units, having a different rank. The base of the *Flemingites/Hedenstroemia* beds appears to be the boundary of the largest units (stages), Induan and Olenekian in Kiparisova and Popov (1964) sense, but the base of the *Olenikites* beds and their equivalents (sequences characterized by columbitid ammonoids) believe to be the boundary of substages.

Firstly, the substages for the Olenekian (Lower Olenekian and Upper Olenekian) were offered by Vavilov (1967) on the basis of ammonoid assemblages of the Boreal realm. The base of the Upper Olenekian in ammonoid terms was drawn at the base of the *Olenikites spiniplicatus* Zone. Later Dagys and Kazakov (1984) moved *Dieneroceras* and *Northophiceras* (=*Bajarunia* *euomphala* and *Northophiceras contrarium*) Zones from the Lower Olenekian to the Upper Olenekian. But I agree with original Vavilov's proposal taking into account the greatest change in ammonoid succession at the base of the *Olenikites spiniplicatus* Zone (Mojsisovics, 1886; Zakharov. 1996). For the Tethys, the Ayaxian (*Hedenstroemia*, *Anasibirites* and *Tirolites* beds) and Russian (*Neocolumbites* and *Subcolumbites* beds) substages have been proposed (Zakharov. 1997), their stratotypes locate in Russian Island, South Primorye .

The analysis of data on the Lower Triassic sections of the stratotype area (Olenek River basin) shows that they can not beoffered as candidates for GSSP of the IOB, because the Induan Ulakhan-Yuryakh Formation in the Olenek River basin consists of lagoonal sediments (predominantly sandstone) with rear mollusk fossils; ammonoids and conodonts have not been discovered there near the IOB. At the same time we have a representative Induan–Olenekian sections in South Primorye, South China and Himalyas. Four candidates for GSSP of the Induan-Olenekian boundary have been offered: Tri Camnya Cape and Abrek Bay sections in South Primorye (Zakharov, 1996; Zakharov et al., 2001), Chaohu section in South China (Tong et al., 2003), and Muth section (Spiti) in Himalayas (Krystin et al., 2004, 2005).

In South Primorye the most representative Lower Triassic sections are known in Russian Island (Fig. 1), which ammonoid fossils were firstly described by Diener (1895) and Kiparisova (1961), but most diversed ammonoid fauna from the Induan-Olenekian boundary beds were discovered on the western coast of Ussuri Gulf (Tri Camnya Cape) and on the northern coast of Strelok Gulf (Abrek Bay).

The biohorizon that defines the Induan-Olenekian boundary (IOB) at the Tri Kamnya Cape section is the FAD of the ammonoid *Hedenstroemia bosphorensis* (Bed 16) (Zakharov, 1996), firstly discovered in Russian Island (Zakharov, 1978). This species is associated with *Parahedenstroemia* sp., *Gyronites separatus*, *G.* aff. *planissimus* and *Ambites* sp. indet. in the upper part of the Lazurnaya Bay Formation. Overlying sediments of the uppermost part of the Lazurnaya Formation (6 m) and lowermost part of the Tobizin Cape Formation (44 m) are characterized by ammonoids *Gyronites separatus*, *Meekoceras subcristatum*, *Koninckites* cf. *timorensis* and *Parahedenstroemia conspicienda*, *Ussuria iwanowi*, *Arctoceras septentrionale*, *Koninckites timorensis*, *Meekoceras gracilitatis*, *M. subristatum*, *Anakashmirites shamarensis*, *A. latiplicatus*, *Flemingites radiatus*, *Euflemingites prynadai*, *Prosphingitoides* sp., correspondingly. Conodonts seem to be very rare in the Induan-Olenekian boundary beds of the Tri Camnya Cape section: only *Neogondolella* cf. *carinata*, *Neospathodus*? sp. indet., *Hindeodella* sp. indet. and *Lonchondina* sp. indet. Were discovered in the uppermost part of the Induan *Gyronites subdharmus* Zone (G.I. Buryi's determination) and *Neospathodus dieneri* (Buryi, 1979) in association with *Euflemingites* sp. indet. of the Olenekian *Hedenstroemia bosphorensis* Zone.

After revision of paleontological data on the Abrek Bay section in South Primorye its IOB seems to be located somewhat upper, than it was expected earlier. Y. Shigeta has discovered conodonts from nine horizons of the Abrek section: (1) at 43.3 m above the base of the Induan - *Neogondolella carinata*, according G.I. Buryi and H. Igo's determinations (Bed 130-1), in association with *Ambites* sp. and *Koninckites* sp. (= "*Meekoceras boreale*"); (2) at 66 m above the base of the Induan - *N. carinata*, here and further according H. Igo's determination (middle part of the Member 12) (Zakharov et al., 2000), in association with ammonoid *Gyronites subdharmus,* in adjacent layers *Inyoites spicini, Koninckites* aff. *timorensis, Dieneroceras chao, Pseudoprosphingites magnumbilicatum* and *Koninckites varaha* are known (Zakharov et al., 2000); (3) about at 60 m above the base of the Induan - *Neogondolella carinata* (Member 13), in association with ammonoid *Gyronites subdharmus,* in adjacent layers *Parahedenstroemia conspicienda, Proptychites* sp. (= "Arctoceras septentrionale") and *Preflorianites* cf. *radiatus* were discovered (Zakharov et al., 2000); (4) 75.3 m above the base of the Induan - *Neospathodus* cf. *kummeli, N. dieneri, N. cristagali, N. pakistanensis* (Member 13, Bed 130-9), in association with *Parahedenstroemia conspicienda*; (5) at 80.6 m above the base of the Induan - *Neospathodus waageni, N. discreta, Platyvillosus costatus* (the base of the Member14, Bed 130-10), in association with ammonoid *Flemingites radiatus,* in adjacent layers ammonoids *Pseudoprosphingites magnumbilicatum, Koninckites varaha, K. timorensis,* Gyronitidae, *Anaxenaspis* cf. *orientalis* were discovered (Zakharov et al., 2000); (6) about at 92 m above the base of the Induan - *Neospathodus symmetricus* (middle part of the Member 14), in association with *Arctoceras septetrionale*; (7) at 102.7 m above the base of the Induan - *Neospathodus symmetricus, N. homeri, N. abruptus , N. triangularis, N. crassatus* (base of the Member 15, Bed 132-1), in association with ammonoids *Koninckites timorensis* and *Palaeokazakhstanites ussuriensis*, in adjacent layers juvenile ammonoid *Anasibirites nevolini* was discovered; (8) at 114.6 m above the base of the Induan – *Neospathodus* abraptus (lower part of the Member 15, Bed 132-3), in association with *Koninckites timorensis,* in adjacent layers ammonoids *Arctoceras septentrionale, Owenites koeneni*, Gyronitidae gen. et sp. nov. (=?*Rohillites* sp. nov.), *Palaeokazakhstanites ussuriensis, Eophyllites* sp. (Zakharov et al., 2000); (9) at 122.6 m above the base3 of the Induan – *Neospathodus homeri* and *N. abraptus* (the middle part of the Member 15), about 10 m above the previous horizon ammonoids *Arctoceras labogense* and *Euflemingites prynadai* were collected; in the uppermost exposed part of the Lower Triassic of the mentioned section the such representatives of the lower-middle Olenekian ammonoids as *Parakymatites*, *Preflorianites*, *Koninckites* and *Hemiprionites* are known (there are no outcrops of sequences with typical upper Olenekian ammonoid assemblages at the Abrek Bay area therefore the first *Neospathodus homeri* occure in the middle Olenekian in South Primorye) (Zakharov et al., 2000).

The biohorizon defined the IOB at the Abrek Bay section considers to be the FAD of the conodont *Neospathodus waageni* (base of the Member 7, Bed 130-10) (Zakharov et al., 2000) now. As was shown above, the first *N. waageni* associate with flemingitid ammonoid there. In Prof. K. Kodama's conclusion, it is impossible to obtained reliable paleomagnetic data from both the mentioned sections in South Primorye, as well as from Lower Triassic sections in Japan, because of strong remagnitization of Triassic rocks in Far East.

The largest complex of field and analytic works have been done for the West Pingdingshan section now. It is located in Anhui Province of South China. For the West Pingdingshan section the IOB is suggested to locate at the FAD of *Neospathodus waageni eowaageni* (=*N. waageni* n. subsp. A) (Tong et al., 2005) within the lineage *N. dieneri-N. waageni eowaageni- N. waageni waageni*. The FAD horizon is at the base of Bed 24, Subbed 24-16. The FAD of flemingitid ammonoids is located 2-3 decimeters above the suggested GSSP (Tong and Zakharov, 2004; Tong et al., 2005a). Excellent results on both bio- and magneto- hemostratigraphy have been obtained for this section (Tong and Zhao, 2005; Tong et al., 2005b). The $\delta^{13}C$ excursion through the Lower Triassic expresses a very close relation to the ecological evolution in the aftermath of the end-Permian mass extinction and environmental catastrophe. As at most Permian-Triassic boundary sections, a big negative anomaly occurs during the Permian-Triassic transition; during the Induan the $\delta^{13}C$ increased steadily with only some small-scale fluctuations in the middle time. The positive shift arrives in a highest value (less than 2‰) around the Induan-Olenekian boundary. Then a big dropping happened in the early Olenekian and negative anomaly occurs in the *Neospathodus waageni* Zone. The positive carbon-isotopic anomaly was discovered around the *Neospathodus* sp. M Zone corresponded to the *Tirolites* Beds; the latter may be correlated with middle Olenekian positive anomalies of South Primorye and North Caucasus (Zakharov et al., 2001). Many plugs for paleomagnetic polarity have been sampled and measured, covering the whole Lower Triassic and uppermost Permian in the Pingdingshan section. The Permian-Triassic boundary belongs to a normal polarity interval. It is followed by R-N-R and suggested IOB is situated close to the top of the second normal polarity interval. The Lower Triassic sequence is thus composed of five normal intervals separated by reversed ones. The observed inclination of the magnetic vector in the vicinity of the Permian-Triassic boundary corresponds to a paleolatitude of around 30°N. Four clay beds have been discovered in the Pingdingshan section, all within one meter's distance above the suggested IOB. Zircon grains were found there, denoting that some or all of them are ash beds, therefore the mentioned section is very important in its potential to obtain a zircon/Ar-Ar data on the IOB.

The Muth section is situated in the Spiti area, Indian Himalaya. According to Prof. Krystyn (2005) data, Upper Induan-Lower Olenekian sequences of the Muth section are represent by the next subdivisions: (1) a*"Gyronites"* sp. Zone, containing ammonoids of typical Induan affinity time-equivalent to the *nepalensis* Zone; (2) the *Rohillites rohilla* Zone equivalent to the *eowaageni* respectively *N. waageni* n. subsp. A Zone sensu Zhao et al. (2004); (3) the *Flemingites griesbachi* Zone coeval to he *elongate = N.waageni* n. subsp. B; (4) the *Euflemingites* Zone, corresponding to the top of the *elongata* and the (lower) *N. w. waageni* Zone. The Muth zonal scheme gives, in Krystyn (2005) opinion, way to three IOB opinion: 1) the FO (or FA) of ammonoid *Rohillites rohilla* in Bed 13C, 2) the FO/FA of *Flemingites griesbachi* (and of *Flemingites* s. str.) in Bed 14B, and 3) the FO of *Euflemingites* in Bed 15A. As was shown above, the similar ammonoid succession was found in the Abrek Bay section in South Primorye, but in the Tri Kamnya Cape section *Flemingites* and Euflemingites occur together. Obtion 1, mentioned by Krysyn, represents the most distinct ammonoid boundary, which seems to correlate with the onset of the *N. waageni* group in the West Pingdingshan (South China) and Abrek Bay (South Primorye) sections. Krystyn considers that options 2 and 3 are less distinctive ammonoid boundaries despite the fact that the pandemic genus *Euflemingites* may represent the only direct stratigraphic link between faunas of the Tethys and Boreal realm. A severe handicap of the Muth section as well as sections of South Primorye and Japan is a regional thermal overprint that precludes a reliable magnitostratigraphy, at the same time a sterling chemostratigraphy is possible for this section.

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7. Some results on the preliminary straw vote (up to September 1, 2005)

All IOBWG members were asked: 1) Do you prefer the FAD of *N. waageni* sensu lato (n. subsp. A) for the Induan-Olenekian boundary? If no, what would your preference be?

2) Which section would you prefer for the Global Stratotype Section and Point (GSSP) for the Induan –Olenekian boundary?
a) The West Pingdingshan Section, Chaohu?
b) The Muth Section, Spiti, Himalayas?
Obtained results (16 members from 21 have assisted) are shown in the Table:

No.	Name	Question 1 (FAD of *N. waageni* sensu lato)	Question 2a (West Pingdingshan)	Question 2b (Spiti)
1	Baud, A.	No. I prefer FAD *Rohillite rohilla*	No	Yes
2	Buryi, G.I.	Yes	Yes	No
3	Ehiro, M.	Yes	Yes	-
4	Guex, J.	Yes	Yes	-
5	Henderson,Ch.	Yes	Yes	-
6	Hirsch, F.*	Yes	Holded back	Holded back
7	Tong Jinnan	Yes	Yes	No
8	Orchard, M*.	Holded back	Holded back	Holded back
9	Lozovsky, V.R*.	Yes	Holded back	Holded back
10	Popov,	Yes	Yes	Yes
11	Shigeta, Y.	Yes	Yes	-
12	Shen Shuzhong	Yes	Yes	-
13	Shishkin, M.	Yes	Yes	-
14	Yin Hongfu	Yes	Yes	No
15	Vuks, V.	Holded back	Yes	-
16	Zakharov, Y.D.	Yes	Yes	No

* See comments in the appendix.

Notes on the business meeting of the Induan/Olenekian Boundary Working Group (16 august 2006, Longyearbyen, Svalbard) and the after meeting discussion

Yuri D. Zakharov

The twenty nine persons, including seven members of IOBWG, were present at the business meeting.

Michael Orchard:

A proposal for the I-O GSSP at Chaohu is well advanced but fairness demands that the Spiti option be considered. Clearly, replication of the two data sets can only strengthen the final choice. To this end, I suggest that all Spiti I-O data should be summarized as quickly as possible (certainly within the next month or two) and distributed to the task group ahead of publication in *Albertiana* (publication schedule uncertain). My study of the Spiti conodonts is complete and already sent to Leo, Yuri, and Jinnan. Insights achieved doing this analysis have led me to the view that *Neospathodus posterolongatus* (first recognized in Chaohu) within the lineage *pakistanensis -posterolongatus - spitiensis*, can serve as a good index, but waageni sensu lato might be preferred. The Chinese researchers should confirm the conodont succession in Chaohu by study of the lower surface morphology of key elements - this will strengthen the value of the datum, which appears widespread. Collectively, the task group also needs to assess the chemostratigraphy of the two sections and its relationship to the biostratigraphy. When all this data is available and duly considered, the task group can make a reasoned choice. This should be possible by year-end.

Yuri D. Zakharov:

Induan-Olenekian Boundary Working Group (IOWG) exists during ten years, the last IOBWG Meeting took place in Chaohu (May 2005).As a result, the four candidates for global stratotype of the Induan/Olenekian boundary have been offered: Tri Kamnya Cape and Abrek Bay sections in South Primorye (Zakharov, 1996; Zakharov et al. 2001), Chaohu section in South China (Tong et al., 2003), and Muth section (Spiti), Himalayas (Krystyn et al., 2004, 2005).

Important biostratigraphical data were obtained for South Primorye, but according to Prof. K. Kodama’s note, we have a big problem with paleomagnetic because of strong remagnitization of Triassic rocks in Far East. During the Chaohu Meeting many workers, including myself, noted that the Chaohu (Western Pingdingshan) section is best candidate for the I-O GSSP, because a large complex of different works, including magneto- and chemostratigraphical ones, have been done there. Most ammonoid shells from the Chaohu section are badly preserved, flattened, but there is a possibility to find small phosphate ammonoid shells with well preserved suture-lines there. I close my eyes on the bad preservation of ammonoids of the Chaohu section, because its conodonts are very abundant and it yields volcanic ash layers that may provide radio-isotopic geochronological calibration.

Spity (Muth) section in the Himalayas is classic section with well preserved ammonoids and diverse conodonts. Excellent results on both biostratigraphy and chemostratigraphy have been obtained there. A single defect of the Muth section, as was mentioned earlier, is a strong remagnetization of Triassic rocks.

In September 2005, I organized the preliminary straw vote to learn which candidate is better. Most members of the IOBWG referred the Chaohu section then.

During the last year additional important information appeared concerning all main candidates. In particular, data on the conodont succession of the Abrek section in South Primorye have been obtained by Prof. Igo and Dr. Shigeta. In spite of some progress in studying Induan and Early Olenekian conodonts in South Primorye, I continue to consider that the Chaohu and Spiti sections seem to be best candidates for the I-O.

Mike offered new taxonomic concepts on the basis of data on conodonts from Spiti and Chaohu. Therefore in future, before voting, the IOBWG will be following mainly his recommendations on this topic.

Aymon Baud:

Concerning the I/O Boundary I think we have now very good data about Chaohu and congratulations to Jinan Tong and his team. But during the Boreal Triassic meeting the magnetostratigraphic results were contested and the ammonoids seems not well preserved. I am now waiting the final data and proposal of L. Krystyn team which seem very promising with the best outcrops that can be followed a long distance, more complete ammonoid and conodont successions, and excellent carbonate isotope curve. A good proxy for magnetostratigraphy will be the Nammal Gorge section (Salt Range, Pakistan) that is correlated very precisely with ammonoids and conodonts.

Hugo Bucher

Dear Yuri, dear Triassic colleagues, following the Triassic meeting in Longyearbyen, Yuri asked me to put in writings my comments about the Induan-Olenekian boundary. These you will find below.

Comments on the I/O Bdry:

1/ As a general rule, stages boundaries must be placed where faunal and floral turnovers are the most pronounced. Other information like magnetostratigraphy, geochemistry, etc. is secondary and should not have priority over faunal and floral changes in deciding where to place major boundaries.

2/ the I/O bdry does not coincide with any major break in the evolution of ammonoids. This is what led Guex to propose the Nammalian stage for the Dienerian + Smithian. The most drastic change within the early Triassic is obviously at the Smithian-Spathian bdry. As shown by Mike Orchard, the same applies to conodonts.

3/ As again recently stressed by Tong et al. (2003), the Olenekian was defined in the Boreal Realm, and the Induan in the Tethyan Realm. In terms of ammonoids, correlating this boundary between the high and low paleolatitude faunas is far from clear. Moreover, the I/O bdry is not an exact equivalent of the Dienerian/Smithian bdry as far as ammonoids are concerned.

4/ Tong et al. (2003) proposed the Chaohu section for the I/O bdyr. However, the very poor ammonoid preservation in this section is a major hindrance and does not help in solving the I/O bdry problem. On the contrary, it creates some confusion through doubtful associations of ammonoids characteristic of distinct and well separated zones. For instance, the stratigraphic range chart of Chaohu shows the co-occurrence of *Anasibirites* + *Juvenites* + *Euflemingites* + *Owenites* + *Arctoceras* + *Wasatchites*. This is simply an impossible association when compared to the rest of the world, and implies either a dramatic condensation of most of the Smithian or a more probable taxonomic over-interpretation of extremely poorly preserved ammonoids.

5/ In Chaohu, the base of the Smithian (or base of the Olenekian) is drawn at the first occurrence of *Flemingites* and *Owenites*. This is at variance with the excellent Smithian record from NW Guangxi (Brayard & Bucher, Fossils & Strata, in press), which shows that there are older and different ammonoid associations of Smithian age (*Hendenstroemia hedenstroemi* beds and *Kashmirites densistriatus* beds) below the *Flemingites rursiradius* beds. Moreover, the *Owenites* beds are also above the *Flemingites rursiradius* beds in NW Guangxi.

6/ Among others, sections from the Spiti area could probably best cover the I/O bdry for both ammonoids and conodonts. In NW Guangxi, the ammonoid record of Dienerian age is rather spotty, thus making this area inadequate for the I/O bdy. Primorye has a good ammonoid potential for this time interval, but I do not know precisely about the conodonts.

7/ There is not a single section that possesses a complete faunal or floral record. We all know that the record is discontinuous and pervaded with gaps. Therefore, looking for such a section is an illusion and a good zonation will always be a composite and abstract succession of zones combining data from different sections. If we want to designate any stratotype for stage or substage boundaries, then one must search for a section or a group of sections having the minimum amount of faunal gaps. Again, magnetostratigraphy and geochemistry must be considered as secondary information, and should not be over weighted against the fossil record. Magnetostrat and Chemostrat have their own load of problems, too. Secondary and complementary sections with good magnetostrat and geochemical record can always be proposed, provided that reasonable correlations can be established with the main section(s) yielding the best possible faunal and floral records.

8/ Last but not least, I would urge all colleagues to definitively give up on using FADs and LADs for correlations and boundary definitions. Diachronous FADs and LADs are more the rule than the exception, even for ammonoids and conodonts. The use of Oppel zones, maximal associations, concurrent range zones, Unitary Associations is the only reliable way of constructing robust correlations with fossils. There is absolutely no way to reconstruct a continuous time scale (such as interval zones which assume synchronicity of FADs) from discontinuous information such as the fossil record. Constructing a discontinuous system of zones based on maximal associations is also very well suited for the incorporation of new faunas. Finally, synchronicity of FADs is a biological non-sense, all modes of speciation being geographically restricted processes, whatever the rate of dispersal of the new species.

Charles M. Henderson:

Dear Mike, Jinnan, Yuri and Hugo: Tyler passed Hugo’s message on to me and as an I-O voting member and ICS Subcommission Chair I would like to make a few comments. During the Leicester ICOS meeting in July (July 19, 2006 at Beaumont Hall) Mike Orchard, Leopold Krystyn, Alda Nicora and I met to discuss Triassic definitions and correlations. At that meeting we agreed that a reasonable course of action was the following:

To ask the Working Group to vote on Chaohu versus Muth/Spiti with the boundary defined at a point equivalent to the FAD of *N. waageni* sensu lato. Once a firm favourite section was decided by the working group then a proposal would be prepared with that section as the GSSP and the other as a secondary reference section. This was decided because of the variation in conodont versus and ammonoid preservation at the two locations. Furthermore, we decided that since subspecies appeared in different orders at the two sections that the broader definition for *waageni* was more appropriate and very workable for definition. Yuri: I urge you to communicate with Mike Orchard to confirm this procedure agreed at ICOS and proceed with a vote along those lines (one point at two sections; so the vote is “which section”). Jinnan: I urge you to keep pushing for Chaohu. In my opinion, this section is excellent because it has a very good conodont record, it has ammonoids (although not well preserved) and it has isotopic work. It will be well protected and it is very accessible. There are a number of ways to correlate and it can be well correlated into Western and Arctic Canada. The selected level occurs in Western Canada at a very natural break (there really is a mid-Lower Triassic sequence stratigraphic event in many locations). Furthermore, I would like to stress the difference between DEFINITION and CORRELATION. Hugo: I agree that Oppel zones or derivatives thereof are very useful for correlation. However, they are by their very nature not as valuable for definition. A GSSP is defined at a point and that point must coincide with a single event otherwise the point cannot be distinguished. The most useful methodology is the FAD of a taxon within a lineage of well sampled fossils. The base or top of an Oppel Zone cannot be defined precisely, but the fossils within it and the trajectories of those fossils into other sections will be very valuable for correlation. The local first occurrence or FO of that same taxon may or may not coincide with the FAD at the GSSP – it becomes just one other means of correlation in other sections. It is a mistake, all too often made, to say that the FO of a GSSP taxon defines that boundary in another section. The taxon "defines" the boundary at only the GSSP. The procedures are well defined in the ISG and we should stop looking for perfection and define a workable point that has numerous means of correlation. We need to make these definitions so that we can get on with the more interesting story of correlating various physical and biological events in the rock record. For the Induan-Olenekian the work necessary for definition has already been done. The correlation game will continue on including the development of new multi-element lineages, but at least the discussion will have a common reference point.

