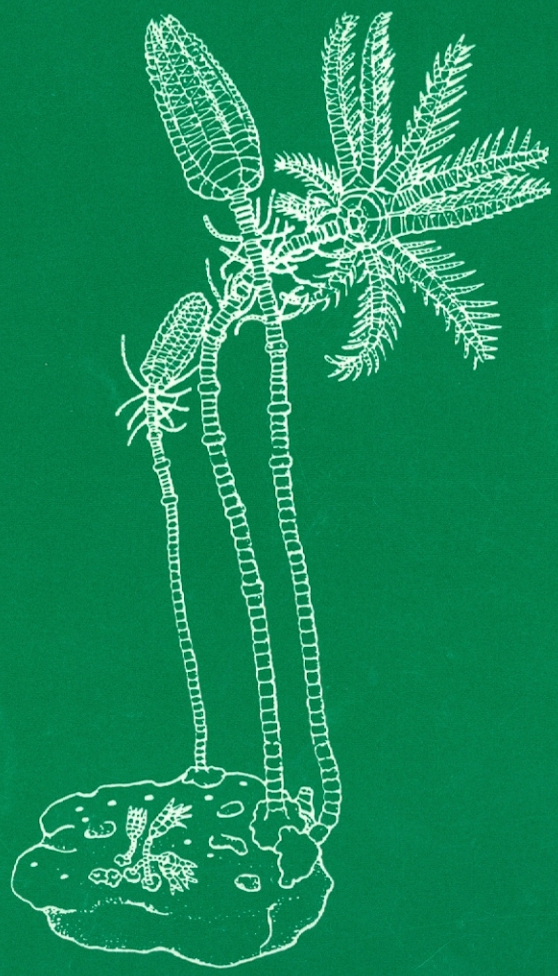
ALBERTIANA



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ALBERTIANA

Editor ALBERTIANA: Hans Kerp
WWU, Abt. Paläobotanik
Hindenburgplatz 57-59
D-48143 Münster, Germany
Tel.: +49-251-832 3966
Fax: +49-251-832 4831
E-mail: kerp@uni-muenster.de

The primary aim of ALBERTIANA is to promote the interdisciplinary collaboration and understanding among the members of the I.U.G.S. Subcommission on Triassic Stratigraphy. Within this scope ALBERTIANA serves both as a 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 announcements, literature reviews, progress reports, preliminary notes etc. - i.e. those contributions in which information is presented relevant to current interdisciplinary Triassic research.

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EPICONTINENTAL
TRIASSIC
INTERNATIONAL
SYMPOSIUM
Halle/S. Germany
September 21 – 23, 1998

Dear colleague,

On behalf of the Faculty of Geosciences, the Organizing Committee and the German Subcommission on Permian and Triassic Stratigraphy, I cordially invite you to participate in the International Symposium on the Epicon tinental Triassic in Halle/Saale, Germany.

There has been a remarkable response to our first two circulars and to the preliminary questionnaires. Over 200 geoscientists from more than 20 countries worldwide are planning to attend the Symposium and to join the excursions. The titles of oral presentations and posters announced so far indicate that all important aspects of the epicontinental Triassic will be addressed. Thus, the Symposium will be an excellent platform for presenting the results of your research or giving a more overview-type paper on "your" special epicontinental Triassic, and discussing it with colleagues worldwide. An Exhibition and especially the Excursions before and after the Symposium will give you a unique opportunity to get closely acquainted with many aspects of the classic Germanic Buntsandstein, Muschelkalk and Keuper, and to visit a number of type regions and type sections. Additionally, we have dedicated one special excursion to the classic Rotliegend and Zechstein (and the historic Kupferschiefer mines), since the type region is near Halle.

The 1000-year-old City of Halle with its 500-year-old University is in a region famous for its history, and the excursions go to areas famed for their scenic beauty and cultural wealth. We suppose that many of you have not been to those areas (or even Germany) before. So we have asked the excursion leaders to consider (depending on the time available) short stops at "cultural highlights", too.

In addition to these aspects, you will also have the opportunity to see a country and a city, almost a decade after Germany's "Wiedervereinigung" (reunification), in a time of transition – in which there are still great problems, but also plenty of hope and progress.

We are very honoured that Dr. Hans-Dietrich Genscher has agreed to be patron of our international Symposium. Dr. Genscher was Foreign Minister of the Federal Republic of Germany in those dramatic days of the Wiedervereinigung and was one of its architects.

We are looking forward to seeing you in Halle.

Sincerely yours,

Prof. Dr. Gerhard H. Bachmann
Dean of the Faculty of Geosciences

INTERNATIONAL SYMPOSIUM ON THE EPICONTINENTAL TRIASSIC

SEPTEMBER 21 - 23, 1998

Martin-Luther-Universität Halle-Wittenberg, Fachbereich Geowissenschaften
Institut für Geologische Wissenschaften und Geiseltalmuseum

Unter der Schirmherrschaft von / Under the Patronage of
Dr. h. c. mult. Hans-Dietrich Genscher
Bundesaussenminister i. R.
Ehrensenator der Martin-Luther-Universität Halle-Wittenberg

International Symposium on the Epicontinental Triassic
Symposium Office / Kongressbüro

Martin-Luther-Universität Halle-Wittenberg
Dipl. Phil. Karin SCHUBERT
Universitätsring 2
D-06099 Halle/Saale, Germany
Tel.: + +49-345-55 26113 / Fax: + +49-345-55 27 066
E-mail: trias@geologie.uni-halle.de
Symposium web site: http://www.geologie.uni-halle.de/trias/trias.html

ORGANIZATION

G.H. BACHMANN, G. BEUTLER, H. HAUBOLD
Institut für Geologische Wissenschaften und Geiseltalmuseum Martin-Luther-Universität Halle-Wittenberg, Domstrasse 5, D-06099 Halle/Saale, Germany

Subkommission Perm-Trias der Stratigraphischen Kommission der Deutschen Union der GeologischenWissenschaften (DUGW); Chairman: E. PLEIN.

SYMPOSIUM CALENDAR 1998

• January 31	Deadline for application for travel support for participants from Eastern Europe and former Soviet Union.
• February 28	Deadline for receipt of abstracts, enrollment for excursions and payment of registration and excursion fees.
• March-April	Confirmation of registration for the Symposium, places on excursions, and fees paid. Information on accommodation. Confirmation of acceptance of oral presentation or poster.
• September 17-20	Pre-Symposium Excursions

• September 20	19:00 h, Icebreaker Party, *Institut für Geologische Wissenschaften und Geiseltalmuseum*, Domstrasse 5
• September 21	Deadline for submission of manuscripts for Symposium Volume
• September 21-23	Symposium, Martin-Luther-Universität Halle-Wittenberg, *Melanchthonianum*, Universitätsplatz: Scientific Sessions, Poster Party, Industrial Exhibition, Meetings of Commissions The Mayor's Reception, *Stadthaus*, Marktplatz "Triassic" Exhibition, *Stadtmuseum Halle, Christian-Wolff-Haus*, Grosse Märkerstrasse 10
• September 24-27	Post-Symposium Excursions

Starting Point for all Excursions is Halle, Universitätsplatz. The only exception is Excursion H, starting on September 17, approx. 16 h, from Frankfurt / Main airport.

SCIENTIFIC PROGRAMME

The technical sessions run from Monday 21 through Wednesday 23, September 1998 and consist of oral and poster presentations. All contributions pertinent to the Symposium theme are welcome, but especially those that are covered by the topics listed below. Overview type papers are very welcome. Please indicate on the registration form under which topic your particular contribution falls.

1. Global aspects of the Triassic: plate tectonics, climate, eustasy
2. Epicontinental Triassic of Central and Western Europe
3. Epicontinental Triassic of Eastern Europe
4. Epicontinental Triassic of Eastern Laurasia
5. Epicontinental Triassic of the Mediterranean and Peritethys
6. Epicontinental Triassic of Gondwana
7. Epicontinental Triassic of North America
8. Triassic of the Tethys and correlation with the Epicontinental Triassic
9. Paleotectonics
10. Sequence stratigraphy, cyclostratigraphy and correlation
11. Magnetostratigraphy
12. Sedimentary processes and environments
13. Palaeontology, Biostratigraphy:
    a. Vertebrates
    b. Invertebrates
    c. Flora
    d. Microfauna/Microflora
    e. Trace Fossils
14. Economic Geology
    a. Petroleum
    b. Industrial Minerals (Steine und Erden)

SYMPOSIUM VOLUME

It is planned to publish the proceedings as a Symposium Volume in cooperation with the international Springer-Verlag. Manuscripts should be submitted by September 21, 1998 to the Symposium Office. We aim to put together a volume that will be a standard reference on the Epicontinental Triassic for years to come. Therefore it should be highly attractive for your publication. Regional, stratigraphic or palaeontological overview type papers are especially welcome. You may submit a paper to the Symposium Volume even if you are unable to attend the Symposium. All papers will be reviewed.

"TRIASSIC" EXHIBITION

Stadtmuseum Halle, Christian-Wolff-Haus, Grosse Märkerstrasse 10.

An exhibition will be organized by the Institut für Geologische Wissenschaften in cooperation with the Forschungsinstitut Senckenberg, Frankfurt/Main, and the Stadtmuseum Halle.
The exhibition, covering approx. 200 m^2, will show the different aspects of the classic Germanic Triassic including its terrestrial and marine life. It will also address the tremendous economic importance of Triassic sediments. Numerous museums have agreed to lend unique original material and models. It is the first time that a comprehensive Triassic exhibition has been held and aims to attract geoscientists as well as the general public.
Opening: September 6, 1998, 11:00 h.

EXCURSIONS

- **Excursion A** — **The classic Rotliegend and Zechstein (Permian) of the Saale basin**
  M. SCHWAB, W. KNOTH (1 day)
  Cost: DM 80, including excursion guide and lunch
- **Excursion B** — **Stratigraphy, sedimentary environments and cyclicity of Buntsandstein and Muschelkalk in the central Germanic basin (north of the Harz Mountains)**
  N. HAUSCHKE, M. SZURLIES, V. WILDE (1 day)
  Cost: DM 80, including excursion guide and lunch
- **Excursion C and D** — **Stratigraphy and sedimentology of Buntsandstein and Muschelkalk in the southeastern part of the Germanic basin (Jena and Unstrut valley)**
  R. GAUPP, TH. VOIGT, H. LÜTZNER (2 days)
  Cost: DM 80 each, including excursion guide and lunch
- **Excursion E** — **Sedimentary structures and depositional environments of the Buntsandstein and Muschelkalk east of Halle**
  T. RÜFFER, W.U. EHRMANN (½ day)
  Cost: DM 50, including excursion guide
- **Excursion F** — **Stratigraphy, sedimentary environments and cyclic deposition of the Keuper in the southeastern part of the Germanic Basin (Thuringia)**
  G. BEUTLER, T. MARTENS (1 day)
  Cost: DM 80, including field guide and lunch
- **Excursion G** — **The classic Germanic Triassic in the southern part of the Germanic Basin: Stratigraphy, sedimentary environments, cyclic and sequence stratigraphy**
  G. H. BACHMANN, G. BEUTLER (4 days)
  Cost: DM 580, including excursion guide, 3 breakfasts, 4 lunches, 3 dinners, hotel accommodation
- **Excursion H** — **The Buntsandstein of the Hessian Depression: Contrasting styles of basinal and marginal deposition**
  J. LEPPER, M. HORN, H.-G. RÖHLING, H. STOLLHOFEN, K.-W. TIETZE (3½ days)
  Cost: DM 570, including 3 breakfasts, 3 lunches and hotel accommodation
- **Excursion I** — **Stratigraphy, sedimentary environments, palaeoecology and cyclicity of Buntsandstein, Muschelkalk and Keuper in the central Germanic Basin (north of the Harz Mountains)**
  N. HAUSCHKE, V. WILDE (2 days)
  Cost: DM 250, including excursion guide, 1 breakfast, 2 lunches, 1 dinner and hotel accommodation

REGISTRATION FEES

	receipt before Feb. 28		receipt after Feb. 28	
		1-Day Registrant		1-Day Registrant
Participant	DM 250	DM 160	DM 320	DM 200
Student*	DM 125	DM 80	DM 160	DM 100
Accompanying Person**	DM 100	DM 40	DM 130	DM 50

* Student ID required
** No Symposium Material
Fees include: Icebreaker, Welcome Reception, Exhibition, Poster Party (for 1-Day Registrants on respective day only), Symposium Material

STS MEETING IN HALLE ON 22 SEPTEMBER 1998

During the International Symposium on the Epicontinental Triassic in Halle a meeting of the Subcommission on Triassic Stratigraphy will be held on Tuesday, 22 September 1998 at 4.00 p.m. All voting and corresponding members are kindly invited. Please note that this will be the only full meeting of the STS in 1998. The agenda will be distributed in due time.

Sincerely yours, Maurizio Gaetani

Chaiman of the STS

INTERNATIONAL CONFERENCE ON PANGEA AND THE PALEOZOIC-MESOZOIC TRANSITION

(First Circular)

Organizer: Professor Yin Hongfu, Member of Academia Sinica, President of the China University of Geosciences (Wuhan)

Objective: The conference is designed to provide a forum to all kinds of scientists who are interested in the special interval of Pangea for discussing Pangea formation and dispersion; global changes related to Pangea integration and break-up; biotic crisis, extinction, recovery and evolution at the Paleozoic-Mesozoic transition; and Tethys evolution during Pangea interval.

Dates:

Pre-Conference Field Excursion: 7-8 March, 1999
Conference: 9-11 March, 1999
Post-Conference Field Excursion: 12-16 March, 1999

Place: China University of Geoscience (Wuhan)

Language: English will be the official language for all presentations.

Important Dates:

1 April 1998: Deadline for submission of response to first circular
1 October 1998: Deadline for submission of abstracts
1 February 1999: Deadline for submission of pre-registration

Themes:

1. Tectonics and dynamics of Gondwana break-up, Pangea integration and Tethys evolution;
2. Paleogeography, paleoclimatology and paleoecology during Pangea interval;
3. Stratigraphy, sea level changes, high-resolution events and boundary;
4. Biotic crisis, mass extinction, recovery and evolution at the Paleozoic-Mesozoic transition.

Field Excursions:

Pre-conference Field Excursion: Huangsi, SE Hubei Province (7-8 March, 1999). This two day field excursion will visit some typical marine Carboniferous-Lower Triassic and terrestrial Middle Triassic sections in Huangsi, SE Hubei Province. Some key boundaries will be examined there as well.

Post-conference Field Excursion: The Yangtze Gorges (12-16 March, 1999). The Yangtze Gorges areas are not only famous for the attractive scenery and the construction of the Dam, but also for the well-exposed Pre-Cambrian to Triassic stratigraphic sequences and their special geological bene-fits. The excursion is planned to mainly examine the stratigraphic sequence and it related geological aspects. As the Yangtze Gorges Dam will cut off the river at the end of 1997, an exploration might be ahead of us.

Publications: We anticipate that refereed and accepted papers will be published either as a book or as a special issue of an international journal series. The paper must be presented (either orally or in poster) before being considered for publication.

Registration and excursion: Registration forms will be included in the second circular that will be sent to all who respond to the first circular. The registration fee for the conference (including proceedings, morning and afternoon teas and three lunches) will be US $150. The pre-conference field excursion fee (including transportation, accommodation, field guidebook and meals) will be US $120. As the Yangtze Gorges Dam is in construction and it will dam the river late 1997, the post-conference field excursion fee is presently estimated at about US $500 (refer to second circular for the details).

Transportation: Wuhan is the capital of Hubei Province, situated in the center of China. The international airport has daily flights from Hong Kong, Beijing, Shanghai, Guangzhou and other major cities in China. Wuhan is on the mid-way of Beijing-Guangzhou Railway with more than 20 express and rapid trains daily from Beijing and Guangzhou. Meanwhile, Wuhan is situated in the middle part of Yangtze River with more than 10 scheduled boats from Shanghai and Chongqing every day.

Send all Correspondence to: Dr. Tong Jinnan (Secretariat), Faculty of Earth Science, China University of Geosciences, Wuhan, Hubei 430074, P. R. CHINA Tel: +86-27-7482031; Fax: +86-27-7801763; E-mail: jntong@dns.cug.edu.cn

IGCP PROJECT no. 359 - ANNUAL REPORT

IGCP Project Short Title: Correlation of Tethyan, Circum-Pacific and marginal Gondwanan Permo-Triassic

Duration and Status: (1993-1997)

PROJECT LEADERS:

1. YIN HONGFU, Palaeontology Laboratory, China University Of Geosciences, Wuhan, Hubei, 430074, China. Phone: 086 27 7806812. Fax: 086 27 7801763
2. J.M. DICKINS, Australan Geological, Survey Organization, P.O.Box 378, Canberra, A.C.T.2601, Australia. Phone: 061 06 2805439. Fax: 061 06 2499999
3. A. BAUD, Musée Géologique, Unil-Bfsh2, CH-1015, Lausanne. Phone: 041 21 6924820. Fax: 041 21 6924897
4. YANG ZUNYI, Dept. Geology, China, University Of Geosciences, 29 Xueyuan Road, Beijing, 100083, China. Phone: 086 01 62022244 Ext. 2575. Fax: 086 01 62014873

Date of submission of the report: 20 September, 1997

Signature of the Leader: YIN Hongfu

1. Summary of Past Major Achievements of the Project

The project embraces 185 members from 25 countries and develops relations with IGCP projects 306, 321, 335, 343, 369, 383, as well as the Shallow Tethys Symposium and GSSP project (Pangea). During 1993-1995 noteworthy progress has been achieved on two main tasks of this project: the intersystem and intrasystem boundaries of Permian and Triassic, and compilation of the regional stratigraphic charts. In the past four years about 28 books and about 250 papers have been published. We helped more than 40 persons to participate; 14 workshops and meetings were conducted or co-organized by the project.

2. Achievements of the Project This Year

2.1. General scientific Achievements

The results of the preceeding IGCP Project 272 have been published in Dickins et al. (1997), a book that contains 25 papers dealing on Permo-Triassic biota, stratigraphy, paleogeography, climatology and tectonics. For a summary of results one is referred to Dickins et al. (1997).

The international conference on stratigraphy and tectonic evolution of SE Asia and the South Pacific, and the associated meetings of IGCP 359 and IGCP 383 (19-24 August 1997, Bangkok, Thailand), summarized recent achievements in the stratigraphic and tectonic framework as well as related energy and mineral resources of Thailand, Laos, Malaysia and adjacent regions, as shown in some key papers read in this meeting. Map series of Thailand were displayed. The tectonic subdivision and stratigraphic correlation of whole Indochina Peninsula plus SW China, Australia and other adjacent regions were vividly discussed and showed considerable advances compared to those of the late 1980's. A two-volume proceeding of this meeting was distributed to attendants

during the meeting, including all papers and abstracts submitted, altogether 769 pages (Phisit Dheeradirok et al., 1997). Member of Project 359 submitted more than ten papers, part of them are listed in 7. of this report.

Kotlyar (1997) proposed a new scheme for correlation of the Permian concentrating on the Kungurian as a stage of international standard. In a series of papers Zakharov et al. (1997) investigated $\delta^{13}C$ and $\delta^{18}O$ isotopes of Carboniferous to Jurassic rocks, ammonoid shells and reached some interesting results. For other contributions of the Russian group please refer to the Annual report (1997) of Russian group elsewhere in this issue. Triassic stratigraphy and paleogeography of South China and Bayan Har-Hoh Xil were published by Feng et al. (1997) and Zhang (1997). Other Chinese contributions include conodonts (Wang, 1996), radiolarians (Du et al., 1997) and ammonoids (Xu and Wang, 1997). Tazawa (1997) and his colleagues made a serial research of Permo-Triassic paleobiogeography of Japan, NE China and Russian Far East based on brachiopods, corals and forams. Waterhouse (1996, 1997) published systematic descriptions of Triassic ammonoids in Nepal.

The Permo-Triassic boundary: A joint paper to propose *Hindeodus parvus* as the boundary marker and Meishan as the type locality was published by Yin et al. (1997). This may serve as the draft of a formal submission of the PTBWG for ballot. Nevertheless, the P/T- boundary has been under discussion by Baud (1996), Bai & Yang (1996), Kozur (1996) Wang (1996), Yin (1996) and others, focusing on these two topics raised by Yin et al. Despite these discussions there is no substitution of the above proposal yet. Research on other criteria like ammonoids and carbon isotopes and other localities like Arctic Canada and Himalaya are still far behind the standard required by the ISC Guidelines.

Other boundaries: Zakharov (1996) suggested the ravine near Tree Kamnya Cape in South Primorye as a candidate of GSSP for Induan-Olenekian boundary. The Triassic-Jurassic boundary (Gonzalez et al., 1996) is also discussed.

2.2. List of Meetings with Approximate Attendance and Number of Countries

(1). International Field Excursion on Permian-Triassic sections on the North Caucasus, 7-17, July, 1997, Psebai, Russia. Organizers: IGCP Projects 359, 343 and North Caucasus Organizing Committee. Subjects: field trips in the basins of the Laba and Belaya Rivers to demonstrate the Upper Permian (Dorashamian) sections in various facies, the Lower Permian red-colour continental deposits and the Triassic deposits. 8 attendants include Russian and USA specialists. Among other results, Triassic deposits of NE Caucasus were for the first time subdivided into ten ammonoid beds.

(2). GEOTHAI'97 - International Conference on Stratigraphy and Tectonic Evolution of SE Asia and the South Pacific, 19-24 August, 1997, Bangkok, Thailand. Organizers: The Department of Mineral Resources, Thailand, jointly sponsored by IGCP nos. 359 and 383. Subjects: scientific programme from 19-21 August, followed by 3 excursion routes on 22-24 August to study the stratigraphy and tectonic evolution of eastern, western and northeastern Thailand respectively. About 400 attendants, nearly half of them were foreigners from 22 countries, including about twenty IGCP 359 members. The meeting consisted of 5 oral sessions: stratigraphy & palaeontology, tectonics, economic & applied geology, fossil fuels and special, plus poster sessions and an exhibition. More than 100 presentations, oral and poster, were given. A workshop meeting of IGCP 359 was held.

(3). International Conference on the Permian of eastern Tethys: Biostratigaphy, Palaeogeography & Resources, jointly sponsored by IGCP 359 and Deakin University, 30 November--3 December, 1997, Deakin University, Rusden Campus, Melbourne, Australia. Subjects: Permian stratigraphy, sedimentology and palaeontology of peri-Gondwana and eastern Asian terranes; non-tropical

distribution of Permian biota; Permian palaeogeography and climate of the eastern Tethys; Permian migration pathways of biotas in the eastern Tethys; correlation of Permian sequences between Gondwanan, Tethyan and Boreal Realms; distribution of Permian coal deposits; geochronology and boundaries of the Permian Period. During- and post-conference field excursions. Already about 60 people responded positively on the 1st and 2nd circular.

2.3. Number of Publications: List of Major or Most Important Publications

Five books and more than 60 papers have been published. The statistics is based on books and reprints sent to the project leader by the members.

Books:

ZHANG YIFU, 1997, Formation and evolution of the Hoh Xil-Bayan Har Triassic sedimentary basin. Qinghai People's Press, Xining, China.136 pp.

FENG ZHENGZAO, BAO ZIDONG and LI SHANGWU, 1997, Lithofacies and paelogeo- graphy of Early and Middle Triassic of South China. The Petroleum Press, Beijing, 222pp.

PHISIT DHEERADILOK, HINTHONG, C., CHAODUMRONG, P. et al. (eds.), 1997, Stratigraphy and tectonic evolution of Southeast Asia and the South Pacific. Proceedings Intern. Conference on Stratigr. Tectonce Evolution SE Asia and S Pacific. Pt. 1(p.1-464) & Pt. 2 (p. 465-767).

DICKINS, J.M., YANG ZUNYI, YIN HONGFU, LUCAS, S.G. and ACHARYYA, S.K. (eds.), 1997. Late Palaeozoic and Early Mesozoic Circum-Pacific Events and their Global Correlation. Cambridge University Press, 245 pp.

Papers:

DU YUANSHENG FENG QINGLAI, YIN HONGFU, ZHANG ZONGHENG and ZENG XIANYOU, 1996, New Evidence for eastward extension of late Hercynian-early Indosinian Qinling Sea. Journal of China University of Geosciences, 7(2):141-146.

GONZALEZ-LEON, C.M., TAYLOR, D.G. and STANLEY, G.D., 1996, The Antimonio Formation in Sonora, Mexico, and the Triassic-Jurassic boundary. Can. J. Earth Sci., 33: 418-428.

KOTLYAR, G.V., 1997, The basic correlative levels of the Permian system. Stratigr. Geol. Correl., 5(2): 35-50 (in Russian).

KOZUR, H., 1996, The conodonts *Hindeodus*, *Isarcicella* and *Sweetohindeodus* in the Uppermost Permian and Lowermost Triassic. Geol. Croat., 49(1): 81-115.

TAZAWA, JUN-ICHI and SHEN SHUZHONG, 1997, Middle Permian brachiopods from Hiyomo, Mino Belt, central Japan. Their provincial relationships with North America. Sci. Rep., Niigata Univ., Ser. E (Geol.), 12:1-17.

TONG JINNAN, 1997, A study on the Griesbachian cyclostratigraphy of Meishan section, Changxing, Zhejiang Province. Proceedings Intern. Conf. Stratigr. Tectonic Evolution SE Asia and S Pacific, pp. 158-163.

WANG CHENGYUAN, 1996, Conodont evolutionary lineage and zonation for the Latest Permian and the Earliest Triassic. Permophiles, 29, 30-37.

XU GUANGHONG and WANG CHUANSHANG, 1997. Extinct summit of ammonoids near the boundary between Guadalupian and Lopingian of Permian. Geology and Mineral Resource of South China, 16:11-22.

YIN HONGFU, SWEET, W.C., GLENISTER, B.F., KOTLYAR, G., KOZUR, H., NEWELL ,N.D., SHENG, J., YANG, Z. and ZAKHAROV, Y.D., 1996. Recommendation of the Meishan section as Global Stratotype Section and Point for basal boundary of Triassic System. Newsl. Stratigr., 34(2): 81-108.

ZAKHAROV, Y.D., 1996, The Induan-Olenkian Boundary in the Tethys and Boreal Realm. Ann. Mus. Civ. Rovereto, Sez.: Arch., St., Sc. Nat., Suppl., 11(1995): 133-136.

ZAKHAROV, Y.D., UKHANEVA, N.G., IGNATYEV, A.V., AFANASYEVA, T.B., VAVILOV, M.N., KOTLYAR, G.V., POPOV, A.V. and POPOV, A.M.,1997, Isotope composition of carbon and oxygen in Upper Paleozoic and Mesozoic organogenic carbonates of Eurasia. Geology of the Pacific Ocean, 16(1): 45-58 (in Russian).

*2.4. List of Countries Involved in Project (*indicate the countries active this year)*

Australia*, Austria*, Canada, China*, France, Germany, Hungary*, India, Iran, Italy*, Israel, Japan*, Jordan, New Zealand*, Poland, Russia*, Slovakia, Slovenia, Spain, Switzerland*, Thailand*, Turkey, United Kingdom, USA, Vietnam, Yugoslavia.

2.5. Activities Involving Other IGCP Projects, IUGS or Major Participation of Scientists from Developing Countries

A joint conference with IGCP Project 383 was held in Thailand, August 1997, with major participation from developing countries. Joint research with CCOP, involving SE Asian developing countries, is under discussion. Cooperations with IGCP Projects 335, 343 and 369 are by member participation and exchange of newsletters. Thailand is the developing country that contributed considerably by organizing the GEOTHAI'97 meeting.

3. Proposed Activities of the Project for the Year Ahead

Because the project will finish by the end of this year, no activities are proposed. The Chinese members are currently preparing a draft of the first circular for a Permo-Triassic meeting to be held in the spring of 1999. If a successor project is established, that meeting will of course become part of the new project. The meeting of Shallow Tethys 5, in close connection with our project, will be held in Chiang Mai, Thailand, 1-5 February, 1999 (correspondence: Dept Geol. Sci., Faculty Science, Chiang Mai Univ., Chiang Mai, Thailand).

4. Intention to Propose Successor Project.

In 1996 Dr. Trinh Dzanh, director of the Geological Museum of Vietnam, and Dr. Phan Cu Tien, director of Geological Research Institute of Vietnam, have suggested a project on the geological development and mineral resources of SE Asia emphasizing on Late Palaeozoic and Early Mesozoic. In the workshop meeting held during the GEOTHAI'97 meeting, Dr. John Rigby was chosen to contact the Vietnamese specialists and to raise a proposal of the successor project.

5. Summary

A number of regional stratigraphic charts covering large parts of Tethys, Circum-Pacific and marginal Gondwana have been submitted and discussed and other are being compiled. Major progress has been achieved in the research on intersystem and intrasystem boundaries of Permian and Triassic. This has been recognized as a dynamic project on the Permian and Triassic and as a compilaton of research on the global changes that occurred during this important geological time interval which contribute to a better understanding of the past, present and future of the world.