Michael Orchard:

Dear Charles,

My recent summary to the group in Svalbard did indeed emphasize the suitability and wide acceptance of *waageni* sensu lato as a datum (the co-eval *posterlongatus*, formerly *waageni* subsp. B, a practical proxy), as we agreed at ICOS. This agreement represented a welcome and important consensus amongst most of the conodont workers within the larger task group, and is a view also held by our Chinese colleagues. The plan of action espoused on that occasion (indeed, on all occasions since the Chaohu meeting), to have the Spiti data published in Albertiana and/or freely available to the whole task force to consider prior to a choice of section, is on track - as I have relayed to both Yuri and the ICS. As STS Chair, I hope for this vote by the end of the year but that decision lies with the Task Group Chair. Meanwhile, important discussions continue amongst task group members about Lower Triassic ammonoid stratigraphy (Hugo's concerns), magnetostratigraphy (Jim Ogg's concerns, email forwarded to Yuri & Jinnnan), and chemostratigraphy (Spiti data not yet widely available yet). I am also aware that Jinnan and his co-workers are busy on new work identified as necessary at Chaohu. Of course, it is vital to have well understood correlations of these markers with the conodont datum and that this precede (voting on) definition.

Yuri D. Zakharov:

Dear Hugo,

Many thanks again for your additional very important comments on the Chaohu section and your NW Guangxi record, concerning first of all a position of the *Hedenstroemia* beds.

I would like to answer that in South Primorye, *Owenites* and *Arctoceras* were found within both the *Hedenstroemia* and *Anasibirites* zones, *Euflemingites* occurs in different levels of the Lower Olenekian, including the *Hedenstroemia-Anasibirites* boundary beds (Artyom) and possibly the *Anasibirites* Zone (Abrek). Therefore the middle Early Olenekian ammonoid association (*Anasibirites, Juvenites, Euflemingites, Owenites, Arctoceras, Wasatchites*) of the Chaohu section seems to be more or less real one. At the same time, I see that ammonoid control for Chaohu is significantly worse than for Spiti, but I expect that it would partly compensate by possible radio-isotopic geochronological calibration, if larger zircon crystals will be found in volcanic ash layers from the Induan-Olenekian boundary beds (according to Nicoll's data, only small zircon crystals were found in Chaohu).

I am waiting from Leo and your concrete ammonoid, conodont and isotope data from Spiti, including evidence for correlation of the *Hedenstroemia hedenstroemi* Zone, and information on magnetostratigraphy from neighboring areas (Salt Range, for instance) as soon as possible for unbiased comparison of the both sections and final conclusion. It is most important now.

Dear Jinnan,

Nice to hear from you again. Indeed, it is not so good that we have not full information from Spiti now, but this situation, as I hope, would be changed at the end of next October, when Leo and Hugo will finish their analysis of all paleontological and isotope data from Spiti and South China. I am waiting Mike's conclusion on conodont assemblages of Chaohu and his recommendations and also Heinz's remarks. Just before the voting I will inform all members of our working group on results of our discussion and give my recommendations taking into account manly Mike's (main expert on conodonts of South China and Spiti) conclusions and his general recommendations, as I said in the Longyearbyen meeting.

Tong Jinnan:

Dear Mike,

I indeed felt disappointed that I was not given a chance to introduce you our new studies in Chaohu and South China when we were in Longyearbyen. Because of my language difficulty, I spoke very little during the workshop. But I feel gratified that our results achieved in Chaohu have attracted a wide attention and used for the base to discuss the related matters. This would be what we expected and it is forcing the related studies over the world.

It is evident that many basic studies in Chaohu are reliable because of repeated works due to a good working condition and a full support from various sources (this must be prerequisite for a GSSP.)

Taking the data from Chaohu as a base, the bio-zones, paleomag, and carbon isotopes have been applied for a regional or global correlation. Some data have been approved and some are in discussion. Many works have been done as well in Spiti area, but the early years publications are hardly taken as a reference for a GSSP and no new data achieved in recent years have been published, so it is impossible to evaluate and use them as a reference. The only data (identification and distribution of conodonts) reported from Spiti at the Chaohu Symposium last year seem not proved by you.

The study of carbon isotopes in Chaohu has been published for many years and the excursion is well correlated at least throughout South China to Iran (Horacek reported at the Chaohu Symposium). The curve is clearly coinciding with that published by Payne et al. (Science, 2004). It looks like a good accessory marker to correlate the boundary. I have not seen the data from Spiti.

The magnetostratigraphic work in Chaohu has been done by Dr. Hans Hansen. Sorry that due to a health problem, he has not formally published the data yet, but the data have been provided as discussion for years. Though Dr. Mark Hounslow feels it is difficult to correlate the Chaohu polarity zonation with that in Boreal area, it is well correlated to that in Germany (as Bachmann and Kozur reported in 2006). Of course, I will communicate with Dr. Hansen for a further analysis of the data and discuss with other colleagues, i.e. Dr. Ogg, Menning and Hounslow. In addition, a paleomag expert from Beijing resampled the section early this year. I wish he could have a result soon.

'As you know, ammonoids are indeed preserved poorly in Chaohu though they are really very rich (even richer than Spiti). They are of course good indicators of the age. In fact, many ammonoids are significant for the I/O boundary definition at a generic level. However, in my opinion, for the GSSP definition microfossils are better than macrofossils. The macrofossils such as ammonoids are sized in several or more centimeters but the definition of the GSSP is usually in centimeter. As a result, I would suggest to use conodonts as the first mark of the boundary. I doubt that the coincidence of the boundaries of ammonoids and conodonts in Spiti is because of condensation or insufficient work in the underlying strata (as you mentioned, the conodonts in the Dienerian are indeed very rare). We have done same sampling in the strata but recovered only very few specimens from the Dienerian).

Thank you for the great conodont work for the samples from Spiti, which urges us a further consideration of the conodonts from Chaohu. Yesterday I invited some conodont colleagues here to discuss the conodonts Zhao achieved as well as your suggestions. We got the following points:

1) The conodont works of Chaohu are reliable and sufficient for a precise definition of the I/O boundary. The conodonts show a clear sequence across the boundary (the conodonts from Spiti might be condensed so that the succession could not be recognized or some more work might be necessary in the underlying strata).

2) As our early proposal, *Neospathodus waageni* would be the best index for the boundary. One species must have a variation range. You may subdivide a species into several morphotypes but the variation is within the species definition. In my opinion, the *eowaageni* would be only a morphotype of *N. waageni* (not a subspecies), maybe a primitive one. However, your Morphotype 1 from Spiti (the first occurring *waageni* in Spiti) looks an advanced form according to Sweet's description when he (1970) named this species because it has an expanded oval basal cavity with a well-thickened rim, and is conspicuously thickened laterally. This is an evolutionary trend in the Triassic conodonts such as the *parvus*-lineage and some Middle Triassic lineages. Therefore, I the data from Spiti are either condensed and further subdivision of the bed is necessary, or more work is necessary in the underlying strata. Anyway, it seems clear that *N. waageni* occurs a little early than *N. posterolongatus*.

3) We carefully examined all photos Zhao scanned and found that one main lineage *N. dieneri*-*N. waageni*-*N. pingdingshanensis* looks reasonable. However, the different morphotypes of *N. waageni* might go different lineages with a small explosion in the early Olenekian. I urge Zhao to summarize this lineage and send it to you for advice in a week. Meanwhile, we found a question with your lineage *N. pakistanensis*-*N. posterolongatus*-*N. spitiensis*. *Neospathodus spitiensis* was named by Goel (1977) based on the specimens from Spiti. He indicated that this species is also very common in the Dienerian (Gyronites-bearing strata) below the waageni zone. In addition, Goel's conodont work indicates that the Induan Stage in Spiti is not only very condensed, but probably incomplete.

Dr. Hugo Bucher argued about the definition by FAD. I think this is going a little too far for our discussion of the GSSP of I/O boundary and it might cause confusion. So far so many GSSPs have been defined. It seems that the FAD is the best way to provide a precise definition though it might not be so ideal in theory as the immigration of any species takes a period. Some other methods such as the Oppel zones may be very practical in correlation and general stratigraphical studies, but it hardly provides a precise definition for the boundaries.

Hugo Bucher

Dear Yuri:

The NW Guangxi record also shows that *Hensenstroemia* is a long ranging genus. It starts with *H. hedenstroemi* at the base of the Smithian, and ends in the *Anasibirites* faunas with a new, distinct species.

So, I think that what is first needed is a taxonomic and biostratigraphic tune-up of the Smithian faunas between Primorye, Spiti and NW Guangxi. This we can do all three together, Leo, you and I. Leo and I should look at our respective material next October, as a first step. Then, as we planned together, the Primorye data must absolutely be integrated so that we'll have a coherent taxonomy and biostratigraphy for the Smithian. That's where unitary associations may come into the play, because contradictions are more the rule than the exception, even for ammonoids and conodonts. This is also the reason why I used the term "beds" instead of "zone" for NW Guangxi. Reliable zones are abstract constructions which integrate and solve contradictions generated by preservation, ecological, and sampling bias. Three basins with good taxonomically consistent data set will be something fun to work out!

Chaohu: If you agree that the ammonoid record in Chaohu is not good enough for defining the I-O boundary, I think that it is YOU who should write an email to all members of the I/O working to make it clear that Chaohu is not suitable for a GSSP. In doing this you will save the entire Triassic community a great deal of future thorny problems by dragging along this poor Chaohu section as a GSSP.

The very poor preservation of the ammonoids is a major hindrance, and as such disqualify this section anyway. About the volcanic ash layers: my own experience in NW Guangxi is that the fine grain tuffs usually show important lead-loss. This can be explained by the large surface/volume ratio of the zircons in the fine grained ashes, thus favoring exchanges (lead-loss). If Primorye was to have good medium or coarse grained ashes, then it would be fantastic.

Dear Charles:

There is more than a philosophical debate between the GSSP procedure and what type of correlations and definitions are used. For instance, we all know that chunks of the sedimentary record are missing within maximal regression surfaces (not to mention ecological control, selective preservation, and sampling effort of the "normal record"). As the gaps are being progressively filled with information from new sections (yes, hopefully it happens, otherwise biostratigraphy would be a fossilized science), new faunas become available, and we must then determine if these have more affinities with previously known older or younger faunas. In doing so, we can narrow down the position of the main faunal turnovers, on which stage boundaries must be based.

Effects of gaps have a comparable impact on chemostratigraphy, magnetostratigraphy and the rest of it. The pattern of any isotopic signal will be dramatically changed by gaps and variable sedimentary rates, magnetic reversals associated with faunas of different ages if included into a sedimentary gap, and using a black and white code bar without independent and good paleontological age control can be extremely misleading, etc. If the base of a stage is defined by a fixed point, any new fauna to be discovered above this point will automatically be attributed to this stage, even if its composition shows that it has more affinity with older faunas. In such a case, the stage boundary will not reflect a faunal turnover at all. This is exactly why an open system with zones separated by intervals of separation preserves flexibility and adaptability with regard to any new piece of information that adds to the previously known faunal succession. Of course, for formal purpose, we have to designate a boundary section with a fixed point. But then, the question arises as to which of these two cars is best: the one with three wheels or the one with four wheels? Chaohu has a good conodont and $\delta^{13}C$ record, but a very poor, unusable ammonoid record. Spiti has a good record for ammonoids, conodonts and $\delta^{13}C$ (see Atudorei's thesis on Losar and Galfetti et al. submitted Pal.Pal.Pal., plus current work by Leo in Muth). Moreover, the lithological succession, carbon isotope fluctuations and ammonoid succession of Spiti correlates perfectly with NW Guangxi, thus verifying the potential value of Spiti as a reference section (see Galfetti et al. 2006, NGF abstracts and proceeding, n 3, p. 53). It is not too late to make the right choice, and not doing so will imply dragging along a broken leg for all future works (and hopefully more interesting, I completely agree on this point!) in the Early Triassic.

Hi Mike:

I had long discussions with Leo on the phone, and therefore will only briefly summarize them. Leo asked me to participate to the Spiti proposal for the correlations aspects, and I will be happy to work with him.

For the Smithian ammonoid succession, the Spiti and Guangxi sequences are in a good general agreement. Leo gave me his documents summarizing the work he has done, and I gave him a copy of the Brayard & Bucher monograph which will appear in Fossils & Strata, our unpublished Loulou $\delta^{13}C$ record from the P/T bdry up to the late middle Anisian with a new U/Pb age for the *Kashmirites densistriatus* beds, and some other works presently accepted for review (Geology, Galfetti et al. on the Barentz sea pollen record and $\delta^{13}C$ from Spitzbergen, i.e. part of the talk given by Hochuli), or accepted (Palaeo3, Galfetti et al. the talk I gave, including part of the $\delta^{13}C$ record of the Luolou), or in press (Brayard et al. Palaeo3, the talk given by Arnaud).

Leo and I agree that some fine taxonomic tune-up between Spiti and the Luolou Fm is still needed, and we plan to do it together next October. As acknowledged by Leo, the obvious point is that the Luolou clearly demonstrates that there are older Smithian faunas (i.e. *Hedenstroemia hedenstroemi* beds and *Kashmirites densitriatus* beds) BELOW the *Flemingites* beds (The *Hedenstroemia hedenstroemi* fauna is the oldest known Smithian fauna in Canada and Siberia). These faunas are lacking in Chaohu, where a crummy Dienerian fauna immediately underlie a crummy *Flemingites* fauna. This is a major argument against Chaohu, and supports Spiti where the v*ercheri* beds and the *Gyronites frequens* beds may probably correlate with the *K.densistriatus* beds of Guangxi. This is one of the important points to be checked by Leo and I, along with any possible occurrence of *Hedenstroemia hedenstroemi* in Spiti. Now, since I've got Leo's documents including his provisional d13C record, I can also add some new comments on the d13C record and its implications. A $\delta^{13}C$ record for the Spiti area is already available from Losar. Viorel measured my samples from Losar in his thesis and this curve is included in the accepted Galfetti et al. Palaeo3 paper, with Viorel as a co-author. A clear positive shift occurs just below the *Flemingites* beds in Viorel's work. In Losar, a mitigate ammonoid record led to place the Dienerian/ Smithian bdry at the base of the *Flemingites* beds. We will see below that such a position of the Dien/Smith bdry is wrong, if one assumes synchronous fluctuations of the carbon isotope signal. But anyway, the lithological succession of Losar correlates with that of Muth, which is not far away. A more comprehensive $\delta^{13}C$ record from Muth would surely be a nice additional piece of information to have. Expansion of Leo's sampling below and above the portion he has already measured is needed for a positive peak to clearly emerge. As this positive shift is evident in Losar, it must also occur in Muth. At present, the lower part of Leo's probable positive shift is missing on his log. Even thin carbonate beds or concretions interbedded between the continuous and thicker beds can be sampled. I did it in Losar in the younger *Parahedenstroemia* beds, and it worked well. Now, the Luolou record shows that a positive shift peaks at the boundary between the *Kashmirites densistriatus* beds and the *Flemingites rursiradius* beds (=*Rohillites* beds of Leo in Muth), and that the Dienerian/Smithian bdry must be within a long, almost straight and useless portion of the d13C curve, at a minimum distance of 4/5 m below this positive peak (i.e. below the oldest occurrence of H. hendenstroemi). Hence the nearest obvious d13C marker is this positive shift, which is WITHIN the Smithian, at a minimal distance of 4 to 5 m above the Dien./Smith bdry. Incidentally, Payne et al. 2004 placed the same positive peak exactly at the Dienerian/Smithian bdry in southern Guizhou, a peak which the ammonoid-rich Luolou record now also demonstrates to be of Smithian age. Finally, the best d13C record from Chaohu appears to be that of the West Pingdingshan section. As shown by Tong & Zhao 2005 (Albertiana 33, fig. 10, p. 136, the most recent of the many published versions, I guess), a positive shift weakly bulges over ca 15m of rocks. These authors placed the Dienerian/Smithian bdry somewhere in the middle of this positive shift, obviously at the FO of *Ns. waageni* n. subsp. A. (see Tong et al. 2003, fig 3).

The comparison with our $\delta^{13}C$ curve from the Luolou Fm that covers the entire early Triassic shows that this expanded shift must be our Smithian shift. When combining the Luolou ammonoid data with this isotopic correlation, it implies that the I/O boundary at Chaohu should be drawn at least 10 meters below the position indicated by Tong & Zhao, and that it might again occur within the flat, useless part of the curve below the shift. Then, the logical conclusions we cannot escape from are :1/ the FO of *Ns. waageni* n. subsp. A. (as well other M subspecies of waageni as shown on the Spiti section) cannot be used to define the base of the Smithian. It is in contradiction with the ammonoid record of the Luolou, based on the d13C correlation between Chaohu and the Luolou. 2/ the FO of *Ns. waageni* n. subsp. A. is in fact much younger and should more or less coincide with the *vercheri* beds or the base of the *Rohillites* beds in Muth and, assuming little or no diachronism with respect to ammonoids, with the base of the *Flemingites rursiradiatus* beds in Guangxi, predictively. 3/ the Dienerian/Smithian boundary, as constrained by the Smithian ammonoids from the Luolou Fm., is within the flat part of the rather consistent and globally reproducible $\delta^{13}C$ record. The nearest recognizable $\delta^{13}C$ fluctuation is the Smithian positive shift which peaks between the *Kashmirites densitriatus* beds and the *Flemingites rursiradiatus* beds of the Luolou. Hence, sad to say, but the $\delta^{13}C$ record will finally be of no help in narrowing down the Dienerian/Smithian boundary in sections where paleontological data are deficient. This is again another strong argument supporting the rejection of Chaohu, which is then left with its conodont record as a single asset. Preference must absolutely be given to a section having BOTH good ammonoids and good conodonts, e.g. Spiti.

Vladimir Davydov

Dear Yuri,

I did not receive zircons from the samples that I collected in Chaohu. What I can tell you is that minimal size of zircons for reliable analyzes should be at least 60-70 microns. Second, it should be high Pb content, so it is really hard to tell unless zircons are tested. Dr. Nicoll is working with guys from Berkley and they eventually have very similar machine to our. That is all I can tell.

Heinz Kozur

If the GSSP will be chosen between Chaohu and Spiti, then Spiti has the better potential. However, additionally the Salt Range sections should be investigated. A correlation with ammonoids and conodonts will be easy in the Salt Range and palaeomagnetic data will be reliable, like for the underlying Permian. Moreover, sporomorphs may give a good possibility for correlation with continental beds, especially in Gondwana. (see Kozur's paper).

Hugo Bucher

(1) Comments on Kozur's paper: Heinz Kozur argues in favor of choosing a reference point (i.e. a FAD) within an evolutionary lineage to define the base of the Olenekian. In an ideal world, where we would *a priori* know all mother/daughter species relations, this would be theoretically possible. But unless the same phylogenetic transition between two species is found everywhere at the time, this approach will remain nothing but a guess. And of course, synchronicity of an evolutionary transition must rely on arguments independent from the lineages being considered to avoid circularity. Otherwise, it may be impossible to distinguish a true evolutionary transition from (i) an ecological gradient being shifted in time and space, (ii) the consequences of the incom-

pleteness of the fossil record (i.e. selective preservation, sampling effort, etc.). Moreover, all models of speciation imply spatial segregation of a founding population for the birth of new species. This makes the assumption of synchronicity of FADs a generally shaky concept illustrating our inability to think in terms of 3D for the time/space distribution of a fossil species. The general 1D perception of the distribution of a fossil species is nothing but a simplistic, unfounded hope. Not acknowledging that we know very little about ancestor/descendant relations and using preconceived phylogenetic relations (for ammonoids, conodonts, and any other clade) will usually end up in wrong correlations.

At best, fossils can only be used to make phylogenetic inferences based on morphology of the few preserved hard parts of more complex organisms. What needs to be first established is the best possible distribution in time and space of our morphological species. This brings a first set of constraints on the whole array of possible morphological changes between our morphological species, whose definition should include ontogeny and intraspecific variation, provided that large and good enough samples can be obtained. Only after the time/space frame of the distribution of species is established can phylogenetic relations be addressed, by means of characters analyses. Not the other way around. Life is not always as simple as we wish, and we must avoid being confused between our 1D oversimplifying dreams and the combinatorial (3D) reality of the fossil record.

Dear Heinz,

Thanks for your comments and your ms. We stick to English so that all of our colleagues can keep up. I am fully aware of the scientific interest and potential of the Salt Ranges. But this area needs to be completely reinvestigated. NW Guangxi is now almost completely in the bank (ammonoids, conodonts, d13Ccarb, microfacies, ostracods, U/Pb ages, etc.), and only minor additional field work is still needed, especially for the Griesbachian and Dienerian.

Next month, Leo Krystyn and I will look together at our respective material from NW Guangxi and Spiti in order to tune up ammonoid taxonomy between these two basins. *Rohillites* also occurs in NW Guangxi, but there, its FO is apparently slightly above that of *Flemingites*. This again illustrates why the FO of an association is more realistic than a single FAD based on a phylogenetic interpretation when trying to define the base of a stage. In the Longyearbyen meeting, I said that NW Guangxi has no good Dienerian ammonoid record. This I said because I then followed the Tozer + Dagys definition for the base of the Smithian (i.e. the *H. hedenstroemi* beds). Now, if we want to have a better and more natural definition of the base of the Olenekian, I would recommend choosing the base of the *Flemingites + Rohillites* association (the *Fl. rursiradiatus* beds of NW Guangxi). These beds also record a major radiation of ammonoids worldwide.

If so, then NW Guangxi becomes also an ideal place for the I/O bdry. The ammonoid succesion comprises in ascending order: *H. hedenstroemi* beds, *Kashmirites rursiradiatus* beds, *Fl. rursiradiatus* beds, *Owenites* beds, *Anasibirites* beds, and almost the entire succesion of Spathian ammonoid faunas. The next unambiguous Dienerian fauna is 8 m below the *H. hedenstroemi* beds. This is why I played down the role of NW Guangxi in Longyearbyen. If we change the definition of the base of the Olenekian, then I'll cancel what I said. Conodonts are presently worked out by my PhD student Nicolas Goudemand. The *Fl. rursiradiatus* beds are concomitant with the explosive radiation of conodonts (cf. M. Orchard). $\delta^{13}C_{carb}$ is also available (my PhD student Th. Galfetti) and show a positive shift at the boundary between the *K. densitriatus* beds and the *Fl.rursiradiatus* beds. This shift occurs in many other sections, worldwide.

Last but not least, we have a new U/Pb age for the *K. densitriatus* beds (this new one will be published soon). What NW Guangxi does not have are the pollens (the OM is cooked) and magnetostrat (late diagenetic fluid circulations have erased the primary magnetization). But NW Guangxi has more than 15 partial sections with excellent exposures and fossil content for the I/O brdy if using the *Flemingites+Rohillites* association as the first zone of the Olenekian. And these partial sections can be correlated almost bed by bed throughout the entire Luolou Formation, whose lateral extension exceeds 200 km within the Nanpanjiang Basin. So, if we decide to use *Flemingites+Rohillites* to define the base of the Olenekian (an option I would personally favor), then we have two excellent places for a potential stratotype: Spiti and NW Guangxi. As I never had any personal ambitions in having my own sections designated as stratotypes (a stoneage concept), I am nevertheless prepared to support Spiti, whose lithological and ammonoid succession correlates perfectly with NW Guangxi. This provided that we use an appropriate definition for the base of the Olenekian (the FO of an association, not the FAD of an index species based on a phylogenetic interpretation).

Coming now to the type of zones to be used, maximal association zones (empirical Oppel zones, empirical concurrent range zones, combinatorial unitary associations, etc.) do provide the most robust, reliable and objective means for constructing biochronological correlations. Although such zones have an unknown duration and are intercalated with intervals of separation, the base of a stage can arbitrarily be defined by the first occurrence (FO, NOT FAD!) of the characteristic association of taxa of any given zone. Using the first occurrence of an association of characteristic species drastically reduces and practically eliminates all the flaws inherent to the designation of the FAD of a supposed evolutionary transition for the definition of the base of a stage. A phylogenetic relation is and will always remain an interpretation. The first occurrence (FO) of an assemblage of characteristic taxa is a fact. The use of FAD also prevents any further refinement and accommodation of future data still to discovered. It locks us up into a fixed frame based on a single phylogenetic interpretation that may prove wrong later on.

The more interesting question is then to find out when did the most pronounced and global faunal turnovers occurred, and to use these to define stage boundaries. For the I/O boundary, the NW Guangxi ammonoid record (Brayard & Bucher, submitted, Fossils & Strata) shows a succession including, in ascending order: the both depauperate *Hedenstroemi* Zone and *Kashmirites densistriatus* beds, followed by a dramatic diversification within the *Flemingites rursiradatus* beds. If this turnover pattern fits with Spiti (next October, Leo Krystyn, Arnaud Brayard and I will clear up some taxonomic points between NW Guangxi and Spiti), Primorie, the Salt Ranges, Siberia, Canada, etc…, then the I/O boundary can be safely placed at the base of the *Flemingites rursiradiatus* beds and its worldwide correlatives. However, such a definition is obviously at variance with the current definition of the base of Smithian in the Boreal Realm as proposed by Tozer and Dagys (the *Hedenstroemia hedenstroemi* Zone being used as the first Smithian zone). I think that these are the two options to be discussed within the frame of STS.

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ANNUAL REPORT 2006 OF THE RUSSIAN NATIONAL WORKING GROUP ON THE IGCP PROJECT 467

By Y.D. Zakharov

Main results

1. The problems of cyclicity the Triassic, Jurassic and Cretaceous sedimentation in the Sikhote-Alin have been discussed (Markevich et al., 2005).

2. Early Triassic ammonoids (eight species of Kashmiritidae, Melagathiceratidae, Prionitidae, Flemingitidae? and Palaeophyllitidae?) from Mt. Undur Ovoo area, Khentey Province, Mongolia are described in the first time. One new subgenus and one new species of the family Kashmiritidae (subgenus Saikhanites and species Pseudoceltites (Sakhaites) khenteyensis are proposed. The fauna includes probable flemingitid ammonoids, common elements for Early Olenekian ammonoid faunas. The Early Olenekian age is also confirmed by the presence of Juvenites and prionitid ammonoids, which closely resemble the Early Olenekian Gurleyites of the Tethys and Arctoprionites of the Boreal realm. The ammonoid fauna of Khentey Province, consisting mainly of Tethyan type, allows us to draw a suppoused Tethys-Boreal realm boundary during Early Triassic time between the Uda River (Khabarovsk region) in the north and Khentey (Mongolia) and Bolshiye Churki Range (Amur area) in the south. The existemce of the ammonoid-bearing marine Triassic in Mongolia supports the idea that the Mongolia-Okhotsk Ocean between the Siberia and Mongolia-North China continents still existedduring the Triassic (Ehiro et al., 2006).

3. A new classification is proposed in which Bactritoidea and Ammonoidea are considered as subclasses. The subclass Bactritoidea includes a single order, Bactritida Shimansy, 1951. The subclass Ammonoidea includes ten orders: (1) Anarcestida Miller et Furnish, 1954 (with suborders Agoniatitina Ruzhencev, 1957, Auguritina Bogoslovsky, 1961, Anarcestina Miller et Furnish, 1954, Gephuroceratina Ruzhencev, 1957, Timanoceratina Bogoslovsky, 1957, and Prolecanitina Miller et Furnish, 1954), (2) Tornoceratida Wedekind, 1918, (3) Goniatitida Hyatt, 1884 (with suborders Goniatitina Hyatt, 1884 and Cyclolobina Leonova, 2002), (4) Praeglyphioceratida Ruzhencev, 1957, (5) Clymeniida Hyatt, 1884 (with suborders Gonioclymeniina Schindewolf, 1923 and Clymeniina Hyatt, 1884), (6) Medlicottiida Zakharov, 1983, (7) Ceratitida Hyatt, 1884 (with suborders Paraceltitina Shevyrev, 1968, Otocerina Shevyrev et Ermakova, 1979, Meekoceratina Druschits et Doguzhaeva, 1976, Sagecerina Zakharov, 1983, Ptychitina Hyatt et Smeeth, 1905, Ceratitina Hyatt, 1884, Pinacoceratina Waagen, 1895, Megaphyllitina Shevyrev, 1985, Arcestina Hyatt, and Lobitina Schindewolf, 1968), (8) Phyllocerida Schindewolf, 1923, (9) Lytocerida Hyatt, 1889 (with suborders Lytocerina Hyatt, 1889 and Turrilitina Besnosov et Michailova, 1983) and (10) Ammonitida Zittel, 1884 (with suborders Psiloceratina Schindewolf, 1923, Haploceratina Besnosov et Michailova, 1983, Stephanoceratina Besnosov, 1960, Cardiocerina Lominadze, Topchishvili et Sharikadze, and Ancyloceratina Wiedmann, 1966).

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International Symposium on Triassic Chronostratigraphy and Biotic Recovery 23-25 May 2005 – Chaohu, China

The International Symposium on Triassic Chronostratigraphy and Biotic Recovery was held at the Tang Shan Hotel in Chaohu City, Anhui Province, China on 23-25 May 2005 with about 70 colleagues from 14 countries in attendance. The Symposium was co-sponsored by the Subcommission on Permian Stratigraphy, Subcommission on Triassic Stratigraphy, IGCP-467, Task Group on Induan-Olenekian Boundary, NSF-CHRONOS Project, as well as the National Natural Science Foundation of China and China National Commission of Stratigraphy. It was organized by the China University of Geosciences and hosted by the Government of Chaohu City and Office of Land and Resources, Anhui Province. Dr. Mike Orchard acted as the chairman and Drs. Yuri Zakharov and Yin Hongfu as the vice-chairmen, while Dr. Tong Jinnan served as the secretary.

The Open Ceremony was chaired by Prof. Yin Hongfu and six opening speeches were addressed by Zhen Weiwen, Mayor of the Chaohu City, Tao Qingfa, official of the Ministry of Land and Resources of China, Yang Xianjing, vice-director of the Office of Land and Resources of Anhui Province, Mike Orchard, chairman of the Subcommission on Triassic Stratigraphy and IGCP-467, Wang Yanxing, vice-president of China University of Geosciences (Wuhan), and James Ogg, secretary general of the International Commission on Stratigraphy. 47 oral reports were presented at 13 sessions during two and half days, and 15 posters were displayed at the Symposium.

Most speeches at the symposium expounded the Permian-Triassic transition with emphasis on the nature and pattern of extinction and events, the ecosystems and evolution during the crisis and recovery, and the processes of the biotic recovery and radiation. **Yin Hongfu** addressed the multiple phases of events leading to the extinction. **Yukio Isozaki** expressed the process of the anoxia from the late Permian to middle Triassic. **Pedro Marenco** proposed a hypothesis to explain the sulfur isotopic excursion around the Permian-Triassic transition. **Feng Qiao** reported an idea about the influence of climate change on the mass extinction according to a study on the terrestrial P-T sequences. **Shen Shuzhong** provided evidence of the transitional events from the peri-Gondwana facies.

Richard Twitchett ascribed the fossil dwarfism (Lilliput Effect) to the secular atmosphere oxygen-depletion and oceanic anoxia during the transition and crisis. **David Bottjer** considered the reduction of bioturbation as the sparseness of benthic communities resulting from the harsh environmental conditions in the Early Triassic. **He Weihong** assumed that the brachiopod miniaturization was a special appearance and resulted from the increasing environmental stress during the crisis. **Margaret Fraiser** suggested that a biocalcification crisis caused by an increased atmospheric CO_2 bought on the ecologic switch at the P/T boundary and prolonged biotic crisis in the early Triassic. **Yan Jiaxing** related the secular Phanerozoic chemical evolution of seawater to the selectivity of taxonomic biocalcification during the extinction-recovery transition. **Chen Zhongqiang** proved that the brachiopods were highly selective in taxonomy, ecology and biogeography through the extinction, survival and recovery. **Adam Woods** correlated the seafloor precipitates with the anachronistic anoxic facies, which resulted in the biotic recovery first at high latitudes and shifting to low latitudes over time.

Michael Orchard demonstrated the origination and explosive radiation of some major conodont groups during the Permian-Triassic transition and Early Triassic from a novel multielement perspective. **Robert Nicoll** provided details of the conodont lineages from *Hindeodus* to *Isarcicella* at the beginning of the Triassic. **Demir Altiner** illustrated the evolution of calcareous foraminifers through the Early Triassic and their representations in the survival and recovery. **Christopher McRoberts** described the revolution of the marine bivalve Myalinidae from the Permian to Triassic and showed the nature of simple opportunistic Early Triassic myalinids. **Lar Schmitz** and **Jiang Dayong** narrated the origin, evolution, radiation and spreading of the ichthyopterigians during the Triassic, and related the connection of the shell-eating marine reptiles with the recovery and radiation of the shellfish in the early Triassic. **Tyler Beatty** documented the ichnofossil assemblages from the Lower Triassic of the northwest margin of the Pangea (western North America) and explained the variable recovery along the margin.

The calcimicrobialites at the Permian-Triassic boundary and in the Lower Triassic were a popular theme of the proceedings. Besides the designed post-Symposium Field Excursion 2 for the observation of the "Great Bank of Guizhou" that includes a well-developed Permian-Lower Triassic calcimicrobialite sequence, several reports focused on microbialites from various regions over the world. **Wang Yongbiao** displayed evidence of cyanobacteria observed in the Permian-Triassic boundary calcimicrobialites from various areas of South China and deduced the environmental origination of the rocks. **Daniel Lehrmann** demonstrated the origination, growth and drowning of the "Great Bank of Guizhou" that provided the circumstance for the development of calcimicrobialite at the Permian-Triassic boundary and through the Lower Triassic: unfavourable marine and/or atmospheric conditions prevented rediversification of metazoans and stimulating microbialite deposition. **Oliver Weidlich** introduced the microbialites from the Lower Triassic of the Central European Basin (Germany) and showed their marine origination. **Demir Altiner** also briefly mentioned the microbialites at the Permian-Triassic boundary and in the Lower Triassic of Turkey.

Aymon Baud summarized the Early Triassic microbialites into four episodes and especially detailed the first microbial episode at the Permian-Triassic boundary.

Regarding the stratigraphy of the Permian-Triassic boundary, **Jin Yugan** presented a re-study on the sedimentology at the Meishan Section, indicating that Bed 27 contains some hard-ground structures. **Wu Yasheng** proposed taxonomic revision for some conodonts at the boundary sections. **Thomas Algeo** introduced a Permian-Triassic boundary section of carbonate facies in the northern Vietnam, relating geochemical anomalies to the transitional events. **Tea Kolar-Jurkovsek** showed some Permian-Triassic boundary sections with good conodont records in Slovenia. **Ian Metcalfe** summarized the latest isotopic age dating in the boundary strata at the Meishan and Shangsi sections and presented a correlation of the Permian-Triassic boundary between the marine and terrestrial sequences. **Peng Yuanqiao** traced the Permian-Triassic boundary from the marine to terrestrial via a paralic facies in the western Guizhou and eastern Yunnan.

Chaohu being both the location of the meeting and the West Pingdingshan Section, a candidiate for the GSSP of the Induan-Olenekian boundary, the Lower Triassic stratigraphy and the Induan-Olenekian boundary were key topics at the symposium. **Tong Jinnan** summarized the main achievements in the Lower Triassic of Chaohu, including conodont, ammonoid and bivalve biostratigraphy, carbon isotope stratigraphy, magnetostratigraphy, and especially the definition and recognition of the Permian-Triassic boundary and Induan-Olenekian boundary in Chaohu. Both the West Pingdingshan Section covering strata from the topmost Permian to the lower Spathian, and the upper part of the South Majiashan Section where the ichthyosaur *Chaohusaurus* occurs and the Olenekian-Anisian boundary is located, were visited on the morning of May 24 during the mid-Symposium Field Excursion. **Zhao Laishi** exhibited the conodonts from the Lower Triassic in Chaohu, introduced the Lower Triassic conodont zonation and demonstrated the taxonomic subdivisions of *Neospathodus dieneri* and *Neospathodus waageni*. **Charles Henderson** correlated the Induan-Olenekian boundary between the Canadian Opal Creek Section and Chaohu Section to confirm that the definitive species of the I-O boundary are widely distributed in both low-latitude Tethyan and extra-Tethyan realms. **Leopold Krystyn** showed the conodont succession at Muth, Spiti, Indian Himalaya, which was in the southern margin of the Tethys, co-occurring with ammonoids *Flemingites* and *Euflemingites*, and proposed the section as a potential GSSP candidate for the Induan-Olenekian boundary. **Manfred Menning** correlated the Germanic (Lower) Triassic with the sequence in Chaohu and, although the numbers of magnetoplarity zones are slightly different, calculated the time spans of the Induan and Olenekian stages (1.4-1.5 m.y. and ~3.7 m.y., respectively) based upon the sedimentary cycles. **Micha Horacek** confirmed the carbon isotopes excursion at the West Pingdingshan Section and correlated it to the Iranian and Italian Dolomites Lower Triassic sequences; he also reported the results of the Moessbauer spectroscopy on the Fe^{2+} and Fe^{3+} phases at the West Pingdingshan Section, showing that the Lower Triassic at the section was mainly formed in a suboxic stratified oceanic condition except for the middle Smithian that seemingly formed in a circulated oxic environment. **Zuo Jingxun** showed several Lower Triassic carbon isotopes excursions from various facies throughout South China and they are quite coincided with that at Chaohu, indicating that the carbon isotopes excursion might be regarded as a good accessory marker for the Lower Triassic correlation.

Some reports also laid stress on the upper part of the Lower Triassic and the Olenekian-Anisian boundary, and some even on the Upper Triassic. **Ian Metcalfe** briefly introduced a Spathian conodont sequence in the Dalishan Section, Jiangsu Province, which contains some ash beds to be dated. **Valery Vuks** documented the Olenekian foraminifer assemblages from Caucasus and its neighboring areas and their application to the reconstruction of paleogeography. **Yuri Zakharov** exhibited some excellent Olenekian-Anisian outcrops with good ammonoid records in South Primorye, Russian Far East and supposed that it might be a candidate for the Olenekian-Anisian boundary GSSP. **Yao Jianxing** reported two Olenekian-Anisian boundary sections with good conodont sequence in South Guizhou, including an isotope dating for the boundary tuffaceous rocks. **Daniel Lehrmann** expressed that the Guandao Section in South Guizhou has a well-documented Olenekian-Anisian boundary sequence, including conodont biostratigraphy, carbon isotopes excursion, magnetostratigraphy, as well as age-dating from tuffs; this sequence was visited during the post-Symposium Field Excursion 2, during which ammonoids were discovered in the boundary interval. **John Marzolf** provided examples of correlation between marine and non-marine Triassic sequences in western USA based upon the sequence stratigraphy. **Kagen Tekin** reported a new Norian radiolarian assemblage from SW Turkey, which contains some new key taxa. **Michaela Bernecker** demonstrated the history of the Kawr isolated carbonate platform of Oman in the neo-Tethys and compared its similar architecture with the Early Triassic “Great Bank of Guizhou”.

Two reports focused on Permian stratigraphy and GSSPs at the Symposium. **Vladimir Davydov** introduced the situation of the Lower Permian stages and boundaries and indicated the possible locations of the GSSPs, and **Wang Yue** described the potential GSSP section for the base of the Changhsingian Stage at Meishan, which was visited during the pre-Symposium Field Excursion.

Other reports were overview in nature: **James Ogg** explained the Geologic Time Scale 2004 (GTS2004) and the current status of the GSSPs as viewed from the ICS. **Bruce Wardlaw** and **Vladimir Davydov** reported the progress of the Permian-Triassic Time Slice Project of

CHRONOS and PaleoStrat database system, and encouraged researchers for the Permian-Triassic time to join in the system and share the various data with colleagues.

Finally, Mike Orchard made some closing remarks. He emphasized the multiple nature of events leading to the P-T extinction, and the increasing evidence that further anomalies and abherrations characterize the rock record through most of the Early Triassic and even into the Middle Triassic. He noted that the community is evidently moving slowly but surely towards a deeper understanding of the complex interplay between all the biological, chemical and physical phenomena that effected planet Earth during this most unusual period and he stressed that a primary tool in achieving a holistic model will be a more highly resolved time scale, towards which each of the sponsoring organizations were working.

He thanked the meeting organizers — especially Yin Hongfu and the very busy secretary Tong Jinnan and his staff, including Zhao Laishi, the pre-meeting excursion leader, and acknowledged the important role of Wolfram Kuerschner, the editor of Albertiana, who provided printable copy of the special issues of abstracts and field guides. Special thanks were also extended to the people and government of Chaohu City, and the staff and volunteers of the Tang Shan Hotel

There were three Symposium Field Excursions associated with the symposium were executed in South China. A pre-Symposium Field Excursion on 21-22 May attracted 27 participants from 10 countries in a trip from Hangzhou–Meishan–Nanjing–Chaohu. The excursion, led by Drs. Zhao Laishi and Wang Yue and assisted by Nanjing Institute of Geology and Paleontology, Office of Land and Resources of Zhejiang Province and Government of Changxing County, had a stop at Meishan, Changxing to visit the type Changhsingian Stage including the potential GSSP of the base of the Changhsingian and the GSSP of the Permian-Triassic boundary, and the Griesbachian sequence. A second stop was at Hushan, Nanjing to view a Lower Triassic profile, especially the cyclic sedimentary sequence and the Induan-Olenekian boundary. A paleontological museum at the Nanjing Institute of Geology and Paleontology was visited during the excursion. A mid-Symposium Field Excursion on the 24th morning involving all symposium participants visited the West Pingdingshan Section that exposes strata from the topmost Permian to the lower Spathian, and the upper part of the South Majiashan Section. Some key boundaries, such as the Permian-Triassic boundary, Induan-Olenekian boundary, Smithian-Spathian boundary and possible Olenekian-Anisian boundary, were examined and discussed. The excursion was guided by Tong Jinnan and assisted by the Government of Chaohu City and Office of Land and Resources of Anhui Province. A post-Symposium Field Excursion on 26-29 May attracted 28 participants from 11 countries and focused on southern Guizhou Province. Various facies across the “Great Bank of Guizhou” were examined: the calcimicrobialites at the Permian-Triassic boundary and in the Lower Triassic, the Middle Triassic coral reef and carbonate precipitates, and the Guandao sections at the edge of the bank, which has been well studied from the Permian-Triassic boundary to the lower Carnian and especially at the Olenekian-Anisian boundary. The trip was guided by Dr. Daniel Lehrmann of the University of Wisconsin and Wei Jiarong and Yu Youyi from Guiyang. It was assisted by the Bureau of Geology and Mineral Resources of Guizhou Province, Guizhou University and Office of Land and Resources of Guizhou Province.

The symposium received 68 abstracts, which are all published in two volumes of Albertiana (issue #33), together with the symposium program and all field excursion guides.

The symposium and field excursions had attracted a good attention to the local news media. The news from the symposium and excursions mostly occurred on the front pages of the local newspapers, such as Chaohu Daily, Anhui Daily, and Guizhou Daily. It was also reported continuously by the local newscast and television stations.

The Symposium and Field Excursions were financially assisted by the Subcommission on Triassic Stratigraphy, IGCP-467, National Natural Science Foundation of China, China University of Geosciences, Government of Chaohu City, Office of Land and Resources of Anhui Province, as well as Office of Land and Resources of Zhejiang Province and Bureau of Geology and Mineral Resources of Guizhou Province.

(written by Tong Jinnan and Mike Orchard)

Scientific Reports

The *Chiosella timorensis* lineage and correlation of the ammonoids and conodonts around the base of the Anisian in the GSSP candidate at Desli Caira (North Dobrogea, Romania)

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The GSSP candidate for the Anisian base at Desli Caira (North Dobrogea, Romania) is well exposed and has a rich ammonoid and conodont fauna. The conodonts are well preserved and have a conodont alteration index of 1. There are also reliable magnetostratigraphic (Besse et al., 2000) and stable isotope (Atudorei, 1999) results. The ammonoids and nautiloids of Desli Caira and especially their stratigraphic value are presented by Grãdinaru (2000, 2003) and Grãdinaru & Sobolev (2006). The boundary is placed between beds with *Deslicairites simionescui* n. g. n. sp., *Procarnites kokeni* and other upper Spathian ammonoids below and the *Paracrochordiceras-Japonites* Beds of basal Anisian age above. Especially important for correlation with the Boreal Realm is the outstanding occurrence of olenekitids (*Deslicairites*, ? *Svalbardiceras*) in the topmost Olenekian of the Tethys and of ?*Karangatites* at the very base of the Anisian at Desli Caira. *Karangatites* is the zonal marker for the base of the Anisian in Arctic Siberia.

Conodonts are well studied in Desli Caira (Grãdinaru et al., 2002) but there were for a long time unresolved questions concerning the correlation of the ammonoid and conodont zonations. Whereas conodont workers assumed that *Chiosella timorensis* (Nogami) begins at the base of the Anisian in the Desli Caira section, Grãdinaru was not fully convinced about its FAD, and this with good reason, because it is obvious that even in the recent literature there are some conodont workers which have different interpretations of *C. gondolelloides* (Bender) and *C. timorensis* (e.g., Germani, 1997; Mertmann & Jacobshagen, 2003). The first author of the present paper claimed the necessity to have an exact definition of the two species, which have to be adopted by all conodont workers interested in the definition of the Olenekian-Anisian boundary. Choice of *C. timorensis* as a marker for this boundary in the absence of a clear separation from *C. gondolelloides*, unanimously accepted, may lead to controversial correlations of the Olenekian-Anisian boundary. In this contribution, we provide definitive criteria for distinguishing these two species and show that *C. timorensis* is indeed a suitable index for the Olenekian-Anisian boundary in the Desli Caira section, and that this conodont taxon can be proposed as a global marker for this boundary.