Brief statement of financial expenditures in 1997 (in US $)

Funds forwarded from IUGS under UNESCO Contract	1800
Funds forwarded from IUGS (supplementary IUGS Contribution)	3500
Total	**5300**
Expenditure	
Dr. Dickins, J.M., AGSO, Canberra, Australia	400
Dr. Galina Kotlyar, VSEGEI (All Russia Geol. Inst.), St.-Petersburg, Russia	500
Dr. Jin. Yugan, Nanjing Institute of Geology and Paleontology, Nanjing, China	500
Dr. Prinya Putthapiban, Geol. Surv. Division, Dept Mineral Resources Thailand	700
Dr. Shi. G. R., Deakin University, Rusden Campus, Melbourne, Australia)	500
Prof. Tong Jinnan, China University of Geosciences, Wuhan, Hubei, China	900
Dr. Vuks, V.Ja., VSEGEI (All Russia Geological Institute), St.-Petersburg, Russia	300
Prof. Yin Hongfu, China University of Geosciences, Wuhan, Hubei, China	1000
Administrative fee	500
Total	**5300**
Balance	

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NEW DATA ON LATE CARBONIFEROUS, PERMIAN, TRIASSIC AND JURASSIC EVENTS

Annual Report 1997 of IGCP project 359 - Russian NWG, PTBWG and IOBWG

Yuri D. Zakharov

Summary of achievements

1. The first information on Late Carboniferous paleotemperatures on the basis of data on the isotopic composition of aragonitic ammonoid shells (*Aristoceras* and *Glaphirites*) from the Gzhelian of South Urals (10.4-15.2°C) was reported by Zakharov et al. (1997b).

2. Zakharov et al. (Zakharov, 1996a; Zakharov et al. 1996a,b, 1997b) communicated new positive shifts of $\delta^{13}C$, recently discovered in the Lower Permian Kabayama limestone in Kitakami (+4.8‰), in the Midian-Dzhulfian boundary beds in the Transcaucasia (+4.0‰); paleotemperatures for the Late Midian (25.2-27.9°C) and the Late Dorashamian (24.2°C - *Paratirolites kittli* Zone) have been determined on the basis of the isotopic composition of well preserved brachiopod shells.

3. Studies of Permian limestone blocks of Crimea made by Kotlyar, Zakharov, Pronina, Baud, Belyaeva, and Nestell (in press) demonstrate that the epochs of carbonate sedimentation continued at near-by area almost uninterrupted from the Late Bolorian to the end of the Permian. The taxonomic composition of all studied groups (foraminifers, sphinctozoans, brachiopods, ammonoids, trilobites) definitely points to a Tethyan type fauna. The presence of almost all zonal assemblages of the Bolorian, Kubergandinian, Murgabian, Midian as well as of the Dzhulfian and Dorashamian is revealed.

4. Kotlyar, Zakharov and Pronina (Kotlyar, 1997; Kotlyar et al., in press) proposed a new scheme for the correlation of the Permian. The Kungurian can be retained as the International Standard if two conditions are met. Firstly: by lowering the lower boundary of the Kungurian stage in the stratotype area to the base of the *Neostreptognathodus pnevi* Zone. Secondly: the precise drawing of this boundary in the Northern Urals section, composed of normal marine deposites. The Kubergandinian ammonoid assemblage of the Crimea differs from the Wordian assemblage of the Sosio Formation in the absence of *Waagenoceras*, as well as of *Hyattoceras, Doryceras, Clinolobus, Aristoceratoides, Hoffmania* and some other genera. These data confirm the assumption of Miklukho-Maklai, Grunt and Dmitriev concerning the Kubergandinian (or Roadian) age of the *Neoschwagerina simplex* Zone.

5. Pronina (1996) proposed to distinguish two subgenera of *Sphairionia*: *Sphairionia* and *Pseudosphairionia* n.subgen. Its significance for the wide world correlations was examined. The short time interval and also the finds of *Sphairionia* together with Early Midian fusulinids allow to consider this genus as a marker for the Lower Midian. New species of *Sphairionia*

(*Pseudoshairionia*) from the Lower Midian (Arpa Formation) of Trans-caucasia have been described.

6. According to Y.D. Zakharov a typical representative of the Late Changxingian pseudotirolitid ammonoids (*Dushanoceras* n.sp.) with distinct suture line has been discovered during the North Caucasian field excursion (Psebai Meeting, July 1997) in the upper part of the Urushten Formation (argillaceous facies) of North Caucasus. It was found at the level characterized by *Claraia caucasica* Kulikov and *Xenodiscus koczyrkeviczi* Zakharov (dominant) which he previously considered to be Midian.

7. Kozur et al. (1994/95) described a conodont fauna that was found in the *Otoceras* beds of the Verkhoyansk region (Setorym River), NE Siberia. The typical representatives of the *Otoceras boreale* Spath are restricted here from interval from 0.7 to 17.5-?19.5 m above the base of the Nekuchan Formation (Zakharov, 1996). The latter overlies the Imtachan Formation with Upper Permian *Kolymya* sp. and plant remains (*Noeggerathiopsis* and *Equisetites*). The stratigraphical interval for the ammonoids identified by Y.V. Arkhipov, A.S. Dagys and S.P. Ermakova as *Otoceras concavum* Tozer seems to be significantly more limited: 0.7-7.2 m in Zakharov's (1996) data, to 12.0 m in Dagys and Ermakova's (1996) data, but coincides with the lower part of the interval mentioned above. For this reason, Zakharov (1996) regarded the lower part of the *Otoceras* beds in the Verkhoyansk region (mudstone member 1, 7.2 m thick) as basal *Otoceras boreale* Zone. The Zone of *Otoceras concavum* proposed for the lowermost part of the Nekuchan Formation, seems in his oppinion to be invalid for the Siberian section, if we want to use the *Otoceras* boreale Zone. 5 m above the base of the Nekuchan Formation both forms of *Otoceras* are abundant. A recent revision of Zakharov's collection shows, that in this level also very large *Tomponautilus setorymi* Sobolev (rare), *Tompohiceras pascoei* (Spath) and "*Claraia*" sp. are present. From this same level a conodont fauna with *Hindeodus typicalis* and *Clarkina* cf. *changxingensis* (Kozur et al., 1994/95) has been found; 7.2 m above the base of the Nekuchan Formation (the top of the mudstone member 1) *Aldanoceras* sp. (= "*Ophiceras*" sp.) was found in association with *Otoceras boreale*. Beginning from this level any *concavum*-formed *Otoceras* seem to be absent in described section. The next lithological unit (mudstone member 2) is 11 m thick, with a 0.95m thick sandstone bed at the base, is characterized by association of *Otoceras boreale* Spath (rare), *Tompohiceras pascoei* (Spath), *T. morpheous* (Popov) and *Aldanoceras* sp. The overlying mudstone member is 3.5 m thick, with a 0.5m thick sandstone at the base and yields *Tompophiceras pascoei* (Spath) (rare) in its lower part. A single *Otoceras boreale* shell was found by Zakharov in member 3 in a block near the bed located 2 m above the base of the member 3. The upper part of the member 3 is 3 m thick and characterized by the association of *Tompophiceras pascoei* (Spath) and *T. morpheous* (Popov), however, *Otoceras* is completely absent. Mudstone member 4 is 19 m thick and starts with a 0.15m thick sandstone bed at the base. This member yields abundant *T. morpheous* (Popov), associated with *T. pascoei* (Spath) (rare), *T. gracile* (Spath), *Aldanoceras* sp. and the bivalve *Anodontophora* sp., in the lower part, and *T. pascoei* (Spath) (rare), *T. gerbaensis* (Popov), *Aldanoceras* sp., *Wordieoceras domokhotovi* (Zakharov), *Wordieoceras* sp. indet., *Tomponautilus setorymi* Sobolev and *Anodontophora* sp., in the upper part; *Ophiceras transitorium* (Spath) (Dagys and Ermakova, 1996) was apparently found in the upper part of the member 4, although there is some problem in correlation (every worker has original point of view on the thickness of the lower Nekuchan Formation needed in reconstruction). The upper part of the Nekuchan Formation in Setorym section (sandstone and siltstone) is characterized by extremely rare fossils (*Tomponautilus setorymi* and *Tompophiceras morpheous* within 1.5 m of the base). In H. Kozur's original version, conodont assemblage of the lower *Otoceras* beds in Verkhoyansk region is rather a Permian fauna, but not a specific one; in his last version, it is a typical Late Changxingian association. By this, the conodont data of Greenland have been fully confirmed for the lower *O. boreale* Zone. In A. Dagys and S. Ermakova's (1996) opinion, the *Tompohiceras morpheous* Zone (=member 4, in Zakharov's sence) which is marked by the first appearance of the genus *Ophiceras* may be correlated with the

Lower Induan *Ophiceras commune* Zone of Arctic Canada and Greenland. Noteworthy is the close similarity of the Siberian *Aldanoceras* to the form from the base of the Induan in Transcaucasia identified as *Ophiceras* (*Lytophiceras*) *medium* Griesbach. Because the first *Aldanoceras* specimens were discovered in the upper *Otoceras boreale* Zone of the Setorym river section, it is possible to speculate that at least this part of the section in the Verkhoyansk region is Lower Induan.

8. Wang Cheng-yuan et al. (1996) reported on new data on the P/T of South China.

9. Zakharov et al. (1997a,b) published $\delta^{18}O$ and $\delta^{13}C$ values of organogenic carbonates from the Upper Carboniferous, Permian, Triassic, Jurassic and Cretaceous from different regions of Eurasia in order to provide isotopic data for comparisons of major changes in oceanic regimes of the Tethys and the Boreal basin. There are reasons to believe that the low index of $\delta^{18}O$ in the ammonoid shells from the Lower and Middle Triassic of Arctic Siberia (Buur, Mengilyakh and Taimyr), which almost entirely (± 98%) consist of original aragonitic material, was caused by recurrent fresh-water influence in that part of the Boreal realm. The lower $\delta^{13}C$ values in aragonitic ammonoid shells from the Gzhelian of Sakmara River in South Urals (from -2.2 to -0.5‰), the Lower Olenekian of Buur River (from -1.0 to -0.5‰), the Upper Olenekian of Mengilyakh Creek, the Olenek River (from -4.6 to -2.4‰), the Middle Anisian (-5.2‰) and Upper Anisian (from -3.3 to -1.4‰) of Taimyr seem to correlate with the significant reduction in the biological productivity in the Boreal realm (as compared with productivity in the Tethys) during the Late Carboniferous and Early-Middle Triassic, just after the mass extinction.

10. For the first time, Triassic deposits of the NW Caucasus were subdivided into ten ammonoid beds: (1) *Owenites-Dieneroceras* - Lower Triassic, (2) *Stenopopanoceras* - Lower Anisian, (3) *Laboceras-Megaphyllites*, (4) *Isculites*, (5) *Phyllocladiscites-Neocomedites*, (6) *Ptychites-Flexoptychites* - Middle Anisian, (7) *Bugunzhites-Parasturia* - Upper Ladinian, (8) *Proarcestes-Phloioceras* - Lower Carnian, (9) *Goniojuvavites-Pararcestes* - Upper Carnian, and (10) *Placites-Rhacjphyllites* - Upper Rhaetian by Shevyrev (1995, 1996) who described 78 species (28 new ones) and 58 genera (7 new ones).

11. Zakharov (1996b) proposed the section located in the ravine ±1.6 km NE of the Tree Kamnya Cape in South Primorye as a candidate of global stratotype section and point of the Induan-Olenekian boundary. A detailed description of the section was made. The base of the Olenekian in this section is marked by the first appearance of *Hedenstroemia bosphorensis* (Zakharov); apart from the zonal index, *Gyronites* aff. *planissimus* Spath and *Ambites* sp. indet. are restricted to these beds at Ussuri Gulf. *Flemingites* and *Euflemingites* were found somewhat higher (in association with *Meekoceras*, *Paranannites*, *Anakashmirites*, etc.) which permits a correlation of the *Hedenstroemia bosphorensis* Zone in the Primorye region with the *Flemingites flemingianus* Zone in Salt Range and Madagascar, and the *Meekoceras gracilitatis* Zone in North America; the upper part of the zone apparently corresponds to the *Euflemingites romundary* Zone in Arctic Canada. Zakharov (1997) also reviewed the recent data on the Induan, Olenekian and Anisian ammonoid taxa and zonal assemblages of South Primorye.

12. The age of the radiolarian and conodont bearing terrigenous Vlamburos Formation of the Cyprus was determined by Bragin and Krylov (1996) as late Carnian-Norian.

13. Original data on paleontological characteristic of Triassic limestone blocks from the Alma and Salgir Rivers basins in Crimea were given by Kotlyar, Vuks, Pronina, Zakharov and Baud (Pronina and Vuks, 1996; Kotlyar, Vuks, Pronina, Zakharov, and Baud, in press). Rich foraminifer and brachiopod associations has been faund in the limestone blocks within Jurassic Eskiorda Formation; a single ammonoid shell (*Megaphyllites* sp.) was discovered only in the largest block of pink

limestone located at Izvestnyakovy Creek (Alma River basin). A study of exotic Triassic limestone blocks shows that most of them, including the largest one, are Rhaetian in age.

14. The Taukha terrane is a component of the Sikhote-Alin accretionary system in the Russian Far East and forms its southeastern part. The tectonic enclosures of Taukha prism are represented by allochtons, which are Late Devonian-Late Triassic reef-forming limestones associated with high-titanium alkaline basalts (fragment of paleoguyots), cherty and cherty-terrigenous formations of Permian and Triassic-Late Jurassic age, tholeiitic basalts associated with the Late Jurassic cherty formations, relatively deep-sea flysch deposits of the Late Permian age and Middle-Late Triassic sandstones interbedding with siltstones. New radiolarian biostratigraphic studies on Triassic-Jurassic chert in the Sokolchi area (Kametaka, Kojima and Kemkin, in press) indicate that the upper part of the chert sequence in the Taukha terrane is Middle Triassic to Middle Jurassic in age. The siliceous shale that forms the transition from cherty to clastic rock in this region yields Upper Jurassic (Tithonian) radiolarians. Therefore the chert accumulation ceased in Late Jurassic time (Kemkin, Rudenko and Taketani, in press). Early Cretaceous (Berriasian-Valanginian) radiolarians were recently discovered in an olistostrome matrix in the Rudnaya River basin. The chert-clastic rock unit formed accretionary complexes in early Cretaceous time, together with the melange-turbidite and shallow marine clastic rock units of the Taukha terrane. The general features of the accretionary complexes of the Taukha terrane are very similar to those of the accretionary complexes in Japan (Kametaka, Kojima and Kemkin, in press).

15. Volokhin et al. (1996) demonstrated that the carbonate-chert facies of the Triassic chert formation is widespread in northern Sikhote-Alin as a band of ± 400 km along the strike of the bolded belt. In the Khor River basin it includes siliceous shale and argillite at the bottom and bedded chert at the top of the Anisian, in the Ladinian bedded chert with dolostone and limestone intercalations, in the Upper Carnian-Norian limestone unit and Rhaetian bedded chert dated with conodonts. There is an early Carnian hiatus in continuous carbonate-chert macrocyclotheme in the Khor region. Rates of silica accumulation in Khor area were: during the Anisian - 4.0-4.4, and during the Ladinian - 2.2-2.6 g/cm^2 per 1000 ys.

16. Clastic rocks occur rarely in the Triassic bedded chert of the Mino terrane, Central Japan, and the Samarka terrane, Sikhote-Alin; according to Kojima et al. (in press) they mainly consist of silt- to granule-sized fragments of basaltic(?) volcanic rocks, altered volcanic glass, chert, siliceous shale and radiolarian remains, with minor amounts of polycrystalline quarts, plagioclase, lutecite and glauconite(?). Microfossils are concentrated in some clastic rocks. Ages of the clastic rocks range from late Anisian to early Carnian based on radiolarian and conodont fossils. The clastic material was most probably derived from the basaltic volcanic edifices such as oceanic island/plateau and immature volcanic arc, and were trans-ported by turbidity currents.

17. New data on Early Jurassic radiolarians from cherty allochtons of the Samarka accretionary prism (Sikhote-Alin) and Mid Jurassic radiolarians from turbidite matrix have been made available by Kemkin and Golozubov (1966).

18. According Kemkin, Palandzhan and Chekhov's data, the costal ophiolite belt of the Taigonos Peninsula (NE Asia) is the extreme SW part of the regional Pen-zhinsky-Peculneisky ophiolite belt, in which fragments of the Early Cretaceous accretionary prism are exposed. Allochtonous assemblages of the prism consist of of ultramafites, serpentinites, meta-morphic and siliceous-volcanogenic rocks forming a series of tectonic sheets and slices in the serpentinite matrix. Middle and Late Jurassic radiolarians were found in the siliceous-volcanogenic assemblages.

Meeting

The local joint meeting of the Peri-Tethys Project and IGCP Project 359 (eight participants from St. Petersburg, Vladivostok, Krasnodar, Maikop, Gelenzhik and USA) was held in Psebai, 7-17 July, with field trips to the Nikitin and Severnaya ravines, the M. Laba river basin (Nikitin and Urushten Formations, Dorashamian limestone and argillite), the Rufabgo Ravine, the Belaya River basin (Upper Yatyrgvarta Formation, Olenekian limestone), Svinyachy and Mamryuk Creeks, the Sakhrai River basin (Yatyrgvarta Formation, Induan conglomerate, sandstone and limestone and Olenekian limestone and argillite), the Kapustin Ravine, the M. Laba River basin (Yatyrgvarta Formation, Induan *Claraia* beds, limestone and argilite, and Olenekian limestone; Malotkhach Formation of the Tkhach Series, Lower Anisian limestone; Acheshbok Formation of the Tkhach Series, Middle Anisian argillite and limestone; Lower Babuk formation of the Sakhrai Series, Lower Carnian conglomerate and limestone), the Kamennomostsky Canyon, the Belaya River (Gerbegen Formation, Kimmeridgian limestone), the Polkovnichya Ravine, the Belaya River basin, and the Abadzekh Bridge, Belaya River (Aphib Formation, Lower Aptian argilite). The meeting was organized by Dr. G.V. Kotlyar and Dr. A. Baud. The discussion will be continued at the Bangkok Meeting (19-24 August 1997).

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Further references to this report are to be found in the list of publications of IGCP 359 (pp. 11-12 of this issue)

INDUAN-OLENEKIAN BOUNDARY WORKING GROUP

Newsletter No.1 **June 1997**

Dear colleague,

If you would like communicate with any other persons involved in our Induan-Olenekian Boundary Working Group (IOBWG), below you find are their e-mail and fax addresses. We are very interested to receive brief information on your work on this topic, recommendations (if you have any), or your short programme for next two years (deadline for submission is about 1 September of every year). Many thanks in advance. We invite you to discuss some problems on the Induan-Olenekian boundary in Albertiana and hope to have a possibility to publish a special volume on this topic in Mém. Géol. (Lausanne) in feature, if it would be necessary.

All good wishes,

Yuri Zakharov (e-mail: fegi@online.marine.su) & Aymon Baud (e-mail: Aymon. Baud@sst.unil.ch)

List of members of the IOBWG (up to June 1997)

1. Arkhipov, Yuri V., Russia (Moscow), home phone: 8(095)205-11-74; (w. phone): 8(095)179-56-37
2. Baud, Aymon [Vice-Chairman of the IOBWG], Switzerland (Lausanne); E-mail: Aymon.Baud@sst.unil.ch; Fax: 0041 21 692 4475
3. Buryi, Galina I., Russia (Vladivostok); E-mail: fegi@online.marine.su; Fax: 7(4232)317847
4. Dagys, Algirdas S., Lithuanian (Vilnius); Fax: 72-92-57.
5. Dobruskina, Inna A., Israel (Jerusalem); E-mail: innadob@vms.huji.ac.il
6. Ehiro, Masayuki, Japan (Sendai); E-mail: nagahama@ganko.tohoku.ac.jp
7. Guex, Jean, Switzerland (Lausanne); E-mail: jean.guex@igp.unil.ch
8. Hirsch, Francis, Israel (Jerusalem); E-mail: hirsch@mail.gsi.gov.il
9. Hounslow, Mark, Britain (Norwich); E-mail: m.hounslow@uea.ac.uk; Fax: +441603507719
10. Kukhtinov Dmitrij A., Russia (Saratov); postmaster@scnit.saratov.su
11. Kurushin, Nivolai I., Russia (Novosibirsk); E-mail: shurygin@uiggm.nsc.ru
12. Lozovsky, Vladlen R., Russia (Moscow).
13. Lucas, Spencer, USA (Albuquerque); E-mail: lucas@darwin.nmmnh-abq.mus.nm.us; Fax: 505-841-2866
14. Marcoux, Jean, France (Paris); E-mail: marcoux@ipgp.jussieu.fr
15. Ochev, Vitali G., Russia (Saratov); E-mail: postmaster@scnit.saratov.su
16. Okuneva, Tamara M., Russia (S.-Petersburg); E-mail: vsg@sovam.com Fax: (812) 2135738
17. Orchard, Mike, Canada (Vancouver); E-mail: morchard@gsc.nrcan.gc.ca; Fax: 604-666-1124
18. Paull, Rachel K., USA (Milwaukee); E-mail: rpaull@csd.uwm.edu; Fax: (414)229-5452
19. Popov, Alexander M., Russia (Vladivostok); E-mail: fegi@online.marine.su; Fax: 7(4232)317847
20. Rudenko, Valeria S., Russia (Vladivostok); E-mail: fegi@online.marine.su; Fax: 7(4232)317847
21. Silberling, Norm J., USA (Denver); E-mail: slbrlng@msn.com
22. Shishkin, Michael A., Russia (Moscow); E-mail: vnikit@paleo.msk.su
23. Sobolev, Eugene S., Russia (Novosibirsk); E-mail: alfalfa@cgi.nsk.su
24. Tozer, E.T., Canada (Vancouver); E-mail: ttozer@gsc.NRCan. gc.ca
25. Vuks, Valeri J., Russia (S.-Petersburg); E-mail: vsg@sovam.com; Fax (812)2135738
26. Yin Hongfu, China (Wuhan), E-mail: hfyin@dns.cug.edu.cn; Fax: 086 27 78006 812
27. Zakharov, Yuri D. (Chairman of the IOBWG), Russia (Vladivostok), E-mail: fegi@online.marine.su; Fax: 7 (4232)317847

PERMIAN-TRIASSIC BOUNDARY:

a discussion on *Hindeodus parvus* and the Meishan section

Yin Hongfu

The paper of Dr. Baud (1996) expresses doubt on the choice of *Hindeodus parvus* as the index and the Meishan section for the type-section of Permian-Triassic boundary. The arguments are important because it raises a serious challenge to the recommendation of a joint paper (Yin *et al.*, 1996) primarily aimed to serve as the base for a formal proposal to the PTBWG. Discussions on these arguments will certainly help to clarify the status of this problem. In this paper I would like to list his arguments, followed by my viewpoints as a part of such discussions.

1. About the choice of Hindeodus parvus as the index for the basal Triassic

Argument a. "*H. latidentatus* from bed 25 in the Meishan section (Zhang *et al.*, 1995) is in fact a *parva* morphotype as discussed by Orchard (1996) and by Mei (1996b)". This implies that *parvus* occurs below our suggested P/T boundary.
Discussion to argument a. Both Orchard (1996) and Mei (1996b) did not mention the taxonomic reasons of their comment. This year a meeting was held to discuss this problem. Attendants included Zhang, Mei, Lai (Xulong) and me, and Mei clarified that his comment was based on the lateral view of the specimen published in Zhang et al. (1995), which regretfully did not show the profile of the cusp in basal view. The original specimen of *H. latidentatus* from bed 25 was displayed. After discussion all of us including Mei agreed that this is *H. latidentatus*, not *H. parvus*. The profile of the cusp of *H. latidentatus*, is compressed and thus much narrower than in *H. parvus*, which has a nearly rounded profile. The specimen shows the same character and thus is a *H. latidentatus*.

Argument b. "Wang (1994) noted that 'there is indistinction and confusion' (in recognition of *parvus*), and proposed to split the species (*parvus*) in morphotype I, morphotype II and *postparva*."
Discussion to argument b: Because of its importance, the taxonomic content of *parvus* has been under extensive investigation in recent years, e.g., Sweet (1992), and it is no wonder that some of its occurrences have been questioned, e.g., Schoenlaub (1991, see discussion in Yin et al., 1996a). However, the questions dealt with the identification of the concrete specimens and did not deny the taxonomy of the species, and the general tendency is more and more common recognition of *Hindeodus parvus* as a valid species (including Sweet, see Yin et al., 1996b). Except for Wang (1994) I have yet not found serious questions on its taxonomy. During the Nanjing Meeting on GSSPs (22-23 May, 1997) which both Wang and me attended, I commented in my speech that (1) because the ISC guidelines on GSSP require 'correlation precedes definition', it is better not to use morphotype 1 as the index because its application in worldwide correlation has not been proven, and it is very probable that people can not find morphotype 1 in so many sections as those in which *parvus* has already been found; insisting to use morphotype 1 as the index would ruin the value of both *H. parvus* and its morphotype 1 as indexes, and (2) data of the original horizon of morphotype 1 are contradictory in the text and plate explanation of Wang's 1994 paper: his text mentioned the occurrence of *H. parvus* at his two original specimens of morphotype 1 occur not at but higher (in 882-4 and 884-4), thus not valid as index of P/T boundary. I agree with Dr. Baud that the choice of

a morphotype for the index of the Permian-Triassic boundary will bring more difficulties. In the joint paper of Yin et al. (1996b), authors of various countries agreed to use the whole species as the index.

Argument c: The FAD of *I. parva* in the Shangsi section is above the first ophiceratids and *Claraia*, but below in the Meishan section, and the FAD of *I. parva* in the Selong section is synchronous with the appearance of *Otoceras* latilobatus. As shown by Henderson and Baud (1996), this species appears at the base of the *Ophiceras* zone in Ellesmere Island profiles, about 30 m above the first *Otoceras* and *Claraia*..... We agree with Li et al. (1996) and Mei (1996a) that the FAD of *I. parva* is not synchronous and will only bring confusion in determining the P/T boundary.
Discussion to argument c: Aside from the Shangsi section which will be discussed in following paragraphs, for this discussion one must first determine whether you are taking the so-called *Otoceras-Ophiceras* succession for P/T standard and the so-called '*Claraia*=basal Triassic' concept for granted. New data have shown that some *Otoceras* (e.g. *O. concavum*) may have occurred since Permian (Chinese PTB Working Group, 1993; Yin, 1995), and some *Otoceras* (e.g. *latilabotum, woodwardi, boreale*) and ophiceratids (*O. connectens, Metoophiceras subdemissus)* co-occur at basal Triassic. Some claraiids are latest Permian (Yin, 1985). It would make the problem more confused if we stick to the assumptions that any *Otoceras* or *Claraia* is Triassic, and that *Ophiceras* never co-occurs with *Otoceras* and always overlies the latter. In this respect I see no contradiction if *H. parvus* occurs below ophiceratids but above *Otoceras*? in Meishan (because these ophiceratids belong to *Isarcicella isarcica* Zone, and the *Otoceras*? specimen is Permian), co-occur with *Otoceras latilobatum* in Selong as mentioned by Mei(1996b) (because *O. latilobatum* is basal Triassic), appear at the base of *Ophiceras* Zone in Ellesmere Islands (if it corresponds to basal Triassic *Otoceras boreale* zone) and above *Otoceras* (if it is the Permian *O. concavum*) and *Claraia*.
In the paper of Henderson and Baud (1996), the only text citing *parvus* is as follows: 'Conodonts within the *Otoceras boreale* Zone (22 to 40 meters above base at Otto Fiord south) include *Neogondolella carinata* (common), *N.* sp. cf. *N. planata, N.* sp. cf. *N. taylorae*, and *Hindeodus* sp. cf. *H. parvus* (rare: 2 specimens). This fauna is comparable to conodonts from Selong, Tibet associated with *Otoceras* and from basal Triassic in South China. The bivalve *Claraia* has also been recovered within the *O. boreale* Zone. Either *Otoceras* or *Hindeodus parvus* would represent good indices for the basal Triassic in the Canadian Arctic; although their apparent appearances are not coincident, they do co-occur.' The fact and viewpoint of that paper is different from argument c. Until detail of the Ellesmere Island profile are published, I do not see the FAD of *parvus* at this section conflicts with other sections.
Li *et al.*(1996) mentioned that 'the *Hindeodus parvus* Zone is a range-zone whose lower boundary is not defined (i.e. not defined by the lineage or biotic evolution), and the definition of the P-T boundary pointed by the first appearance of *H. parvus* seems untenable'. Argument of Li *et al.* does not dealt with concrete fact but mainly concern with validity of the lineage, which will be discussed in argument e.
After the above discussions the remaining problem seems to be the conceptual diachroneity of the FAD of I. *parva*. It should be admitted that every single species has its ecological restriction. Dr. Baud is right to claim that the FAD of *H. parvus* (in various sections) may not be synchronous, but so are FADs of all species (in various sections). Let me cite a few sentences from the Guidelines for GSSP (Remane *et al.*, 1996): 'Biostratigraphic boundaries, i.e. the boundaries of the material stratigraphic occurrence of species, are diachronous. This fact has, however, been overstated. A species exists for a finite span of time and is therefore characteristic of a certain geologic interval.' 'Fossil species depend on the environment and are biogeographically limited. An appropriate choice of wide spread species may diminish but never totally eliminate these shortcomings.' 'This means that an occurrence of the primary marker does not automatically determine the boundary. Other markers should therefore be available near the critical level, in order to support chronostratigraphic

rrelation in sections other than the GSSP. If the primary marker is a fossil species, first appearan-
s are generally more reliable than extinction events, especially if the gradual transition between
ɜ marker and its ancestor can be observed.' Following these guidelines it is clear that our aims
ɜ not to deny the role of FAD of an index species in GSSP due to conceptual diachroneity but
ɜtead, 1) to seek for the appropriate, or wide spread, species that can diminish this shortcoming;
to establish the transition, or lineage of the index species (see argument e); 3) to establish other
pporting markers(this has been discussed in Yin, 1995 and will not be discussed here).
ıw to the aim 1), there is little doubt that *H. parvus* are discovered synchronously in much more
ctions than any other conodonts or ammonoids near P/T boundary. In the 13 world-famous P/T
undary sections listed and correlated in Yin et al. (1996), 10 of them have *H. parvus* correlated
the same level. For the rest three sections, lack of *H. parvus* at the two Arctic sections may be
e to lack of investigation because they are based on data of the 1970's when conodont
ɜearches are rare. The only exceptional section is the Shangsi section as mentioned in argument
This apparently is due to facies change or collection failure. On the other hand, how many P/T
undary sections are correlatable by means of other species or assemblages? For *Otoceras boreale*
d *O. woodwardi*, 2 each; for *O. latilabotum* or *concavum* only 1 (the Siberian occurrence of
ncavum has been denied by Zakharov and Dagis). Prospect of ammonoids to become more
dely correlatable than *H. parvus* is faint, because they are much more ecologically restricted.
ıta of neogondolellids near the P/T boundary has already accumulated to such extent that an
aluation of their correlation potentiality should be made immediately. Dr. Baud emphasized this
int in his concluding remarks. If documents of the neogondolellids proves in the future to be more
dely correlatable than *parvus*, I will be happy enough to replace it with them.

gument d: 'I *parva* is a shallow-water form, very sensitive to the palaeoenvironment (Orchard,
ı96)', which implies that it is not suitable for correlation.
scussion to argument d: That *H. parvus* is a shallow water species has been repeatedly mentio-
d, but this assumption does not accord with records of its occurrences, and thus needs careful
-assessment. I will leave the re-assessing discussion to Lai (1997) in this volume, in which
posite view held by quite a number of conodontists are cited, and I only like to add one more
ference (Kozur, 1993) in which *parvus* occurs in the pelagic facies of P/T boundary of Sicily. The
stulation that *H. parvus* 'is a shallow-water species and thus brings more problems than it
ɜolves' has not been proved.

gument e: 'The lineage of *H. latidentatus, Isarcicella parva, I. tugida* and *I. isarcica* receives
vere criticism by experienced conodont specialists.'
scussion to argument e: Following are different opinions on the lineage of *parvus*:
The lineage as above-mentioned (Kozur, 1989, Ding et al., 1996, Yin et al., 1997)
The lineage is *H. latidentatus-H. parvus* Morphotype 1-*I. staeschei-I. isarcica* (Wang, 1996).
Mei (1996b) held that *parvus* evolved from typicalis and thus did not agree the cline from
'*identatus* to *parvus*.
vo points can be derived from the above statements. First, that *I. isarcica* evolved from *H. parvus*
s been generally accepted. Disagreements exist on whether there is an intermediate species and
ıether *tugida* or *staeschei* (*decrescens* in Yin et al., 1996) is the intermediate one. This is of
nor significance in evaluating *parvus* as GSSP marker. I will not go further because a discussion
staeschei has been given by Lai (1997) in this volume.
ɜcond, disagreements exist on which is the direct ancestor of *parvus-typicalis* or *latidentatus*.
i's paper (1997) in this volume discusses the professional part relatively throughly and I will only
ɜe some amateur comments. It seems generally accepted that the morphological affinity(strong
sp, fewer denticles) is stronger between *latidentatus* and *parvus* than between typicalis and
rvus. However, there is doubt on whether *latidentatus* antedates *parvus*, whereas the precedence
typicalis is for certain. The doubt aroused partly from the FAD of *parvus* discussed in argument a

and has been replied. For further discussion it should be noted that the concept in conodont biostratigraphy is based on successive range zonation, i.e., the FAD of the succeeding conodont zonal species automatically culminates the zonal range of the preceding conodont zone, regardless of whether the preceding zonal species survived into or even above the next zone. Thus, occurrence of preceding zonal species together with or even above next zonal species does not pose problem, as long as its FAD predates FAD of the next. This may explain the cases of *latidentatus* and *parvus* in Spiti as indicated by Baud (1996). The immediate precedence of *latidentatus* to *parvus* has been demonstrated in Meishan, Dorasham and Gartnerkofel, so I prefer the cline from *latidentatus* to *parvus*. If we change mind and agree to apply the cline from *typicalis* to *parvus*, it does not change the status of *parvus* very much, because in most sections *typicalis* can be found immediately anteceding *parvus*, as *latidentatus* does (Yin et al., 1996). In both cases the requirement of Guideline: 'first appearances are generally more reliable than extinction events, especially if the gradual transition between the marker and its ancestor can be observed' is fulfilled. However, in view of different opinions I will leave this argument on *parvus* lineage as an open question.

2. About the choice of the Meishan section for the GSSP.

Argument f: Meishan 'is one of the most condensed sections among the candidates for the GSSP.' 'According to the guidelines of the ICS for the GSSP, a stratigraphic condensation does not satisfy the geological requirements and numerous facies changes in the critical interval of a boundary are in contradiction with the biostratigraphical requirement for a GSSP.'

Discussion to argument f: The Guidelines (Remane et al., 1996) indicates concerned requirements in Term 4.1.2. 'Continuous sedimentation: no gaps, no condensation in proximity of the boundary level.' and in Term 4.1.3. 'The rate of sedimentation should be sufficient that successive events can be easily separated.' There are two alternative interpretations for the word 'condensation': 1) 'condensation' means long-term, thin deposits with very slow sedimentary rate, or 2) 'condensation' means integration and condensation of a few fossil zones (or other zones) into one single horizon. In the above-mentioned Term 4.1.2. of Guidelines, the word `condensation' is reciprocal to the word 'gap', and there is the Term 4.1.3. dealing with sedimentary rate, so it is clear that in Term 4.1.2. 'condensation' takes the interpretation 2) and leave requirement of sedimentary rate to Term 4.1.3, which cites that it 'should be sufficient that successive events can be easily separated.' The Meishan section indeed has very thin deposits near the boundary, although not so many 'important facies changes' as stressed by Dr. Baud. However, it displays so far the most complete fossil and event zonation as documented in Yin (1996). The only exception, doubtful existence of *Otoceras?* at Meishan, can be compensated by a synchronous ammonoid fauna (Yang et al., 1996) and conodont fauna of the same horizon. It is to Meishan that Arctic Canadian zonations are correlated, not *vice versa*. As indicated in the Guidelines, it is the sufficiency of event separation (and recognition), not the absolute value of rate that is essential for the sedimentary rate. The biotic, sequence stratigraphic, magnetic, geochemic, radioisotopic, anoxic, volcanic and other events have been separated and documented in Yin (1996). Readers are welcome to compare it with other relatively well-documented sections such as Tesero, Gartnerkofel and Guryul Ravine and make their own judgements.

It should also be noticed that the Arctic Canadian deposition of that interval is very rapid compared to Tethys and even Siberia, and it is in accord with its lithology. That the P/T boundary strata of Meishan is a few tens times thinner than Arctic Canada does not necessarily mean it is extremely slow in absolute rate. Whether sedimentary rate is very low in Meishan is still controversial (Lai et al., 1996, on one side; Chai et al., 1992, on the other side). The saltationism (Yin et al., 1989) holds that events of major significance do not distribute evenly in time, but instead gather around the turnovers in geological history. In palaeontology it is the puntuated equilibrium and in sociology it is revolution. Near the turnovers and punctuations crises accumulated to such an extent that the

first ignition may touch off a string of time bombs. Therefore, occurrence of many events and fossil zones in thin but critical stratum, as is the case of P/T boundary sections in the Himalayas and South China, does not necessarily mean that the stratum spanned over extraordinary long time and is condensed, but rather means that events occur at short interval. Conclusion of sedimentary condensation at Meishan is not proved and needs further investigation.

Argument g: `The choice of I. *parva* brings more problems than it resolves.' 'The Meishan section does not satisfy the geological requirements nor the biostratigraphical requirements for a GSSP.' 'A candidate section has to be found either in the Himalayas. or in the (Canadian) Arctic islands'.
Discussion to argument g: The majority of PTBWG members agree that the choice of *H. parvus* has solved many problems which the previous marker *Otoceras* can not solve. It would be unfair not to point out the shortcomings of *Otoceras*, but only to blame *parvus* for its imperfectness, and jump over to other fossils whose prospect is not yet clear. The same criteria should be impartially applied to all candidate sections, for example, the Himalayan P/T boundary strata are as thin as Meishan if one takes thinness as a criteria, and if talking of GSSP requirements, the Arctic sections does not meet the requirement cited in Term 4.4.2. of ISC Guidelines: 'Candidate sections in remote regions which can only be visited by organizing costly expeditions should normally be excluded from the selection.'

The majority approval of Meishan and *parvus* has been demonstrated by previous replies to questionaires and opinions expressed in workshops. After the Dalongkou event, some colleagues both at home and abroad commented that I should have taken a vote earlier, thus we could have avoided the negative influence of the event. However, I believed that unbiased choice of GSSP should be based only by scientific evaluation and thus postponed the ballot in view of objections from minority. These past facts show that many PTBWG members have been anxious to see a solution of this long-existing (17 years) problem, although there are also people who do not wish to `press a vote'. I really have not 'pressed' a vote. However, Dr. Baud's criticisms will give an impetus to improve the search for a better GSSP, including Meishan. One of our important tasks is to quickly give a comprehensive evaluation on the neogondolellid group, and to publish more documents on the Himalayas and Arctic Canada, the biostratigraphy and other related researches of which, frankly speaking, are not up to the requirements of a GSSP. In my opinion, the joint proposal (Yin et al., 1996b) is still the best solution up to now. It is too early to say that '*parvus* brings more problems than it resolves' and that `Meishan does not meet the requirements of GSSP'.

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Comments, reactions or contributions to ALBERTIANA?
Send it to the editor!
Hans Kerp, WWU - Abt. Paläobotanik
Hindenburgplatz 57-59, D - 48143 Münster, Germany
Note the new telephone and fax numbers !!!
Tel. +49-251-832 3966; Fax: +49-251-832 4831
E-mail: kerp@uni-muenster.de
http://www.uni-muenster.de/GeoPalaentologie/Palaeo/Palbot/ebot.html

A DISCUSSION ON PERMIAN-TRIASSIC CONODONT STUDIES

Lai Xulong

Introduction

Since Yin et al. (1988) proposed the first appearance of *Hindeodus parvus* as a marker of the basal Triassic, the study of the conodont faunas across the P/T boundary became more and more important. In recent three years, successive presentations about conodont diagnosis, zonation, clines and biofacies near the P/T transitional period have been published. Besides some agreements, there are still some disagreements on P/T conodont studies. This paper mainly deals with some problems of conodont nomination, lineage and biofacies. It is hoped that conodont workers can reach an agreement after a further study of these problems. It is very important for understanding the P/T boundary and the establishment of the Global Stratotye Section and Point (GSSP) of the Permian-Triassic Boundary (PTB).

1. Regulation of establishing a new conodont species or subspecies

Sometimes we can hear complaints from non-conodont palaeontologists and even conodont workers who are not specialized on the Permian-Triassic that there are too many species and subspecies in P/T conodonts. Actually, it is a natural result of intensive study on conodont for this interval. However, it is very important for the P/T conodont workers how to appropriately distinguish the interspecific and intraspecific variations of different conodont taxa. Otherwise, too many new conodont species and subspecies will bring more problems than they resolve. Some commonly accepted rules for establishing a new conodont species near the P/T boundary are needed. Besides stable minor morphological changes, a clear distribution range, enough material and the regional or worldwide correlation of a newly established species or subspecies should be emphasised. Morphologically, e.g., *Isarcicella isarcica* (Huckriede,1958) has the following morphotypes based on denticle numbers and denticle distribution: (a) one denticle on one side, (b) two denticles on one side, (c) three denticles on one side, (d) more than three denticles on one side, (e) one denticle on each side, (f) one denticle on one side and two denticles on the other side, (g) one denticle on one side and three denticles on the other side, (h)one denticle on one side and a denticle series with more than three denticles on the other side, (i) two denticles on each side, (j) two denticles on one side, three denticles on the other side etc.. If we only consider the minor morphological changes of the conodont specimens, there would be more than 10 species within the genus *Isarcicella*. Moreover, if these so-called new species are without a definite distribution, enough materials and correlatable characters, this may evoke confusion on the P/T boundary study.

Mei (1996), Zhu (1996) and Kozur (1996) have proposed many new species or subspecies of *Clarkina* (*Neogondolella*) and *Hindeodus* (*Isarcicella*). Some of these new species or subspecies need to be re-assessed based on the above-mentioned regulations.

2. *Isarcicella staeschei* is it a valid species?

The holotype of *Isarcicella isarcica* has one denticle on each side of the carina (Huckriede, 1958). According to Staesche (1964), *Spathognathodus isarcicus* (*Isarcicella isarcica*) included three morphotypes. Morphotype 1(M1) is the laterally adenticulate element which was later ascribed to

the new species *Anchignathodus parvus* (*Hindeodus parvus*) by Kozur and Pjatakova (1976). Morphotype 2 (M2) is the element with one denticle or a denticle series on one side of the carina. Morphotype 3 (M3) is the element with one denticle or a denticle series on both sides. Dai and Zhang established a new species *Isarcicella staeschei* for M2 (in Li et al., 1989), which received few response from the conodont specialists. Perri (1991, including M2 and M3), Tian (1993a,b, both M2 and M3), Orchard et al. (1994, only M2), Lai et al. (1995, only M2), Zhang et al. (1995, only M2) still use the *Isarcicella isarcica* for the Morphotype 2 element.

Wang (1996) listed several reasons (a-h) to verify that *Isarcicella staeschei* (M2) (the species name was wrongly spelled as *staescheri* in Wang's paper) appears much earlier than *Isarcicella isarcica* (M3) and *Isarcicella staeschei* is valid.

In the Heping section, Luodian County (Wang, 1996), the Selong section (Orchard et al., 1994) and the Guryul Ravine section (Matsuda, 1981), so far only M2 elements were reported. The M2 element does not associate with M3 element. It is impossible to determine which morphotype appears earlier in these sections.

Perri (1991) documented many *Isarcicella* specimens from the Werfen Formation, Southern Alps, Italy. These *Isarcicella isarcica* specimens were collected from two sections, the Bulla section and the Tesero section. In the Bulla section, M2 and M3 only co-occur at the same horizon - Bed BU27. The M2 and M3 elements were found in the same horizon - Bed 33 in the Shangsi section (Li et al. 1989, p. 11). In the Yangou section of Leping County, the M2 and M3 element also occur in the same bed (bed 15) (Wang, 1996). It is difficult to deternine which *Isarcicella isarcica* morphotype appears earlier in these sections. The sequence of *I. staeschei- I. isarcica* (Wang, 1996) does not exist in the Shangsi section.

On the other hand, some data suggest that M2 occurs earlier than the M3 element . The material from the Tesero section, Italy show that the M2 appears earlier than the M3 element (Perri, 1991). The M2 element first occurs in bed TS19(1) and TS25 (3), and co-occurs with M3 late in bed TS26. In the Xiaoba section, Anxian County, Sichuan Province, China, the M2 element appears much earlier than the M3 element (Li et al., 1989). The M2 element itself occurs in Bed 21 and 22, co-occurs with M3 in bed26, while M3 independently extends to bed 27. In the Meishan section, one M2 specimen has been reported from Bed 28, section A (Lai et al., 1995; Zhang et al., 1995), and one M3 specimen was recently found in Bed 29, Section D (Yang, 1997).

So far, there is no evidence for proposing that the M3 element appears earlier than the M2 element of *Isarcicella isarcica*. Nevertheless, these two morphotypes are separately preserved in many intensively studied P/T boundary sections such as the Xishan section of Selong, the Guryul Ravine section of Kashmir, and the Heping section of Ludian. It is difficult to recognize the relationship between *I.isarcica*(M3) and *I. staeschei*(M2) in the above mentioned sections. Hence, we prefer that *Isarcicella staeschei* is a synonym of *Isarcicella isarcica* until more fossil evidence is presented, and the minor morphological differences between them can be considered as intraspecific variability.

3. The *Hindeodus Isarcicella* cline

Kozur (1989, p. 390) first proposed the phylomorphogenetic line of *Hindeodus typicalis-H. latidentadus-H. turgidus-Isarcicella isarcica*. Ding et al. (1996) established the same lineage of *H. latidentadus - H. parvus- Isarcicella turgida (H. turgidus)- I. isarcica* in Meishan. Wang (1996) mistook this lineage as proposed by Lai et al. (1995) and Zhang et al. (1995). Actually, there is no paragraph or sentence dealing with this lineage in these two papers.

In the last two years, different opinions on this lineage were published (Mei, 1996; Baud, 1996; Wang, 1996). Wang (1996) suggested a *H. latidentatus-H. parvus* M1-*I. staeschei-I. isarcica* lineage instead of *latidentatus-parvus-turgida-isarcica*. To support his viewpoint, he emphasized that Lai et al. (1995) and Zhang et al. (1995) [actually Ding et al. (1996)] did not document *Isarcicella turgida* between the *parvus* zone and *isarcica* zone in the Meishan sections. However, Ding et al. (1996) based *I. turgida* on Wang's data, because Wang reported *Hindeodus turgidus* (*Isarcicella turgida*) from Bed 882-3 (sesus Bed 27c) at Meishan section (Wang, 1994, Plate 1, fig. 6-8). In the illustration of Ding et al. (1996), they explicitely indicated that their *I. turgida* data from Meishan are according to Wang (1994). Later, Wang (1996) gave different data stating that "according to the identification of Wang (1994, 1995), and Kozur et Wang (1995), *Hindeodus turgidus* (*I. turgida*) first occurs in bed 29". Because of the contradictory statements in Wang (1994) and Wang (1996) the exact position of the first occurrence of *Isarcicella turgida* in Meishan still needs to be settled. Baud (1996) strongly expressed his opposition to the *latidentatus-isarcica* lineage of Ding et al. (1996). He cited "Both Orchard (in Krystyn & Orchard, 1996) and Mei (1996d) do not agree with the supposed cline from *H. latidentatus to I. isarcica* (p.7)". However, except that Mei (1996) disagreed that *Hindedus latidentatus- Hindeodus parvus* cline, Krystyn & Orchard (1996) in fact did not deal with this lineage.

Tian (1993a) and Mei (1996) considered that *H. parvus* evolved from *H. typicalis*. Kozur (1989, 1995), Ding et al. (1996) and Wang (1996) prefered that *H. parvus* evolved from *H. latidentatus*. Morphologically, *latidentatus* is closer to *parvus* than to *typicalis*. Stratigraphically, the first appearance of *latidentatus* is lower than that of *parvus*, and these two species can co-occur in the basal Triassic *parvus* zone. In Meishan, *latidentatus* occurs i n bed 25 (white clay) near the top of the Upper Permian (section B: Lai et al., 1995; Zhang et al.,1995) and co-occurs with *parvus* at bed 27c (Wang, 1995). In NW Iran (Kozur et al., 1975), Dorasham (Kozur, 1980), Armenia (Kotlyar et al., 1993), Austria (Schönlaub, 1991), the same conclusion can be reached. Orchard (1996) suggested that *H. latidentatus* from bed 25 at Meishan in Zhang et al. (1995) showed closer affinity to *Isarcicella parva* (*H. parvus*) than to *H. latidentatus*. Mei (1996) also considered it much more similar to *Hindeodus parvus*. Ding et al. (1997, in press) insist on the specimen close to *H. latidentatus* with some explanation. Kozur (1996, p. 92) regarded this specimen as a *H. latidentatus* sensu stricto. Apart from this disagreement, we should admit that first occurrence of *latidentatus* is lower than that of *parvus* by worldwide data. Baud (1996) claimed that "Orchard (in Krystyn & Orchard, 1996) found *H. latidentatus* emend. above the *I. parva* FAD and co-occuring with this species in the Spiti area" for supporting his opposition to the cline *latidentatus-parvus* of Ding et al. (1996). This argument is not satisfying. That *Hindeodus latidentatus* co-occurs with *H. parvus* is a common phenomenon, but it does not influence the cline *latidentatus-parvus* which is based on the fact that *latidentatus* appears earlier than *parvus*. Actually, in fig 5.3 of Ding et al. (1996), the authors clearly show that *latidentatus* distribution ranges much higher than the FAD of *H. parvus*.

That *Isarcicella isarcica* evolved from *I. parva* (*H. parvus*) becomes a common idea (Kozur, 1989, 1995; Tian, 1993a; Wang and Cao,1993; Wang, 1996; Ding et al., 1996). The main discrepancy is whether there existed a transitional form between *parvus* and *isarcica*, and what is the intermediate form.

Tian (1993a) and Wang et al. (1993) considered that *isarcica* directly evolved from *parvus*. Kozur (1989, 1995) and Ding et al. (1996) supposed that *Isarcicella turgida* (*H. turgidus*) is the transitional form between *parvus* and *isarcica*. Morphologically, *I. turgida* has a transverse ridge on the sides of its upper surface, so it is acceptable that it evolved to laterally denticulate *isarcica*. Stratigraphically, *I. turgida* occurs earlier than *parvus* in Hambast C, Abadeh (Iranian-Japanese Research Group, 1981), NW Iran (Kozur et al., 1975) and Gartnerkofel (Holser et al., 1991). These data support that *I. turgida* evolved from *H. parvus*.

On other hand, *turgida* occurs earlier than *parvus* in Shangsi (Li et al., 1989, Lai et al., 1996). Even in Meishan, the first appearance of *H. parvus* (Zhang , 1987; Wang ,1994,1995; Yang, 1997) and that of *I. turgida* (Wang, 1994) located at the same horizon bed 27c (sesus 882-3). It is difficult to confirm *I. turgida* evolved from *H. parvus* in Shangsi and Meishan. Therefore, the main problem of the cline *parvus-turgida-isarcica* is the relative stratigraphical range between *parvus* and *turgida*.

Wang (1996) proposed *I. staeschei* instead of *I. turgida* as the intermediate form between *parvus* and *isarcica*. In fact, Tian (1993a) displayed the same cline of *parvus-staeschei-isarcica* in his figure 9 (p.184), but he attributed the specimen of *Isarcicella* (M2) with two denticulates on one side to *I. isarcica*. Morphologically, that *I. staeschei* (*I. isarcica* M2) evolved to *I. isarcica* (*I. isarcica* M3) can be accepted. Stratigraphically, the data from Tesero (Perri, 1991), Xiaoba of Anxian (Li et al., 1989) and Meishan (Lai et al. 1995; Yang 1997) also support this lineage. As mentioned above, the main problem of this cline is that we need more intensively studied P/T sections with both two species coexisting.

4. The Permian-Triassic conodont biofacies

Tian (1993b) considered that gondolellid elements (*Neogondolella* or *Clarkina*) near the P/T boundary were planktonic - free-swimming types and occurred at deep water, and that hindeodid elements (*Hindeodus* and *Isarcicella*) were benthonic swimming types and occurred in shallower water. Orchard (1996) concluded that "throughout the Permian and beyond, *Neogondolella* is more common in offshore, deeper, and /or cooler water marine environments, whereas *Hindeodus* and its antecedents flourished in the near shore, shallower, and/or warmer regions". Wang (1996) supposed that the gondolellid conodont was a pelagic facies type and that the hindeodid conodont was a shallow water facies type. He gave two different conodont zonations for these two different facies. Baud (1996) also believed that *I. parva* (*H. parvus*) was a shallow-water species.

However, many geological data do not support the above conclusion. Clark et al. (1983) and Halteberg et al. (1984) concluded the Griesbachian hindeodid conodont *Isarcicella* and *Hindeodus typicalis* from the western USA belong to the basinal to outshelf biofacies. Based on a systematic study of the Lower Triassic conodonts from eastern Yuannan, western Guizhou and northern Guangxi, SW China, Wang et al. (1990) divided the conodont biofacies into basinal and platform facies. In platform facies area, the *Hindeodus minutus* zone and *Hindeodus parvus* zone are outlined. In basinal facies area, *Hindeodus minutus*, *H. parvus* and *Isarcicella isarcica* zones also can be recognized. Kozur et al. (1996) pointed out that the first appearance of *H. parvus* is not facies related and can be discovered both in ammonoid-free shallow water deposits and in ammonoid-bearing pelagic deposits. Kozur (1996) vividly expressed his opposition to Orchard's conclusion in more than two pages. The evidence presented in his paper should be considered. The assumption that *parvus* is a shallow water conodont should be re-assessed. Intensive sedimentological and palaeoecological analyses in conodont biofacies study are required before we reach a reliable conclusion on the ecology of hindeodids and gondolellids.

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New Book: The Permian and Triassic of Morocco

From 3 to 5 October 1995 a round table conference on the Permian and Triassic of Morocco was held at the Institut Scientifique in Rabat. Coordinators were Prof. Dr. Mohammed El Wartiti (Permian) and Dr. Fida Medina (Triassic), Université Mohammed V, Institut Scientifique, Département de Géologie, Av. Ibn Batouta, B.P. 703, Rabat-Agdal, Morocco. The contibutions to this round table conference are now bundled in a book:

Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, ISBN 9981-818-18-6.

This volume includes 17 contributions by Moroccan and foreign geologists. The contri-butions on Triassic geology and palaeontology are referenced in the 'Annotated Triassic Literature'. The price of this well produced book is US $ 25 or FF 150 (plus postage) and it can be ordered from:

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243, Av. Allal El Fassi
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Important Message from the Editor of ALBERTIANA

Careful readers may have noticed that this issue is published with considerable delay. Some manuscripts were received very late. However, the major reason for this delay are the very serious time constraints of the editor. After almost eight years and 13 issues the load of ALBERTIANA is becoming too heavy. As an editor, I feel that a newsletter like ALBERTIANA should show uniformity in style and layout, and also in the reference lists. Although several contributions for this issue were very well prepared, others needed very much time in order to get them in a more or less acceptable shape. Careful readers will undoubtedly still find many mistakes. Because I cannot longer combine the editorship of ALBERTIANA with my normal work, I feel forced to step down as editor. Moreover, I think that ALBERTIANA could use some fresh blood. Interested candidates to take over the position of editor of ALBERTIANA can contact me or the secretary of the STS. I highly appreciate all the positive comments I received during the years and sincerely regret that some readers and contributors may sometimes have been unsatified.

OBSERVATIONS ON THE INDUAN-OLENEKIAN BOUNDARY BASED ON CONODONT BIOSTRATIGRAPHIC STUDIES IN THE CORDILLERA OF THE WESTERN UNITED STATES

Rachel K. Paull

Establishment of Early Triassic conodont zones is intimately tied to eustatic history. Rapidly expanding transgressive faunas provided the opportunity for essentially worldwide correlation. Episodes of falling sea level resulted in extinctions, and hence these faunas lacked diversity and abundance. The conodont faunas associated with the three Early Triassic (Scythian) transgressive events had widespread distributions in Tethyan and circum-Pacific areas where marine sedimentation was generally continuous (Paull and Paull, 1994, 1997).

The Early Triassic conodont zones represented in the western Cordillera of the United States are based on forms that were distinctive and tolerated a broad range of open marine environments. Data from over 200 measured stratigraphic sections in the western United States provide a regional evaluation of the effectiveness of these biostratigraphic zones (Carr and Paull, 1983; Paull, 1988; Paull and Paull, 1994, 1997).

The initial Griesbachian transgression at the close of the Paleozoic spread rapidly over some 270,000 sq. km in the western United States. The subsequent Dienerian stage was a time of regression, coupled with the progradation of terrigenous quartz silt across the basin margins. Conodont faunas are sparse in rocks of this stage, with the exception of the index forms which were still extant in the northeast-trending offshore depocenter in southeastern Idaho. Zakharov (1994) also notes the scarcity of age-diagnostic conodonts and bivalves during latest Induan (Dienerian) and earliest Olenekian (Smithian) time. With the onset of the next rapid, and even more widespread, Smithian transgression across 310,000 sq. km of the Cordilleran miogeocline of the western United States, a faunal 'explosion' occurred after the paucity of Dienerian life. The Induan-Olenekian boundary falls between these two stages, and it can be determined on the basis of both conodonts and ammonoids.