Kozur (1990) established the genus *Chiosella* on the basis of material from a section 350 m south of Pietra dei Saracini, Sosio Valley, western Sicily (Italy), where an uncondensed continuous section from the upper Spathian to the lower Illyrian contains abundant conodonts but unfortunately no ammonoids. Orchard (2005) reconstructed a multielement apparatus for *Chiosella* based on the material from Desli Caira.

The *Chiosella timorensis* lineage begins with *Triassospathodus* of the *T. homeri* group. One member of this group, *T. sosioensis* (Kozur, Krainer & Mostler), includes specimens that have slight lateral thickening below the base of the denticles: this is best observed in oblique light as a shallow median ridge in the anterior half of the unit, and in parts of the posterior half of the unit, but never below the posterior 3 denticles (Kozur et al., 1997, Pl. 1, Fig. 4a). Behind the pit, there is a short but narrow continuation of the basal furrow (Kozur et al., 1997, Figs. 1b, 3b, 4b). At the end of this furrow a second shallower pit may be developed, a feature, which is very characteristic also for both *Chiosella* and *Neogondolella* s.s., including *N. mombergensis* (Tatge), the type species of *Neogondolella*. A continuous development from these advanced forms of *T. sosioensis* to *Chiosella gondolelloides* can be observed in the development of a continuous median ridge which, however, does not reach the posterior denticle on either side of the blade. As pointed out by Kozur (1990) and Bachmann & Kozur (2004), this is the decisive difference between *Chiosella gondolelloides* and *C. timorensis*. In the latter, the median ridge or very narrow platform reaches the posterior denticle of the unit at least on one side, and in advanced forms it surrounds the posterior end of the blade entirely. Concurrently, the median ridge becomes continuously broader and the average length of the unit increases. As pointed out by Kozur (1990), *C. gondolelloides* is not the juvenile form of *C. timorensis*, which looks very similar. This is typical for those conodont lineages in which a taxonomic important feature develops in adult specimens. The same can be observed in ammonoids, ostracods and other fossil groups. For example, in the Germanic Upper Muschelkalk C*eratites compressus* evolved from *C. robustus* by development of non-bifurcated ribs on the living chamber of adult forms. All other chambers have only bifurcated ribs, as this is the case also in adult *C. robustus*. Therefore, juvenile *C. compressus* are very similar to *C. robustus*, but this does not mean that *C. compressus* is not an excellent guide form. Conodont biostratigraphy (as well as ammonoid and ostracod biostratigraphy) is generally based on adult specimens. Juvenile platform conodonts are easily recognised as immature states (smaller size, missing or incompletely developed platform, fewer fused denticles of the carina, differences in amount and distribution of white matter). However, especially early (platform-less) juvenile stages cannot be determined because they are similar or identical in species with quite different adult forms. Only few platform conodonts have very characteristic juvenile stages (e.g. *Paragondolella* ? *trammeri*, *Metapolygnathus communisti*). In the case of the *C. timorensis* lineages, the similarity between juvenile *C. timorensis* and *C. gondolelloides* cannot lead to biostratigraphic problems because there is an overlap of *C. timorensis* and *C. gondolelloides* in the lowermost Anisian, which indicates that the *C. timorensis* lineage is a complete and well known lineage. If somebody would erroneously determine a juvenile *C. timorensis* as a *C. gondolelloides*, this would not change the range of the two species.

C. gondolelloides begins distinctly earlier than the first *C. timorensis*, as is confirmed at Desli Caira, in the Guandao section of South China (Lehrmann et al., 2005), in the Pietra dei Saracini section (Sicily), and in several sections in Turkey, both in the Palaeotethys and in the Neotethys. Both species occur together in the *C. timorensis* Zone.

A second development from *C. gondolelloides*, which begins later than the development to *C. timorensis*, leads to *Nicoraella*, in which for the first time the pit shifted forward into a median position, as typical for the advanced gondolellids of the Triassic, but in this lineage the median ridge does not evolve into a platform. Likewise documented by transitional forms, *Neogondolella* ex gr. *regalis* (Mosher) evolved from *C. timorensis* by further widening of the platform. The continuous development within the *C. timorensis* lineage from advanced *Triassospathodus* (*T. sosioensis*) into *Neogondolella* was first described by Bender & Kockel (1963) and Bender (1970), and it was the reason for the establishment of *Neogondolella* for the post-Lower Triassic gondolellids (Bender & Stoppel, 1965).

Concerning the generic assignment of these species, Kozur (1990) regarded *C. gondolelloides* to be a perfect transitional form between Spathian *Neospathodus* (now referred to *Triassospathodus*) and *Chiosella*, but put it into *Chiosella* because it shows in the *C. timorensis* lineage for the first time a new feature, that is the development of a median ridge which evolved into a very narrow platform in *C. timorensis*. Orchard (1995) initially assigned the species *gondolelloides* to *Neospathodus,* but for stratigraphic questions this is without importance. The FAD of *C. timorensis* is unaffected by the nomenclatural question of whether in the continuous *Chiosella timorensis* lineage the boundary between *Triassospathodus* and *Chiosella* is placed, between *Triassospathodus sosioensis* and *Chiosella gondolelloides* or between *Triassospathodus gondolelloides* and *Chiosella timorensis*.

Confusion has arisen in the literature concerning the distinction between the species of *Chiosella*, in part because *C. gondolelloides* was regarded as a juvenile form of *C. timorensis* (e.g. Gaetani et al., 1992). Sweet (1970) determined and illustrated typical *C. gondolelloides* from the upper Spathian of the Salt Range as “*Neospathodus*” *timorensis.* In that time the paper of Bender (1970), and therefore also *Chiosella gondolelloides*, was not yet available as discussed by Sweet (1970). Not considering these circumstances, the report of “*N*.” *timorensis* by Sweet (1970) in beds with Spathian ammonoids from the Salt Range caused problems for some ammonoid workers. Similarly, *C. timorensis* was confused with *Neospathodus* ex gr. *homeri* (Collinson & Hasenmueller, 1978). Both Kozur (1990) and Orchard (1995) came to the conclusion that *C. gondolelloides* is not the juvenile form of *C timorensis*, that it begins earlier (in the upper Spathian) than the latter species, and that the two co-occur in the Aegean.

Orchard (1995) also mentioned that *C. gondolelloides* and *C. timorensis* are distinguished by their relative length and the relative width of the rudimentary platform. The latter feature is important for separation of the species because forms in which the platform is very narrow but wider than the median ridge of *C. gondolelloides* belong always to *C. timorensis*. However, among the most primitive *C. timorensis*, in which the rudimentary platform or median ridge extends on at least one side up to the posteriormost denticle, are forms in which the rudimentary platform is not wider than the median ridge in *C. gondolelloides.* The average length of the unit in *C. timorensis* is greater than in *C. gondolelloides* but, as pointed out by Bachmann & Kozur (2004), long specimens of *C. gondolelloides* occur early in the range of the species and long forms in which the median ridge does not reach the posteriormost denticle on either side dominate in faunas prior to the appearance of *C. timorensis*.

Because of these misinterpretations, it has appeared that *C. timorensis* first appeared within the upper Spathian. Examination of conodont material across the ammonoid-defined Olenekian-Anisian boundary at Desli Caira by all co-authors confirm the FAD of *C. timorensis* exactly at the ammonoid-defined Anisian base. Long *C. gondolelloides* are common in the uppermost Spathian defined by ammonoid faunas, and advanced *C. timorensis*, in which the very narrow platform surrounds the posterior end of the carina, begin later, at the base of the *Aegeiceras ugra* fauna (Plate 1). These results show the extraordinary importance of the Desli Caira section for definition of the base of the Anisian. The FAD of *C. timorensis* in this section, based on the diagnosis and illustration given in the present paper, can be used for worldwide correlation of the Olenekian-Anisian boundary, concurrently with other biostratigraphic (ammonoid, foraminifer, etc.) tools and with reliable magnetostratigraphic and chemostratigraphic calibrations.

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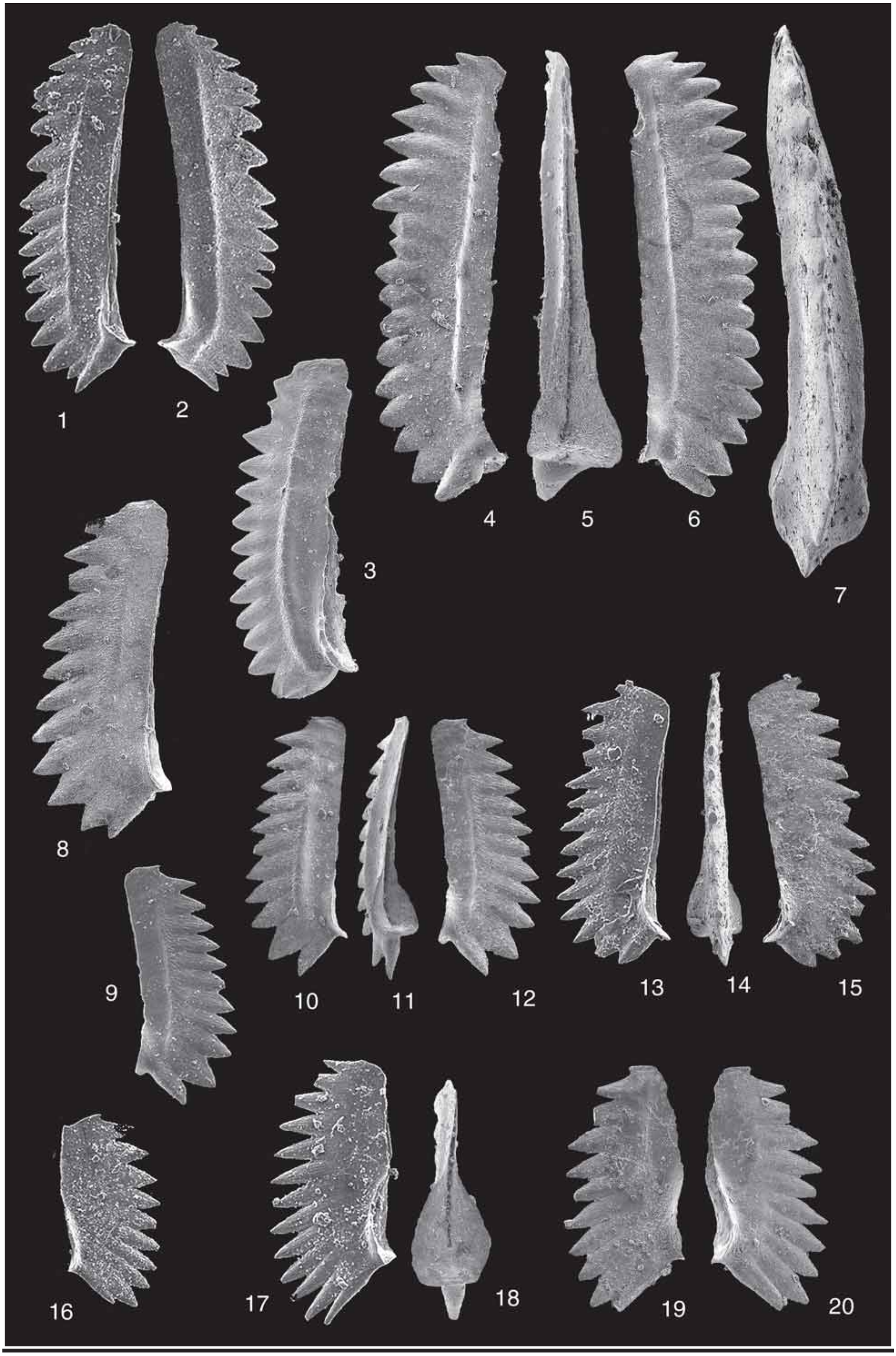
Plate 1:

All specimens from Desli Caira, Romania. Magnification x80
1-7. *Chiosella timorensis* (Nogami).
1, 2. Sample 9042. Anisian (*Paracrochordiceras-Japonites* Beds)
3. Sample 9044. Anisian (*Paracrochordiceras-Japonites* Beds)
4-6. Sample 611A. Anisian (*Aegeiceras ugra* Beds)
7. Sample 611A. Anisian (*Aegeiceras ugra* Beds)
8-15. *Chiosella gondolelloides* (Bender).
8. Sample 9050. Anisian (above *Aegeiceras ugra* Beds)
9. Sample 9039. Olenekian (*Deslicairites simionescui* Beds)
10-12. Sample 9039. Olenekian (*Deslicairites simionescui* Beds)
13-15. Sample 9039. Olenekian (*Deslicairites simionescui* Beds)
16-20. *Triassospathodus* ex gr. *homeri* (Bender); the figured specimens are assigned by Kozur to *Triassospathodus sosioensis* Kozur, Krainer & Mostler, a species in the *T. homeri* group.
16. Sample 9036A. Olenekian (below *Deslicairites simionescui* Beds)
17, 18. Sample 9036A. Olenekian (below *Deslicairites simionescui* Beds)
19, 20. Sample 203B. Olenekian (below *Deslicairites simionescui* Beds)

Plate 1



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A call for fuller documentation of the Chaohu magnetostratigraphy

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The Chaohu magnetostratigraphy, as currently in the public domain, has a number of issues (outlined below), which should be addressed, prior to any decision about a possible GSSP for the Olenekian. Addressing these issues would serve the purpose of strengthening the usefulness and clarity of the magnetostratigraphic information (for global correlation), presented with the proposed Chaohu GSSP.

1) An informal understanding is that the magnetostratigraphic study has been undertaken on the several sections, which make up the Lower Triassic succession at Chaohu. It would be an advantage if the magnetostratigraphic data for each of these sections (with their stratigraphic overlap) were presented, along with the composite section summary. This would (presumably) strengthen any case for the repeatability of the magnetostratigraphy across one or more sections. Such inter-section repeatability is a primary aim to validate magnetostratigraphic data (e.g. point 10 of the quality criteria of Opdyke & Channel, 1996, p94).

2) Since several magnetostratigraphies from the S. China Lower Triassic (Hechuan, Meishan etc.) have now been published, it would seem prudent to consider the correlation of the Chaohu magnetostratigraphic to these other sections, and discuss the consistencies (and inconsistencies) in terms of biostratigraphic and magnetostratigraphic correlation. Without some kind of understanding of how, apparently complete successions, might correlate within the S. China block, it seems premature to consider the relationship of such magnetostratigraphies to those outside China. A discussion along these lines clearly goes hand-in-hand with the necessity to discuss 'inter-section repeatability' (i.e point 1 above).

3) It is not clear from the declination/inclination data presented in Hansen & Tong (2005) and Tong & Laishi (2005), how this was used to interpret the magnetic polarity for the Chaohu sections. It is usually a simple matter to interpret the magnetic polarity from published data. For example, assuming the mean lower Triassic virtual geomagnetic pole (VGP) for the Chaohu section is close to the mean for the S. China block (i.e latitude=42.5, longitude=213.9, presented in Yang & Besse, 2001), then this would give an expected mean lower Triassic (normal) field direction of about $050^o/+30^o$ (palaeolatitude 16^oN) at Chaohu. Using $\pm 60^o$ acceptance windows on reverse and normal declinations and $\pm 30^o$ acceptance windows on the reverse and normal inclination, would give the nominally normal and reverse polarity fields marked in Fig. 1. In this diagram specimens which fall into **both** normal declination/inclination fields should be classified as normal polarity (similar case for reverse). Specimen points which do not fall into both of the declination/inclination acceptance windows would be classified as intermediate. Using this simple procedure, the interpreted magnetic polarity is very different (using Dec/Inc column in Fig. 1) to that which has been presented by Hansen & Tong (2005) and Tong & Laishi (2005), both in detail and more importantly in general character. This is not proposed as the best interpretation (since, mean directions and any tectonic rotations at Chaohu are not presented with the published works). This example is just to illustrate, that without some fuller documentation, the polarity interpretation presented for Chaohu appears **not** to be supported by the data. Therefore, it is of crucial importance that the exact method by which the magnetic polarity was interpreted from specimen data, to magnetic polarity column is fully explained for the Chaohu magnetostratigraphy.

4) A comment on the partial-remagnetisation problems (which seem to plague data from South China, Yang & Besse, 2001), and how this issue has been resolved, would also strengthen the magnetostratigraphic information presented for Chaohu.

Many of these issues would presumably be resolved when the full palaeomagnetic information is published about the Chaohu magnetostratigraphic study, but in the meantime, the impending need to make a decision about the Olenekian GSSP, some more clarity and detail is needed.

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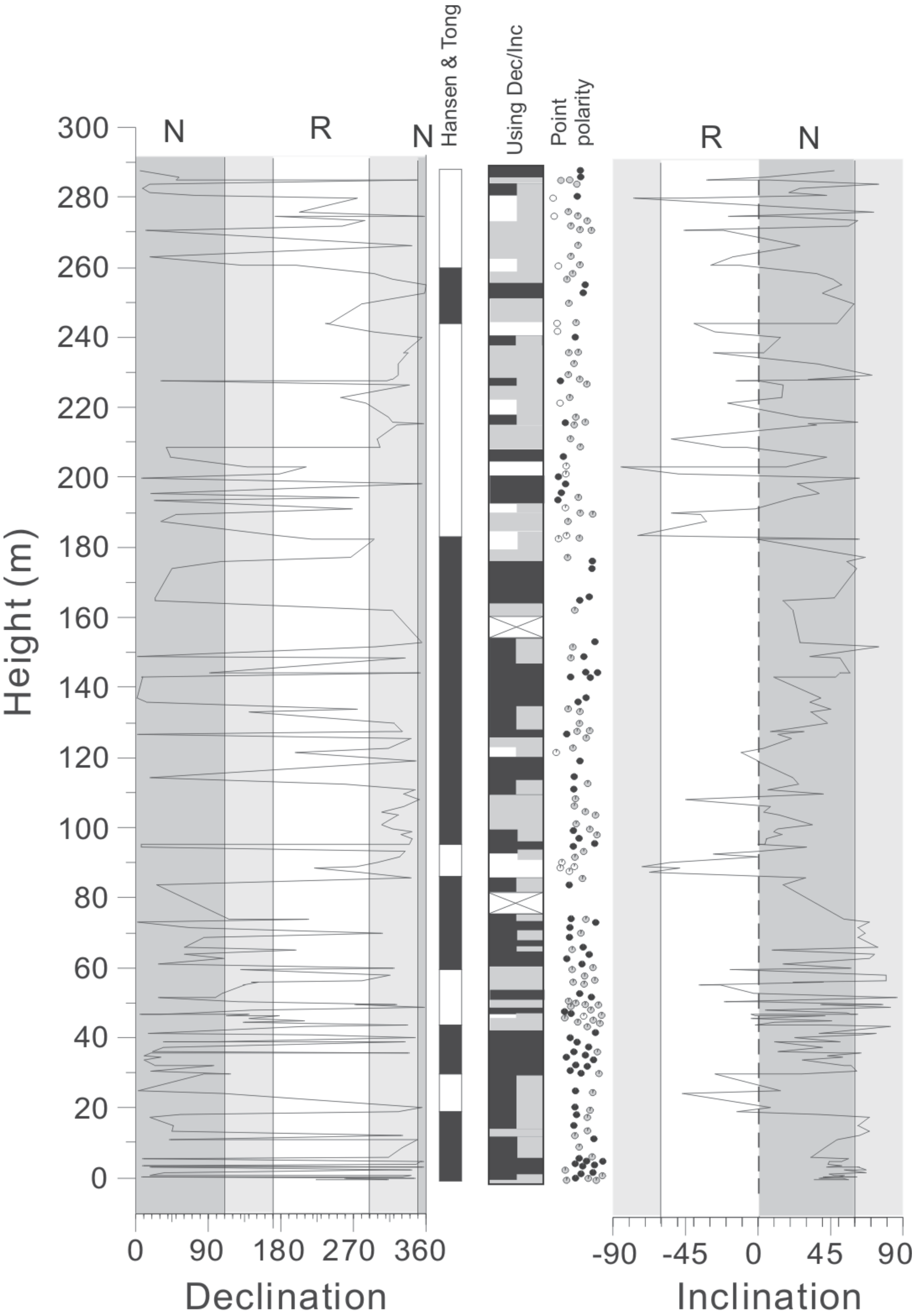
Figure 1: In the Dec, Inc columns, mid grey are nominally normal, white are nominally reverse, light grey are intermediate polarity fields. In polarity and point polarity columns, black=normal polarity, white=reverse, grey=intermediate. Half-bar width indicates polarity not supported by directly adjacent horizons. Dec/Inc Data from Hansen & Tong (2005).


Hansen & Tong
Using Dec/Inc
Point polarity
N
R
N
R
N
Height (m)
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0 90 180 270 360
Declination
-90 -45 0 45 90
Inclination

Lower Triassic Bivalves from Chaohu, Anhui Province, China

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Abstract: Chaohu was situated at the northern margin of the Lower Yangtze block in the low-latitude eastern Tethys archipelago. The Lower Triassic is well developed and lithostratigraphically composed of the Yinkeng, Helongshan and Nanlinghu Formations. Bivalves are very rich throughout the Lower Triassic and 10 genera and 25 species have been recognized. Most bivalve genera are cosmopolitan while most species are regional but only a few species cosmopolitan. Four bivalve assemblages can be distinguished in ascending order: *Claraia griesbachi—C. concentrica* Assemblage Zone, *Eumorphotis inaequicostata—E. huancangensis* Assemblage Zone, *Guichiella angulata* Zone and *Periclaraia circularis* Zone. This paper presents a brief report on the collection of the Lower Triassic bivalves from Chaohu and summarizes their geographic distribution in South China.

1. Introduction

In the investigation on the GSSP of the Induan-Olenekian boundary, we have studied the Lower Triassic of Chaohu, Anhui Province, South China in an all-round way (Tong et al., 2003, 2005). Since Chaohu was located in a deep part on the Lower Yangtze carbonate ramp, which was in the low-latitude eastern Tethyan archipelagic sea during the Early Triassic (Yin et al., 1999), the fossils are very abundant in the Lower Triassic. Besides abundant conodont and ammonoid fossils, bivalves are also a very characteristic group and spread in various horizons throughout the Lower Triassic. As the Lower Triassic bivalves are not so significant as the conodonts and ammonoids in chronostratigraphy due to their relatively wider ecologic adaptation at the time, there has been relatively little specific study on the bivalves, comparing with the conodonts and ammonoids. However, bivalves are one of the commonest taxa in the low-latitude Tethyan region and they are very common and distinctive in the Lower Triassic of South China. Since these fossils are easily collected and identified in field, they received considerable attention in the general geologic and stratigraphic investigations. The general biostratigraphic sequence is apparent and most Lower Triassic genera and species have certain stratigraphic distributions though the zonation might be different in various areas and facies (Tong and Yin, 2002).