In the *Meekoceras* ammonoid beds (early Smithian) at, or near, the beginning of the Olenekian, *Neospathodus waageni* is the most abundant and tolerant conodont index form over a variety of intermediate to offshore environments. However, in basinal (offshore/deeper water) environments, *Neospathodus waageni* and *N. pakistanensis* commonly occur together. Mosher (1973) also noted *pakistanensis* from the lower Smithian *Romunderi* Zone of western Canada (equivalent to the *Meekoceras gracilitatus* ammonoid zone of the western U.S.). Nowhere in the western U.S. does *N. pakistenensis* appear as a separate zonal indicator[1]. In North America, *pakistanensis* is only recognized in early Smithian strata.

[1] I examined the abraded single specimen photographed by Solien (1979); it is not *N. pakistanensis*.

In a Lower Triassic section I recently studied from the southern Canadian Rocky Mountains, both forms appear in the initial Smithian transgression. McTavish (1973) also cited the mutual occurrence of *N. pakistanensis* and *N. waageni* at the lower range of *N. waageni* in Australia. There can no longer be any doubt about the range overlap of these two species.

Sweet (1970) initially placed pakistanensis stratigraphically below waageni in mutually exclusive, adjacent zones in his Salt Range (West Pakistan) study, and assigned it to a position straddling the Dienerian-Smithian boundary (Sweet and others, 1971). This slight difference in range has also been reported from one location each in China and South Primorye (Ding, 1992; Zakharov, 1994). In actuality, there may be a small time lapse before the first appearance of *N. waageni*. However, the diachronous nature of the second Triassic transgression (Smithian; base of Olenekian) may obscure recognition of this slight difference in range. As a result, these two forms are frequently reported as occurring together.

In Lower Triassic strata of the western U.S., the conodont *N. waageni* alone or in association with *N. pakistanensis*, marks the Induan-Olenekian boundary in the early Smithian. The base of the Olenekian has obvious increases in faunal diversity and abundance. In intermediate to offshore areas in the vicinity of the depocenter in southeastern Idaho, *pakistanensis* and *waageni*, or to a lesser extent *waageni* alone are present in most of our sections. In thirteen depocenter sections associated with the *Meekoceras* zone, these forms occur together, and 10 are marked by waageni alone. In shelfal regions of Wyoming and Utah, however, waageni is the only useful index form.

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TRIASSIC CONODONT BIOCHRONOLOGY AND INTERCALIBRATION WITH THE CANADIAN AMMONOID SEQUENCE

M.J. Orchard and E.T. Tozer

This contribution summarizes what is currently known about the Triassic conodont succession in Canada and its intercalibration with the ammonoid zonation and stages of Tozer (1994). The intercalibration has been achieved through study of direct associations or interbedded occurrences of the two fossil groups, largely in Western Canada and the Canadian Arctic. In addition, conodont data from ammonoid-bearing strata in the western United States are utilized to arrive at a more complete record for the North American Triassic. In addition to original field collections made by the authors, the present synthesis has benefited greatly from ammonoid-matrix samples collected by H. Bucher (Lyon), K. Nichols and N. Silberling (Denver), and W. Weitschat (Hamburg) and J. Jenks (Salt Lake City). Further details of the intercalibration for Canada are provided in Orchard and Tozer (in press). The present contribution adds to and slightly modifies the latter account as a result of new collections and the greater scope. It is anticipated that the present scheme will evolve further as conodont taxonomic studies are completed and new taxa in open nomenclature are described.

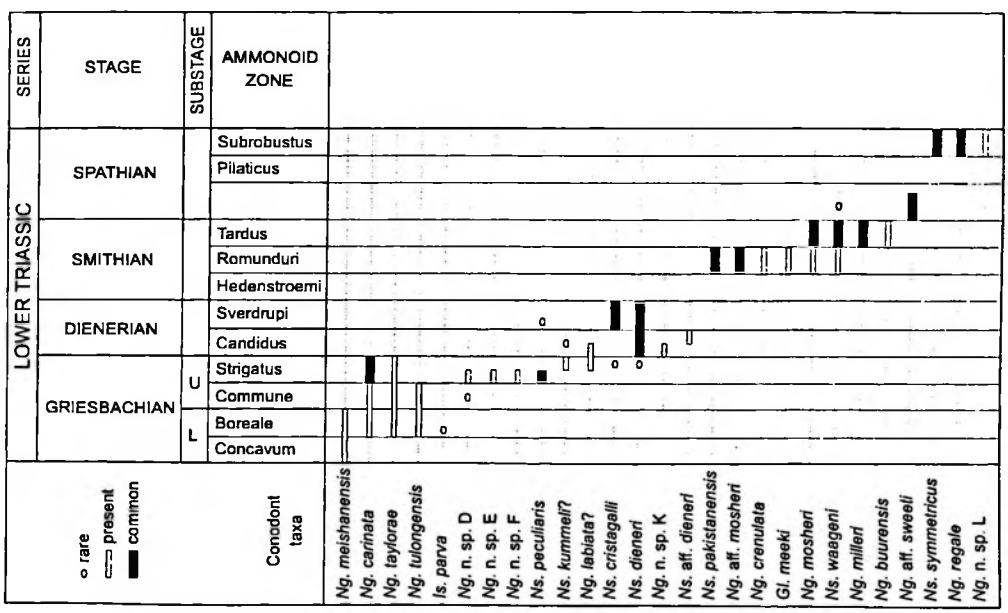

Fig. 1. The occurrences of conodont species with respect to Lower Triassic ammonoid zones in Canada. Conodont occurrences in the Lower Griesbachian based on Henderson and Baud, in press. See Fig. 2 for generic abbreviations.

Griesbachian

Conodont faunas from the Lower Griesbachian *Otoceras concavum* and *O. boreale* zones in the Canadian Arctic are generally sparse. Only a few indeterminate fragments of *Neogondolella* have been recovered from the type section of the Concavum Zone at Griesbach Creek. Elsewhere in the Arctic, several *Neogondolella* species have been reported from strata beneath the Boreale Zone (Henderson & Baud, in press) which may be Concavum Zone equivalents. These conodonts have tentatively been compared with *Neogondolella subcarinata* and *N. changxingensis* (Henderson, 1993), which occur in undisputed Permian strata elsewhere, and with *N. meishanensis* (Henderson and Baud, in press). This last species was first described from the Permian-Triassic boundary lower transition beds (25 and 26) at Meishan, China and has been regarded as a Changshingian species because it pre-dates the appearance of *Isarcicella parva* (=*Hindeodus parvus*) in bed 27c (see below). However, *N. meishanensis* also occurs with *Neogondolella carinata, N. taylorae, N. tulongensis*, and *Isarcicella parva* in the *Otoceras latilobatum* bed at Selong (Orchard et al., 1994), in the *O. woodwardi* Zone in Spiti, India (Krystyn and Orchard, 1996), and in the Boreale Zone of the Arctic (Henderson and Baud, in press)(Fig. 1). Hence, the species should not be regarded as definitively Permian in age. *Isarcicella parva*, proposed as the index species for the base of the Triassic, occurs in the Boreale Zone but whether this represents the evolutionary first appearance of the species is uncertain because *Hindeodus* and its derivatives are very rare in these strata, as is also the case in the lower transition beds at Meishan (see Orchard, 1996). A full description of conodonts from the *Otoceras* beds of the Arctic should address whether a faunal change occurs at the base of the Boreale Zone.

Upper Griesbachian strata in the Canadian Arctic are partly assigned to the *Ophiceras commune* Zone, which contains *Neogondolella* species similar to those from Boreale Zone (Henderson and Baud, in press); this reinforces the Triassic aspect of those conodont taxa. An additional species known from Arctic Canada is *Neogondolella* n. sp. D, a derivative of the *N. carinata* group with an elevated posterior carina. This species is based on Upper Griesbachian material from Spiti (Krystyn and Orchard, 1996), where all of the contemporaneous Arctic species occur.

Several conodont species appear for the first time in the uppermost Griesbachian Strigatus Zone of the Arctic, although the faunas remain dominated by the *Neogondolella carinata* group. *Neogondolella* n. sp. E, also based on Spiti material (Krystyn and Orchard, 1996), is a derivative of the *N. carinata* group characterized by relatively long and discrete denticles; this species may prove to be useful as a guide to the uppermost Griesbachian (Fig. 2). *Neogondolella* n. sp. F (=*N. mombergensis* sensu Mosher, 1973, in part) is a lanceolate form possibly ancestral to *N. composita* from the Smithian of Siberia (Dagys, 1984), and younger representatives of the genus. Both species occur with the distinctive *Neospathodus* (=*Merrillina?*) *peculiaris* in some collections from the Strigatus Zone of Canada (Figs. 1, 2). Although *N. peculiaris* was first reported with abundant *Neospathodus cristagalli* and *N. dieneri* from younger strata of the Ceratite marl in the Salt Range (Sweet, 1970), it is uncommon above the Strigatus Zone in Canada: only a single specimen of the species has also been recovered from Dienerian strata (see below). *Neospathodus peculiaris* has also been reported from Griesbachian and Dienerian correlatives in the United States (Clark et al., 1979).

A different conodont fauna characterizes the younger parts of the Strigatus Zone in the Arctic. Therein, rare specimens allied to *Neospathodus kummeli* and *Neogondolella labiata* occur with the first representatives of *Neospathodus cristagalli* and *N. dieneri* as well as representatives of the *Neogondolella carinata* group. All but the last of these species are better known from younger strata: their appearance in the late Griesbachian presages a major change in conodont faunas.

Dienerian

A conodont collection from the Candidus Zone overlying a Strigatus Zone fauna on northern Ellesmere Island includes rare *Neogondolella labiata?* and *Neogondolella* n. sp. K in addition to more numerous *Neospathodus dieneri*. Typical specimens of the *Neogondolella carinata* group are absent. The contrast with Griesbachian conodont faunas is more pronounced in other Dienerian collections from Canada, all of which are dominated by *Neospathodus*. A large conodont fauna from the lower Dienerian Candidus Zone at its type locality at Diener Creek in the Arctic is of low diversity and contains only *Neospathodus dieneri* and allied forms, including *N. svalbardensis*. The abundance of *N. dieneri* there, and its dominance in other Candidus Zone collections from northeast British Columbia (B.C.), accord well with the peak-abundance zone named for it in the Salt Range (Sweet, 1970).

In northeastern B.C. and Alberta, *Neospathodus dieneri* generally occurs alone in new Candidus Zone matrix samples but both *Neospathodus* aff. *dieneri* and *N. cristagalli* are known in association, albeit rarely. *Neospathodus kummeli* was also recorded from a Candidus Zone collection from B.C. by Mosher (1973), although this record has yet to be duplicated in additional collections from the same locality. However, Collinson *(in* Poole and Wardlaw, 1978) also reported *N. kummeli* together with *N. dieneri* from *Proptychites*-bearing strata in the Candelaria Formation of central Nevada, and the same association was reported in the type collection of *N. kummeli* from *Gyronites*-bearing limestones in the Salt Range (Sweet, 1970), so the species is regarded as chiefly diagnostic for the lower Dienerian (Fig. 2).

Neospathodus dieneri is most commonly accompanied by *N. cristagalli* in the upper Dienerian Sverdrupi Zone of northeastern B.C. The latter species has its first appearance in the Strigatus Zone in the Arctic and re-appears in the upper part of the Candidus Zone at Mount Laurier in northeastern B.C., however it peak abundance in Canada is in the Sverdrupi Zone (Figs. 1,2). A single specimen of *Neospathodus peculiaris* is newly identified from the Sverdrupi Zone too. *Neospathodus kummeli* was reported by Mosher (1973) from this zone in the Arctic, but the specimen is an indeterminate fragment.

Smithian

No conodonts are presently known from the basal Smithian *Hedenstroemia hedenstroemi* Zone in Canada. Conodonts from this interval have been described from Siberia (Dagys, 1984), where the zone contains *Neogondolella nepalensis* and *Neospathodus pakistanensis* amongst other species. The co-occurrence of these two species is tentatively regarded as diagnostic for the basal Smithian (Fig. 2). *Neospathodus pakistanensis* was originally recorded in association with *N. dieneri* from the Mianwali Formation of the Salt Range (Sweet, 1970), and the same two *Neospathodus* species are recorded from the early Smithian in Siberia (Dagys, 1984). Although Zacharov (1995) discussed the occurrence of the *N. pakistanensis* in the late Induan (Dienerian) of South Primorye, as far as is known the interval with *Neospathodus pakistanensis* is wholly Smithian in North America (Fig. 2).

Conodont faunas are known in direct association with Romunduri Zone ammonoids in samples from Smith Creek (the type locality in the Canadian Arctic), northeastern B.C., and broadly contemporaneous *"Meekoceras"* faunas at several localities in the United States. The Arctic collection is dominated by *Neogondolella* ex gr. *mosheri* (including *N. planata* sensu Mosher, 1973) and *Neospathodus* ex gr. *pakistanensis* with fewer *Neogondolella crenulata* and rare *Gladigondolella meeki*. With the exception of *Neogondolella crenulata*, each of these species plus *Neospathodus waageni* are known from Romunduri Zone collections from northeast B.C. However, none of these collections contain both *Neogondolella* ex gr. *mosheri* and *Gladigondolella meeki*.

In the United States, Smithian ammonoid faunas have often been referred to a generalized "*Meekoceras* Zone", or more specifically to the *M. gracilitatus* Zone. A tripartite division of the *Meekoceras* beds has been proposed but it has not been broadly applied (see Silberling and Tozer, 1968, p. 28-30). In the current survey, ammonoid matrix collections from the United States have been assigned to the Canadian ammonoids zones by W. Weitschat and J. Jenks (pers. comm., 1993). A Romunduri Zone collection from Crittenden Springs, Nevada is dominated by *Neospathodus conservativus*, *N. discretus*, and *N.* ex gr. *bicuspidatus* (including *N. bransoni)*, none of which are known from northeast B.C. or Arctic Canada. A second Romunduri Zone collection from (Bear Lake) Hotsprings, Idaho includes a similar conodont fauna but also includes, in common with some Canadian collections, *Gladigondolella meeki* and *Neospathodus waageni.* Data from the Thaynes Formation in Utah (Solien, 1979) implies that the fauna with *Gladigondolella meeki* is slightly older than that from Nevada, but the relative age of the Romunduri collections is difficult to determine with confidence at present.

SERIES	STAGE	SUBSTAGE	AMMONOID ZONE	CONODONT FAUNAS / ZONES	
LOWER TRIASSIC	SPATHIAN		Keyserlingites subrobustus	Ns. symmetricus	Ng. regale
			Olenikites pilaticus	(Ns. triangularis)	(Ng. aff. taimyrensis)
				(Ic. collinsoni)	(Ng. elongata)
				(Ns. crassatus)	Ng. aff. sweeti
	SMITHIAN		Anawasatchites tardus	Ns. waageni	Ng. milleri
			Euflemingites romunduri		Gl. meeki
			Hedenstroemia hedenstroemi	Ns. pakistanensis	(Ng. nepalensis)
	DIENERIAN		Vavilovites sverdrupi	Ns. dieneri	Ns. cristagalli
			Proptychites candidus		Ns. kummeli
	GRIESBACHIAN	U	Bukkenites strigatus	Ns. peculiaris	Ng. n. sp. E
			Ophiceras commune	Ng. carinata	Ng. n. sp. D
		L	Otoceras boreale	Ng. taylorae - I. parva	
			Otoceras concavum	Ng. meishanensis	

Fig. 2. Lower Triassic biochronology showing intercalibration of ammonoid and conodont zones and faunas. Multiple columns shown for the conodonts represent subzones, parallel lineages, or different biofacies. Those intervals in brackets are at present unknown in Canada. The following abbreviations are used for conodont genera: Ng. = Neogondolella, I. = Isarcicella, Ns. = Neospathodus, Gl. = Gladigondolella, Ic. = Icriospathodus.

Comparing the Canadian and American conodont records for the Romunduri Zone, the only segminiplanate element known from both regions is *Gladigondolella meeki* (Fig. 2), some elements of which develop crenulated platforms mimicking *Neogondolella crenulata*. Orchard and Tozer (in press) formerly showed *Neogondolella buurensis* as a guide to in the Romunduri Zone but that species is only known in the overlying Tardus Zone in North America. Amongst the segminate species, both *Neospathodus pakistanensis* and the younger *N. waageni* are known from Romunduri

Zone collections (Fig. 2), but the latter species is far more common in the overlying Tardus Zone, which lacks *N. pakistanensis*.

The widespread conodont fauna of the upper Smithian Tardus Zone comprises *Neogondolella milleri, N. mosheri* (=*N. nevadensis* sensu Mosher, 1973), *Neospathodus waageni,* and fewer *Neogondolella buurensis* (=*N. jubata* sensu Mosher, 1973). In North America this conodont association is known from the Tardus Zone of Smith Creek in the Canadian Arctic, from northeastern B.C., and from the equivalent *Anasibirites* beds in Idaho and Utah. *Neogondolella milleri* occurs without *N. mosheri* in the upper Tardus Zone (with *Xenoceltites*) of Toad River in B.C. and in a new Tardus Zone collection from Crittenden Springs, Nevada. The original description of conodonts from Crittenden Springs (Müller, 1956) includes elements from both the Romunduri and Tardus zones. *Neogondolella milleri* appears useful as an index for the late Smithian (Figs. 1, 2), in spite of a reputedly irregular occurrence (Collinson and Hasenmueller, 1978) within a *Neospathodus waageni* Zone of broad scope.

Spathian

Spathian strata in its type area of the Canadian Arctic has yielded conodonts only in its upper part. A more complete Spathian succession is known from the United States. In California, the Union Wash Formation includes a succession of conodont faunas associated with undescribed lower Spathian *Tirolites* faunas (Bucher, pers. comm.). The conodont succession begins with *Neospathodus* ex gr. *waageni* and passes up to a more diverse fauna dominated by *N. crassatus* and *Neogondolella* aff. *sweeti* and containing fewer *Neospathodus brevissimus* and rare *Platyvillosus* aff. *costatus*. Most of these species also occur in *Tirolites* beds at Paris Canyon, Idaho and one of them, *Neogondolella* aff. *sweeti*, is particularly common above Tardus Zone ammonoids on Toad River in northeast B.C. (Figs. 1, 2). This fauna probably corresponds to the *Platyvillosus* Zone of Collinson and Hasenmueller (1978), which they reported with *Tirolites* in eastern Nevada and west central Utah.

The younger Spathian conodont succession has been summarized most recently by Orchard (1995). The *Columbites* beds are characterized by the *Icriospathodus collinsoni* - *Neogondolella elongata* conodont fauna, which is known from both Paris Canyon and (Bear Lake) Hot Springs in southeastern Idaho. Collinson and Hasenmueller (1978) recognized the value of *Icriospathodus collinsoni* (=*Neospathodus* n. sp. G) , which they also reported from probable *Columbites* beds equivalents in the Confusion and Medicine ranges in Nevada. Neither index conodont species is yet known from Canada.

The undescribed *Procolumbites* beds at Hammond Creek, Idaho (see Orchard, 1995) also include *Neogondolella elongata* but this is associated with the first representatives of the *Neospathodus homeri* group. The succeeding *Prohungarites* beds at the Hammond Creek locality are dominated by *Neospathodus* ex gr. *homeri* and include the distinctive '*Oncodella*' n. sp. A (Orchard and Bucher, 1992). In Nevada, new conodont collections from the *Subcolumbites* beds of the Tobin Range and the *Prohungarites* beds of the Humboldt Range, contain the same two conodont species in association with either *Neospathodus triangularis* (Tobin Range) or *Neogondolella* aff. *taimyrensis* (Humboldt Range). The latter species shows affinity with that originally described from the upper Spathian Spiniplicatus Zone of Siberia (Dagys, 1994). Collinson and Hasenmueller (1978) originally reported that both "*Neogondolella jubata*" and *Neospathodus triangularis* were common in correlative strata in Idaho and Nevada.

The topmost Spathian conodont fauna is characterized as the *Neospathodus symmetricus* (=*N. homeri* sensu lato) - *Neogondolella regale* fauna. It occurs in both the *Neopopanoceras haugi*

ammonoid Zone in the Humboldt Range of Nevada and the *Keyserlingites subrobustus* Zone in northeast B.C. (Orchard, 1994a). *Chiosella timorensis* does not occur directly with Haugi Zone ammonoids in Nevada (cf. Collinson and Hasenmueller, 1978) but in Coyote Canyon the species does appear in strata above the Haugi Zone and beneath the brown calcareous sandstone unit, which itself underlies the oldest Anisian ammonoids.

The Subrobustus Zone of Spath Creek in the Canadian Arctic has yielded only *Neogondolella* species, whereas in the Inyo Mts. of California only *Neospathodus homeri* sensu lato brackets the type Haugi Zone bed. The *Neogondolella* species from the Subrobustus Zone were formerly assigned to both *N. jubata* and *N. regale* by Mosher (1973). The former are now referred to *Neogondolella* n. sp. L rather than to *Neogondolella jubata*, an older species that has been variably interpreted and employed uncritically as the nominal guide for a long-ranging Spathian zone. The appearance of *Neogondolella regale* in the upper Spathian of both northeastern B.C. and Nevada contrasts with its range in Europe, where the species makes its first appearance in the Anisian. This brings into question its supposed ancestry in Anisian *Chiosella timorensis*, which may in fact be derived from *Neogondolella regale* through platform reduction.

Anisian

The oldest Anisian ammonoid fauna in Canada is referred to the Mulleri Zone (Fig.3). The intercalibration of a more complete Lower Anisian ammonoid-conodont faunal succession has been enabled through the work of Bucher (1989) in Nevada where *Chiosella timorensis* and *Neogondolella regale* co-occur in association with *Japonites welteri* (Orchard, 1994a), the oldest Anisian ammonoid fauna in the Prida Formation. Supplementary collections show that *Chiosella timorensis* makes its first appearance earlier, below the calcareous sandstone unit that underlies the Prida Formation, where it is associated with the last *Neospathodus* species as well as with *Neogondolella regale*. *Chiosella timorensis* is also known in the Union Wash Formation of California, at Ursula Creek in northeast B. C., and at several places in the terranes of the Canadian western Cordillera (Orchard and Bucher, 1992).

In Nevada, Bucher (1989) differentiated a fauna with *Pseudokeyserlingites guexi* above the Welteri beds. Neither of these ammonoid faunas were differentiated when Nicora (1977) first described Lower Anisian conodonts from Nevada, so more precise ranges of key conodont species like *Chiosella timorensis* can now be provided. The Guexi beds contain both *Nicoraella* n. sp. A and the first rare *N. germanica*, a species that characterizes the Bithynian in Europe (Kozur, 1980). These species are newly interpreted to be successive derivatives of *Chiosella*. The succeeding Mulleri Zone in Nevada includes more common *Nicoraella germanica* but is otherwise dominated by *Neogondolella regale*. In Canada, the oldest conodont faunas known with Lower Anisian ammonoids are from the Caurus Zone and contain predominantly *Neogondolella regale* and fewer *Neogondolella* n. sp. (=*N. mombergensis* sensu Mosher, 1973)(Fig. 3).

In British Columbia, the *Neogondolella regale* group ranges through most of the Middle Anisian, including the Hayesi Zone from which the type material was described (Mosher, 1973). The species is accompanied by a variety of new species of *Neogondolella* but the collections are similar until the Minor Zone when a faunal change is marked by the appearance of *Neogondolella shoshonensis*, recorded originally from Nevada (Nicora, 1976), and the replacement of *N. regale* with forms tentatively assigned to *Paragondolella bulgarica*. A further new species, *Neogondolella* n. sp. P appears to be confined to the upper part of the Minor Zone. Details of the Lower-Middle Anisian succession in B.C. and Nevada are yet to be worked out.

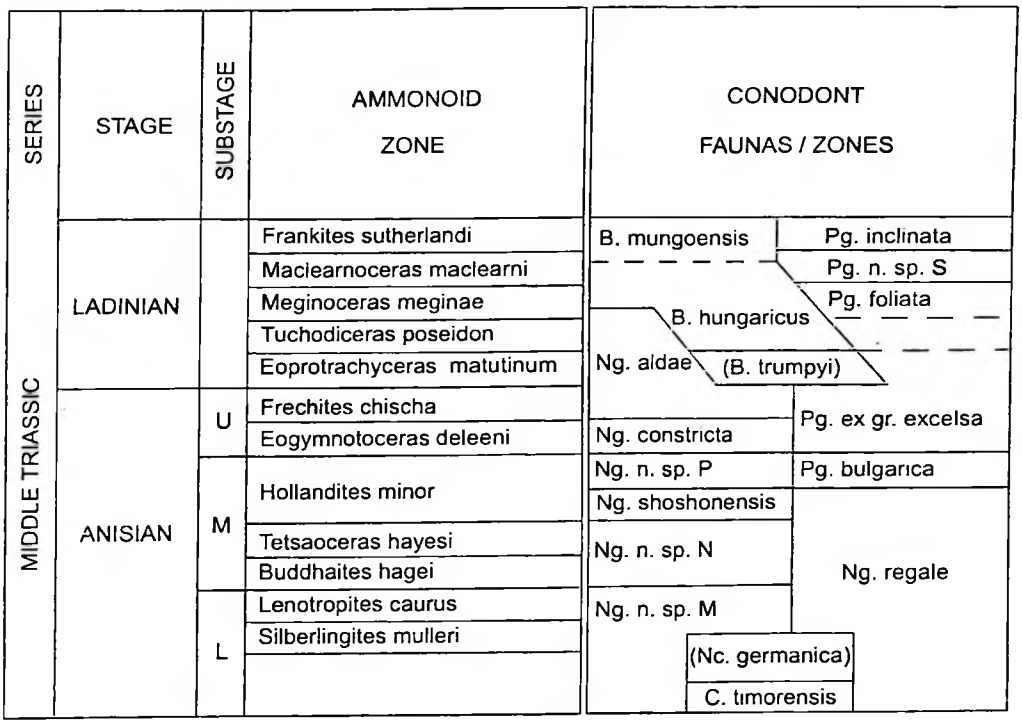

Fig. 3. Middle Triassic biochronology showing intercalibration of ammonoid and conodont zones and faunas. Multiple columns shown for the conodonts represent subzones, parallel lineages, or different biofacies. Those intervals in brackets are at present unknown in Canada. The following abbreviations are used for conodont genera: Ng. = Neogondolella, C. = Chiosella, Nc. = Nicoraella, Pg. = Paragondolella, B. = Budurovignathus.

The Upper Anisian *Eogymnotoceras deleeni* Zone in the northeast B.C. is characterized by *Neogondolella constricta*, with fewer *Paragondolella* ex gr. *excelsa* and rare *Neogondolella* ex gr. *alpina-szaboi*. These species are also present in the Upper Anisian Rotelliformis Zone of the Prida Formation of northwestern Nevada (Bucher and Orchard, 1995), where the overlying Meeki Zone contains the same species except *Paragondolella*. In the upper part of the Meeki Zone, *Neogondolella aldae* appears and thereafter ranges through the Occidentalis Zone where it is accompanied by *Paragondolella liebermani*, derivatives of *N. szaboi-N. alpina* including *N. pridaensis* and several forms characterized by reduced platforms. Although some small specimens from the Occidentalis Zone resemble the holotype (early growth stage) of *Neogondolella trammeri*, no typical large specimens of that important European index species have been found. In contrast to Nevada, available conodont collections from the uppermost Anisian *Frechites chischa* ammonoid Zone in northeastern B.C. are of low diversity and to date contain only *Neogondolella aldae*.

Ladinian

The first occurrence of protrachyceratids has been regarded as defining the base of the Ladinian stage. In Nevada, this corresponds to the Subasperum Zone of Silberling and Tozer (1968). Recent work by Bucher (in Bucher and Orchard, 1995) established five successive faunas in the lower Ladinian, in ascending order: *Eoprotrachyceras* sp. A, *Eoprotrachyceras lahontanum, Eoprotrachyceras subasperum, Progonoceratites* n. sp., and (?*Eo*)*Protrachyceras* sp. C. A distinctive conodont fauna occurs with *P. lahontanum.* It is marked by the mass appearance of *Budurovignathus trumpyi (=B. praehungaricus*), new *Paragondolella* species, rare *N.* aff. *transita,* and distinctive elements of *'Cornudina'* sp. Most conodont taxa found in the Occidentalis Zone range through the Subasperum beds and into the *Progonoceratites* beds, where several new taxa appear. Above this level, diversity drops dramatically and only the *Neogondolella constricta* group accompanied by rare *N.* aff. *mombergensis* occur in the Upper member of the Prida Formation.