2. Composition

As bivalves are very common in the Lower Triassic, most studies on the Lower Triassic in Chaohu dealt with this fossil group (e.g. Li, 1979; Li and Ding, 1981; Wang, 1984; Sheng et al., 1987; Yang et al., 1987; Yin et al., 1995). In our investigation on the Lower Triassic of Chaohu, we also have got a good collection of bivalve fossils. As a whole, the Early Triassic bivalve fauna is similar to those in other areas of the Yangtze region. It was dominated by the *Claraia* group and *Eumorphotis* group, which occurred successively. The *Claraia* group was dominated in the early time and in Chaohu it was mainly composed of *Cl. griesbachi*, *Cl. concentrica*, and *Cl. hubeiensis*, i.e. mostly the forms well ornamented with homocentric sculptures. It contained only few elements with indistinctive radial sculptures such as *Cl. radialis*. The *Eumorphotis* group mainly occupied the marine ecosystem in Chaohu during the middle-late time of Early Triassic and it was mainly composed of *Eu. inaequicostata*, and *Eu. huancangensis*. But the *Eumorphotis* group became less preponderant in the late time though it still preponderated over the *Claraia* group and some forms were also distinct, such as *Eu. dafangensis* and *Eu. hinnitidea*. In the meantime, a characteristic bivalve group was localized in Chaohu and its neighboring areas, in which *Guichiella* was predominant in the Early Spathian while *Periclaraia* dominated in the Late Spathian. *Posidonia* existed mainly in the middle and upper part of the Lower Triassic in Chaohu. This form is usually small-sized, a few millimeters in general, and enriched in preservation at some horizons of black calcareous shale, indicating a dysoxic environment. Some forms common in South China, such as *Bakevellia costata*, *Entolium discites*, *Pteria ussurica variabilis* and *Leptochondria minima*, occurred as well in Chaohu.

3. Biostratigraphy

Consequently, the Lower Triassic bivalves of Chaohu can be stratigrapically reduced to four zones in an ascending order: (1) *Claraia griesbachi – C. concentrica* Assemblage Zone in an age of the Griesbachian, corresponding to conodont *Neogondolella krystyni – N. planata* Zone and upper part of the *Hindeodus typicalis* Zone, or ammonoid *Ophiceras – Lytophiceras* Zone; (2) *Eumorphotis inaequicostata – E. huancangensis* Assemblage Zone in the Dienerian-Smithian, corresponding to the conodont zones from the *Neospathodus kummeli* Zone to *N. waageni* Zone, or the ammonoid zones from the *Gyronites – Prionolobus* Zone to *Anasibirites* Zone; (3) *Guichiella angulata* Zone in the Smithian, corresponding to conodont *Neospathodus* n. sp. M Zone and *N. homeri* Zone, or ammonoid *Columbites – Tirolites* Zone; and (4) *Periclaraia circularis* Zone in Spathian, corresponding to conodont *Neospathodus anhuinensis* Zone, or ammonoid *Subcolumbites* Zone (Fig. 1) (Tong et al., 2005).

4. Distribution

Table 1 lists some bivalves collected and identified from the Lower Triassic of Chaohu and their geographic distribution. It can be seen that most bivalves occurring in Chaohu had a wide distribution in paleogeography except for *Guichiella* and *Periclaraia*. Their paleogeographic distributions can be divided into three types: (1) cosmopolitan: only few species were cosmopolitan, such as *Claraia griesbachi*, *Eumorphotis venetiana*, *E. hinnitidea*, *Entolium discites*, though most genera were cosmopolitan; (2) regional: most species were regionally distributed and widespread in South China as well as Mts. Qinling and the Qinghai-Xizang Plateau; and (3) local: only some species of *Guichiella* and *Periclaraia* were locally distributed in Chaohu and its neighboring areas.

Acknowledgements

This is one of the serial studies of the GeoTurn Group at the China University of Geosciences. The study is supported by the National Natural Science Foundation of China (Grant Nos. 40232025, 40325004 and 40072011), the Ministry of Education (Grant No. 03033), and the China National Stratigraphic Commission.

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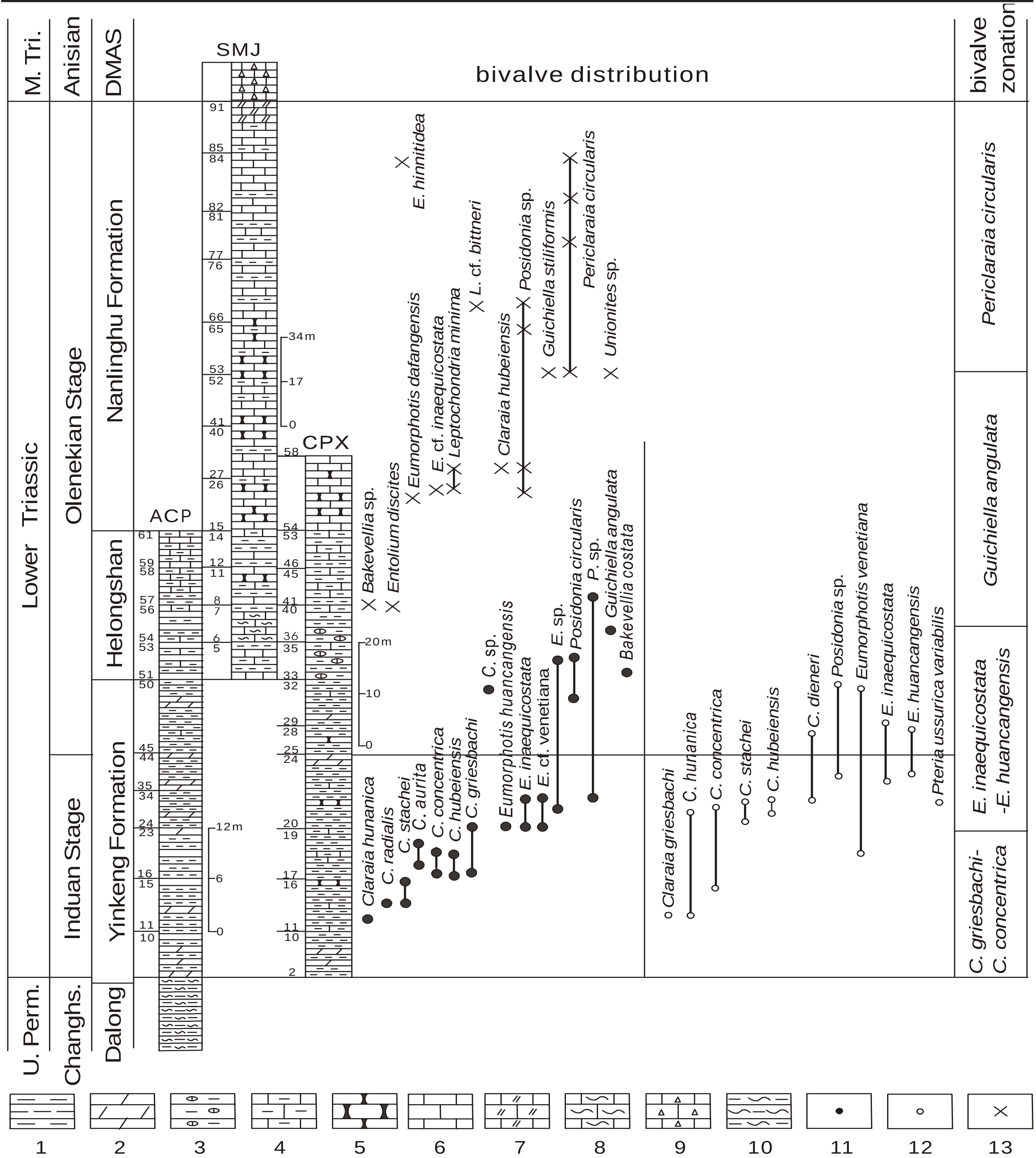


Figure 1. Stratigraphic distribution of the Lower Triassic bivalves in Chaohu, Anhui and the biostratigraphic sequence. 1-mudrock, 2-marlstone, 3-lenticular limestone, 4-argillaceous limestone, 5-nodular limestone, 6- limestone, 7- dolomitic limestone, 8- siliceous limestone, 9-brecciated limestone, 10-muddy chert beds, 11-fossils in the North Pingdingshan Section (ACP), 12-fossils in the West Pingdingshan Section (CPX), 13-fossils in the South Majiashan Section (SMJ). DMAS-Dongmaanshan Formation, ACP-North Pingdingshan Section, CPX-West Pingdingshan Section, SMJ-South Majiashan Section.

Table 1. Distribution of the bivalves collected from the Lower Triassic of Chaohu, Anhui Province

Name	Age	Distribution	Name	Age	Distribution
Claraia	L. Tri.	cosmopolitan	***Bakevellia***	Perm.-Cret.	cosmopolitan
C. hunanica	Induan	South China: Hunan, Fujian, Anhui, etc.	*B. costata*	Triassic	South China: Sichuan, Guizhou,Fujian, Anhui, etc.; Europe
C. radialis	Induan	South China: Guizhou, Guangxi, Anhui, etc.	***Entolium***	Tri.-Cret.	cosmopolitan
C .stachei	Induan	South China: Sichuan, Guizhou, Yunnan, Hubei, Guangxi, Hunan, Anhui, etc.	*E. discites*	L.-M. Tri.	South China: Sichuan, Yunnan,Guizhou, Anhui, etc.; Mts. Qilian; Europe
C. aurita	L. Tri.	South China; Mts. Qilian; Mts. Qinling	***Pteria***	Tri.-Recent	cosmopolitan
C .concentrica	Induan	South China	*P. ussurica variabilis*	Induan	South China: Yunnan, Guizhou, Zhejiang, Anhui, etc.
C. hubeiensis	L. Tri.	South China: Hubei, Sichuan, Anhui, etc.	***Unionites***	Triassic	Europe; Asia; Arctic; New Zealand
C. griesbachi	Induan	South China; West Sichuan; South Xizang; Mts. Qinling	***Periclaraia***	Olenekian	Anhui
C. dieneri	L. Tri.	South China: Fujian, Jiangxi, Anhui, etc.; Southwest Japan	*P. circularis*	Olenekian	Anhui
Eumorphotis	Triassic	cosmopolitan	*P. reticulata*	Olenekian	Anhui
E. huancangensis	L. Tri.	Southern Qilian; Lower Yangtze region	*P. chaoxianensis*	Olenekian	Anhui
E. venetiana	L. Tri.	South China: Yunnan, Jiangxi, Hubei, Anhui, etc.; Qinghai; Alpine region	***Guichiella***	L. Tri.	Anhui
E. hinnitidea	L. Tri.	South China: Jiangxi, Anhui, etc.; Alpine region	*G. styliformis*	Olenekian	Anhui
E. inaequicostata	L. Tri.	South China; Alpine region; Europe	*G. angulata*	Olenekian	Anhui
E. dafangensis	L. Tri.	South China: Jiangxi, Anhui, etc.	***Leptochondria***	Triassic	cosmopolitan
Posidonia	Carb.-Juras.	America; Europe; Asia; East Africa	*L. minina*	L. Tri.	South China: Anhui; Mts. Qilian
P. circularis	Olenekian	South China: Sichuan, Jiangsu, Anhui, etc.	*L.* cf. *bettneri*	L. Tri.	South China: Sichuan, Guizhou, Anhui, etc.

Plate 1

1-4. *Eumorphotis* sp nov.:
All ×3 from Yinkeng Fm at West Pingdingshan Section (CPX-25): 1. right view (P12); 2. left view (P11); 3. external mold of right valve (P17); 4. left view (P16).
5-7. *Eumorphotis venetiana* (Hauer):
5. left view ×4 from Yinkeng Fm at West Pingdingshan Section (CPX-25; P19);
6. left view ×4 from Yinkeng Fm at North Pingdingshan Section (ACP-44; M08);
7. left view ×3 from Yinkeng Fm at North Pingdingshan Section (ACP-50; M12).
8, 9, 12. *Eumorphotis inaequicostata* (Benecke):
8. external mold of left view ×3 from Yinkeng Fm at West Pingdingshan Section (CPX-25; P04);
9. left view ×3 from Yinkeng Fm at North Pingdingshan Section (ACP-44; M36);
12. left view × 3 from Yinkeng Fm at West Pingdingshan Section (CPX-25; P05).
10, 11, 13-15. *Eumorphotis* cf. *venetiana* (Hauer):
10, 11. left view ×3 from Yinkeng Fm at West Pingdingshan Section (CPX-25; P29, P30);
13-15. left view ×3 from Yinkeng Fm at North Pingdingshan Section (ACP-46; M32-1, M32, M33).
16-19. *Guichiella angulata* Li and Ding:
All ×4 from Yinkeng Fm at West Pingdingshan Section (CPX-33): 16 . left view (P09); 17. left view (M01); 18. left view (M04); 19. right view (M06).

Plate 1

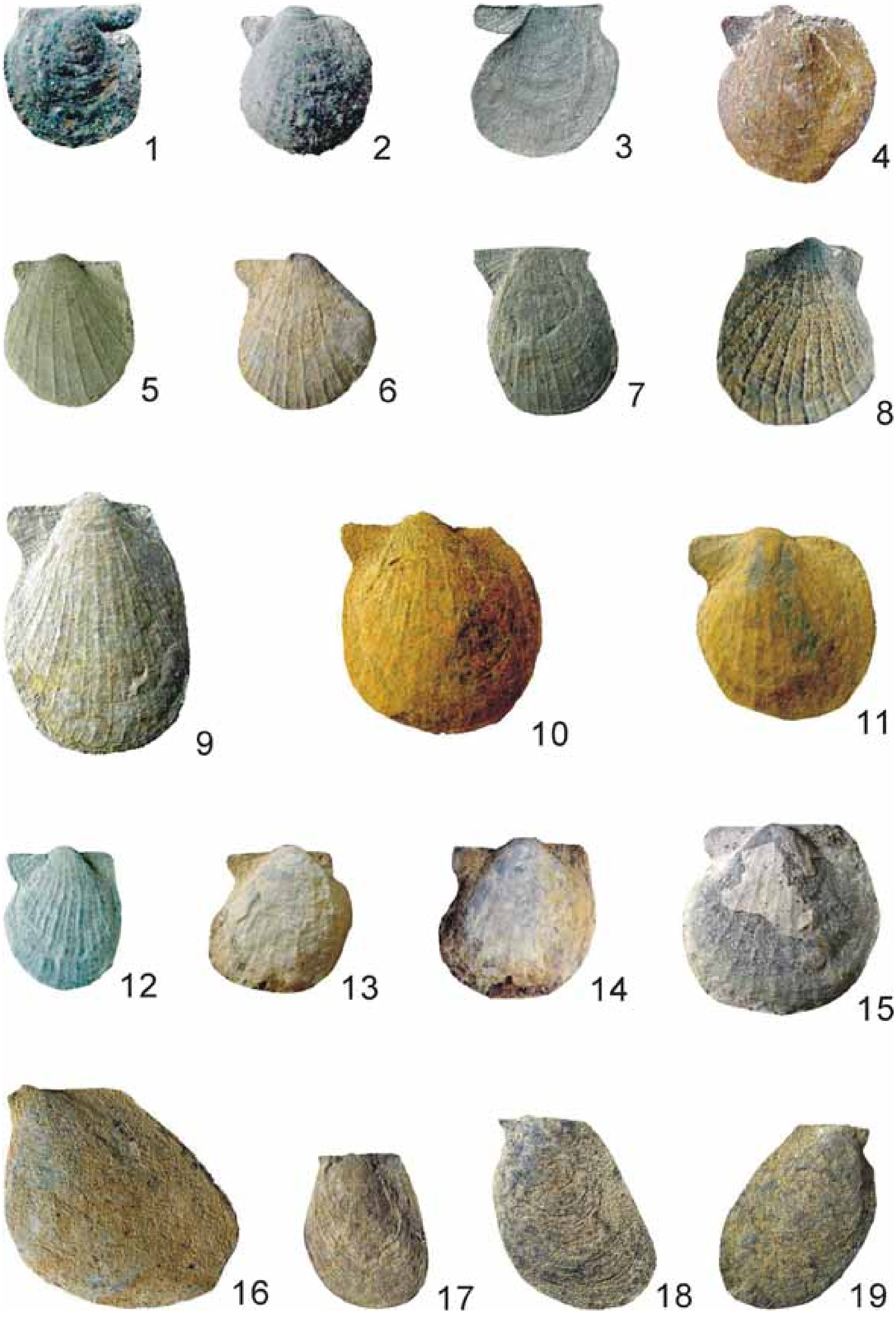


Plate 2

1-5. *Guichiella angulata* Li and Ding:
1, 2. ×4 from Yinkeng Fm at West Pingdingshan Section (CPX-33; M02, M03);
3. left view ×4 from Yinkeng Fm at West Pingdingshan Section (CPX-33; M30-1);
4. left view ×4 from Yinkeng Fm at West Pingdingshan Section (CPX-18; M31);
5. left view ×4 from Yinkeng Fm at West Pingdingshan Section (CPX-33; P08).

6, 7. *Claraia concentrica* (Yabe):
6. ×1 from Yinkeng Fm at West Pingdingshan Section (CPX-18; M 28-1);
7. left view ×2 from Yinkeng Fm at North Pingdingshan Section (ACP-32; M25).

8. *Claraia dieneri* Nakazawa:
Left view ×4 from Yinkeng Fm at North Pingdingshan Section (ACP-32; M14).

9, 10. *Claraia aurita* (Hauer):
9. left view ×1.5 from Yinkeng Fm at West Pingdingshan Section (CPX-17; MM3);
10. left view ×1.5 from Yinkeng Fm at North Pingdingshan Section (ACP-28; MM5).

11-14. *Claraia hubeiensis* Chen:
11. right view ×2 from Yinkeng Fm at North Pingdingshan Section (ACP-32; M26);
12. left view ×2 from Yinkeng Fm at North Pingdingshan Section (ACP-30; M27);
13. right view ×2 from Yinkeng Fm at North Pingdingshan Section (ACP-27; M23);
14. left view ×2 from Yinkeng Fm at North Pingdingshan Section (ACP-27; M13).

Plate 2

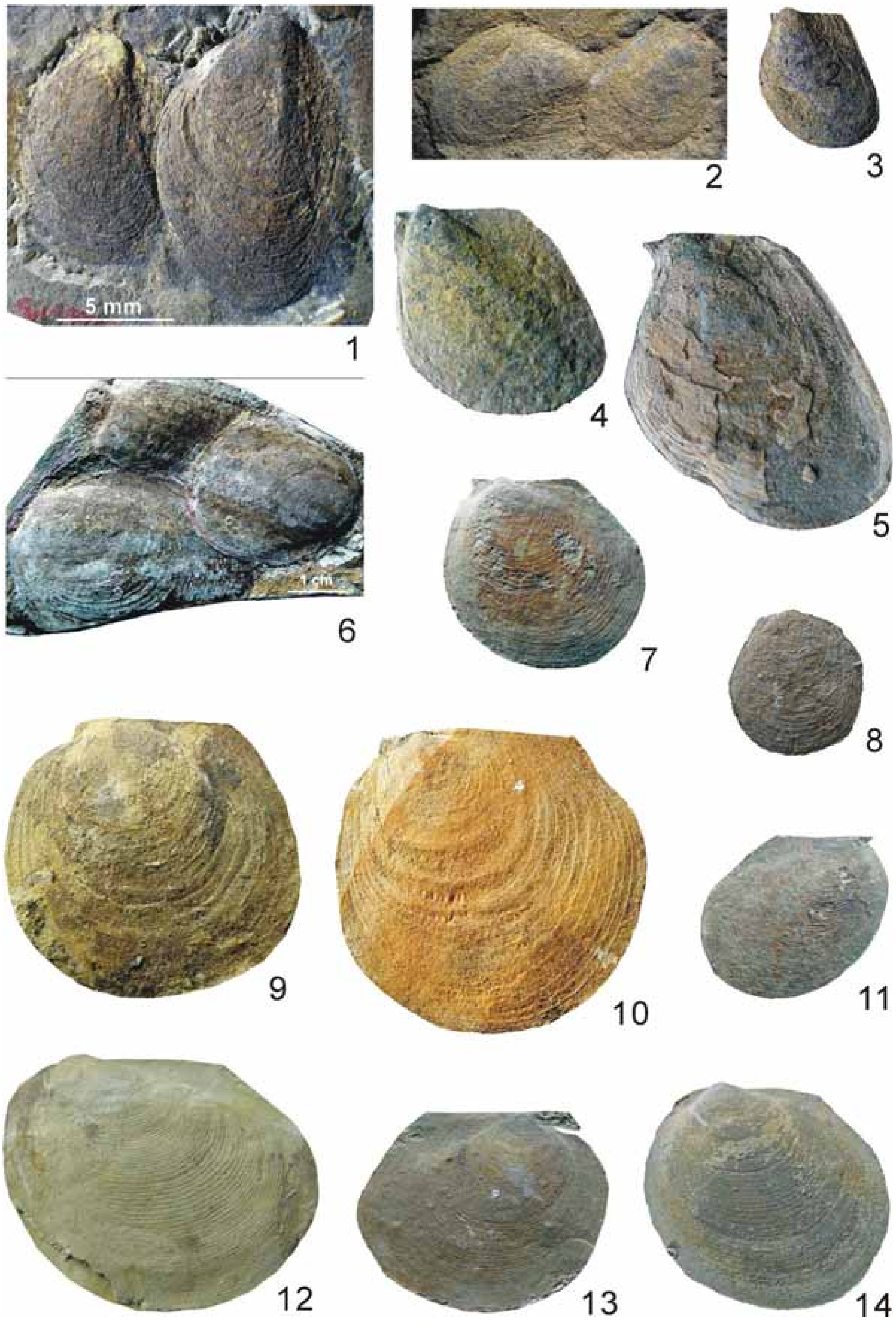


Plate 3

1-4. *Claraia concentrica* (Yabe):
1. right view ×1.5 from Yinkeng Fm at West Pingdingshan Section (CPX-18; M29);
2. external mold of right valve ×1.5 from Yinkeng Fm at North Pingdingshan Section (ACP-26; M24);
3. right view ×1.5 from Yinkeng Fm at West Pingdingshan Section (CPX-18; MM2);
4. left view ×1.5 from Yinkeng Fm at West Pingdingshan Section (CPX-18; M30).