In contrast to Nevada, conodont faunas from the basal Ladinian Matutinum Zone in northeast B.C. contain only a low diversity population of *Neogondolella aldae* and *Paragondolella ex gr. excelsa,* essentially identical to those from the Upper Anisian Deleeni Zone (Fig. 3). Conodont collections from the successive Poseidon ammonoid Zone in northeast B.C. are also dominated by long-ranging *Neogondolella aldae,* but *Budurovignathus hungaricus,* the successor species to *B. trumpyi,* is also known. This supports correlation of the Subasperum beds sensu Bucher with the Poseidon Zone of Canada.

A succession of younger Ladinian conodont collections from the Meginae Zone also consist of *Neogondolella aldae* but *Paragondolella foliata* becomes increasingly common through the zone. Conodont collections from the next younger Maclearni Zone formerly reported as *Metapolygnathus polygnathiformis* by Mosher (1973) are assigned to a new species, *Paragondolella* n. sp. S, which apparently developed from *Paragondolella foliata*. Species of *Budurovignathus* transitional between *B. hungaricus* and *B. mungoensis* also occur in the Maclearni Zone. The latter species has its peak abundance with *Paragondolella inclinata,* and less common *Mosherella,* in the Sutherlandi Zone in northeastern B.C. This is the terminal ammonoid zone of the Ladinian, although Silberling and Tozer (1968, p. 45) discuss the possibility that it may range into the lower Carnian (see below).

Carnian

The conodonts co-occurring with lowermost Carnian Desatoyense Zone ammonoids, originally referred to *"Neogondolella navicula"* by Mosher (1973), are now assigned to *Paragondolella inclinata*. Both this species and others allied to *Mosherella* (e.g. *Neospathodus* sp. E of Mosher, 1973) also occur in the younger Lower Carnian Obesum and Nanseni ammonoid zones (Fig. 4). In Nevada, Lower Carnian *Trachyceras* beds occur within the middle member of the Augusta Mountain Formation. There, the conodont *Mosherella newpassensis* occurs from 22 m above the base of the member, and is joined by *Metapolygnathus polygnathiformis* 40 m above the base (Mosher, 1968). The records of *Mosherella* in some Sutherlandi Zone collections implies either that the genus is common to both Ladinian and Carnian strata, or some Sutherlandi Zone collections are Early Carnian. The more definitive Carnian conodonts, *Metapolygnathus polygnathiformis* and *M. tadpole,* have been recovered to date only in the Nanseni Zone of the Lower Carnian.

With the exception of *Metapolygnathus polygnathiformis,* all the conodonts species of the Lower Carnian disappear prior to the Upper Carnian Dilleri Zone, from which conodonts are known on Vancouver and Queen Charlotte islands on the Pacific coast of Canada. A more widespread records of the Welleri Zone have provided conodont collections from both western and northeastern B.C., and from the Arctic. These show a radiation of the metapolygnathids from the root stock

represented by the *Metapolygnathus nodosus* group. The radiation continued through the succeeding Macrolobatus Zone. At least two separate lineages have been described and used to subdivide the Upper Carnian (Fig. 4) (Orchard, 1991a, b). The older comprises *Metapolygnathus lindae-M. zoae-M. samueli-M. pseudoechinatus* (Welleri-Macrolobatus zones), and the younger lineage involves *M. communisti-M. primitius* (Macrolobatus-Kerri zones).

SERIES	STAGE	SUBSTAGE	AMMONOID ZONE		CONODONT FAUNAS / ZONES	
UPPER TRIASSIC	RHAETIAN		Choristoceras crickmayi		Mi. posthernsteini	N. steinbergensis
			Paracochloceras amoenum		E.mosheri	
	NORIAN	U	Gnomohalorites cordilleranus		E. bidentata	
		M	Mesohimavatites columbianus	IV	E. serrulata	
				III		
				II	E. postera	
				I	E. elongata	
					E. spiculata	
			Drepanites rutherfordi		E. multidentata	
		L	Juvavites magnus		E. triangularis	N. navicula
			Malayites dawsoni		E. quadrata	
			Stikinoceras kerri		M. primitius	
	CARNIAN	U	Klamathites macrolobatus		M. communisti	M. pseudoechinatus
			Tropites welleri	II	M. nodosus	M. samueli
				I		M. zoae
						M. lindae
			Tropites dilleri		M. polygnathiformis	
		L	Sirenites nanseni			Pg. inclinata - Mosherella
			Austrotrachyceras obesum			
			Trachyceras desatoyense			

Fig. 4. Upper Triassic biochronology showing intercalibration of ammonoid and conodont zones and faunas. Multiple columns shown for the conodonts represent subzones, parallel lineages, or different biofacies. The following abbreviations are used for conodont genera: Pg. = Paragondolella, M. = Metapolygnathus, N. = Norigondolella, E. = Epigondolella, Mi. = Misikella.

Norian

Norian conodont faunas and their intercalibration with ammonoids have been summarized earlier (Orchard, 1983, 1991b) and will only briefly outlined here (Fig. 4). The conodont *Metapolygnathus primitius* ranges upward through most of the Kerri Zone, where the species is accompanied by uncommon examples of other *Metapolygnathus* species. The appearance of *Norigondolella navicula* is taken to mark the base of the Upper *primitius* Zone and of the Norian Stage.

Kerri Zone collections are dominated by *Metapolygnathus primitius* with variable numbers of *Norigondolella navicula*. *Epigondolella quadrata* appears in collections from the uppermost part of the Kerri Zone, and ranges through the lower part of the succeeding Dawsoni Zone. In the upper half of the Dawsoni Zone and through the succeeding Magnus Zone the conodont collections are dominated by various morphotypes of *Epigondolella triangularis*. Morphological variation within this species may be useful as a basis for further subdivision (Orchard, 1991b). Conodonts from the Middle Norian Rutherfordi Zone are dominated by *Epigondolella multidentata*, which replaces *E. triangularis* abruptly at the Lower-Middle Norian boundary. An equally significant faunal turnover characterizes the ammonoid succession.

Conodont collections associated with the lower two ammonoid faunas of the lowest subzone of the Columbianus Zone contain *Epigondolella spiculata*. The highest part of the subzone is characterised by *Epigondolella elongata*. Conodont collections from the second subzone of the Columbianus Zone contain *Epigondolella postera* and commonly an abundance of *Norigondolella steinbergensis*. The third subzone of the Columbianus Zone is characterized by *Epigondolella serrulata*, and conodont collections from the topmost Columbianus Zone contain the first representatives of *Epigondolella bidentata*. The latter species has its abundance peak in the zone of *Gnomohalorites cordilleranus*, which is synonymous with the range of the bivalve *Monotis*.

Rhaetian

Although the scope of the Rhaetian has yet to be defined, in North America the base of the *Paracochloceras amoenum* Zone is the most readily recognized datum on the basis of both conodonts and radiolarians: it corresponds to the base of the *Epigondolella mosheri* (=Upper *E. bidentata*) conodont Zone (Fig. 4) and Radiolarian Assemblage 1 of Carter (1993). The diagnostic conodont and radiolarian faunas occur together in post-*Monotis* strata at several localities on the Pacific margin of western Canada, and *Epigondolella mosheri* occurs at the type locality of the Amoenum Zone at Tyaughton Creek in the Cadwallader Terrane in southwestern B.C., and in the co-eval strata of the Lower Gabbs Formation in Nevada. The diagnostic conodont also occurs in post-*Monotis* strata at a few localities in northeast British Columbia, and has also been described from Peru (Orchard, 1994b).

The youngest occurrence of *Epigondolella mosheri* in Nevada is in strata assigned to the lowest part of the *Choristoceras crickmayi* Zone. Similarly, on Queen Charlotte Islands the conodont species occurs with Radiolarian Assemblage 3 of Carter (1993), also regarded as equivalent to the Crickmayi Zone. The only conodonts known in direct association with Crickmayi Zone ammonoids, also on Queen Charlotte Islands, are rare *Misikella posthernsteini*. In Europe, this species and several others of the same genus characterize Rhaetian strata that is devoid of *Epigondolella*. It is unlikely that the appearance of *M. posthernsteini* within the Crickmayi Zone represents an equivalent stratigraphic datum as that advocated for the base of the Rhaetian (Kozur and Mock, 1991), and it seems probable that *Epigondolella* ranges higher in the Triassic in the Americas than in Europe. The rarity of *Misikella* in North America makes the genus less than ideal for defining the base of the Rhaetian Stage world-wide.

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TRIASSIC AMMONOIDEA - NOTICE OF ERRATA IN TWO PUBLICATIONS

E.T. Tozer

TOZER, E.T., 1994. Significance of Triassic Stage boundaries defined in North America, Mémoires de Géologie (Lausanne), 21: 155-170, pl. 1 (Albertiana 13, May 1994, p. 56).

- p. 161, line 16, "at its" read "and its"
- p. 163, line 11 from bottom, for "PSEUDACROCHRODICERAS" read "PSEUDACROCHORDICERAS"
- Pl.1, Figure 2c, not identified on plate, is placed above figure 2a

TOZER, E.T., 1994. Canadian Triassic ammonoid faunas; Geological Survey of Canada, Bulletin 467, 348 pp. 148 pl. (Albertiana, 14, November 1994, p. 112)

-	p. 8	Column 2	line 26, for "autochthonous" read "allochthonous"
-	p. 43	Column 2	line 4 (Tozer), delete ( )
-	p. 47	Column 2	line 8 from bottom, for "exits" read "exists"
-	p. 68	Column 1	line 5 from bottom, for "example" read "examples"
-	p. 97	Column 1	line 3 from bottom, for "Zone 2" read "Subzone 2 ?"
-	p. 112	Column 1	line 5 from bottom, for "48" read "58"
-	p. 131	Column 2	line 14 from bottom, for "Klamathididae" read "Klamathitidae"
-	p. 132	Column 2	line 18 from bottom, move ")" from 42338 to after 99579
-	p. 142	Column 1	line 15, for "65" read "50"
-	p. 144	Column 1	lines 1,2, for "body chamber is concealed by" read "body chamber conceals"
-	p. 144	Column 2	line 15 from bottom, for "stem" read "them"
-	p. 163	Column 1	line 9, for "30" read "40"
-	p. 165	Column 2	line 2, for "83" read "Pl. 83"
-	p. 239	Column 2	lines 6, 12 from bottom, for "clavate" read "bullate"
-	p. 268	Column 2	line 7 from bottom, for "PHYLLOCERATINA" read "PHYLLOCERATIDA"
-	p. 273	Column 2	line 10, for "fossilien" read "fossilen"
-	p. 297	Column 1	line 10 from bottom, for "Zone" read "Himavatites Zone"
-	p. 311	Column 1	line 22, for "Ayland" read "Aylard"

CARBON ISOTOPE EVENTS DURING THE TRIASSIC

Viorel Atudorei and Aymon Baud

Introduction

Over the last decade, the use of geochemistry and especially stable isotopes in stratigraphy has become commonplace. Recent reviews of the stratigraphic applications of the carbon, oxygen, sulfur and strontium isotopic systems can be found in Holser (1996), Popp et al. (1997), McArthur (1994), Veizer et al. (1997a,b) and Strauss (1997).

Many stable isotope studies have focused on the Permian/Triassic boundary and the lower part of the Lower Triassic. However, much less attention has been paid to the remainder of the Triassic. The Triassic segment of the widely cited Phanerozoic curves (Holser, 1988; Burke et al., 1982; Veizer, 1997b) is poorly constrained for both carbon and strontium isotopes, although a number of papers treated various aspects of origin, paleoclimate or diagenesis using carbon and oxygen isotopes from Triassic carbonates (Scherer, 1977; Henrich and Zankl, 1986; Frisia-Bruni and Weissert, 1989; Spötl and Burns, 1991; Litnerova, 1992; Bernasconi, 1993; Bellanca, 1995; Al-Aasm, 1995; Mutti and Weissert, 1995; Loreau, 1995).

There are basically two approaches employed for reconstructing pre-Jurassic secular variations of carbon isotope ratios, discussed in Grossman (1994) and Scholle (1995). The first considers only the data recorded from carefully selected carbonate components, like marine cements and mainly nonluminescent brachiopod shells, which are more likely to preserve primary signatures. The second one relies on the use of whole-rock micritic limestones or dolomites assuming, through mass-balance criteria, that inorganic carbon isotopes are affected to only a small degree by diagenetic alteration in carbonate rich and organic carbon poor sediments; oxygen isotopes have been, in most cases, reset during diagenesis.

The scarce occurence of thick shelled brachiopods in Triassic deposits seriously limits the acquisition of 'high-confidence' carbon and oxygen isotope data. In addition, due to the current correlation problems that are posed (mainly to the Lower and Middle Triassic), an isotopic curve with a good chronostratigraphic coverage must be obtained from sections that are well calibrated by biostrati-graphical means.

One of the few studies that present in detail carbon isotope variations along measured Triassic profiles are given by Steuber (1991) and Simon and Steuber (1993). The data were obtained on a Middle Triassic to Lower Jurassic section from the Helicon Mountains, Greece. No well defined fluctuations were observed in $\delta^{13}C$ values of the carbonates, instead, a gradual increase in $\delta^{13}C$ values of organic matter from Ladinian to Norian was found. More recently, Böhm and Gawlick (1997) reported a positive carbon isotope excursion in the Upper Triassic based on data obtained on a section from the Northern Calcareous Alps.

During the last three years, we have studied the carbonate carbon and oxygen isotope variations in several marine Triassic sections, under close biostratigraphic control, in order to detect any systematic fluctuations that would potentially serve for chemostratigraphical correlations. Here below we briefly overview some Triassic carbon isotope events, some of them already described elsewhere, others are newly described.

Carbon isotope events

Permian/Triassic boundary

The sudden drop in $\delta^{13}C$ values that accompanied the end-Permian extinction event have been documented worldwide (e.g., Baud et al., 1989; Magaritz and Holser, 1991). Regardless of the cause of the shift, it can be used in correlating Upper Permian to Lower Triassic sections that lack fossils. However, fine scale correlations are limited (partly) by uncertainities related to the precise biostratigraphical correlations near the Permian/Triassic boundary interval. Magaritz and Holser (1991) reported for the Gartnerkopfel core (Carnic Alps) a multiple minima carbon isotope profile in the lowermost Triassic. Scholle (1995) questioned the primary nature of this multiple minima pattern, arguing that there is a good correlation with the organic carbon content. Although a similar $\delta^{13}C$ pattern with two minima has been reported from the Guryul Ravine section (Baud et al., 1996), it is not clear whether it is 'real' and, at the present state of knowledge, their use for fine scale correlations is not recommended.

In many sections covering the Lower Triassic there is organic material present, that could account for an input of ^{13}C depleted components. It is also likely that the ocean stratification that characterized part (if not all) of the Early Triassic (Hallam, 1994a; Isozaki, 1997) resulted in marked vertical gradients in $\delta^{13}C$ values of the seawater. Consequently, the interpretation of the carbon isotope record for this time interval is not straightforward. Therefore, there are some uncertainities as to the carbon isotope pattern following the end-Permian drop. Our data-set confirm an earlier observation that Triassic $\delta^{13}C$ values are generally lower than their Permian counterparts (Holser, 1987; Grossman, 1994), the high Permian $\delta^{13}C$ values are encountered only occasionally during the Triassic.

Smithian/Spathian boundary

A well marked positive excursion of $\delta^{13}C$ values has been found by Guex and Menoud (unpublished) and further described by Baud et al. (1996), just bellow the Smithian/Spathian boundary in the classical section from Nammal Gorge, Salt Range, within the Anasibirites pluriformis Zone (Guex, 1978). It was reproduced in another section from Salt Range, Landu Nala, situated about 70 km far to Nammal Gorge section. Its global extent has yet to be demonstrated. However, an increased $\delta^{13}C$ values at the Smithian/Spathian boundary can be explained by an increase in ocean productivity, in agreement with the radiation event that took place simultaneously (Hallam, 1996).

Spathian/Anisian

For the Spathian to Carnian time interval we have a consistent data set derived from the study of several sections from North Dobrogea. We had the advantage to acquire this data set in a very well-defined biostratigraphical context, due to the generous collaboration with Prof. E. Gradinaru, University of Bucharest, who provided a wealth of unpublished information. In addition, the selected units escaped to a severe tectonic deformation and burial diagenesis, as revealed by field observation, microfacies analysis, low Colour Alteration Index of conodonts and oxygen isotope $\delta^{18}O$ values from carbonate cements. Further constraints are provided by trace elements geochemistry, studied by S. Zerrari and M. Renard (University Paris VI). The most interesting feature offered by the Dobrogean record is a pronounced positive excursion in $\delta^{13}C$ values across the Lower Triassic/Middle Triassic boundary (Atudorei et al., 1996). It is well defined in a composite section made-up exclusively by Halsttatt-type red pelagic limestones, spanning from the Lower Spathian to Lower Carnian. Hallstatt-type limestones are particularly suitable for carbon isotope analysis because of their pelagic nature, their lack of organic carbon and their richness in

fossils which offer a good age control. It is noteworthy mentioning that the composite section includes the Desli Caira section, a candidate for the Spathian/Anisian boundary stratotype (Gradinaru, 1993; Gaetani, 1994; Crasquin-Soleau and Gradinaru, 1996). The rise in $\delta^{13}C$ values starts in the Uppermost Spathian and the most positive values are attained in the Lowermost Anisian (*Aegeiceras ugra* Zone). The recovery to background values (that are typical to the Lower Spathian and the remainder of the Middle Triassic), takes place somewhere close to the Lower/Middle Anisian boundary. This pattern was reproduced in two other sections from North Dobrogea, in different lithological settings. The Lower/Middle Triassic carbon isotope event has a particular significance (Atudorei et al., in prep.); it may reflect a time when major changes took place in oceanic circulation patterns, a time when the biological recovery after the end-Permian mass extinction was significantly accelerated. Indeed, a major radiation of marine biota was reported for this time (Erwin, 1996). A pronounced global excursion of sulfur isotope ratios from marine sulfates, one of the most striking feature of the sulfur isotopic curve for all the Phanerozoic (e.g., Holser et al., 1977) also occur at that time.

Regardless of the implications relating to the recovery from the mass extinction, we believe that the Spathian/Anisian carbon isotope event can be used as a stratigraphical marker and may help in the choice of the Spathian/Anisian boundary stratotype. However, data from other sections spanning this time interval are needed to confirm the $\delta^{13}C$ pattern.

Carnian to Norian

The carbon isotope record from Hallstatt-type limestones also exhibit a gradual and gentle rise of 1.5‰in $\delta^{13}C$ values during the Carnian. Unfortunately, our data set do not include enough data from the Upper Triassic to better define this trend. Böhm and Gawlick (1997) studied the carbon isotope profile for the Upper Triassic from a section in the Northern Alps, analysing also Halsttatt -type limestones. They reported high $\delta^{13}C$ values for the Upper Carnian and a positive excursion in the Lower Norian. Combining our data-set with the one reported by Böhm and Gawlick, a consistent trend can be defined, with a gradual rise in $\delta^{13}C$ values from the Lower Carnian to Lower Norian, followed by a decrease in $\delta^{13}C$ values starting with the Upper Lower Norian. Certainly, this pattern needs further constraints; however, as a first approximation, it seems to be in agreement with Steuber's (1991) organic carbon isotope record.

Triassic/Jurassic boundary

Most extinction events have been associated with marked carbon isotope excursions (Magaritz, 1991). Of the five Phanerozoic major extinction events (Raup, 1986), only for the end-Triassic extinction there is no clear evidence of carbon isotope variations. Hallam (1994b) reported a negative inorganic carbon isotope excursion in the Kendelbach section (Austria), but considered it to be a diagenetic artifact as it is mirrored by the organic carbon isotope curve (Morante and Hallam, 1996). In a preliminary study of the classic New York Canyon section, Taylor et al. (1992) reported some variations of the $\delta^{13}C$ profile near the boundary, but full data have not been published yet.

Conclusions

Excepting the negative carbon isotope excursion that paralleled the end-Permian mass extinction, three positive carbon isotope events have been recorded during the Triassic. All of them need further confirmation as to their global extent. At least for the Spathian/Anisian event, we have strong reasons to presume his global nature. Positive carbon events are commonly interpreted in terms of the net flux of organic carbon buried and the effectiveness of the 'biological pump'. For

the Smithian/Spathian and Spathian/Anisian events, they may reflect pulses of increased productivity, as they are coincident with reported radiation events. In this respect, the Triassic carbon isotope curve shares much of its Cambrian counterpart, for which a number of isotopic events were correlated with global bio-events (Brasier, 1996).

A review of the actual state of knowledge of the Triassic carbon isotope variations is presented in this note, as well as an evaluation of their potential use for stratigraphic correlations. Our aim is to call the attention of people working in Triassic stratigraphy on a field they may find useful in their research. We did not attempt to discuss here the origin of the proposed carbon isotope excursions, neither did we detail the problems that might be encountered by such studies. It is strongly recommended that stable isotope studies in stratigraphical issues should be coupled with biostratigraphy, carbonate sedimentology, microfacies analysis and other physical or geochemical studies. In the absence of such constraints, the interpretation could be misleading.

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MAGNETOSTRATIGRAPHY AND BIOSTRATIGRAPHY OF THE ANISIAN-LADINIAN BOUNDARY SECTION FELSŐÖRS (BALATON HIGHLAND, HUNGARY)

E. Márton, T. Budai, J. Haas, S. Kovács, I. Szabó, A. Vörös

Introduction

The classic Anisian–Ladinian section at Felsőörs, Hungary is one of the candidates for global stratotype section for the base of the Ladinian. In the last decades and particularly in the last couple of years, a lot of efforts were made to elaborate precise biostratigraphic subdivisions, based on various fossil groups. The results of investigations on the ammonites, conodonts, radiolarians, foraminifers and palynomorphs were published in a thematic volume of the Acta Geologica Hungarica, in 1993 (Vörös, 1993, Kovács, 1993a, Dosztály, 1993, Góczán & Oravecz-Scheffer, 1993), and some other papers (Kovács et al. 1990, Kovács 1993b, Budai and Vörös 1993). Based on these and more recent studies, Kovács et al. (1994), Vörös (1995) and Vörös et al. (1996) summarised the biostratigraphy and discussed the problem of the Anisian/Ladinian boundary interval in the Balaton Highland area.

Although the Felsőörs section seemed to fulfil the severe requirements of the GSSP in a lot of respects, hitherto the section lacked published magnetostratigraphic results. The first samplings and paleomagnetic measurements of the section were carried out by E. Márton and J. Haas in 1981-82. Another sampling focusing mainly on the boundary layers and the Ladinian part of the section was made by E. Márton and A. Vörös in 1996.

The aim of the present paper is to integrate the results of the earlier and recent series of measurements and present the relationships of the magnetostratigraphy and the biostratigraphic boundaries. Difficulties in the interpretation of the measurements and the grade of confidence of the presented results are also discussed.

Magnetostratigraphy of the Felsőörs section is an important tool to check the biostratigraphically based correlations and also the continuity of the prominent sections exposing the Anisian/Ladinian boundary interval.

Geological setting

The Felsőörs area is located in the north-eastern part of the Balaton Highland forming the southern flank of the Transdanubian Range's synclinorium (Fig. 1). The area is made up by the following main stratigraphic units (Budai 1991): Upper Permian red sandtsones of fluviatile-lacustrine facies (Balatonfelvidék Sandstone Fm.) overlying the Hercynian anchimetamorphic basement; Lower Triassic shallow marine siliciclastic-carbonate series of mixed ramp facies ("Werfen Group"); Lower-Middle Anisian carbonates of shallow marine ramp facies (Aszófő Dolomite, Iszkahegy Limestone, Megyehegy Dolomite); Middle-Upper Anisian (Felsőörs Fm.), Ladinian (Buchenstein Fm.) and lowermost Carnian (Füred Fm.) limestones of pelagic basin facies; tongues of Lower and Middle Carnian platforms (Budaörs and Sédvölgy Dolomite) which are intercalated into the basin successions (Veszprém Marl); and finally Upper Carnian platform carbonates (Main Dolomite).

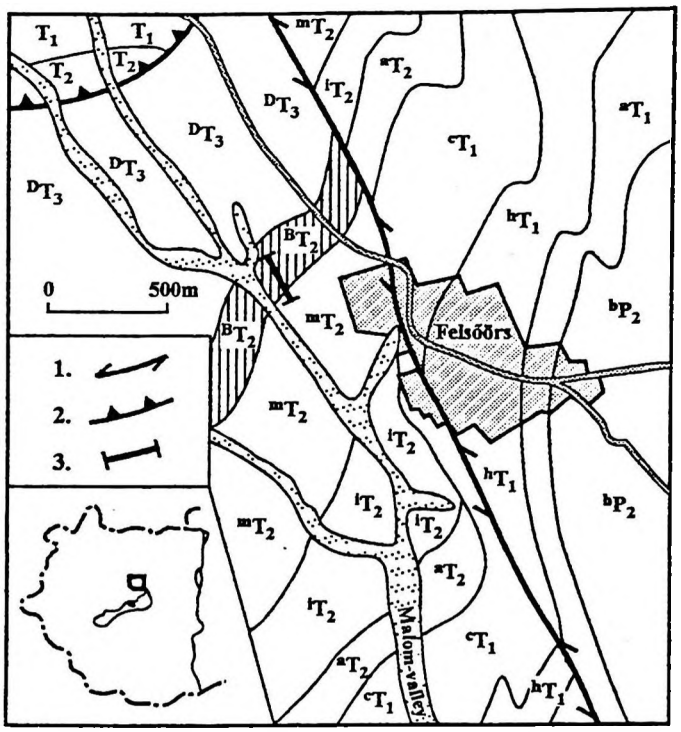


Fig. 1. Geological sketch of the Felsőörs area (simplified after Budai 1991, Fig.1).

Legend: 1. strike slip fault; 2. "Litér overthrust"; 3. key section.

Symbols of the formations:
$^{b}P_2$ Balatonfelvidék Sandstone Formation;
$^{a}T_1$ Arács Formation;
$^{h}T_1$ Hidegkút Formation;
$^{c}T_1$ Csopak Formation;
$^{a}T_2$ Aszófő Dolomite Formation;
$^{i}T_2$ Iszkahegy Limestone Formation;
$^{m}T_2$ Megyehegy Dolomite Formation;
$^{B}T_2$ Felsőörs + Buchenstein + Füred Formation;
$^{D}T_3$ Budaörs + Sédvölgy + Main Dolomite Formation

A significant structural feature of the territory is characterised by the "Litér overthrust" running North to Felsőörs and a sinistral strike slip fault crossing the village from Northwest to Southeast.

The Middle Anisian to Upper Ladinian key-section at Felsőörs is exposed in three, partly overlapping trenches on the NE side of the Malom valley. The first trench (Fig. 2a) begins with bedded dolomicrosparite of the Megyehegy Formation (Beds 0-22). The overlying yellowish-grey bituminous, thin-bedded dolomites and dolomitic marls of restricted basin facies (Beds 23-43) represent a transition towards the Felsőörs Formation ("transitional unit"). The next part of the section consisting of grey, bedded limestones with chert nodules (Beds 44-67) and crinoidal-brachiopodal marly limestones (Beds 68-81) belongs to the Felsőörs Formation. At the base of the second trench poorly exposed crinoidal limestones are visible which are probably equivalent to the uppermost beds of the first trench. Above these layers grey, flaser-bedded limestone occurs. It is followed by 1 m thick tuffitic intercalation.

The overlying well-bedded sequence (Beds 87-99/C) consists of 8-20 cm thick, grey limestone layers with 5-30 cm thick, yellow clay interlayers (Fig. 2b). At the top of the second trench an uneven bedding surface has been exposed - the footwall of the overlying tuffaceous succession. In the third trench a 18 m thick tuffitic sequence is visible. It consists of greenish-white, locally brownish-yellow K-trachyte tuffs with thin limestone interlayers or lenses ("pietra verde"). The tuffaceous sequence is overlain by pinkish-grey, nodular limestones which are exposed at the end

of the trench. Higher up on the hillside, red, cherty limestones crop out representing the Nemesvámos Limestone Member of the Buchenstein Formation.

Paleomagnetic sampling and measurements

Paleomagnetic samples were drilled and magnetically oriented in the field. Each bed, suitable for drilling was sampled. In order to test the consistency of the magnetic signal, two or more samples were collected from some of the beds. Most of the beds, however, are represented by one sample. The total number of samples is 132.

The cores drilled in the field were cut into standard-size specimens. The NRM and the susceptibility of each specimen was measured using JR-4 spinner magnetometers and a KLY-2 susceptibility bridge. All specimens were demagnetised, using AF, or thermal method (Schonstedt demagnetizers) or the combination of the two. In case of thermal demagnetisation, the susceptibility was monitored.