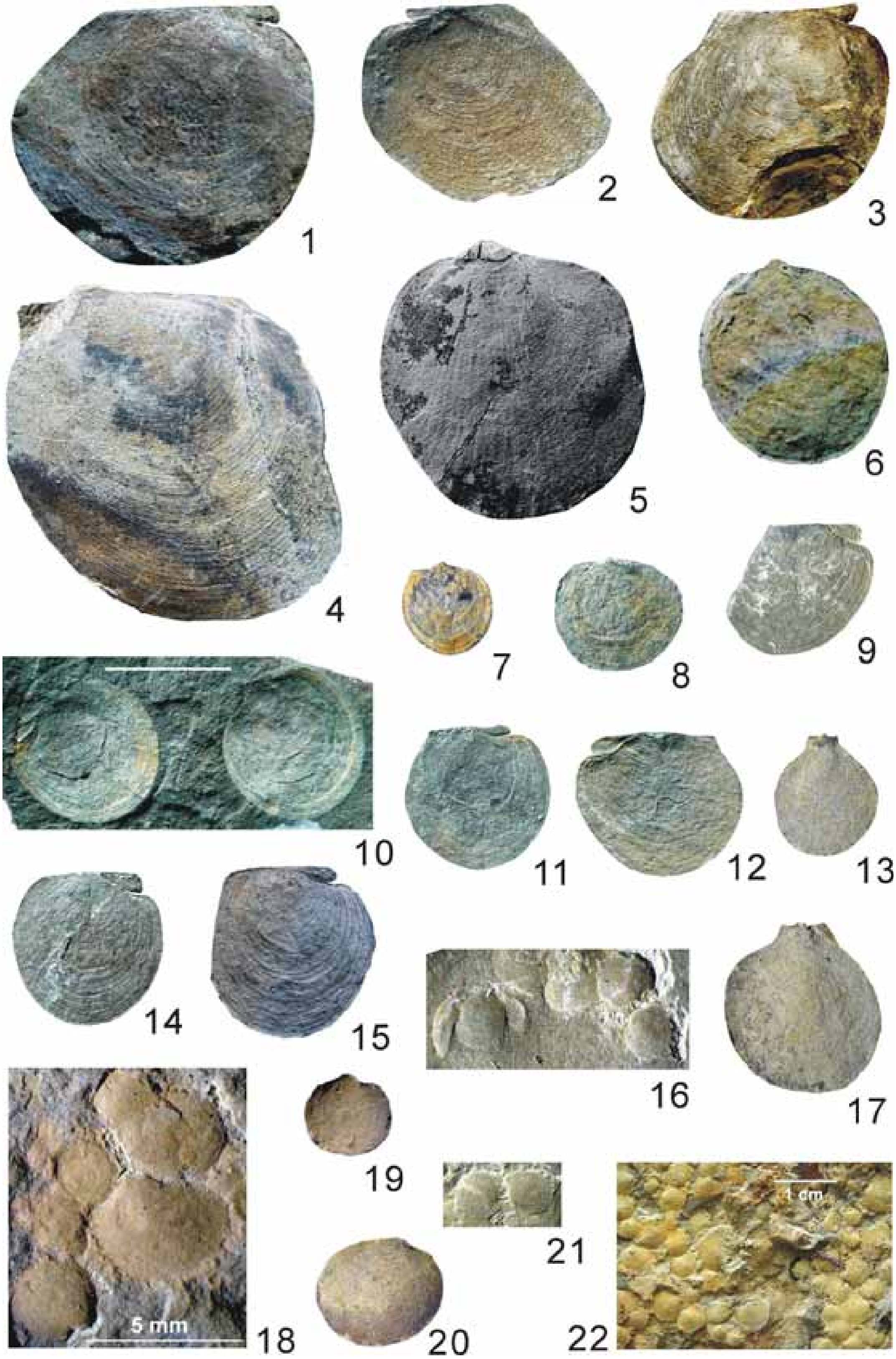
5. *Claraia stachei* Bittner:
Left view ×1.5 from Yinkeng Fm at West Pingdingshan Section (CPX-13; MM4).

6-12, 14, 15. *Periclaraia circularis* Li and Ding:
All ×2 from Nanlinghu Fm at South Majiashan Section (MJ-75): 6. left view (M44); 7. left view (M52); 8. left view (M20); 9. right view (M53-1); 10. external molds of right valve (M16); 11. right view (M17-1); 12. external mold of right valve (M15); 14. right view (M45); 15. right view (M18).

13, 17. *Entolium discites microtis* (Bittner):
All ×5 from Helongshan Fm at South Majiashan Section (MJ-8): 13. right view (M41); 17. left view (M42).

16, 18-22. *Posidonia circularis* Hsu:
16, 18, 21. ×5 from Yinkeng Fm at West Pingdingshan Section (CPX-32; M39, M39, M50);
19. left view ×5 from Yinkeng Fm at West Pingdingshan Section (CPX-32; M50);
20. right view ×5 from Yinkeng Fm at West Pingdingshan Section (CPX-32; M51);
22. ×1 from Yinkeng Fm at West Pingdingshan Section (CPX-31; MM1)

Plate 3



Some Additional Data to the Lower Triassic of the West Pingdingshan Section in Chaohu, Anhui Province, China

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A brief summary of the studies on the Lower Triassic was present in Albertiana (No.32, pp.57-63) and it includes some general information and lists most early studies on the Triassic in Chaohu, Anhui Province, China. In addition, many recent studies on the Lower Triassic of Chaohu have been presented successively in the early Albertiana volumes (25:23-27, 27:20-25, 27:26-29, 29:13-28, 29:41-43, 31:65-69, 32:57-63) and the references published in other publications are listed in Albertiana (32:57-63). The last volume of Albertiana (No.33) is composed of two issues, which contain all materials of the International Symposium on the Triassic Chronostratigraphy and Biotic Recovery held in Chaohu, Anhui Province on 23-25 May 2005. A mid-Symposium field excursion had been performed for all participants to visit the Lower Triassic in Chaohu, especially the West Pingdingshan Section. The Symposium report is present in this Albertiana (No.34). Meanwhile, a paper on the Lower Triassic bivalves also occurs in this volume. Here we would like to present only some additional ammonoid pictures from the boundary strata at the West Pingdingshan Section, though most of them are preserved very poorly, for a better understanding of the definition of the Induan-Olenekian boundary. A palynologic result is also present here but the retrieved sporomorphes are relatively rare.

Plate 1

(The scar bar is 1 cm; all fossils are from the Yinkeng Formation at the West Pingdingshan Section.)

1. *Lytophiceras*? sp., Bed 17-2 (Lower Induan)

2-12, 18. *Gyronites*? sp., Bed 20 (Upper Induan)

13. *Prionolobus* sp., Bed 21 (Upper Induan); 13a. Suture line of Fig.13

14. *Pseudosageceras* sp., Bed 24-7 (Upper Induan)

15. *Pseudosageceras* sp., Bed 24-1 (Upper Induan)

16, 17. *Prionolobus* sp., Bed 24-7 (Upper Induan)

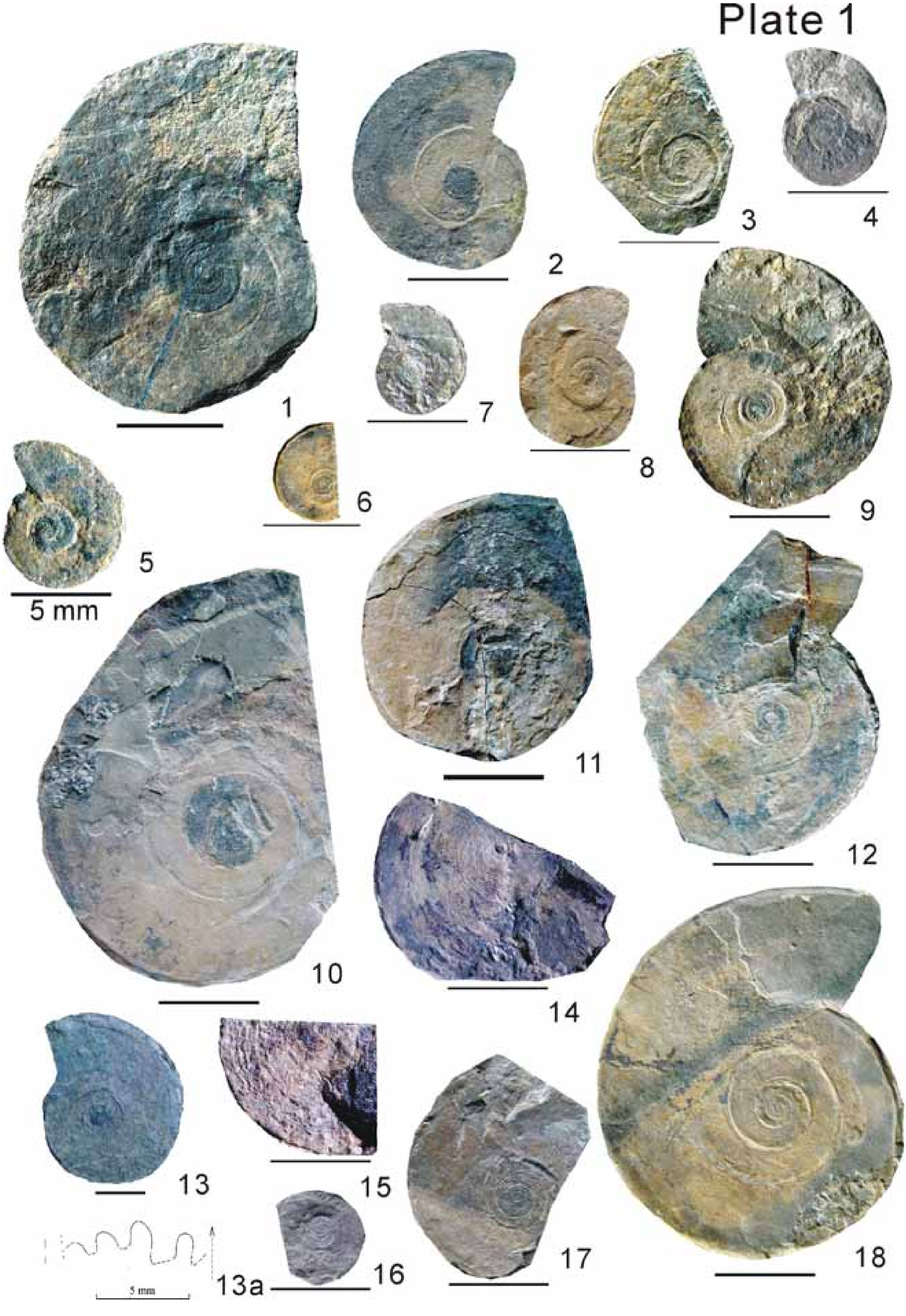
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Plate 2

(The scar bar is 1 cm; all fossils are from the Yinkeng Formation at the West Pingdingshan Section.)

1-7, 9. *Prionolobus* sp., Bed 24-8 (Upper Induan)

8. Undetermined ammonoid, Bed 24-8 (Upper Induan)

10. *Prionolobus* sp., Bed 24-10 (Upper Induan)

11. Undetermined ammonoid, Bed 24-21 (Lower Olenekian)

12. *Koninckites* sp., Bed 24-22 (Lower Olenekian)

13. *Euflemingites* sp., Bed 24-22 (Lower Olenekian)

14. *Euflemingites* cf. *tsotengensis* Chao, Bed 24-22 (Lower Olenekian); 14a. Suture line of Fig.14

15. *Preflorianites*? sp., Bed 25-1 (Lower Olenekian)

16-18. Undetermined ammonoids, Bed 25-1 (Lower Olenekian)

19, 20. Undetermined ammonoids, Bed 25-2 (Lower Olenekian)

21-26. Undetermined ammonoids, Bed 25-3 (Lower Olenekian)

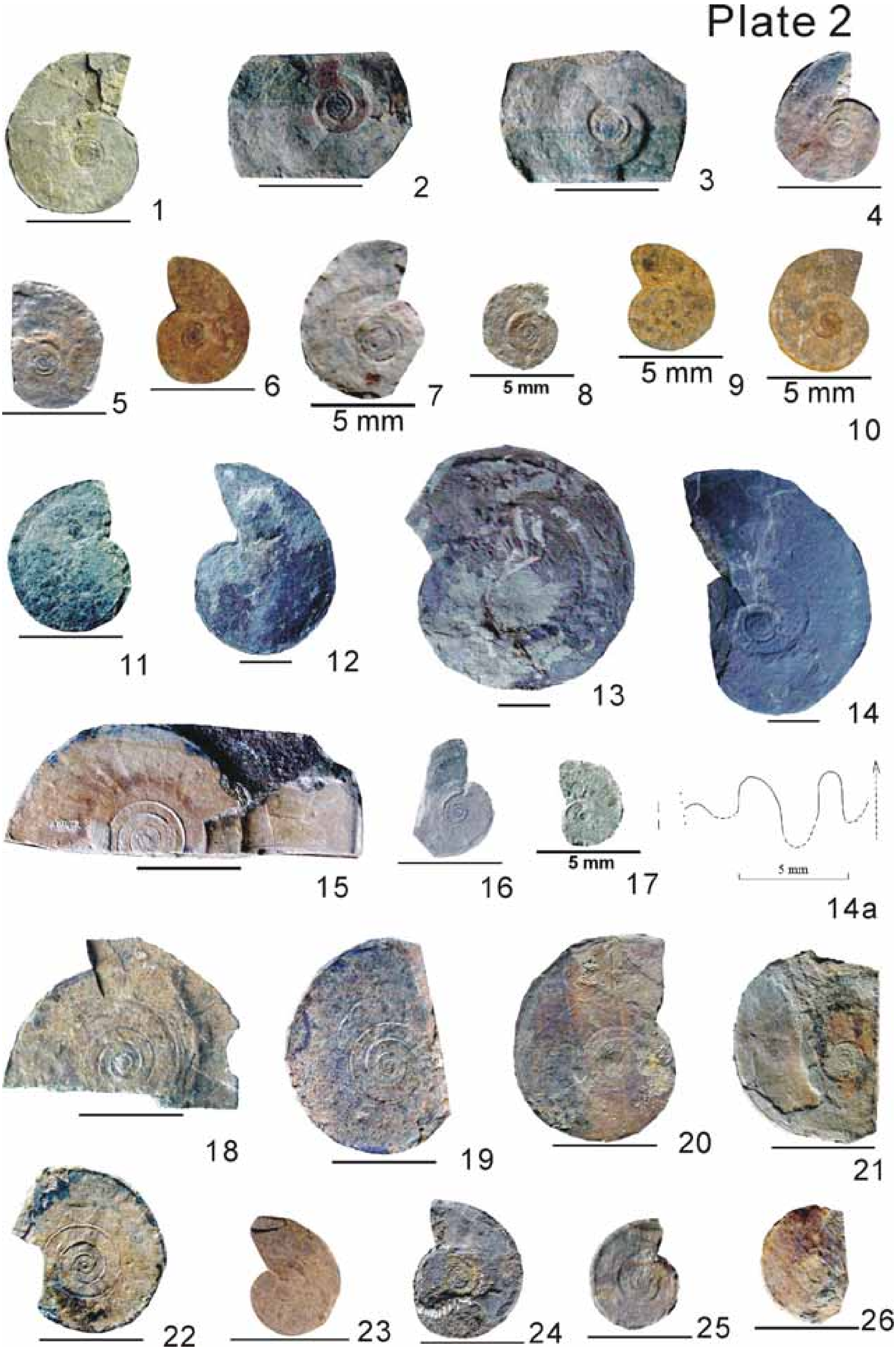
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Plate 3

(The scar bar is 1 cm; all fossils are from the Yinkeng Formation at the West Pingdingshan Section.)

1-3. Undetermined ammonoids, Bed 25-6 (Lower Olenekian)

4. *Euflemingites*? sp., Bed 25-7 (Lower Olenekian)

5, 6. Undetermined ammonoids, Bed 25-8 (Lower Olenekian)

7. *Flemingites*? sp., Bed 25-11 (Lower Olenekian)

8. *Euflemingites*? sp., Bed 25-11 (Lower Olenekian)

9. Undetermined ammonoid, Bed 25-11 (Lower Olenekian)

10-12. Undetermined ammonoids, Bed 25-12 (Lower Olenekian)

13. *Euflemingites* sp., Bed 25-13 (Lower Olenekian); 13a. Suture line of Fig.13

14-16. Undetermined ammonoids, Bed 25-13 (Lower Olenekian)

17. *Flemingites*? sp., Bed 25-21 (Lower Olenekian)

18. *Koninckites* cf. *lolowensis* Chao, Bed 25-21 (Lower Olenekian)

19. Undetermined ammonoid, Bed 25-21 (Lower Olenekian)

20. *Euflemingites*? sp., Bed 25-21 (Lower Olenekian)

21, 23, 24. Undetermined ammonoids, Bed 25 (Lower Olenekian)

22. *Arctoceras* aff. *lolouense* (Chao), Bed 33 (Lower Olenekian)

25-27. Undetermined ammonoids, Bed 25-lower (Lower Olenekian)

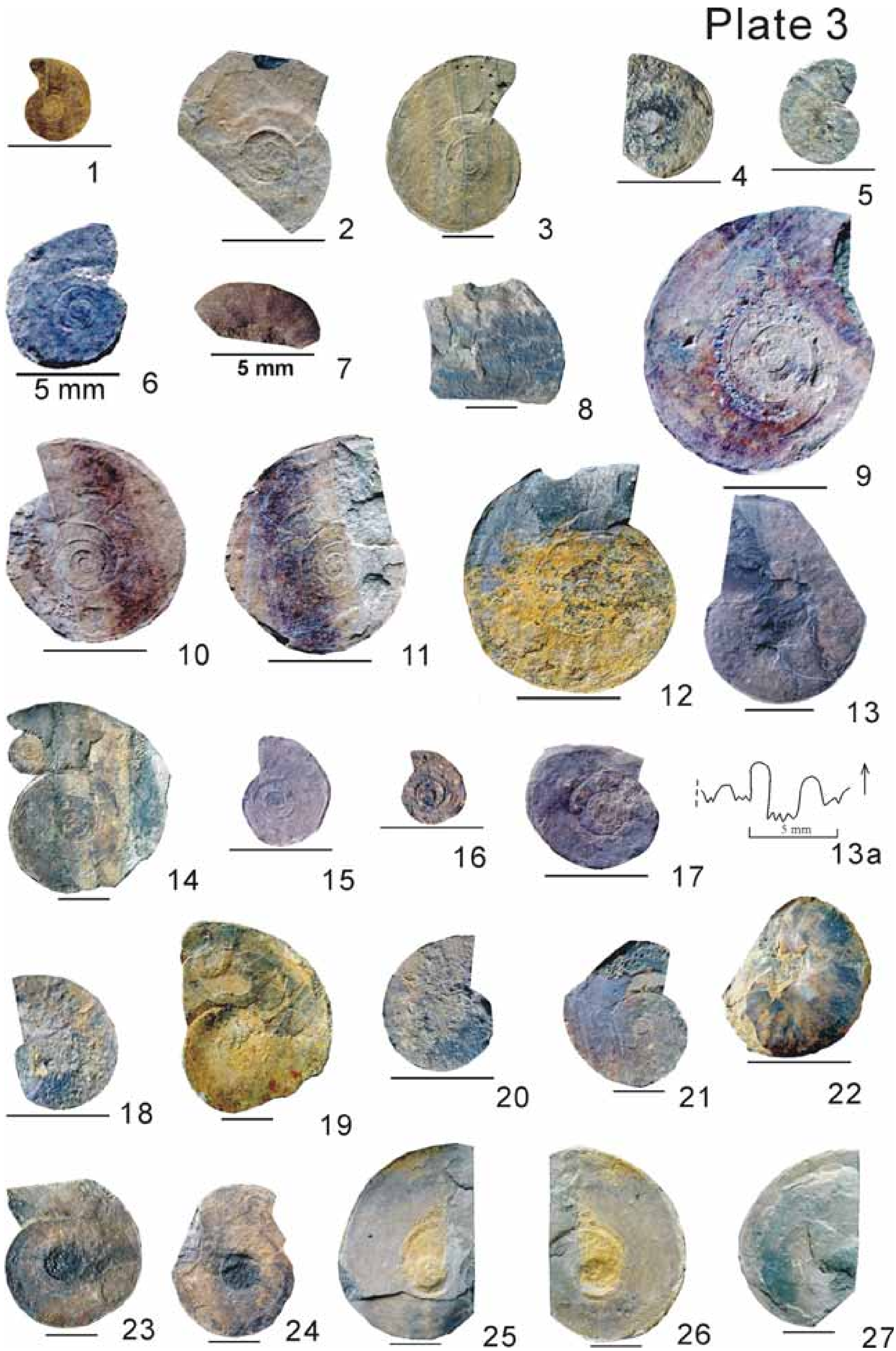
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Plate 4

(All are magnified 1000 times, studied by Yu Jianxin and Guo Gan)

1. *Retusatriletes* sp., Bed 25 in Yinkeng Formation at West Pingdingshan Section (Lower Olenekian)

2. *Punctatisporites* sp., Bed 26 in Yinkeng Formation at West Pingdingshan Section (Lower Olenekian)

3. *Retusatriletes mesozoicus* Klaus 1960, Bed 46 in Helongshan Formation at West Pingdingshan Section (Lower Olenekian)

4. *Lundbladispora*? sp., Bed 46 in Helongshan Formation at West Pingdingshan Section (Lower Olenekian)

5. *Osmundaeidites*? sp., Bed 46 in Helongshan Formation at West Pingdingshan Section (Lower Olenekian)

6. *Leiotriletes* sp., Bed 29 in Nanlinghu Formation at Southeast Majiashan Section (Upper Olenekian)

7. *Laevigatisporites* sp., Bed 29 in Nanlinghu Formation at Southeast Majiashan Section (Upper Olenekian)

8. *Limatulasporites fossulatus* (Balme) Helby & Foster, Bed 57 in Nanlinghu Formation at West Pingdingshan Section (Middle Olenekian)

9. *Nevesisporites rigidus* Wang et Qu, Bed 57 in Nanlinghu Formation at West Pingdingshan Section (Middle Olenekian)

10. *Striatopodocarpites rugosus* (Jansonius) Hart 1964, Bed 26 in Yinkeng Formation at West Pingdingshan Section (Lower Olenekian)


Plate 4
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Project outline "The Pan-European correlation of the epicontinental Triassic"

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Introduction

The epicontinental Triassic successions in Europe show much similarity in the overall pattern of evolution, which is mainly due to similar basin evolution and climatic conditions. In the various parts of Europe, the relative timing of basin extension, the environments of sedimentary infill (marine, lacustrine, fluvial), impact upon biota, and synchronicity of lithological boundaries are often hotly debated. The standard model of these epicontinental successions is in the Central European Basin (CEB), where the tripartite Triassic system (Buntsandstein, Muschelkalk, Keuper) was originally defined by Friedrich von Alberti (1834), the so-called "Germanic Triassic". Whilst this standard model is commonly applied in large parts of Central and Southwestern Europe, it cannot be used, for instance, in Western Europe, where a bi-partite division into the Sherwood Sandstone and Mercia Mudstone groups is normally applied, or north of the Mid-North Sea High, where fluvial-sandstone to lacustrine mudstone successions are common in the Middle and Upper Triassic.

This project group aims to improve the understanding of the epicontinental Triassic in Europe on a number of fronts.

Better correlation to the Triassic stage boundaries

With the establishment of Triassic stage boundaries proposed by the task forces of the STS by 2008, it is necessary to better understand the mapping of these stage boundaries into the European epicontinental Triassic. This is likely to be possible only by an approach that uses integrated stratigraphic tools.

The best understood part of the European epicontinental Triassic is the Germanic Triassic, where the continental Buntsandstein can be dated and correlated using conchostracans, sporomorphs and partly vertebrates. Additionally, the marine-influenced Upper Buntsandstein can be correlated by bivalves and in places ammonoids and holothurians. The correlation of the overlying marine Muschelkalk is based on conodonts and in part ammonoids, bivalves, brachiopods, echinoderms and sporomorphs. In the mainly continental Keuper, conchostracans, sporomorphs, bivalves as well as ostracods and vertebrates are useful for correlation. Close to the Triassic-Jurassic boundary, conodonts occur in the Penarth Group (United Kingdom). Thus, in terms of biostratigraphy, the Germanic Triassic and its lateral equivalents can be correlated, in places in detail, with parts of the marine Triassic stages, but in other places rather poorly (e.g. Kozur, 1999, Bachmann & Kozur, 2004). Extending this knowledge, gained from many years of study on the CEB, to other parts of Europe is an important aim of this project group.

In the last decade, a considerable number of magnetostratigraphic studies have been carried out in the Triassic, which has lead to a working model for the magnetic field polarity for most of the Triassic (Muttoni et al., 2004). Through the correlation of this stage-related biomagnetostratigraphy it is now possible to correlate the Triassic stages into the European epicontinental successions through the use of magnetostratigraphy (e.g. Nawrocki, 1997, Hounslow & McIntosh, 2003, Szurlies et al., 2003, Szurlies, 2004, Hounslow et al., 2004, Dinarès-Turell et al., 2005).

Stable isotope stratigraphy also appears to provide markers for isochronous correlation, such as at the Permian-Triassic boundary (e.g. Hiete, 2004) and the Triassic-Jurassic boundary (Hesselbo et al., 2002), both based on stable organic carbon isotopes. This clearly has the potential for development, if other synchronous "biological/climatic events" can be found both in marine and terrestrial environments. Hence, a detailed correlation of the entire epicontinental succession, including the fossil-free intervals, requires the stratigraphic evaluation of many tools including biostratigraphy, magnetostratigraphy, stable isotope stratigraphy and perhaps other isochronous event markers such as impact ejecta horizons and microspherules (e.g. Walkden et al., 2003, Bachmann & Kozur, 2004).

Integration of lithostratigraphic and cyclostratigraphic schemes

A speciality of the Triassic of the CEB is the confusingly large number of often synonymous or homologous lithostratigraphical terms, which have proliferated in more than 150 years of research. Another characteristic is the frequent use of unconformities and marker beds for lithostratigraphic subdivisions and correlations, which result in a mixture of lithostratigraphy and allostratigraphy. The introduction of wireline logs to basin-wide correlation has opened up the possibility for an integrated high-resolution log- and lithostratigraphic framework for the epicontinental Triassic (e.g. van Adrichem Boogaert & Kouwe, 1994, Geluk & Röhling, 1997, Bourquin et al. 1998, Michelsen & Clausen, 2002, Szurlies et al., 2003). Furthermore, such correlation within the CEB is supported by numerous marker beds, which seem to provide quasi-isochronous horizons (e.g. Szurlies et al., 2003, Szurlies, 2004, Lutz et al., 2005). The Triassic of the CEB is indicated by a distinct cyclicity of varying magnitude, which is considered to reflect water depth and climatic variations in the CEB due to tectonic activity or solar-induced Milankovitch cycles (e.g. Aigner & Bachmann, 1992, Clemmensen et al., 1994, Goggin and Jacquin, 1998). These offer a promising tool for correlation of the epicontinental Triassic, but also potentially for improving the global Triassic time scale (e.g. Bachmann & Kozur, 2004). The challenge here is to attempt to correlate these base-level cycles (sequences) and cyclostratigraphic units into other parts of the CEB as well as to basins outside of it, to see if it is possible that they may be linked to a set of European-wide tectonostratigraphic or climatic events which drive the cycles. For this, a combination of lithostratigraphy and (wireline) log stratigraphy is most promising, in that it provides a robust high-resolution lithostratigraphic framework, which additionally can be supported by prominent quasi-isochronous marker beds. Other biomagnetostratigraphic constraints are required to validate this.

A first stage in this process would be to establish key transects (E-W, N-S) by linking the different lithostratigraphic nomenclatures in the separate basins using all available methods (e.g., biostratigraphy, magnetostratigraphy, lithostratigraphy, cyclostratigraphy, log-stratigraphy, chemostratigraphy) resulting in a robust and detailed high-resolution stratigraphic correlation framework for the European epicontinental Triassic.

Triassic palaeoclimate, environmental and biotic change

The sedimentary record of the epicontinental Triassic is modulated by climatic, tectonic, environmental and biotic changes. The interplay between these factors can be better understood within a framework that attempts to link them to a chronostratigraphic and cyclostratigraphic scale. It is then possible to separate European-wide change in these factors from local and regional events, and so better understand the causal events of climatic and biotic changes. This is illustrated by the many studies, which attempt to understand the timing and nature of events at the Permian-Triassic (e.g. Bachmann & Kozur, 2004, Hiete, 2004) and Triassic-Jurassic boundaries (Hesselbo et al., 2002). There are without doubt similar major environmental and biotic changes, which have a story to tell at or near other boundaries in the Triassic (e.g. near Olenekian/Anisian, Norian/Rhaetian boundaries).

Forums for collaboration

The work of the project group will be aided by a number of forums, which provide for dissemination of information, discussion, learning of new concepts and ideas and development of means by which collaborative efforts can improve research outcomes. The project group forums will include:

1. A forum for earth scientists who are interested in the epicontinental Triassic.
2. The opportunity to visit the different parts of the European epicontinental Triassic on annual field workshops and through this to bring together Triassic researchers and to encourage them to start cooperation.
3. The support of studies of the European epicontinental Triassic using a multidisciplinary approach.
5. An information forum in Albertiana.
6. The installation of a Website.

Field workshops

In 2004 and 2005, two field workshops took place, which formed the precursors of this project group. These were held in the United Kingdom and in Germany, respectively, to evaluate the relationships between the Triassic lithostratigraphies of the different European regions.

The initial **“Field workshop on the British Triassic”** was held during August 10-17, 2004, lead by Mark W. Hounslow, Peter Turner and Ramues Gallois. It brought together 12 geoscientists from 4 European countries (**Fig. 1**) to examine the similarity and differences between the Triassic basin evolution and succession development between the British and German Triassic. A north-south transect was examined from the Triassic successions of NW England, to those Triassic successions in SW England. This transect gave the opportunity for examination of most of the UK Triassic from near to the Permian-Triassic boundary to the Triassic-Jurassic boundary, and also the different styles of basin development, from those basins formed in Palaeozoic-age basement to those formed on Variscan basement.

The second **“Field Workshop on the Triassic of Germany and surrounding countries”** took place in July 14-20, 2005, lead by Gerhard H. Bachmann, Gerhard Beutler and Michael Szurlies. This workshop was attended by 24 geoscientists from 6 countries (**Fig. 2**) to discuss the relationships between the German Triassic and its relationships to the successions in the neighbouring countries.

The venue and starting point was Halle (Saale). **Fig. 3** shows a geological map of Thüringen (Thuringia) and Sachsen-Anhalt with the some 20 outcrops visited. There, on a total distance of some 120 km, a complete overview from the Zechstein-Buntsandstein boundary, including the continental Permian/Triassic boundary (Stop 1, 10), to the Triassic-Jurassic boundary (Stop 21) could be given. Examples of most relevant Buntsandstein, Muschelkalk and Keuper formations as well as the stages within, were visited and discussed.

To consolidate the activities of the project group, the series of annual workshops has been continued with a **“Field Workshop on the Triassic of eastern France”**

Figure 1: Participants of the field workshop on the British Triassic at the Bristol Channel.

Figure 2: Participants of the field workshop on the German Triassic in the Steudnitz outcrop.

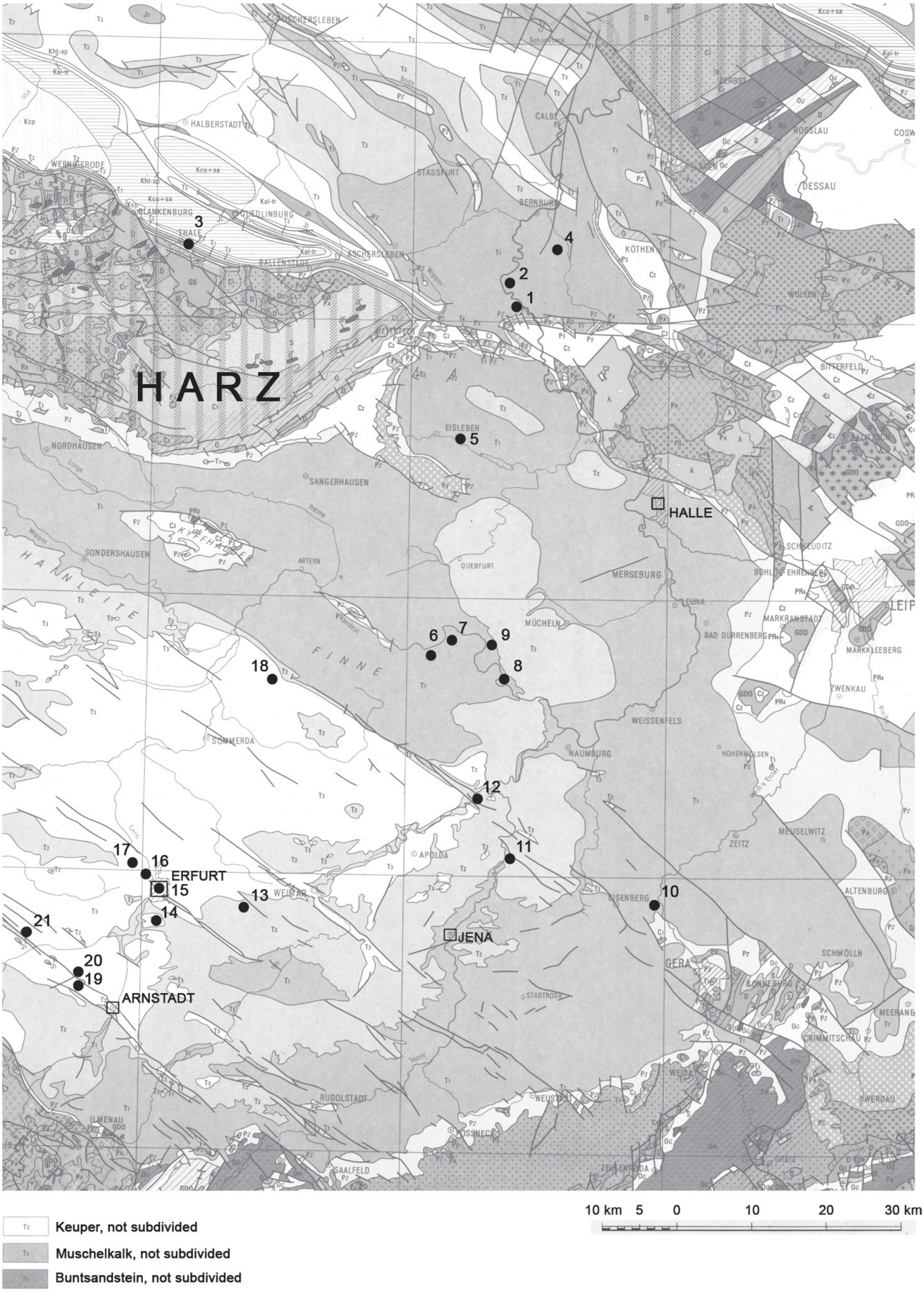

Figure 3: Geological map (without Cenozoic) with Stops 1-21 of field workshop on the German Triassic.

Stop 1	Nelben near Könnern (Uppermost Zechstein / Lower Buntsandstein: Fulda Fm – Calvörde Fm, PTB)
Stop 2	Beesenlaublingen (Lower Buntsandstein: Bernburg Fm)
Stop 3	Thale (Lower Buntsandstein: Calvörde Fm), optional
Stop 4	Baalberge (Middle Buntsandstein: Volpriehausen Fm)
Stop 5	Unterrissdorf (Lower Buntsandstein: Bernburg Fm)
Stop 6	Grosswangen (Lower / Middle Buntsandstein: Bernburg Fm – Volpriehausen Fm)
Stop 7	Nebra (Middle Buntsandstein: Hardegsen Fm – Solling Fm)
Stop 8	Glockenseck near Laucha (Upper Buntsandstein: Röt Fm)
Stop 9	Karsdorf (Upper Buntsandstein, Lower Muschelkalk: Röt Fm, Jena Fm)
Stop 10	Caaschwitz (Upper Zechstein / Lower Buntsandstein: Leine Fm – Fulda Fm, Calvörde Fm, PTB)
Stop 11	Steudnitz (Lower / Middle Muschelkalk: Jena Fm – Karlstadt Fm)
Stop 12	Krähenhütte near Bad Sulza (Middle Muschelkalk / Upper Muschelkalk: Diemel Fm – Trochitenkalk Fm)
Stop 13	Troistedt (Upper Muschelkalk: Meissner Fm)
Stop 14	Erfurt, Egstedter Trift (Lower Keuper: Erfurt Fm)
Stop 15	Erfurt, Petersberg (Middle Keuper: Weser Fm)
Stop 16	Erfurt-Gispersleben (Middle Keuper: Stuttgart Fm – Weser Fm)
Stop 17	Schwellenburg (Middle Keuper: Weser Fm)
Stop 18	Groß Monra (Middle Keuper: Stuttgart Fm)
Stop 19	Wachsenburg near Arnstadt (Middle Keuper: Weser Fm – Arnstadt Fm)
Stop 20	Burg Gleichen near Arnstadt (Middle Keuper: Arnstadt Fm)
Stop 21	Grosser Seeberg near Gotha (Upper Keuper / Liassic: Exter Fm – Liassic)

taking place in **October 2-7, 2006**. This field trip was organized by Sylvie Bourquin (CNRS, University Rennes 1, France).

We look forward to hearing from all interested colleagues who are willing to participate in this project group. We hope to stimulate discussion and further investigation of the above-mentioned aspects by the community of Triassic workers. Please contact Michael Szurlies if you are interested in the project group.

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Remarks to the base of Olenekian

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General remarks

Lower Triassic stages and substages

Mojsisovics et al. (1895) introduced the stage subdivision for the Tethyan Triassic, except the Rhaetian stage, which was introduced earlier by Gümbel, 1861 and adopted by Mojsisovics et al. (1895). Best defined from all stages was the Brahmanian Stage, with the Gangetian and Gandarian Substages defined in the Salt Range and in the Himalayas (Gangetian Substage). The Mojsisovics et al. (1895) paper was well known to all Tethyan workers and the there established Middle and Upper Triassic stages were accepted with some modifications (Ladinian Stage replaced the Norian Stage and the Norian Stage replaced the Juvavian Stage). The Scythian Series by Mojsisovics et al. (1895) was, however, lowered to a Scythian stage. According to our present knowledge about the short duration of the Scythian (5.6 myrs according to Bachmann & Kozur, 2004) this was not a bad decision. In the 50ies of the last century, the Mojsisovics et al. (1895) paper was either unknown to the majority of the Soviet and some American workers or intentionally not regarded. Kiparisova & Popov (1956) introduced the Induan and Olenekian stages for the Lower Triassic, without regarding the fact that already Mojsisovics et al. (1895) had introduced and well defined a Brahmanian and Jakutian Stage for this time interval. The Olenekian was defined in the Boreal Realm of Russia. The Induan Stage has got its name from the Indus River, flowing through the Salt Range which its excellent, ammonoid- and conodont rich Lower Triassic sections. The Salt Range is also the type area of the Brahmanian Stage, which has clearly the priority. More important, however, is that the Induan was several times drastically changed in its scope. One of the reason for this is that it was named after its type area in the Salt Range, but Kiparisova & Popov (1956) had not studied this area and only a restricted literature knowledge about this area (they did even not know the Mojsisovics et al., 1895 paper). In reality, the Induan was defined with Lower Triassic Boreal ammonoid faunas from the base of the Boreal *Otoceras* faunas (later defined as the base of the *O. concavum* Zone). A lot of problems with the definition of the Olenekian base came from the original definition of the Induan and Olenekian. The exact equivalents of the Perigondwanan Lower Triassic ammonoid faunas of the Salt Range and of the Boreal ammonoid faunas was unknown in 1956, and thus Kiparisova & Popov (1956) assigned the largest part of the Lower Olenekian to the original Induan. Later, Kiparisova & Popov (1964) removed the lower Olenekian part from the original Induan and this was the first drastic change of the scope of the Induan. With the definition of the base of the Triassic with the FAD of *H. parvus* (Kozur & Pjatakova) the entire lower part of the Griesbachian, the Boreal *O. concavum* and *O. boreale* Zone s.s. belongs to the Permian (Kozur, 1998a, b). By this a distinct part of the original Induan get Permian. After this second big change of both the upper and lower part of the Induan, the Induan finally corresponds fully to the Brahmanian which has more than 50 years priority. For these reasons, I furthermore use the unchanged term Brahmanian instead of the several time drastically changed term Induan.

Two substages were assigned to the Brahmanian, the Gangetian and the Gandarian substages. The Gangetian was defined by the Perigondwanan *Otoceras woodwardi* Zone s.l. which starts with the Perigondwanan *Otoceras* fauna and included also the *Ophiceras* faunas s.l. that means all the ammonoid fauna from the level of the present base of the Triassic (FAD of *H. parvus*) to below the base of the Dienerian. It corresponds therefore exactly to the lowermost substage of the Triassic. The term Gangetian has not only 60 years priority against the Griesbachian (Tozer, 1965), but can be used unchanged, whereas the Griesbachian is half of Permian (lower Griesbachian), half of Triassic age (upper Griesbachian). Therefore also here I use the term Gangetian instead of Griesbachian for the lowermost substage of the Triassic. The Dienerian (Tozer, 1965) fully corresponds to the Gandarian (Mojsisovics et al., 1895). Except the priority, the advantage of the Gangetian and Gandarian is the definition in the Tethyan realm (Perigondwanan margin of the Tethys), whereas both Griesbachian and Dienerian are defined in the Boreal Realm with lower diversity then the Tethyan faunas. In the present discussion, the Brahmanian Stage (= strongly revised Induan Stage) with Gangetian (= upper Griesbachian) and Gandarian (= Dienerian) substages are used (Figs. 1, 2).

The Jakutian of Mojsisovics et al. (1895) comprises only a part of the Smithian. Therefore, the name Olenekian can be used. The Smithian and Spathian substages can be discriminated.

Fossil groups for definition of the Olenekian base

The stratigraphic resolution potential within pelagic marine Lower Triassic sediments is highest in ammonoids and conodonts. As a conodont specialist, I prefer to use ammonoids for definition of the Olenekian base because the Olenekian conodonts are in a rather preliminary stage of taxonomic investigation. This is best seen in the big oversplitting of *Neospathodus waageni* Sweet in the Chaohou area in Tong Jinnan et al. (2004). Beside *Neospathodus waageni waageni* several species and subspecies has been discriminated within *N. waageni*. The FO of one of them, *N. waageni eowaageni* was chosen to define the base of the Olenekian. However, this subspecies is rather an ecologically controlled morphotype which appears in different places in different sections and has not too wide regional distribution. Its FO in one of the two GSSP candidates is obviously unsuitable to define the base of the Olenekian. L. Krystyn provided me with the ammonoid and conodont range chart of the Spiti GSSP candidate, in which conodont data of Orchard are involved. They show a much more realistic picture of the intraspecific variability of the *N. waageni* group, subdivided into two species *N. waageni* s.l. with 5 morphotypes, and *N. posterolongus* Orchard in press. Two of the *N. waageni* morphotypes and *N. posterolongus* begin at the same level preferred by Krystyn at the base of ammonoid defined Olenekian. 3 morphotypes begin somewhat later, two of them at the same level. Lumping to very broad species which contain different taxa and oversplitting of variable taxa are common features for early stages of conodont investigation. Every new species within the *N. waageni* group should be also tested in the Salt Range with the stratum typicum of the holotype. It makes not too much sense to use highly oversplit taxa which can be determined by 3-5 specialists (which are often not in full agreement about the separation of these taxa) for definition of any boundary. If conodonts will be used for defining the Olenekian base, the FO of *N. waageni* s.l. in broad not oversplit sense should be used or alternatively, the FO of *N. posterolongus*, but by no means the FO of *N. waageni eowaageni* for which I doubt that it is really a subspecies and not only one of the intraspecific morphotypes of the highly variable *N. waageni*.

However, it seems to me, ammonoids are better suitable to define the base of the Olenekian. If we use the base of the *Rohillites rohilla* Zone, then 7 different species begin at that level. The FO of one of them, best of *R. rohilla* (Diener) may be used. However, according to ammonoids, there are also two other possibilities to define the base of the Olenekian. A little above the base if the *R. rohilla* Zone is the FO of *Flemingites griesbachi* Kraft, which should be also taken into consideration (beginning of 4 ammonoid species in Spiti). *Flemingites* has a wider distribution than *Rohillites* and occurs even in Madagascar. A third horizon is the FO of *Euflemingites* which has also a wide distribution. However, I agree with Krystyn to take the base of the *R. rohilla* Zone as the base of the Olenekian.

To use ammonoids for definition of the Olenekian base bring the question to use Oppel Zones, Concurrent Range Zones, Unitary Associations or the FAD/FO of a species for definition of the lower boundary of the Olenekian. This is a general problem what reflects mainly the question of very sharp definition in a point or good correlation potential. The GSSP need a very precise definition in a point, and this requires for definition the FAD of a species (when its forerunner in a phylomorphogenetic lineage is known) or the FO of a species, if its forerunner in a phylomorphogenetic lineage is not definitely known). The correlation can be made by any stratigraphic method and tool and then the highest potential for correlation should be chosen which may be one of the first three methods. This correlation potential is also given by biopalaeomagnetic correlations and stable isotope trends which, however, should not be the primary tool for definition in a GSSP.

The exact coincidence of an ammonoid FAD/FO with changes in other fossil groups should not influence the selection of a certain level for definition. For biological reason perfect coincidence of the FAD in different fossil groups will be rarely found. It is possible at ammonoids and conodonts because of similar facies preference, but the coincidence of the FAD/FO in different fossil groups should be always regarded with caution because it generally rather indicates abrupt facies changes, gaps, condension and other negative factors in definition of a boundary. On the other hand, a level should be preferred close to which but not necessarily in exactly the same level changes in different fossil groups can be observed. This is the case for all three potential ammonoid boundaries mentioned above.

GSSP candidates

Sections in the Chaohu area and in Spiti were proposed as GSSP candidates. Both have shortcomings and advantages. Unfortunately, sections in the Salt Range were not taken into consideration despite the fact that the Salt Range is the classical area of the Lower Triassic stratigraphy. The Salt Range sections are rich in well preserved ammonoids, contain very much conodonts, the CAI is 1, palaeomagnetic works well and the stable isotope results are very good for the investigated Lower Triassic part of the sections but were unfortunately not yet carried out just for the interval around the Olenekian base. Additionally sporomorphs are present and of good preservation in the Salt Range sections. According to ammonoid specialists, the preservation of the ammonoids in Chaohu is bad and ammonoids can be therefore surely not used for definition of the Olenekian base, if Chaohu is chosen as GSSP. Moreover, genera occur together in Chaohou and have there the same FO (e.g. *Flemingites* and *Euflemingites*) which have in Spiti distinctly different FO and ranges. Below the FO of *Flemingites* and *Euflemingites* in Chaohu, there is a longer interval without ammonoids (Tong Jinnan et al., 1974). Either condension (not probable for the facies in Chaohu) or this longer ammonoid-interval in Chaohu or problems with determination because of bad preservation may explain the obvious differences in ammonoid ranges in Chaohu compared with other sections.