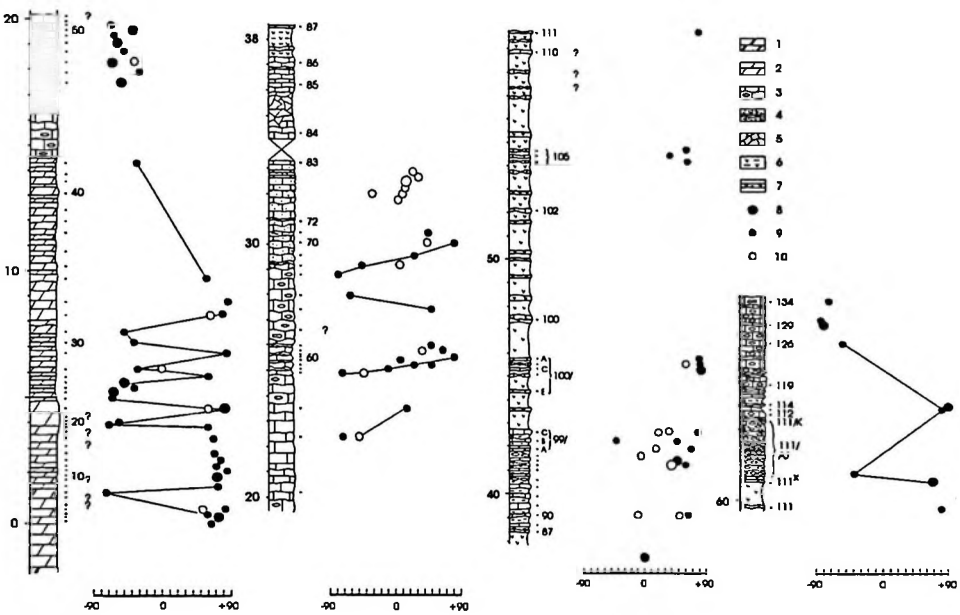


Fig. 2 a(left) and b (right). Lithologic column of the Felsőörs section with the VGP curve. Legend: 1. bedded dolomites of Megyehegy Fm.; 2. bituminous marly dolomites of the "transitional unit"; 3. limestones, nodular cherty limestones; 4. crinoidal-brachiopodal limestones of Felsőörs Fm.; 5. poorly exposed, fractured limestones; 6. tuffs, tuffitic clays; 7. crystal tuff interlayers; 8. VGP latitude as the mean of two coinciding directions; 9. VGP latitude; 10. transitional VGPs or in case of two or more samples/bed lower then the maximum VGPs.

Paleomagnetic results

Some samples, which were either too weak to stand demagnetisation or the magnetic signal was acquired in the present Earth magnetic field, were rejected. The majority, however, exhibited characteristic magnetisation which was different from the direction of the present Earth field. Typically, the NRMs were apparently single-component, after the removal of a very soft component (Fig. 3). Despite of such behaviour on demagnetisation, the scatter of the characteristic remanence directions was large.

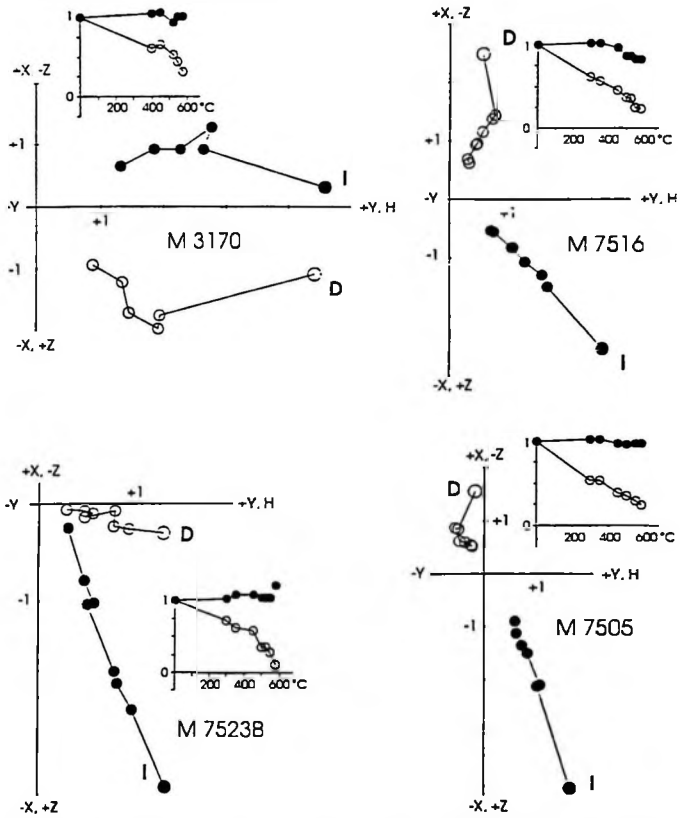


Fig. 3. Typical demagnetisation curves. Modified Zijderveld diagrams (D-declination, I-inclination) and normalised intensity (circles) / susceptibility (dots) versus temperature curves. Thermal demagnetisation. They are suggesting single-component NRM, with easily removable overprint in specimens M3170, m7516 and M7505. One unit in the Zijderveld diagrams is $4x10^{-5}$, $8x10^{-4}$, $5x10^{-4}$ and $1.6x10^{-4}$ A/m. Initial susceptibilities/intensities are: $-7x10^{-6}/1.8x10^{-4}$ A/m; $9x10^{-5}$ /$2.2x10^{-3}$ A/m; $2.4x10^{-5}$ /$5.1x10^{-4}$ A/m; $1.8x10^{-5}$ /$6.9x10^{-4}$ A/m.

From each of the characteristic magnetisation direction, virtual geomagnetic pole positions (VGP) were calculated. The mean of the VGPs were based on all the VGPs. Then, VGP latitudes were computed and plotted against the lithostratigraphic column (Fig. 2 a-b).

The plot of the VGP latitudes reveals that while certain parts of the section are characterised by clear-cut polarity pattern, others are poorly defined. Nevertheless, when data with VGP latitudes lower than 60 degrees are omitted, the population of normal and reversed polarity directions (Fig. 4) still fails the reversal test. The failure is due to the difference between the inclinations of the two groups. We think that the explanation lies in slow diagenesis, during which field reversal took place, the carrier of the characteristic remanence became basically set along the field prevailing during deposition, but the alignment of some grains was delayed , and took place only in the next polarity event.

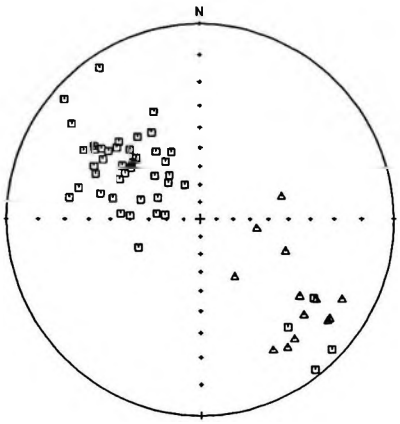
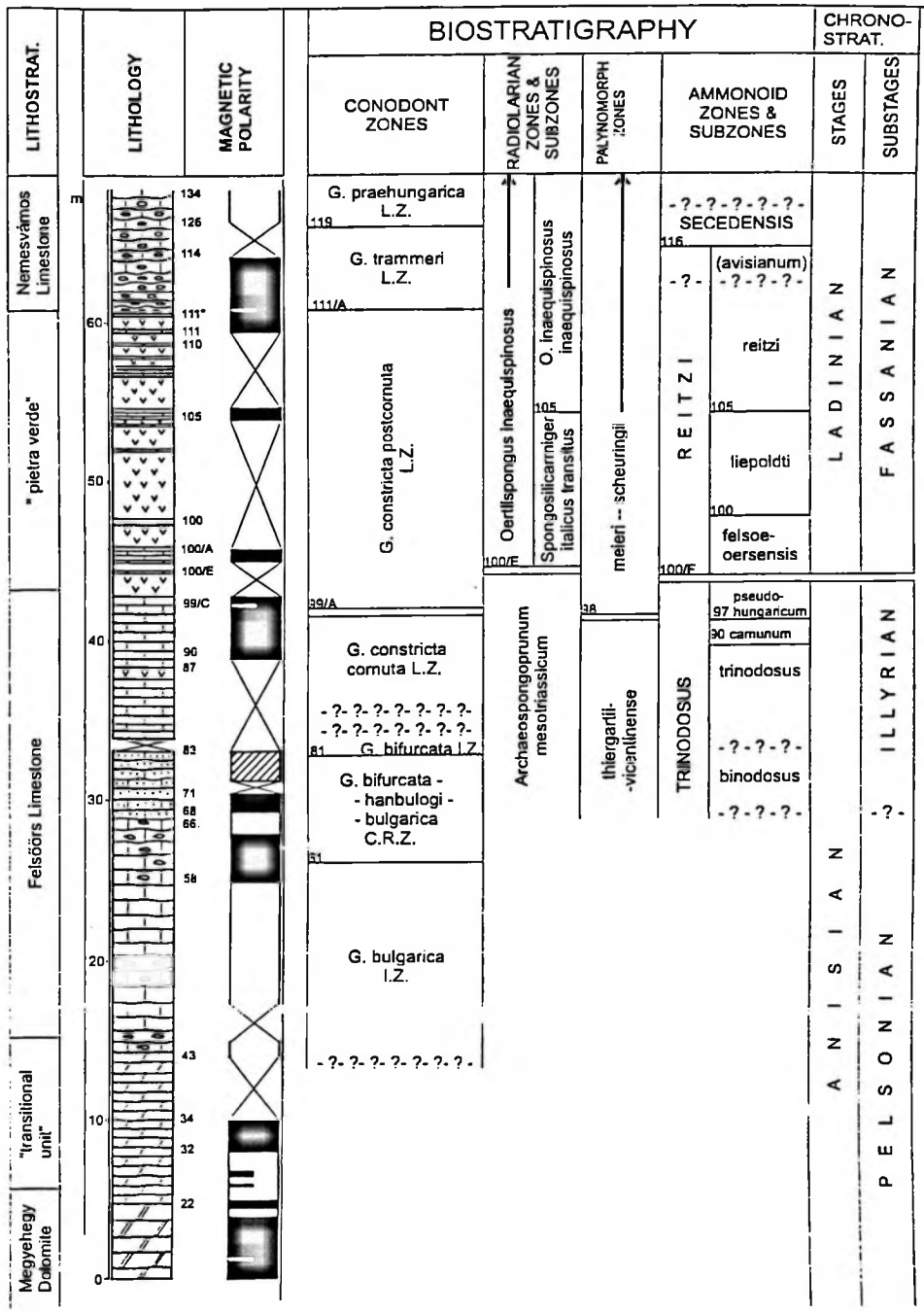


Fig. 4. Plot of characteristic remanence directions for samples with VGP latitudes ≥ 60°. Squares positive, triangles negative inclinations. Stereographic plot, geographic system (using the program by Enkin, 1992). Note that the directions are significantly different from the directions of the present Earth field (D=0°, I=60°) at the sampling locality.

The VGP latitudes, when positive, correspond to normal, when negative, to reversed polarity. The VGP latitudes at the Felsőörs section are sometimes of "ambiguous" character, i.e. the paleolatitudes are persistently near-equatorial (see for example the 75-81 beds of the section, which is, incidentally, a reworked part of the section). In such cases, we do not define a polarity zone. In case of a single VGP of opposite polarity, within a polarity zone, an indentation of corresponding polarity indicates a possible reversal event.

Fig. 5. Integrated stratigraphy of the Felsőörs section. The magnetic polarity column was constructed from the VGP curve shown in Fig. 2.a-b. In the biostratigraphical column the ammonoid and radiolarian zones are the same as in Vörös et al. (1996). The conodont and palynomorph zones were introduced by Kovács (1993) and Kovács et al. (1994). The preferred position of the base of the Ladinian (candidate No. 1: base of the Reitzi Zone) is marked with double horizontal lines. Note that the corresponding zonal boundaries of the microfossil groups, though not exactly coincide, show very good correlation with the ammonoid zonal boundary.


LITHOSTRAT.
LITHOLOGY
MAGNETIC POLARITY
BIOSTRATIGRAPHY
CHRONO-STRAT.
CONODONT ZONES
RADIOLARIAN ZONES & SUBZONES
PALYNOMORPH ZONES
AMMONOID ZONES & SUBZONES
STAGES
SUBSTAGES
Nemesvámos Limestone
"pietra verde"
Felsöörs Limestone
"transitional unit"
Megyehegy Dolomite
m
0
10
20
30
40
50
60
134
126
114
111*
111
110
105
100
100/A
100/E
99/C
90
87
83
71
68
66
58
43
34
32
22
G. praehungarica L.Z.
119
G. trammeri L.Z.
111/A
G. constricta postcornuta L.Z.
99/A
G. constricta cornuta L.Z.
81
G. bifurcata L.Z.
G. bifurcata - - hanbulogi - - bulgarica C.R.Z.
51
G. bulgarica I.Z.
Oertlispongus inaequalispinosus
O. inaequalispinosus inaequalispinosus
105
Spongosilicarniger italicus transitus
100/E
Archaeospongoprunum mesotriassicum
meleri -- scheuringii
98
thiergartii- -vicentinense
- ? - ? - ? - ? - ? -
SECEDENSIS
115
- ? -
(avisianum)
- ? - ? - ? -
reitzi
105
liepoldti
100
felsoe-oersensis
100/F
REITZI
pseudo-97 hungaricum
90 camunum
trinodosus
- ? - ? - ? -
binodosus
- ? - ? - ? -
TRINODOSUS
LADINIAN
FASSANIAN
ANISIAN
ILLYRIAN
- ? -
PELSONIAN

Discussion

In Fig. 5 we present the integrated stratigraphy of the Felsőörs section where the magnetic polarity column is correlated with the litho- bio- and chronostratigraphical subdivision.

Of the biostratigraphical units the ammonoid and radiolarian zones are identical with those used in Vörös et al. (1996). The conodont and palynomorph zones were introduced and used for the section by Kovács (1993a,b) and Kovács et al. (1994). It has to be mentioned that the palynomorph zones ("phases") have not been recorded directly in the Felsőörs section but in several other (mainly borehole) sequences in the Balaton and Bakony area (e.g. Balatonfüred, Szentantalfa, Bakonyszűcs; see Góczán and Oravecz-Scheffer, 1993). In these borehole sequences the sharp palynological change (from the *thiergartii-vicentinense* to the *meieri-scheuringi* phase) showed a definite correlation with an important change, a replacement, in the foraminifer associations. This diagnostic change of the foraminifer association was recorded in the bed No. 98 of the Felsőörs section and by means of this the palynological zonal boundary was drawn here by Góczán and Oravecz-Scheffer (1993).

In the biostratigraphical column the preferred position of the base of the Ladinian is marked with double horizontal lines. For the ammonoids, this is at the base of the *Reitzi* Zone (the *Felsoeoersensis* Subzone) at the bed No. 100/F. This is the variant No. 1, the lowermost from the three candidates, suggested by Gaetani (1993), Brack and Rieber (1994) and others, for the base of the Ladinian. The corresponding zonal boundaries of the three microfossil groups, though not exactly coincide, show very good correlation with the ammonoid boundary.

The magnetic polarity column, constructed from the data and the VGP curve shown in Fig. 5, is discontinuous therefore its evaluation and comparison to other Anisian-Ladinian scales (e.g. Muttoni and Kent, 1994, Muttoni et al., 1996, 1997) is rather ambiguous. The geomagnetic record is good and almost continuous in the lower (Pelsonian) part of the section and shows a dominantly reversed interval with a few, short normal episodes. This seems to be an important new contribution to the Middle Triassic magnetostratigraphy complementing the respective part of the magnetic polarity scale of Gradstein et al. (1994).

In the higher part there are several gaps of information in our magnetic polarity column. It seems to be sure that the base of the *Reitzi* Zone, i.e. our suggested candidate for the base of the Ladinian, falls into a normal polarity interval, recorded in the highest part of the Felsőörs Limestone and in the lowermost limestone intercalations in the thick tuffitic "pietra verde". This normal polarity interval can probably be correlated with the rather long normal interval found by Muttoni and Kent (1994) in the upper part of the Prezzo Limestone (*Trinodosus* zone and *Lardaroceras* beds) and in the basal part of the Buchenstein Formation of west Lombardy. A further correlation seems to be possible with the lowermost part of the Vlichos section (Hydra) where, just above the beds with *Asseretoceras* and "*Kellnerites*", a normal polarity interval was found in the lowermost part of the Reitzi Zone (Muttoni et al., 1997).

The marked normal polarity interval in the beds 111 to 114 (corresponding to the *G. trammeri* conodont zone) and the subsequent reversed interval in the beds 126 to 134 (corresponding the *G. praehungarica* conodont zone) may tentatively be correlated with the respective polarity intervals found in the top of the *Reitzi* Zone and in the lowermost *Curionii* Zone in Frötschbach and in Vlichos by Muttoni et al. (1996, 1997).

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FIRST USE OF ORNITHISCHIAN DINOSAURS FOR BIOSTRATIGRAPHIC ZONATION OF THE UPPER TRIASSIC

Andrew B. Heckert and Spencer G. Lucas

The recently recognized ornithischian dinosaurs *Tecovasaurus murryi* and *Revueltosaurus callenderi* occur stratigraphically superposed at several localities in the Chinle Group in Texas, New Mexico, and Arizona; U.S.A. *Tecovasaurus* occurs at the type locality in the Tecovas Formation in Crosby County, Texas, at the *Placerias* quarry in the Bluewater Creek Formation of eastern Arizona, and from low in the Bluewater Creek Formation near Fort Wingate, New Mexico. These localities are in strata that produce a vertebrate fossil assemblage typical of the Adamanian (latest Carnian) land vertebrate faunachron (lvf). *Revueltosaurus* is known from its type locality in the Bull Canyon Formation of eastern New Mexico and from the Painted Desert Member of the Petrified Forest Formation in the Petrified Forest National Park in eastern Arizona. These strata have been assigned to the Revueltian lvf of early-mid Norian age on the basis of tetrapod fossils, including phytosaurs and aetosaurs. Because the biostratigraphic zonation of *Tecovasaurus* and *Revueltosaurus* independently support other biostratigraphic correlations, particularly those of tetrapods, we suggest that the dinosaur *Tecovasaurus* is an additional index taxon of the Adamanian lvf, which is generally characterized by the aetosaur *Stagonolepis* and the phytosaur *Rutiodon*. Similarly, *Revueltosaurus* is an index taxon of the Revueltian lvf, in addition to the aetosaur *Typothorax* and the phytosaur *Pseudopalatus*. To date, *Tecovasaurus* and *Revueltosaurus* are the only Triassic ornithischians identified from multiple localities. This is the first use of dinosaur genera as biostratigraphic indicators in the Upper Triassic and should be useful in future studies of microvertebrates in the Chinle Group.

Introduction

In spite of many recent discoveries of new Triassic dinosaurs, particularly in the Western Hemisphere (e.g., Hunt, 1989; Sereno et al., 1993) and continued work on older, better-known forms (Colbert, 1989; Hunt and Lucas, 1991; Sereno and Novas, 1992; Novas, 1993; Sereno, 1993; Sereno and Novas, 1993), dinosaurs remain poor biostratigraphic indicators of Upper Triassic strata. This is largely due to the endemism of most Triassic dinosaur taxa, which are often limited to a single locality. Consequently, tetrapod-based correlations of Upper Triassic sediments have remained tied to phytosaurs, aetosaurs, and metoposaurs (e.g., Gregory, 1957; Colbert, 1972; Lucas and Hunt, 1993; Lucas, 1997). Although many recent advances in the temporal and spatial distribution of these large tetrapod taxa have greatly improved these correlations (Lucas and Huber, 1998), two facts are readily apparent. First, dinosaurs are conspicuously absent from the present correlation schemes, and second, the bulk of the taxa used for correlation, such as phytosaurs and aetosaurs, are all relatively large (often >2 m). Here, we document the first use of Triassic microvertebrate fossils to correlate two superposed zones in nonmarine Upper Triassic strata. Interestingly, the fossils themselves are teeth of the ornithischian dinosaurs *Tecovasaurus murryi* (of latest Carnian age) and *Revueltosaurus callenderi* (of early-mid Norian age). Here, MNA refers to the Museum of Northern Arizona, Flagstaff, Arizona, and NMMNH refers to the New Mexico Museum of Natural History, Albuquerque, New Mexico.

Taxa

The fossil record of Triassic ornithischians remains relatively poor, in spite of continued research on Late Triassic faunas. The only undisputed Triassic ornithischians that include material beyond teeth are *Pisanosaurus mertii* from the Ischigualasto Formation of Argentina (Casamiquela, 1967; Bonaparte, 1976) and parts of the holotype of *Technosaurus smalli* from the Bull Canyon Formation of West Texas (Chatterjee, 1984; Sereno, 1991). Hunt (1989) named *Revueltosaurus callenderi* for a collection of ornithischian teeth from a single locality in the Bull Canyon Formation of east-central New Mexico. Hunt and Lucas (1994) named a variety of ornithischian taxa based on teeth from the Upper Triassic of North America, including *Tecovasaurus murryi* from the Tecovas Formation of West Texas. Other taxa named by Hunt and Lucas include *Galtonia gibbidens* (= "*Thecodontosaurus*" *gibbidens* Cope, 1878) from the New Oxford Formation in Pennsylvania, *Pekinosaurus olseni* from the Pekin Formation of North Carolina, USA, and *Lucianosaurus wildi* from the Bull Canyon Formation of New Mexico, USA. At the present time, *Galtonia*, *Pekinosaurus*, and *Lucianosaurus* are known solely from their type localities and thus are not yet biostratigraphically useful. *Tecovasaurus* and *Revueltosaurus*, however, have broader distributions and thus are of biostratigraphic and biochronological interest.

Tecovasaurus murryi

We present the following diagnosis of *Tecovasaurus*, revised slightly from Hunt and Lucas (1994, p. 232): ornithischian with dentary/maxillary tooth crowns that are low and mesio-distally long and markedly asymmetrical, with up to six large and 3-4 small denticles on the steeply inclined, convex, distal margin and approximately twice as many (12-18) small denticles on the gently sloping, flat to concave mesial margin. The distal denticles do not reach the base of the crown and there are no cingula (Fig. 1).

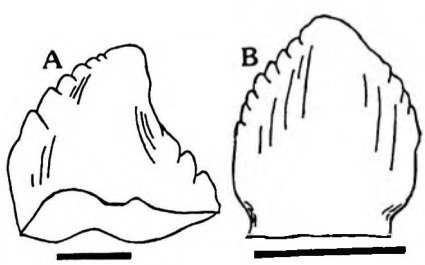

Fig. 1. Tooth crowns of Triassic ornithischain dinosaurs: (A) Tooth crown of Tecovasaurus murryi *from the Tecovas Formation of west Texas; (B) Maxillary/dentary? tooth of* Revueltosaurus callenderi *from the Bull Canyon Formation of eastern New Mexico. Scale bars: A = 0.5 mm, B = 5.0 mm.*

Tecovasaurus murryi is currently known from three localities: (1) the type locality in the Tecovas Formation, in Crosby County, West Texas (Hunt and Lucas, 1994, figs. 12.5G-J, 12.6, 12.7A-B); (2) the *Placerias* quarry in the Bluewater Creek Formation, eastern Arizona (Hunt and Lucas, 1994, fig. 12.6A-B; Kaye and Padian, 1994, fig. 9.108); and (3) the lower Bluewater Creek Formation in western New Mexico (NMMNH locality 2739).

Hunt and Lucas (1994) noted that, in addition to the holotype, NMMNH P-18192, several other teeth of *Tecovasaurus murryi* were present at locality 1430. Since that time, we have confirmed that several additional teeth of *Tecovasaurus* were collected from that locality (e.g., NMMNH P-26417). There were also some ornithischian teeth of strikingly different morphologies and, therefore, presumably, of different taxa. Hunt and Lucas also pointed out that some of the ornithischian teeth assigned to MNA PL. 1704 from the *Placerias* quarry in eastern Arizona pertain

to *Tecovasaurus*. Heckert et al. (1997) briefly noted that, of several ornithischian teeth culled from screen wash material from NMMNH locality 2739 in west-central New Mexico, at least one can be assigned to *Tecovasaurus*.

Tecovasaurus localities in Texas, New Mexico, and Arizona are in strata that produce a tetrapod fauna of Adamanian (latest Carnian) age, including the phytosaur *Rutiodon* and the aetosaur *Stagonolepis*.

Revueltosaurus callenderi

We present the following diagnosis of *Revueltosaurus*, slightly modified from Hunt (1989) and Hunt and Lucas (1994): ornithischian with tall, slightly recurved, "premaxillary" teeth (length/height = 0.72) with denticulated mesial and distal margins. "Premaxillary" tooth crowns are twice the height of "dentary/maxillary" tooth crowns. "Dentary/maxillary" tooth crowns are also tall (length/height = 0.88) and lack accessory cusps. Root:crown ratio of dentary/maxillary teeth of up to 1.75. Teeth are large by the standards of Triassic ornithischians, up to 28 mm in total height from base of root to tip of crown (Fig. 1).

Revueltosaurus callenderi is currently known from two localities: (1) the type locality in the Bull Canyon Formation, east-central New Mexico (Hunt, 1989, pl. 8,E-H, pl. 9A-H; Hunt and Lucas, 1994, figs. 12.7E-F, 12.8C&H); and (2) "Dinosaur Hill" in the Painted Desert Member of the Petrified Forest Formation, Chinle Group, in eastern Arizona (Padian, 1990, fig. 1). Ornithischian teeth referred to *Revueltosaurus* by Long and Murry (1995, fig. 194) superficially resemble *Revueltosaurus* but differ significantly in size and shape and thus probably represent a different taxon.

Padian (1990) recognized teeth of *Revueltosaurus* from the Painted Desert Member of the Petrified Forest Formation in east-central Arizona, but relegated *Revueltosaurus* to the status of form genus. Sereno (1991), in his review of early ornithischian dinosaurs, believed the association of the type and topotypic material of *Revueltosaurus* questionable and thus considered *Revueltosaurus* a *nomen dubium*. Kaye and Padian (1994, fig. 9.71) referred a tooth from the *Placerias* quarry, MNA V3690, to *Revueltosaurus*. However, this tooth is considerably smaller (1 mm mesio-distally) than the type of *Revueltosaurus* and morphologically more similar to *Galtonia gibbidens* than *Revueltosaurus*. Other teeth identified as ornithischian, possibly aff. *Revueltosaurus*, by Kaye and Padian (1994, figs. 9.104, 9.108) do not pertain to that taxon. Instead, V3682 (Kaye and Padian, 1994, fig. 9.104) is not even clearly ornithischian, and V3597 (fig. 9.108) is instead a tooth of *Tecovasaurus*, quite possibly one of the largest yet known for that genus. Ornithischian teeth referred to *Revueltosaurus* by Long and Murry (1995, fig. 194) superficially resemble *Revueltosaurus* but differ significantly in size and shape and thus probably represent a different taxon.

Revueltosaurus localities in New Mexico and Arizona occur in strata that produce a tetrapod fauna of Revueltian (early-mid Norian) age, including the phytosaur *Pseudopalatus* and the aetosaur *Typothorax*. Based on tooth size, *Revueltosaurus* is one of the largest Triassic ornithischian dinosaurs.

Stratigraphic Distribution

The Tecovas Formation in Texas produces a diverse tetrapod fauna that includes the phytosaur *Rutiodon* (*sensu* Ballew, 1989) and the aetosaur *Stagonolepis* (Case, 1932; Lucas and Hunt, 1993). For a detailed review of the lithostratigraphy and biostratigraphy of the region, see Lucas et al. (1994).

Lucas et al. (1997) discussed the litho- and biostratigraphy of the *Placerias* quarry, and noted that it occurs low in the Bluewater Creek Formation, not in the Blue Mesa Member of the Petrified Forest Formation, as most previous workers had thought. The *Placerias* quarry produces a tetrapod fauna almost identical to that of the type Adamanian (Lucas and Hunt, 1993; Long and Murry, 1995; Lucas et al. 1997), including abundant specimens of the aetosaur *Stagonolepis* and phytosaur skull fragments assignable to *Rutiodon*. Therefore, the Arizona occurrence of *Tecovasaurus* is of undoubted latest Carnian age.