Compared with our material from Nepal and the data from Spiti, the conodont control of Chaohu is incomplete. Some important taxa are missing, others have a very different range from other sections in the world. *Chengyuania nepalensis* (Kozur & Mostler), a widely distributed gondolellid genus with rudimentary platform, is absent Chaohu. This species partly has been assigned in recent time to *Borinella* Budurov & Sudar, 1994. This, however, is both against the intention of the authors and also not confirmed by the morphological features. *Borinella* Budurov & Sudar, 1994 is a replacement name for *Kozurella* Budurov & Sudar, 1993, a junior homonym of the holothurian *Kozurella* Mostler. *Borinella buurensis* (Dagis), the type species of *Borinella* and all other assigned species are forms with a broad platform, assigned by Kozur (1989) to primitive earliest *Paragondolella* Mosher. *Chengyuania nepalensis* has a Pa element with strongly reduced rudimentary platform. Budurov & Sudar (1993) assigned this species to *Kashmirella*, likewise with reduced platform, but from another lineage. They pointed out that "*K.*" *nepalensis* is distinctly different from *Borinella* what is correct. In all Triassic lineages genera with strongly reduced platform of the Pa element are treated as different genera then gondolellids with broad unreduced platform, and this brings inconsistency in the Triassic conodont taxonomy, if *C. nepalensis* is assigned to a genus which has per definition and holotype an unreduced broad platform. The separation of gondolellids with rudimentary platform from gondolellids with unreduced platform is clearly confirmed by their apparatuses. All gondolellids with strongly reduced rudimentary platform have a distinctly different apparatus from gondolellids with unreduced platform. This is even the case when a form with rudimentary platform evolved from a form with unreduced platform and vice versa and the apparatuses of the immediate forerunner and successor are compared. This is best demonstrated in the Germanic Basin, when *Celsigondolella watznaueri praecursor* (Kozur) with reduced platform evolved from *Neogondolella haslachensis* (Tatge) with unreduced platform. Despite the fact that *C. watznaueri praecursor* gradually evolved from *N. haslachensis*, in *Celsigondolella* the apparatus is more different from the *Neogondolella* apparatus then any apparatus from genera with unreduced platform. Even the Pb element changed into another form genus (*Pollognathus* Kozur). Likewise *Chiosella* with rudimentary platform has an apparatus different from all gondolellid apparatuses with unreduced platform. Thus, the argument that *Borinella buurensis* (as already known to Kozur 1989) evolved from *C. nepalensis* does not confirm that *Chengyuania nepalensis* is a *Borinella*, because otherwise *Celsigondolella* with totally different apparatus must be a *Neogondolella* despite the fact that the *Celsigondolella* apparatus is more different from the *Neogondolella* apparatus, than all apparatuses of not so closely elated gondolellids with unreduced platform

C. nepalensis does not define the base of the Olenekian, but it is a widespread marker for the Gandarian-Smithian boundary interval. *Eurygnathodus costatus* Staesche is a species which occur both in pelagic and shallow water deposits and is therefore important for correlation of the ammonoid-bearing pelagic deposits with ammonoid-free shallow water deposits of the Werfen facies. This species characterizes the uppermost Gandarian and lower Smithian, but in Chaohu it begins only considerably above the base of the Olenekian.

The published palaeomagnetic data (Tong Jin-nan t al., 2005) are an advantage of Chaohu. From the Permian-Triassic boundary to the lower Smithian these data seems to be reliable and can be well correlated with the Germanic Basin and Tethys (Bachman & Kozur, 2004). In younger beds no good correlation is possible. Orchard (discussion in Longyearbyen, August 2006), who studied the conodonts in Chaohu determined the CAI in the Lower Triassic of Chaohu with 3-4. No reliable palaeomagnetic data can be obtained in beds with CAI = 3.5 and higher. At CAI = 3 partly reliable data are possible, partly not. At this CAI often a part of the section or a part of the samples yield reliable data, others not. Tong Jin-nan (pers. comm.) stated that the palaeomagnetic data from the base of the Triassic up to the Lower Olenekian were confirmed by investigation of two different sections. Thus, seemingly, at least a part of the palaeomagnetic data of Chaohu (base of the Triassic to lower Smithian) seems to be reliable data, but in levels, where they contradict biostratigraphic correlations (higher Olenekian), they should be regarded with reserve.

Stable isotope data were published from Chaohu (Tong Jinnan et al., 2004, 2005), but compared with other sections they are difficult to interpret around the base of the Olenekian, if this base is placed at the right place.

If ammonoids are chosen to define the base of the Olenekian, Chaohu is unsuitable. A conodont definition can be only placed at the FO of *N. waageni* n. subsp. A (= *N. waageni eowaageni*), if taken the conodont range chart by Tong Jinnan et al. (2004), but this would be a very weak definition.

Spiti has a very good ammonoid-control and also the conodonts are more numerous than in Chaohu. As the conodonts have CAI = 5, no reliable palaeomagnetic data can be obtained. The carbon isotope data (Krystyn, written comm.) show a distinct maximum close to the base of the Olenekian, whereas in general this maximum lies somewhat above the base of the Olenekian.

Both an ammonoid and conodont definition is possible in Spiti independent from the level which is chosen. For the moment, the base of the *R. rohilla* Zone can be favored, a level which is not well correlatable with Chaohu.

Unfortunately, no newer studies were made in the Salt Range. There, ammonoids are numerous and well preserved. Conodonts are extremely frequent and have CAI = 1. Thus, reliable palaeomagnetic and carbon isotope data can be obtained, the latter are partly present (Atudorei, 1998), but unfortunately not for the level around the Olenekian boundary. Sporomorphs are present as well.

If the GSSP will be chosen between Chaohu and Spiti, then Spiti has the better potential. However, additionally the Salt Range sections should be investigated. A correlation with ammonoids and conodonts will be easy in the Salt Range and palaeomagnetic data will be reliable, like for the underlying Permian. Moreover, sporomorphs may give a good possibility for correlation with continental beds, especially in Gondwana.

Correlation with continental sequences

The continental Lower Triassic can be subdivided by conchostracans as detailed as the pelagic marine sediments by ammonoids and conodonts (e.g. Kozur, 1993, 1999). Conchostracans occur also in brackish sediments and can be therefore rather well correlated with the marine scale in intercalations of ammonoid-bearing beds (e.g. northern and northeastern Siberia) and in brackish intercalations in very shallow water beds (e.g. Werfen Beds of Hungary, Kozur & Mock, 1993, Kozur, 1999). Conchostracan guide forms from the low latitude Lower Triassic are also present in high northern latitudes (northern and northeastern Siberia, Greenland) and in northern and central Gondwana (northern India, Central and Eastern Africa, western Africa, Madagascar).

Unlike in marine sediments, a very big faunal turnover can be observed in the conchostracan faunas close to the base of the Olenekian. A fauna dominated by spined conchostracans (e.g. *Cornia*) is replaced by a fauna dominated by *Magniestheria* (large conchostracans without spines and vertical ribs). *Magniestheria* begins already with relatively small forms within the upper Gandarian, but it is there never dominating. This faunal turnover was regarded by Kozur (1993, 1999) as the base of the Olenekian. The spined *Cornia* is very common in some bedding planes (indicating brackish conditions in the very shallow marine Werfen Beds with *Claraia aurita*, upper Gandarian) of Hungary, whereas *Magniestheria*-dominated faunas are known from the lower part of the *Pachycladina* conodont fauna of undoubtedly Smithian age (Kozur & Mock, 1993) in the same area. *M. truempyi* (Kozur & Seidel) occurs in Madagascar in beds with ammonoids (unfortunately without modern investigation) and bivalves above undoubtedly Gandarian *Claraia*-bearing beds) and below lower Smithian *Flemingites*–bearing beds (Shen et al., 2002). Rather an early Smithian age can be assumed for *M. truempyi* from Madagascar. No direct dating is known for the *M. subcircularis* Zone but because it lies above the faunal turnover, it was regarded as the first Olenekian conchostracan zone by Kozur (1993, 1999), variant B in Fig. 2. Korte & Kozur (2005) insignificantly lowered the base of the Olenekian using the palaeomagnetic data by Tong Jinnan et al. (2005) for Chaohu. This boundary lies within the uppermost part of the Gandarian conchostracan complex (variant A) in Fig. 2. Taking into consideration that the Olenekian base is not yet finally fixed in Chaohu and the palaeomagnetic data must be regarded with some caution (but seemingly they are reliable around the base of the Olenekian) because the CAI is 3-4 (see above), variant B is still regarded as an option of the continental Olenekian base.

According to Korte & Kozur (2005) stable carbon isotope data from fresh water limestones in the Germanic Basin show a distinct maximum about 350 000 years above the palaeomagnetically correlated Olenekian base (100 000 years above the conchostracan faunal turnover), if Milankovitch cyclicity is applied (Bachmann & Kozur, 2004). In the Southern Alps this maximum lies within the lowermost part of the Lower Olenekian *Pachycladina* conodont fauna, also there about 350 000 years above the palaeomagnetically correlated Olenekian base and insignificantly closer to the FO of the Lower Olenekian *Pachycladina* fauna. In both cases, the maximum in $\delta^{13}C_{carb}$ lies within the lower Smithian, like in the continental beds of the Germanic Basin. In Spiti, the maximum in $\delta^{13}C_{carb}$ lies a little above the base of the *R. rohilla* Zone (Krystyn, written comm.). In the rather condensed sequence in Spiti the distance between the base of the *R. rohilla* Zone and the maximum in the carbon isotope curve could be well in the range between 100 000 and 350 000 years but rather closer to the first value. The maximum is defined by two values within the *R. rohilla* Zone. The older value is according to the data of Krystyn from the *R. rohilla* Zone in the lower bed with *R. rohilla*, a little above the FO of *R. rohilla*. This level is probably not further away from the base of the *R. rohilla* Zone than 100 000 years, rather closer to this boundary. In that case, the strong faunal turnover in the continental conchostracan faunas (variant B of the Olenekian base in the continental conchostracan succession) would coincide with the base of the *R. rohilla* Zone, making the view of Krystyn a very good decision. This speaks in favour of Spiti and in favour of the boundary proposed by Bhargava et al. (2004) as the lowest Olenekian base. The second and insignificantly higher value lies according the data of Krystyn in the second bed of the *R. rohilla* Zone, in the level where the first *Flemingites griesbachi* appears in the *R. rohilla* fauna. If the maximum in the Germanic Basin corresponds to this level, then in the highly condensed Spiti succession a distance of more than 300 000 years to the base of the *R. rohilla* Zone would be possible and this would be a further confirmation that the palaeomagnetic data of Chaohu are reliable around the Olenekian base (see above), which would elevate the value of the Chaohu section and by this confirm variant A of the continental Olenekian in the conchostracan succession.

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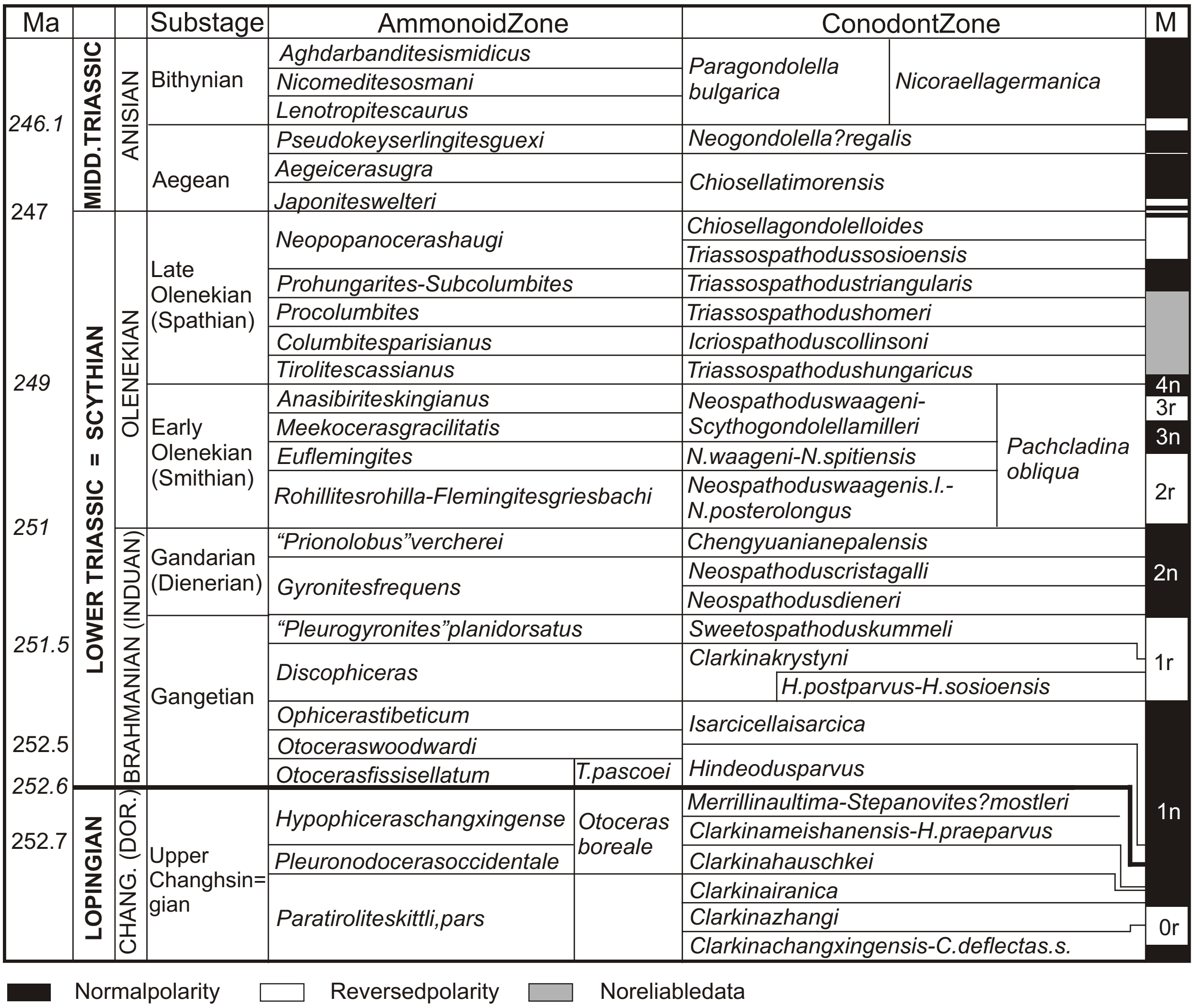

Figure 1: Lower Triassic ammonoid and conodont zonation and palaeomagnetic zonation.
Slightly modified after Bachmann & Kozur (2004)
Full coincidence of base of ammonoid and conodont zones for graphic reasons and only in some cases real.

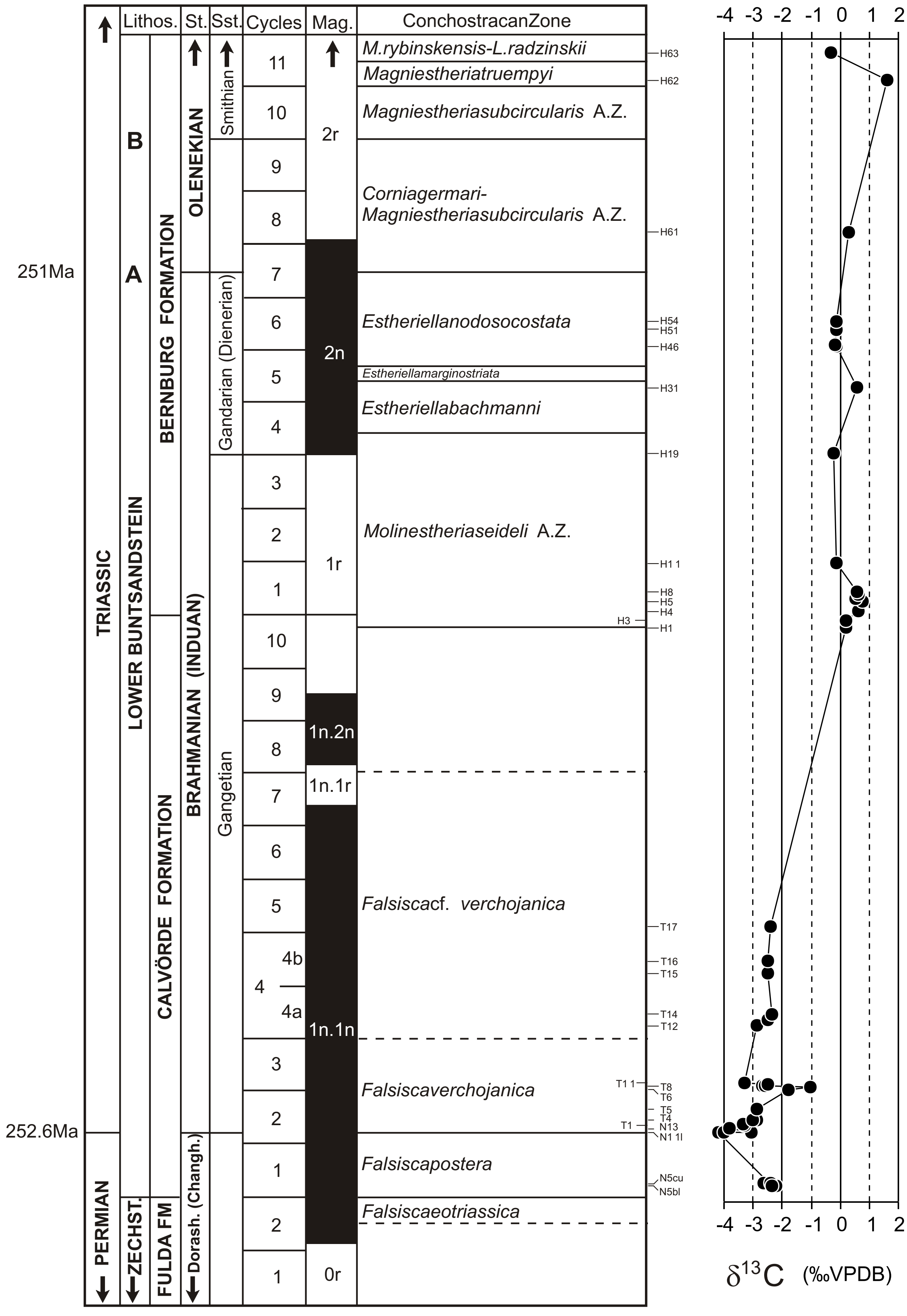

Figure 2: Carbon isotope record of the Lower Triassic Buntsandstein.

New Triassic Literature

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British Triassic palaeontology: supplement 31

G. Warrington

Since the completion of the writer's previous supplement (No.30; ALBERTIANA, 31: 81) on British Triassic palaeontology, the following works relating to aspects of that subject have come to his notice.

Benton, M. J. 2005. Vertebrate Palaeontology (3rd edition). Oxford, Blackwell Publishing Ltd. xi+455p.

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Future Meetings

FIRST CIRCULAR
THE GLOBAL TRIASSIC
23-25 May 2007

New Mexico Museum of Natural History, Albuquerque, New Mexico, USA

This international symposium will be devoted to all aspects of the Triassic System with particular focus on the Triassic timescale and Triassic biotic events. It will be an official meeting of the IUGS Subcommission on Triassic Stratigraphy, and a final meeting of IGCP 467 on Triassic Time and Correlation.

Organizing Committee:

Spencer G. Lucas, Albuquerque
Michael J. Orchard, Vancouver
Adrian P. Hunt, Albuquerque
Justin A. Spielmann, Albuquerque
Jim Jenks, Salt Lake City
Lawrence Tanner, Syracuse
Chris McRoberts, Cortland
Karl Krainer, Innsbruck

The meeting will be three days of talks and posters at the New Mexico Museum of Natural History in Albuquerque. Planning for pre-meeting and post-meeting fieldtrips is underway, and the trips will be announced in the second circular. They will afford an opportunity to visit several classic marine sections including Fossil Hill (A-L), South Canyon (L-C), and New York Canyon (T-J), as well as classic nonmarine Triassic sections in New Mexico-Arizona.

For further information contact:

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At the European Geosciences Union General Assembly 2007 in Vienna, Austria, 15 – 20 April 2007

The following session has been announced:

MPRG09: Integrated (magneto) stratigraphy and chronology of the Triassic; implications for the GPTS and paleoenvironmental reconstructions

Convener: *Szurlies, M.* ***Co-Convener:*** *Kuerschner, W.; Gallet, Y.*

Deadline for abstracts is 15 January 2007

Please find further information at http://meetings.copernicus.org/egu2007/index.html !

GUIDELINES FOR THE SUBMISSION OF MANUSCRIPTS TO ALBERTIANA

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Text files can be submitted formatted as *.wpd, *.doc or *.rtf files and illustrations as pixel based graphics (e.g: *.bmp, *.tif, *.gif or *.jpeg) or vector based graphics (e.g: *.ai, *.cdr) that can be directly imported into Adobe PageMaker. Please provide good, clean, flat, printed copies (NOT xerox copies) of any illustrations, which MUST be designed to fit on an A4 page (centered, with at least 2.54 cm wide margins left and right, and 4 cm margins at the top and bottom).

Special attention should be paid to grammar and syntax - linguistic corrections will be minimal. In case of doubt, send your manuscript to a colleague for proof reading. References should be in the format used in the 'New Triassic Literature' section in issue 25 of Albertiana. Please write all Journal titles in full length. The use of names of biostratigraphic units should be in accordance with the International Stratigraphic Guide:

The formal name of a biostratigraphic unit should be formed from the names of one, or preferably no more than two, appropriate fossils combined with the appropriate term for the kind of unit in question."

The writing and printing of fossil names for stratigraphic units should be guided by the rules laid down in the International Code of Zoological Nomenclature and in the International Code of Botanical Nomenclature. The initial letter of generic names should be capitalized; the initial letter of the specific epithets should be in lowercase; taxonomic names of genera and species should be in italics. The initial letter of the unit-term (Biozone, Zone, Assemblage Zone) should be capitalized; for example, Exus albus Assemblage Zone."

The name of the fossil or fossils chosen to designate a biozone should include the genus name plus the specific epithet and also the subspecies name, if there is one. Thus Exus albus Assemblage Zone is correct. After the first letter; for example, Exus albus may be shortened to E. albus. On the other hand, the use of the specific epithet alone, in lowercase or capitalized, in italics or not (albus Assemblage zone, Albus Assemblage zone, albus Assemblage zone, or Albus Assemblage zone), is inadvisable because it can lead to confusion in the case of frequently used species names. However, once the complete name has been cited, and if the use of the specific epithet alone does not cause ambiguous communication, it may be used, in italics and lowercase, in the designation of a biozone; for example, uniformis Zone."

From: Salvador, A. (ed.), 1994. International Stratigraphic Guide. Second Edition. International Commission on Stratigraphic Classification of IUGS International Commission on Stratigraphy. IUGS/GSA, Boulder, Co, p. 66.

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