<table>
<tr><th colspan="2">east Arizona/ west New Mexico</th><th>faunachron/correlations</th><th colspan="2">east New Mexico/ west Texas</th></tr>
<tr><td colspan="2">Rock Point Formation</td><td>Apachean lvf</td><td colspan="2">Redonda Formation</td></tr>
<tr><td colspan="2">Owl Rock Formation</td><td rowspan="3">Revueltian lvf
Revueltosaurus localities</td><td colspan="2" rowspan="2">Bull Canyon Formation</td></tr>
<tr><td rowspan="3">Petrified Forest Formation</td><td>Painted Desert Member</td></tr>
<tr><td>Sonsela Member</td><td rowspan="4">Dockum Formation</td><td>Trujillo Member</td></tr>
<tr><td>Blue Mesa Member</td><td rowspan="2">Adamanian lvf
Tecovasaurus localities</td><td>Tecovas Member</td></tr>
<tr><td colspan="2">Bluewater Creek Formation</td><td>Colorado City Member</td></tr>
<tr><td colspan="2">Shinarump Formation</td><td>Otischalkian lvf</td><td>Camp Springs Member</td></tr>
</table>

Fig. 2 .Correlation of Chinle Group strata in Arizona, New Mexico, and Texas. Faunachrons are those of Lucas and Hunt (1993). Note that the stratigraphic superposition of Tecovasaurus *and* Revueltosaurus *independently supports the land vertebrate faunachrons of Lucas and Hunt.*

The third occurrence of *Tecovasaurus*, from New Mexico, is also of Adamanian (latest Carnian) age. NMMNH locality 2739, from which a single tooth of *Tecovasaurus* has been recovered, is low in the Bluewater Creek Formation, at a horizon homotaxial to that of the *Placerias* quarry (Heckert, 1997a). In addition to this strong lithostratigraphic evidence for an Adamanian age, the Bluewater Creek Formation in western New Mexico yields a tetrapod fauna that includes *Stagonolepis* (Heckert, 1997a,b). Because there are now three localities that produce teeth identical in size, shape, and overall morphology to the holotype specimen of *Tecovasaurus*, we suggest that *Tecovasaurus murryi* is an index taxon of the Adamanian lvf.

The type locality of *Revueltosaurus* in the Bull Canyon Formation is part of the type area for the Revueltian lvf of Lucas and Hunt (1993), and thus *Revueltosaurus* is clearly of Revueltian (early-mid Norian) age. The Revueltian is characterized by, among other taxa, abundant small metoposaurids of the genus *Apachesaurus*, the phytosaur *Pseudopalatus* (*sensu* Ballew, 1989) and the aetosaur *Typothorax*. The Painted Desert locality reported by Padian (1990) is also Revueltian, based on the

presence of abundant *Apachesaurus* at the locality itself and numerous specimens of *Pseudopalatus* and *Typothorax* from correlative localities. Therefore, we propose that *Revueltosaurus* is an index taxon of the Revueltian lvf.

Conclusion

We have presented here the beginnings of an ornithischian-based dinosaur biostratigraphy for Upper Triassic strata. Multiple lines of evidence suggest that *Tecovasaurus* is an index taxon of the Adamanian lvf, and that *Revueltosaurus* is a suitable index taxon of the Revueltian lvf. This constitutes the first use of ornithischian dinosaurs to correlate multiple, stratigraphically superposed localities in the Upper Triassic.

Further collecting should provide a means by which to test the biostratigraphic hypotheses advanced here. We anticipate that, with increasing study of microvertebrate assemblages, these and perhaps other ornithischian dinosaurs will provide an accurate means of correlating strata across the Chinle Group and possibly to other localities. This appears to be especially likely due to the fact that, whereas Triassic ornithischians are generally more poorly known than other dinosaurs, particularly theropods, the high degree of variability in Triassic ornithischians allows for ready identification of taxa. Therefore we expect that the possibilities of correlating by means of microvertebrate fossils in the Upper Triassic will eventually rely heavily on biostratigraphic schemes like the one proposed here.

Acknowledgments

Susan Harris picked much concentrate from NMMNH localities and thus found many of the specimens of *Tecovasaurus* discussed here. The Mesalands Dinosaur Museum in Tucumcari and the Petrrified Forest Museum Association supported field work in the Petrified Forest National Park. Tom Olson found additional teeth of *Revueltosaurus* at Dinosaur Hill and aided with field work at the Petrified Forest National Park.

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Muschelkalk Museum Ingelfingen, Germany

After having been closed for more than a year, the Muschelkalk museum in Ingelfingen has re-opened with a modern exhibit that has been expanded from 20 m^2 to more 300 m^2 . It shows various aspects of the Muschelkalk worldwide, including two large *Placunopsis* reefs, a display of the borehole Ingelfingen drilled between 1857-1863 and of course many fossils from the collection of Dr. Hans Hagdorn with many crinoids and many other collectors from Germany, France and Poland. Also material from Spain siuthern France and the Southern Alps is shown. A life size model of a swimming Nothosaur and spectacular specimens *Mastodonsaurus* from the Lettenkeuper of Vellberg given an idea about the vertebrate fauna. The museum is opened on Sundays from 10.30 to 16.00 h and on Wednesdays from 15.00 to 17.00 h. For other arrangements please contact:

Dr. Hans Hagdorn, Schloßstraße 11, D-74653 Ingelfingen, Germany
Tel.: xx-49-7940/59500, Fax: xx-49-7940/59501, e-mail: Encrinus@t.online.de

THE FRIEDRICH VON ALBERTI PRIZE OF THE "HOHENLOHER SCHOTTERWERKE"

Friedrich von Alberti Foundation

An a meeting on April 17th, 1997 in Ingelfingen twenty Muschelkalk quarry companies in Baden-Württemberg - Franken have instituted a new foundation, the so-called "Friedrich-von-Alberti-Stiftung der Hohenloher Muschelkalkwerke". The goal of this foundation is to promote palaeontology. Archaeologists often complain that quarrying activities, building and road constructions often lead to the loss of archaeological sites. However, it is rarely realized that such activities for palaeontologists usually provide the only opportunities to investigate the fossil record. Therefore the "Hohenloher Muschelkalkwerke" have instituted the Friedrich von Alberti Foundation, named after the founder of the Triassic System who was a mining engineer, the director of the Friedrichshall salt works and the pioneer of the geology of southwest Germany.

The Friedrich von Alberti Foundation has established a fund of DM 500,000.- to support scientific work, primarily of young scientists for collecting, preparing, documenting and studying fossils, as well as museum displays and popular geological and palaeontological contributions. This primarily supports palaeon-tological activities in the region of Baden-Württemberg - Franken. The Friedrich von Alberti Foundation already enabled Rainer Schoch from Tübingen, who had just finished his Ph.D. research project on mastodonsaurs, to present his results on a congress in Prague.

Moreover, the Friedrich von Alberti Foundation has instituted the Friedrich von Alberti Prize which consists of a sum of DM 20,000.- and a facsimile reprint of von Alberti's classical 1834 book in which he established the Triassic System. The first Friedrich von Alberti prize will awarded annually, the first in the fall of 1998. The winner will be selected by a jury of experts of the "Paläontologische Gesellschaft", an international palaeontologicl society with over 1000 members worldwide. German amateur and professional palaeontologists as well as foreign candidates can be nominated. The awarded scientists, museums, institutes and fossil collectors should benefit from the publicity that is given to this prize. It is hoped that their work will become known to a broader public. By instituting this award the Muschelkalk quarries of the Hohenlohe area show their responsibility for natuarl history, culture and science.

A free translation of the statutes of the Friedrich von Alberti-Preis der Hohenloher Muschelkalkwerke follows below. The editor of ALBERTIANA does not accept any legal responsibility for this translation; the original German text can be obtained from: Dr. h.c. Hans Hagdorn, Schloßstraße 11, D-74653 Ingelfingen, Germany, e-mail: Encrinus@t-online.de

The Friedrich von Alberti-Preis der Hohenloher Muschelkalkwerke

§ 1 Name of the Prize, Award

1. The prize is named: "Friedrich von Alberti-Preis der Hohenloher Muschelkalkwerke"
2. The is given for an outstanding contribution to palaeontology and its popularization.
3. Outstanding contributions to be awarded can be individual single contributions or a complete work, which should documented by, e.g. publications, documentation, collections or exhibitions.
4. The "Friedrich von Alberti-Preis der Hohenloher Muschelkalkwerke" is given alternately to professional and amateur palaeontologists

§ 2 Endowment, Terms of Endowment

1. The "Friedrich von Alberti-Preis der Hohenloher Muschelkalkwerke" consists of a sum of DM 20,000.-. The prize can be awarded to several people.
2. According to § 1 the prize is given annually.

§ 3 Nominations

1. Nominations for the "Friedrich von Alberti-Preis der Hohenloher Muschelkalkwerke" can be made by individuals, groups or institutions. Nominations should he directed to the Board of the Paläontologische Gesellschaft e.V., Senckenberganlage 25, D-60325 Frankfurt am Main. Self-nominations will not be considered.
2. Each year, before December 31st, the board of the Paläontologische Gesellschaft e.V. presents qualified nominations together with short written statement to the board of the Friedrich-von-Alberti-Stiftung.

§ 4 Jury, Decisions

1. The board of the Friedrich-von-Alberti-Stiftung can, in accordance with its board of trustees, institute a juryy of three experts.

2. The board decides about the prize winners after having consulted the board of trustees.

§ 5 Awardance, Ceremony

1. The decision of the board on the date and time of the awardance will be comminucated to the winner(s) by a letter.
2. The prize(s) and diploma(s) will be awarded during an approriate festive ceremony.
3. The awardance will be each year in October in Ingelfingen.
4. The names of the prize winner(s) and a short summary of their achievements will be made public and communicated to the press
5. The name of the prize winner and a short statement about the prize winners contributions will be made public in the press.
6. An appreciation of the prize winner(s) will be published a.o. in 'Albertina', 'Fossilien', 'Geospektrum', 'Nachtrichten der Deutschen Geologischen Gesellschaf't, 'Die Naturstein-industrie', 'Paläontologie Aktuell', 'Steinbruch und Sandgrube' as well as in the newsletters of the 'Berufsverband deutscher Geologen, Geophysiker und Mineralogen' and the 'Deutsche Forschungsgemeinschaft'.

§ 6 Final Regulations

The board of the Friedrich von Alberti-Stiftung der Hohenloher Muschelkalkwerke can in accordance with the board of trustees change the regulations of §§ 1-5, especially with regard to the endowment of the prize.

The regulations of the statute of the Friedrich von Alberti-Stiftung der Hohenloher Muschelkalkwerke are thereby to be considered.

Ingelfingen, 8th November 1997

Eberhard Mühlhausen Chariman of the Board	Hans Hagdorn Board member	Wolfgang Schneider Mayor, Board member

ANNOTATED TRIASSIC LITERATURE

Hans Kerp and Henk Visscher[1]

ALAVI, M., VAZIRI, H., SEYED-EMAMI, K. and LASEMI, Y., 1997. The Triassic and associated rocks of the Nakhlak and Aghdarband areas in central and northeastern Iran as remnants of the southern Turanian active continental margin. GSA Bull., 109: 1563-1575.

The Triassic succession of the Nakhlak area in central Iran consists of: (1) the Alam Formation, which is a sequence of shallowing- and coarsening-upward, marine turbidites deposited on the forearc side of an accretionary prism, (2) the Baqoroq Formation, a sequence of coarse to fine, polymictic, fluvial conglomerates, and (3) the Ashin Formation, which comprises alternating, distal marine shales and sandstones that have turbiditic characteristics. These rocks are not lithologically similar to time-equivalent lithostratigraphic units of the Late Permian-Triassic rocks of the Aghdarband area of NE Iran (which are interpreted to be forearc deposits), but they may have formed in close association with them in a single tectonic and sedimentary framework. Accepting the 135° counterclockwise rotation of the central-east Iranian microcontinent with respect to the Turan plate since Triassic time, and assuming that the Triassic rocks of the Nakhlak and the Late Permian to Triassic rocks of the Aghdarband formed in a single tectono-sedimentary framework on the northern side of the paleo-Tethyan oceanic realm, we present here a sequential development. In this scheme, rocks of the Nakhlak and Aghdarband areas are considered to be deposits of a forearc, basin-ridge-slope environment. The separation of the Nakhlak succession from the rest of the Turan plate and its transportation to central Iran might have occurred as (1) a lithospheric segment of the Turan plate, first detached from Turan and then attached to the Iranian plate, and finally rotated with it in a counterclockwise direction to its present site; or (2) as a thin thrust slice first obducted over the Iranian continental shelf and then displaced to central Iran by its counterclockwise rotation.

ALCOBER, O. and PARRISH, J.M., 1997. A new poposaurid from the Upper Triassic of Argentina. J. Vertebr. Paleont., 17: 548-556.

The Poposauridae are a group of Middle to Late Triassic rauisuchian archosaurs that are the sister group of the Crocodylomorpha. A new specimen from the Ischigualasto Formation (Carnian) of Argentina is the first clear record of this group from Gondwana, and is designated the holotype of a new genus and species, *Sillosuchus longicervix*. The specimen consists of most of the vertebral column, both femora, pubes, and ischia, a partial right ilium, and a single paramedian plate. A distinctive feature shared with *Chatterjeea*, a poposaurid known from the Dockum Formation of Texas, is the presence of elongate cervical vertebrae with deep, dorsoventrally foreshortened excavations in the sides of the centra. The ilium of *Sillosuchus* has a prominent overhang that makes the upper surface of the acetabulum concave and partially encloses its dorsolateral edge. The pubes are elongate and narrow with a modest distal expansion forming a small foot. At least four and possibly as many as six sacral vertebrae are

[1] The continuous help of Gaby Schwenzien (Münster) and Dr. Zwier Smeenk (Utrecht) in tracing relevant Triassic literature is gratefully acknowledged. Thanks are due to all authors who sent information on their recent publications. Of papers without English abstracts and those traced from secondary sources only titles are given. Some references have been traced from secondary sources. Therefore diacritical signs may sometimes be missing.

present. A number of other poposaurids are known from North America and Europe, although all are currently represented by fragmentary material. *Sillosuchus* has derived characters (e.g., increased number of sacral vertebrae, cervical morphology, acetabular shape) in common with more derived poposaurids such as *Poposaurus* and *Chatterjeea*.

APAK, S.N., STUART, W.J., LEMON, N.M. and WOOD, G., 1997. Structural evolution of the Permian-Triassic Cooper Basin, Australia: relation to hydrocarbon trap styles. AAPG Bull., 81: 533-555.

The structural and depositional history of the Cooper basin in eastern central Australia has revealed that the basin is a mildly compressional structural depression controlled by northwest trending and northeast trending pre Permian basement features. Pronounced pre Permian compressions are indicated by northeast trending major structures, the Gidgealpa-Merrimelia-Innamincka and Murteree-Nappacoongee trends. Detailed chronostratigraphic facies analysis, with closely spaced palynological control, of the Patchawarra Formation revealed that two pronounced phases of uplift occurred during the Sakmarian. The major intrabasin highs were rejuvenated during these tectonic events, as documented by crustal unconformities (middle and upper Patchawarra unconformities). Evidence of each event is dominantly tectonic in character, with similar depositional patterns over these highs related to each event. These events are also recognizable in mid flank areas and basin margins with contemporaneous deposition in deeper parts of the basin. Results from this research show potential for future hydrocarbon discoveries within structural, stratigraphic, and structural/stratigraphic traps in the Cooper basin. Various trap styles are closely associated with faults, unconformities, and lateral facies changes. Lowside fault closures, onlap plays, and unconformity traps are expected to be well developed along intrabasinal highs, basin margins, and preexisting structures. The primary reservoir targets would be deltaic sequences comprising shoreline sandstones, distributary and delta mouth bar deposits that may be well developed in synclinal areas, and flanks of intrabasin highs in the Cooper basin.

ARCHE, A. and LÓPEZ-GÓMEZ, J., 1996. de los estilos fluviales del Pérmico y Triásico de la Cordillera Ibérica Suroriental. Cuad. Geol. Ibérica, 21: 203-226.

BALOG, A., HAAS, J., READ, J.F. and CORUH, C., 1997. Shallow marine record of orbitally forced cyclicity in a Late Triassic carbonate platform, Hungary. J. Sed. Res., 67: 661-675.

Well preserved examples of Milankovitch driven cyclicity in the Triassic sedimentary record include Triassic Jurassic lake sedimentary cycles, marine cyclic carbonates on small Middle Triassic platforms in the Dolomite Alps, and off shelf facies equivalent to Late Triassic large passive margin platforms. In contrast, the Late Triassic Hungarian shallow marine carbonate platform that formed on the southern margin of Tethys records a far from perfect Milankovitch eustatic signal. These carbonate cycles contain subtidal skeletal wackestone/packstone, tidal laminites, and paleosols, The cycles include not only transgressive laminites (the classic Lofer cycles): some cycles contain regressive laminites, whereas other cycles have both transgressive and regressive laminites, The stratigraphic successions do not show the clear bundling of five precessional cycles into larger eccentricity cycles, The poor record of Milankovitch sea level changes is interpreted to be due to many missed beats in the platform stratigraphy, Missed beats are evidenced by (1) caliches and paleosols and (2) thick amalgamated subtidal carbonates, and may result from precessional sea level fluctuations either not flooding the platform or flooding it too deeply to allow shallowing up to sea level in one precessional beat, Fourth order bundling of the cycles is weak, with fewer than the typical 5 cycles/100 k.y. bundle and far less than 20 cycles for inferred 400 k.y. eccentricity bundles, Fischer plots of the Hungarian cycles show third order bundling that matches Aigner's (1992) sea level curve from the German Muschelkalk basin but is less similar to the Haq et al. (1987) global sea level curve.

BARABÁS-STUHL, A., 1993. Palynological revaluation of Lower Triassic and lower Anisian formations of Southeast Transdanubia. Acta Geol. Hung., 36: 405-458.

The first palynological investigations of Lower Triassic and lower Anisian formations of SE Transdanubia (Jakabhegy Sandstone, Patacs Siltstone, Hetvehely Dolomite), together with the underlying Permian formations were published by the author in 1981. The revaluation of these investigations has been proved by several reasons, i.e. in the eighties these formations were revealed in other regions of southeast Transdanubia and contained well-preserved microflora, further in the past decade several palynological studies were published (mainly from fossiliferous Alpine and German-type regions) that provided novel data to the classification of Lower and Middle Triassic sequences on palynostratigraphic bases. Triassic formations of Southeast Transdanubia contain sporomorphs from the upper third of the Jakabhegy Sandstone to the bottom of the lower member of the Hetvehely Dolomite (Magyarürög Anhydrite) that can be assigned to three palynological assemblages, from down upwards as follows: *Densoisporites nejburgii, Voltziaceaesporites heteromorphus-Triadispora crassa* and *Triadispora crassa-Stellapollenites thiergartii.* The two older assemblages, indicating the upper part of the Olenekian substage of the Scythian stage, occur only in the Jakabhegy Sandstone Formation, while the assemblage indicating the uppermost, i.e. Anisian stage (*T. crassa-S. thiergartii)* occur in the strata of the overlying Patacs Formations and Magyaürög Anhydrite Member, in addition to the uppermost strata of the Jakabhegy Sandstone. Thus, the Scythian/Anisian boundary can be drawn in the upper part of the upper third of the Jakabhegy Sandstone Formation, the strata of the microfloristically studied sequences above this boundary belong to the Anisian, those below this boundary to the upper part of the Olenekian substage of the Scythian stage. Since as to the palynological investigations of 1981 the Permian/Triassic boundary lies in the underlying layer of the jakabhegy Sandstone, within the upper member of the Kővágószőlős Sandstone, the fossil-free strata of the latter formation above the P/T boundary but below the *D. nejburgi* assemblage of the Jakabhegy Sandstone are of Lower Triassic (Scythian) age.

BARTH, A.P., TOSDAL, R.M., WOODEN, J.L and HOWARD, K.A., 1997. Triassic plutonism in southern California: southward younging of arc initiation along a truncated continental margin. Tectonics, 16: 290-304.

Earliest Cordilleran magmatism in the southwestern United States is recorded by a belt of Triassic plutons that intrude Proterozoic basement of the Mojave crustal province and its cratonal/ miogeo-clinal cover. The belt extends from the western Mojave Desert through the Transverse Ranges to the Colorado River trough. Triassic plutons are predominantly alkali calcic, Fe and Sr enriched quartz monzodiorites and monzonites. The northern part of the belt is composed of two older plutonic suites (241 231 Ma) which are high K to shoshonitic; the southern part of the belt is a younger (218 213 Ma), sodic alkalic suite. The plutonic record in southern California suggests a short lived, southward younging continental margin are setting for emplacement of Triassic plutons, superimposed on a continental margin modified by sinistral transform faulting Triassic plutonism in this region was followed by a magmatic lull prior to the onset of voluminous Middle to Late Jurassic Cordilleran arc magmatism.

BECKER, F., LUTZ, M., HOPPE, A. and ETZOLD, A., 1997. Der Untere Muschelkalk am Südostrand des Schwarzwaldes - Lithostratigraphie und Gammastrahl-Log-Korrelationen. Jber. Mitt. oberrhein. geol. Ver., N.F. 79: 91-109.

BEERLING, D.J., 1997. Interpreting environmental and biological signals from the stable carbon isotope composition of fossilized organic and inorganic carbon. J. Geol. Soc., 154: 303-309.

Stable carbon isotope studies on marine and terrestrial organic and inorganic carbon provide a means for detecting global climate change and for reconstructing past concentrations of atmospheric CO_2. Comparison between the CO_2 estimates reconstructed from carbon isotope

studies for the past 150 Ma show good agreement with the predictions of a long term carbon cycle model based on mass balance studies. Further, the CO_2 estimates from these sources over the entire Phanerozoic show agreement with the fossil record of leaf stomatal density change a feature inversely related to the concentration of atmospheric CO_2. Isotopic studies on temporal sequences of fossilized terrestrial organic matter have contributed to palaeoecological studies on shifts in the dominance of plants with the C-4 photosynthetic pathway in ecosystems and historical changes in the metabolic processes of leaves of individual species. The long term perspective offered by these studies provides critical information for assessing the responses of biological systems to future global environmental change.

Benaouiss, N., 1996. Grès de l'Oukaïmeden àa sédimentation mixte fluviatile, éoliènne et tidale, dans les couloirs tectoniques triasiques (Haut-Atlas de Marrakech). In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 251-268.

The Oukaïmeden sandstones Formation, of Carnian age, was deposited in tectonic troughs associated within a rift system trending ENE-WSW. The formation can be subdivided into three parts, here named the lower, middle and upper parts. The lower part comprises red sandstones dominated by three types of sedimentary bodies such as high regime parallel-laminated sandstones, isolated and grouped dunes (3D type), and sand waves (2D type). These sandstones represent distal braided river deposits. The middle part includes finer facies with marine reworked or in situ fossils and tracks (*Thalassinoides*) and sedimentary structures, especially sigmoidal sets, interpreted as tidal origin. In the upper part, locally in Aït Laqaq-Aït Amer areas, a breccia series dominate and an eolian facies (with wet and dry eolianites), characterizes the uppermost part of the Oukaïmeden Sandstones. Tectonic control on deposition is ascertained : (i) by the parallelism between paleocurrent distribution and fault trends at the border of the troughs, and (ii) by the presence of lateral alluvial fans initiated on the border faults. Paleocurrent measurements reveal a preferential flow toward the SW, with two secondary current directions, trending northeast and southeast. The tectonic troughs consist of a set of blocks, developed within an extensional and strike-slip regime, which delimit the overstepping transit area. This pattern should explain the coexistence of such different, even opposite, current trends, and the episodic opening of gulfs facilitating a marine invasion in the mainly fluvial system.

Benton, M.J. and **Gower, D.J.**, 1997. Owen, Richard - giant triassic frogs: archosaurs from the Middle Triassic of England. J. Vertebr. Paleont., 17: 74-88.

The first archosaurs from the Middle Triassic were described unwittingly by Sir Richard Owen in the 1840s. He combined a variety of archosaurian postcranial elements with skull material of temnospondyls, thus producing his image of giant Triassic frogs. Archosaur bones have been collected from Middle Triassic (Anisian) sediments of Warwick and Bromsgrove in the West Midlands, and more recently, from south Devon. Some of the vertebrae and pelvic elements belong to the poposaurid *Bromsgroveia*, and other elements and teeth to unidentified archosaurs, one perhaps a dinosaur. The English faunas help fill a gap in knowledge of archosaurs in the early part of the Middle Triassic. If *Bromsgroveia* is a poposaurid, it is the oldest member of a family known otherwise from the Late Triassic of North America.

Bérczi-Makk, A., 1996. Foraminifera of the Triassic formations of Alsó Hill (Northern Hungary). Part 1: Foraminifer assemblage of the Steinalm Limestone Formation. Acta Geol. Hung., 39: 175-221.

In the Hungarian portion of Alsó Hill, extending in a length of some 15 km along the Hungarian-Slovakian border, a rich foraminifer assemblage has been found in Triassic formations. The richest foraminifer association characterizes the platform carbonates (Steinalm Limestone Formation, Wetterstein Limestone Formation). The poor foraminifer fauna of the basinal facies (Nádaska Limestone Formation, Reifling Limestone Formation, Derenk Limestone Formation,

Hallstatt Limestone Formation, and Pötschen Limestone Formation), with some exceptions, is not suitable for drawing stratigraphic conclusions. In the foraminifer assemblage of the formations of the lagoonal facies of the Anisian (upper Pelsonian-Illyrian) Steinalm Limestone Formation, *Pilammina densa* Pantic, *Meandrospira dinarica* Kochansky-Devidé et Pantic as well as species of the genus *Earlandinita* are predominant.

BÉRCZI-MAKK, A., 1996. Foraminifera of the Triassic formations of Alsó Hill (northern Hungary). Part 2: Foraminifer assemblage of the Wetterstein Limestone Formation.Acta Geol. Hung., 39: 223-309.

Reefal and lagoonal facies of the Wetterstein Limestone Formation, constituting the main mass of Alsó Hill extends along the Hungarian-Slovakian border, contain a rich foraminifer assemblage of Carnian age. In the species- and specimen-rich foraminifer fauna of the reefal facies, species *Gsollbergella spiroloculiformis* (Oravecz-Scheffer), *Aulotortus sinuosus* Weynschenk, *Urnulinella andrusovi* (Borza et Samuel), *Cucurbita infundibuliformis* Jablonsky, *Miliolipora cuvillieri* Brönnimann et Zaninetti, *Palaeolituonella meridionalis* (Luperto) are frequent. The lagoonal facies is characterized by the great number of specimens of the genus *Earlandinita*, the mass occurrence of *Aulotortus friedli* (Kristan-Tollmann) and the even distribution of the taxon *Variostoma*. A new species, *Endothyranelia inflata* nov.sp., is described. Its representatives can be found in the Wetterstein Limestone of both the lagoon and the back reef on Alsó Hill, Northern Hungary.

BÉRCZI-MAKK, A., 1996. Foraminifera of the Triassic formations of Alsó Hill (Northern Hungary). Part 3: Foraminifer assemblage of the basinal facies. Acta Geol. Hung., 39: 413-459.

In the poor foraminifer fauna of the basinal facies which are exposed at the southern margin and NE end of the Triassic platform carbonates constituting the main mass of Alsó Hill (extending along the Hungarian-Slovakian border), the taxa Nodosariidae and Ichthyolariidae predominate and specimens of species belonging to the genera *Lenticulina, Arenovidalina, Ophthalmidium* and *Turriglomina* are frequent. The richest foraminifer assemblage was found in the open marine slope sediments of the Nádaska Limestone Formation. In its foraminifer association, the species *Turriglomina mesotriasica* (Koehn-Zaninetti), *Arenovidalina chialingchiangensis* Ho, and *Ophthalmidium exiguum* Koehn-Zaninetti predominate and species of the genera *Pseudonodosaria and Lenticulina* are frequent. The foraminifer assemblage of the pelagic basinal facies of the Reifling Limestone Formation is characterised by richness in specimens of the species *Turriglomina mesotriasica* Koehn-Zaninetti and *Arenovidalina chialingchiangensis* Ho. Those associations of the open marine, pelagic radiolarian facies with microfilaments (Pötschen Limestone Formation, Derenk Limestone Formation, Hallstatt Limestone Formation) are the poorest ones. Practically, the foraminifer assemblage is composed of *Turriglomina mesotriasica* (Koehn-Zaninetti), *Turriglomina robusta* Bérczi-Makk, and *Arenovidalina chialingchiangensis* Ho specimens.

BERRA, F. and CIRILLI, S., 1997. Palaeoenvironmental interpretation of the Late Triassic Fraele Formation (Ortles Nappe, Austroalpine Domain, Lombardy). Riv. Ital. Paleont. Strat., 103: 53-70.

The Fraele Formation crops out in the Ortles Nappe (upper Valtellina, Northern Italy), structurally part of the Central Austroalpine Domain. It consists of fine siliciclastics alternating with carbonates, mostly limestones, rare dolostones and marls. The nature of the siliciclastics indicates a cratonic source area (Europe), where intrusive and/or orthometamorphic rocks were being eroded. The formation differs lithologically from the underlying Norian Dolomia del Cristallo, represented by early dolomitised inner platform facies, and the overlying Early Jurassic Monte Motto Formation which consists of cherry and marry limestones deposited in a pelagic setting. The upper and lower boundaries of the Fraele Formation are sharp. Foraminifer and palynomorph assemblages from the Fraele Formation indicate a Late Norian to Rhaetian age. The sedimentary facies and faunal associations of the Fraele Formation differ from those

of the underlying Dolomia del Cristallo because of different paleoenvironmental evolution. The change in environmental parameters was controlled mainly by a climatic change to more humid conditions. This favoured on one hand the mobilisation and transport by rivers of siliciclastic material from the continent to the Tethys gulf, and on the other influenced the sea water chemistry. Freshwater influxes lowered salinity and inhibited early dolomitisation. Input of low density freshwater resulted in the establishment of a permanent water mass stratification which influenced the benthic life. This paleoenvironmental reconstruction fits with the sudden elastic input which occurred in several palaeogeographic domains of the western Tethys realm (Austroalpine, Southalpine, Apennine, Hungary, Poland, Slovakia) during the Late Norian.

BI, D.C., QIAN, M.P. and GUO, P.X., 1996. Trace fossils and palaeoenvironment of Huangmaqing Formation (Middle Triassic) in Lower Yangzi region. Acta Palaeont. Sinica, 35: 463-464.

The Huangmaqing Formation (Middle Triassic) of Lower Yangzi Valley consists mainly of purplish red siltstone,shale and fine-grained sandstone about 1000m in overall thickness and can be subdivided into two members based on lithologic character. The Lower member, i.e. the so-called Multicoloured Bed,is dominated by red beds with some grey yellow,greyish-green and other coloured fine-grained clastic rocks and a small number of intercalated beds of marl, yielding the trace fossils *Rhizocorallium irregularis, R.* sp., *Skolithos* sp., *Planolites* sp. etc. 9 with associated body fossils including not only nonmarine ostracods but also brackish-water bivalves, conchostracans and even marine bivalves as well as phyllocarids. Host rocks with bidirectional cross-bedding formed under the influence of tidal action.

BISCHOF, J., LUND, J.J. and ECKE, H.H., 1997. Palynomorphs of ice rafted elastic sedimentary rocks in Late Quaternary glacial marine sediments of the Norwegian Sea as provenance indicators. Palaeogeogr. Palaeoclimatol. Palaeoecol., 129: 329-360.

Palynomorph assemblages of ice rafted pebbles of elastic sedimentary rocks in surface sediments from 0 to 41 cm depth of the Norwegian Sea are dominated by Triassic and Lower Cretaceous taxa along with occasional Jurassic, Lower Paleozoic, and very rare Carboniferous Permian taxa. Tertiary species were not found, and Upper Cretaceous species were only found in the western Norwegian Sea. The ice rafted rock fragments originated from the Late Pleistocene ice sheets adjacent to the Norwegian Sea. The determined ages of the ice rafted elastic sedimentary rocks indicate the Barents shelf as the main source, because the Barents shelf has exposures of elastic sedimentary rocks whose ages and lithologies match the material found in the majority of the analyzed samples. In addition some material originated from the West Norwegian shelf and some from NE Greenland. Our results confirm that an ice sheet extending from SW-Svalbard onto parts of the northwestern Barents shelf existed during the Late Weichselian. The northern dropstone source areas suggest that currents in the Norwegian Sea from 15 to 9 ka before present were moving in the opposite direction of modern currents.

BLENDINGER, W., 1997. Dolomitization of the Dolomites (Triassic, Northern Italy): Pilot study. N. Jb. Geol. Paläont., Abh., 204: 83-110.

Two types of massive replacement dolomites occur in the Triassic of the Dolomites. Finely crystalline dolomites (Lower Serla Dolomite, Dürrenstein Dolomite, dolomites in the Raibl beds, Hauptdolomit) formed at the seafloor and commonly have isotopic values overlapping with Triassic seawater composition. Coarsely crystalline dolomites (Contrin Formation, Schlern Dolomite, Cassian Dolomite) show a considerable spread of stable as well as of radiogenic isotope values and formed in more or less deep burial conditions. Distribution of coarsely crystalline dolomite indicates mainly vertical flow of dolomitizing fluids. Possible dolomitization scenarios include seepage of Carnian evaporated seawater, and thermal convection of seawater in conjunction with Upper Triassic-Jurassic rifting or during the Late Cretaceous - Tertiary orogeny.

BUDAI, T. and HAAS, J., 1997. Triassic sequence stratigraphy of the Balaton Highland, Hungary. Acta Geol. Hung., 40: 307-335.

Sequence stratigraphic analysis of Triassic formations In the Balaton Highland region revealed that in addition to sea-level-changes, climatic changes and tectonic effects also played an important role In the determination of the facies characteristics as well as the setting and features of the depositional sequences. However, the relative importance of these factors differed in the successive evolutionary stages. In the Early Triassic the moderately and uniformly subsiding shelf was very sensitive to sea-level changes. During the early to middle Anisian, mainly the effects of climatic changes are detectable. A drastic reduction of terrigenous input at the beginning of this stage can be attributed to a climatic change and it is primarily climatic conditions which may have determined whether syndiagenetic dolomite formation or organic rich lime mud deposition prevailed on the restricted inner ramp. From the middle Anisian to the late Carnian tectonic movements played the most decisive role. At the beginning of this stage segmentation of the shelf began, resulting In the differentiation of platforms and basins. Sea level changes manifested themselves in subaerial exposure and inundation of the platforms. Filling up of the basins began in the Carnian, when most probably due to a remarkable climatic change terrigenous influx increased significantly. During this period eustatic sea level changes may have played an important role in the determination of the sedimentation pattern.

BURYI, G.I., 1996. Evolution of Late Triassic conodont platform elements. Acta Micropalaeont. Sinica, 13: 135-142.

In the Late Triassic conodont biota existed the platform elements of the genera *Paragondolella, Metapolygnathus, Ancyrogondolella* and *Epigondolella*. All of them originated in the Middle Triassic, probably, from the same root-*Neogondolella*, but in two different ways. This paper describes the evolutionary changes of the taxonomically most important morphological features of these platform elements such as the details of the platform lower posterior edge-basal field, pit, and especially loop. Special attention is paid to the development of the platform elements of the genus *Metapolygnathus*, with a proposed scheme on the evolution of the Late Triassic platform elements.

BURYI, G.I., 1996. Triassic conodonts from the cherts of Nadanhada Range, northeast China. Acta Micropalaeont. Sinica, 13: 207-214.

Early (?), Middle and Late Triassic conodonts have been found for the first time in cherts from Nadanhada Range of Heilongjiang Province, including *Neospathodus* cf.. *dieneri* Sweet, *N. kockeli* (Tatge), *Neogondolella mombergensis* (Tatge), *Carinella mungoensis* (Diebel), and *Metapolygnathus* cf. *parvus* Kozur. The author determined the stratigraphic position of the beds enclosing the conodonts found and compared them with the coeval conodont zones of other regions.

BUTLER, R.F., GEHRELS, G.E. and BAZARD, D.R., 1997. Paleomagnetism of Paleozoic strata of the Alexander terrane, southeastern Alaska. GSA Bull., 109: 1372-1388.

Paleomagnetic samples were collected from 180 sites (sedimentary horizons or igneous flows) in nine Paleozoic formations of the Alexander terrane on or near Prince of Wales island in southeastern Alaska. The 10°-20° paleolatitudes determined from numerous paleomagnetic studies of Late Triassic igneous rocks from Alexander Wrangellia are almost certainly Northern Hemisphere paleolatitudes. Available evidence indicates: (1) early Paleozoic development of the Alexander terrane as a volcanic are without significant incorporation of continental crust; (2) mid Paleozoic juxtaposition with a continent containing 1.6 1.8 Ga and 1.45 1.6 Ga crust, probably the Scandinavian margin of Baltica; (3) rifting from that margin in Devonian time

followed by tectonic transport to 25 degrees 30 degrees latitude in the northern paleo Pacific by Permian time; and (4) southward motion to a Late Triassic paleolatitude of 10 degrees 20 degrees followed by accretion to North America with subsequent dispersal of fragments from northern Oregon to southern Alaska.

CAI, X., YING, C., ZHANG, Z. and XIONG, Q., 1997. Application and significance of basic sequences and marker beds to 1:50,000 regional geological surveying; examples from the Paleozoic and Triassic strata in the Sandu and Xiushui sheets, northwestern Jiangxi. Sed. Facies Palaeogeogr., 17: 60-66.

CALDWELL, M.W., 1997. Modified perichondral ossification and the evolution of paddle like limbs in ichthyosaurs and plesiosaurs. J. Vertebr. Paleont., 17: 534-547.

Evolution of paddle like limbs in ichthyosaurs and plesiosaurs is correlated with loss of perichondral bone from the shafts of long bones. Among ichthyosaurs, loss of perichondral bone is first observed on the shafts of digit bones of Early Triassic taxa. Late Triassic ichthyosaurs show perichondral bone loss on the postaxial margins of the ulna and fibula. Among plesiosaurs, loss of perichondral bone is first observed on the postaxial margins of the ulna and fibula of Lower Jurassic taxa. In geologically later species of both groups, perichondral bone is progressively lost on all margins of the ulna and radius, and fibula and tibia. Late Triassic and Jurassic ichthyosaurs show an absence of perichondral ossifications on all limb bones distal to the humerus and femur. Delayed ossification of the mesopodium is not observed in ichthyosaurs. Evolutionary changes to the ossification of perichondral tissues appear to affect the sequence of limb ossification as long bones lose perichondral bone. Limb bones of ichthyosaurs and plesiosaurs resemble mesopodial elements through loss of perichondral bone. The proportion of endochondral bone found on these transformed bones is increased, resulting in an increased articular surface area and increased articular complexity.

CANTRILL, D.J., 1997. The pteridophyte *Ashicaulis livingstonensis* (Osmundaceae) from the Upper Cretaceous of Williams Point, Livingston Island, Antarctica. New. Zeal. J. Geol. Geophys., 40: 315-323.

The presence of *Ashicaulis livingstonensis* sp. nov. in the Upper Cretaceous Williams Point Beds of Livingston Island, Antarctica, represents an important new record of the Osmundaceae in the southern high latitudes. It extends the range of *Ashicaulis* to the Late Cretaceous. *Ashicaulis livingstonensis* sp. nov. comprises a small stem surrounded by a mantle of petiole bases and roots. Leaf gaps are narrow, rapidly closing, or occasionally incomplete, and the stem is best regarded as ectophloic siphonostele. The anatomy of *Ashicaulis livingstonensis* suggests an erect, probably mound forming fern.

CAPEDRI, S., TOSCANI, L., GRANDI, R., VENTURELLI, G., PAPANIKOLAOU, D. and SKARPELIS, N.S., 1997. Triassic volcanic rocks of some type localities from the Hellenides. Chemie der Erde, 57: 257-276.

The mineral and whole rock geochemistry of Triassic volcanic rocks from some type localities of the Hellenides (Avdela, Northern Pindos; Divri, Othris; Steni, Euboea: Atalanti; Vardoussia; Koziakas; Argolis peninsula) are consistent with emplacement in extension related regimes. The parental magmas were formed by the melting of heterogeneous upper mantle and underwent magma mixing. In places (e.g. Northern Pindos and Euboea) the magmas were emplaced onto an ocean floor; elsewhere (e.g. Vardoussia, Koziakas, Aralanti) they intruded through the continental crust where the melts underwent differentiation and contamination. The dacites of Argolis probably represent differentiates of such contaminated melts.

CARPENTER, K., 1997. A Giant Coelophysoid (Ceratosauria) Theropod from the Upper Triassic of New Mexico, USA. N. Jb. Geol. Paläont., Abh., 205: 189-208.

A partial skeleton of a very large coelophysoid previously described is redescri 'bed and named *Gojirasaurus quayi* n.g. n.sp. The specimen consists of a tooth, dorsals, ribs, chevron, scapula, pubis, and tibia from an individual estimated to be about 5.5 m long making it one of the largest known Triassic theropod. The specimen shares several apomorphies with other ceratosauromorphs, including transverse process that extends the length of the centrum, parapophysis and diapophysis on the transverse process, web of bone connecting the tuberculum and capitulum, and a long and narrow pubis. The specimen was collected from the Cooper Canyon Formation (middle Norian).

CASSINIS, G., CORTESOGNO, L., GAGGERO, L., RONCHI, A. and VALLONI, R., 1996. Stratigraphic and Petrographic Investigations into the Permian-Triassic Continental Sequences of Nurra (NW Sardinia). Cuad. Geol. Ibérica, 21: 149-169.

The post-Hercynian continental succession in Nurra, NW-Sardinia, displays a wide range of siliciclastic sediments, over 250 m thick, intercalated with volcaniclastic products. The succession can be subdivided into at least two tectonosedimentary cycles. The oldest cycle, which is developed for a maximum of 15 m only, is the Lu Caparoni Fm., rich in the lower part of Autunian plants. This Unit begins with alluvial and lacustrine sediments, above which we find some explosive products, which have been interpreted as kaolinized cinerites. Subsequently, this volcano-tectonic activity generated coarser-grained fluvio-deltaic deposits. However, thin clastic intercalations persisted within these massive deposits, again in the presence of tuffaceous material. The upper cycle is made up of siliciclastic sediments, showing frequent facial and geometrical changes. It has been subdivided into four units, of which the total thickness ranges up to about 250 m. Coeval volcanism is documented by a few scattered products extending into the two lower Units, and perhaps into the the basal part of Unit 3. These products are represented by acidic volcaniclastic deposits, where a possible alkaline-potassic affinity (already advanced by previous authors) is partly obscured by pervasive secondary mobilization. In particular, the gray-greenish and reddish succession of Units 3 and 4 recalls the typical Buntsandstein of Europe. On the basis of past microfloristic research, this Buntsandstein persisted up to the early Middle Trassic times. Lithologic and sedimentologic aspects, together with thickness changes, lead us to interpret this upper cycle as due to alluvial environments, which acted within extensional swell and basin structures. During Buntsandstein development, the deposits were formed in a coastal plain environment and, in proximity with the marine Muschelkalk transgression, also in a littoral environment.

CHALOUAN, A., 1996. Les dépôts du Trias du Rif interne témoins de deux paléomarges tethysiennes en voie d'individualisation. In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 155-179.

The Triassic deposits are studied in the three structural sets of the internal Rif: the Sebtides, the Ghomarides and the Dorsale calcaire. In the Sebtides, which are metamorphic terrains, the Triassic is present only within the upper units, i. e. Upper Sebtides or Federico. The Triassic (and Permian?) of the Federico units is very thick (1200 m) and can be subdivided into two formations: the lower consists of schists, quartzites and metaconglomerates of probable Permian and Early Triassic age ; the upper comprises dolomites of Anisian to Late Triassic (?) age. These facies are similar to the Permian-Triassic described in the Briançonnais. In the Ghomarides, the Triassic is represented by a 200-300 m thick fining-upward detrital mega-sequence, consisting of sandstones, conglomerates and red clays overlain by layered dolomites. The age is Middle to Late Triassic. The internal Dorsale shows a sequence that is similar to that of the Ghomarides. In the external Dorsale, the Early and Middle Triassic are not known, and just the Late Triassic and Rhetian are recognized. They are respectively represented by very

thick (1100 m) dolomites with stromatolites, and limestones and dolomites alternating. Paleostress measurements on syndepositional faults show variable directions of extension, with NNW-SSE to ENE-WSW trends. The scatter may be due to rotations; however, the central part shows more uniform NE-SW directions. On the base of these data, a paleogeographic reconstruction was attempted. The Triassic of the Ghomarides and the internal Dorsale may be correlated with the Triassic formations of the upper AustroAlpine domain. Both may have belonged to the African paleomargin of the Neotethys. They may have occupied ist continental and epicontinental part, with intermediate facies between the German and Alpine Triassic. The external Dorsale, may have been in a deepest zone, inter- to infratidal, of the same margin. Because of their similarity with the Briançonnais, the Federico units (and the Sebtides in general) may have belonged to the European paleomargin of the Neotethys.

CHARROUD, A., CHARROUD, M., FEDAN, B., LAVILLE, E., RIOULT, M., PIQUÉ, A. and DU DRESNAY, R., 1996.Dynamique sedimentaire des formations triasiques du Moyen Atlas méridional. In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 269-289.

The Kerrouchene basin is the southernmost Triassic basin of the Middle Atlas. Detailed lithostratigraphic and sequence analysis leads to differentiate four formations, whose thicknesses are variable across the basin: (1) the Amalou Ignawn Fm. (180 m at the eastern border), or Formation F1, which comprises coarse detrital deposits, such as conglomerates and arkose, shed by the Haute Moulouya terranes; this formation shows coarsening-upward sequences; (2) the Talaghine Fm. or Formation F2, consisting of red coarse sandstones with fluvial-type sequences; (3) the Bou-Izalimane Fm. or Formation F3, composed by fining-upward sequences of sandstones and siltstones, interpreted as deposited by a meandering fluvial system; (4) the El Kbab Fm., or Formation F4, consisting of mudstones with evaporites and basalt flows. Paleocurrent trends are mainly toward the NW and the NNW at the eastern border, and toward the E at the western edge of the basin. The Triassic formations displav a strong extensional tectonism which is generally synchronous with deposition, as attested by several features (asymmetric infill, local fault-related fans, growth faults, hydroplastic striations and sedimentary gliding structures). Some measurement sites show an E-W to NNW-SSE trending direction of extension, with a ratio R comprised between 0.08 and 0.19, that explains permutations of main stresses. The geodynamic evolution can be retraced through 3 stages: (1) a prerift stage, in which the Hercynian thrusts were set; (2) a synrift stage, with a NW-SE extension that led to a negative inversion along the Hercynian faults; contrary to the previous model of basin evolution, we suggest that tilting occurred toward the west; this stage can be subdivided into two events; and (3) a postrift stage (Jurassic) with thermal relaxation and arching of the basin.

CHEN, M.J.,1996. Conodonts of Upper Permian-Lower Triassic of Zhenjiang area. Acta Palaeont. Sinica, 35: 439-440.

Here described in detail are totally 11 genera and 28 species of upper Permian-Lower Triassic conodonts collected from Boreholes 11-1, 11-2, 79-8, etc. near Zhenjiang, with the establishment of 6 conodont zones (including 1 upper Permian zone and 5 Lower Triassic zones), based on which correlations are made between corresponding zones both at home and abroad.

CHEN, P.J., MCKENZIE, K.G. and ZHOU, H.Z., 1996. A further research into Late Triassic Kazacharthra fauna from Xinjiang Uygur autonomous region, NW China. Acta Palaeont. Sinica, 35: 272-305.

CIRILLI, S., 1996. Upper Triassic biogenic mounds in the Northern and Central Apennines (Italy): palaeoecology and palaeobiogeographical implications. Palaeopelagos, 6: 63-73.

The biogenic mounds described in the Upper Triassic sediments of the Northern and Central Apennines show different features according to the palaeogeographical settings in which they grew. The author gives a description of the mounds including morphology, size, internal structures, textures, biological content and lateral and vertical zonation is given. The purpose of this study is to emphasize: (a) the palaeoecological control of the organisms building the mounds; (b) the relationships between the type of mound and the palaeoenvironment context; (c) the role of microbes in the genesis and diagenesis of biogenic mounds.

CLARK, D.L., GRANTZ, A. and MULLEN, M.W., 1997. Paleozoic and Triassic conodonts from the Northwind Ridge of the Arctic Ocean. Mar. Micropal., 32: 365-385.

Conodonts are present in the basal part of six Arctic Ocean sediment cores recovered from the Northwind Ridge in the Chukchi Borderland area of the western Arctic Ocean. The conodonts include species typical of the Upper Cambrian, Lower and Middle Ordovician, Middle to Upper Pennsylvanian, probable Lower, middle and Upper Permian, and Lower Triassic. Most of the conodont elements, including a few of the Cambro-Ordovician and all of the Upper Permian species, were recovered from the sand fraction of the Northwind Breccia in the basal 1.5 m of core 92 P34. Other Ordovician and younger Paleozoic conodont specimens occur in carbonate clasts incorporated in the Northwind Breccia. The talus breccia occurs in the lower part of the Early Pliocene/Miocene unit A (undifferentiated) and is overlain unconformably by Pleistocene age sediment. A few Paleozoic and Triassic conodonts also occur in clasts recovered from the basal parts of five other Northwind Ridge cores. Upper Permian specimens are the most numerous of the conodont elements and occur together with an abundant ichthyolith assemblage. In addition, the sand fraction of the Northwind Breccia contains poorly preserved foraminifera, holothurians, and sponges spicules that are common in all Arctic Ocean Plio-Pleistocene sediment. Occurrence of conodonts in what is interpreted to be talus derived from bedrock indicates that the enigmatic Northwind Ridge is a true continental fragment that includes marine strata of at least Paleozoic and Triassic age. The nature of the conodonts and other fossils recovered from the breccia suggests that the Northwind Ridge originated as part of the Canadian Arctic Islands.

CLARK, J.A., 1997. The evolution of tetrapod ears and the fossil record. Brain Behavior Evol., 50: 198-212.

In the earliest tetrapods, the fenestra vestibuli was a large hole in the braincase wall bounded by bones of different embryological origins: the otic capsule and occipital arch components, and also, in all except the Devonian Acanthostega, the dermal parasphenoid. This means that the hole lay along the line of the embryonic metotic fissure, Early tetrapod braincases were poorly ossified internally, and no specialized opening for a perilymphatic duct is evident, It is arguable that the earliest tetrapods had neither a perilymphatic duct crossing the otic capsule nor a specialized auditory receptor in a separate lagenar pouch. The primitive tetrapod condition is found in the earliest amniotes, and the separate development of (1) a fenestra vestibuli confined to the limits of the otic capsule, (2) a specialized pressure relief window also derived from components on the line of the metotic fissure, (3) a nonstructural, vibratory stapes and (4) increased internal ossification of the internal walls of the otic capsule, can be traced separately in synapsids, lepidosauromorph diapsids, archosauromorph diapsids, probably turtles, and amphibians. This suggests separate development of true tympanic ears in each of these groups, Developments indicating the existence of a true tympanic ear in amniotes are first found in animals from the Triassic period, and a correlation with the evolution of insect sound production is suggested.

CRASQUIN-SOLEAU, S., RAKUS, M., OUJIDI, M., COUREL, L., TOUHAMI. M.E. and BENAOUISS, N., 1997. A new ostracod fauna in the Triassic of Oujda Mountains (Morocco): palaeogeographic relationships between northern and southern tethyan margins. C.R. Acad. Sci, Sér. II, A, 324: 111-118.

An ostracod fauna is discovered for the first time in the Oujda Mountains (Morocco) Triassic series. A new species is described (*Lutkevichinella kristanae* n.sp.). These assemblages allow us to define the age (Late Norian on one hand and Late Ladinian/Early Carnian on the other). Faunal analogies with Germany lead us to place the studied levels in a brackish environment and to propose close relationships between Northern and Southern Tethyan margins at this time. The carbonate levels of the Oujda Mountains, in their tectonic context, suggest marine onlap coming from the North East, from the Tethys.

DAGYS, A., 1997. A new Late Olenekian (Triassic) ammonoid of low palaeolatitude affinity from Arctic Asia (Eastern Taimyr). Paläont. Z., 71: 217-220.

The new exotic ammonoid genus *Byrrangoceras is* described from the Upper Olenekian of the Boreal Triassic (Arctic Siberia). The phylogenetic affinities and palaeobiogeographic distribution of the new genus are discussed.

DAMIANI, R.J. and WARREN, A., 1997. Re-interpretation of *Parotosuchus wadei* Cosgriff, a capitosaurid from the Triassic Narrabeen Group at Gosford, New South Wales, with comments on its growth stage.
Alcheringa, 21: 281-289.

The holotype and paratype of the capitosaurid *Parotosuchus wadei* (Cosgriff, 1972) from the Terrigal Formation (Narrabeen Group) near Sydney are re examined. It is demonstrated that the holotype skull is an immature individual of the genus *Parotosuchus*, and that it exhibits no characters that are derived beyond the generic level. The paratype specimen consists of an impression of the skull, mandibles and dermal pectoral girdle but is largely indeterminate to family. *P. wadei* is therefore a nomen dubium.

DE FRANCESCHI, D. and VOZENIN-SERRA, C., 1997. The upper Vietnamese Triassic flora: palaeogeographical significance. C.R. Acad. Sci., Sér. II, A, 324 (4): 333-339.

The Vietnamese Triassic flora belongs clearly to the coastal floristic assemblage of the South West Pacific, By its littoral features, the boundary of this flora distribution might coincide with the tectonically significant suture zone. Its similarity with the Ussuriland, Japanese and Korean floras raises the question of the real position of these areas in the Triassic. Affinities of its lower plant fossil assemblage with the Krusin flora (Borneo) may be explained by Hutchinson's interpretation (in Ridd, 1980) of a 'West Malaysia Western Borneo' island are broken up probably during the Carnian. The existence of Gondwanian elements in this flora is discussed.

DOBRETSOV, N.L., 1997. Permian-Triassic magmatism and sedimentation in Eurasia as result of superplume. Dokl. Akad. Nauk., 354: 220-223.

DU, Y., FENG, Q., YIN, H.F., ZHANG, Z. and ZENG, X., 1996. New Evidence for Eastward Extension of Late Hercynian-Early Indosinian Qinling Sea. J. China Univ. Geosci., 7: 141- 146.

The problem of the eastward extension of Qinling sea of Late Hercynian-Early Indosinian has always been in suspension. The present paper makes an assumption that the Qinling rock-group should be a tectonic complex consisting of complicated structural slices of different ages according to the new discovery of radiolarians and other faunas in the Yanlinggou rock-formation in the area around eastern Qinling-Tongbai Mountains. The discovery of the Early Triassic radiolarians in Tongbai Mountain and the analysis of the paleogeography of the Yangtze and North China plate margins indicate the existence of eastern Qinling-Tongbai-Dabie sea of Late Hercynian-Early Indosinian, which is considered to be the eastward extension of the

western Qinling rift trough. The rift trough was closed by the convergent collision between the Yangtze and North China plates in Middle to Late Triassic.

DUNCAN, R.A., HOOPER, P.R., REHACEK, J., MARSH, J.S. and DUNCAN, A.R., 1997. The timing and duration of the Karoo igneous event, southern Gondwana. J. Geophys. Res. Solid Earth, 102: 18127-18138.

A volcanic event of immense scale occurred within a relatively short period in early Jurassic time over large regions of the contiguous Gondwana supercontinent. Ln southern Africa, associated remnants of thick volcanic successions of lava flows and extensive dike and sill complexes of similar composition have been grouped together as the Karoo Igneous Province. Correlative volcanic and plutonic rocks occur in Antarctica and Australia as the Ferrar Province. Thirty two new ^{40}Ar-^{39}Ar incremental heating experiments on feldspars and whole rocks from Namibia, South Africa and East Antarctica produce highly resolved ages with a vast majority at 183 ± 1 Ma and a total range of 184 to 179 Ma. These are indistinguishable from recent, high resolution ^{40}Ar-^{39}Ar and U-Pb age determinations reported from the Antarctic portion of the province. Initial Karoo volcanism (Lesotho type compositions) occurred across the entire South African craton. The ubiquitous distribution of a plexus of generally nonoriented feeder dikes and sills intruding Precambrian crystalline rocks and Phanerozoic sediments indicates that these magmas penetrated the craton over a broad region. Lithosphere thinning of the continent followed the main pulse of igneous activity, with volcanism focused in the Lebombo Nuanetsi region, near the eventual split between Africa and Antarctica. Seafloor spreading and dispersion of east and west Gondwana followed some 10-20 m.y, afterward. The volume of the combined Karoo Ferrar province (similar to 2.5 x 10^6 km^3) makes it one of the largest continental flood basalt events. The timing of this event correlates with a moderate mass extinction (Toarcian- Aalenian), affecting largely marine invertebrates. This extinction event was not as severe as those recorded at the Permian-Triassic or Cretaceous Tertiary boundaries associated with the Siberian and Deccan flood basalts events, respectively. The difference may be due to the high southerly latitude and somewhat lower eruption rates of the Karoo event.

EDWARDS, R.A., WARRINGTON, G., SCRIVENER, R.C., JONES, N.S., HASLAM, H.W. and AULT, L., 1997. The Exeter Group, south Devon, England: a contribution to the early post-Variscan stratigraphy of northwest Europe. Geol. Mag., 134: 177-197.

The lower part of the post-Variscan succession around Exeter, south Devon, England, comprises some 800 m of breccias, with subordinate sandstones and mudstones, which rest upon Devonian and Carboniferous rocks folded during the Variscan Orogeny and are overlain, disconformably, by the Aylesbeare Mudstone Group (Early Triassic?). These deposits comprise the most westerly of the early post-Variscan successions preserved onshore in northwest Europe and lie to the south of the Variscan Deformation Front; they are assigned to the Exeter Group (new term). Geochronological and palaeontological studies, in conjunction with detailed geological mapping, show that the constituent formations comprise a lower (Late Carboniferous(?) Early Permian) sequence separated from an upper (Late Permian) sequence by an unconformity which represents an hiatus with a duration of at least 20 m.y. The lower sequence contains volcanic rocks dated at between 291 and 282 Ma (Early Permian) and pre dates intrusion of the nearby Dartmoor Granite (280 Ma). In the overlying, palynologically dated, Late Permian sequence, older breccias contain clasts of the Dartmoor Granite aureole rocks, and younger ones contain clasts of that granite. The lower sequence occurs mainly within the Crediton Trough, an east west trending, partly fault bounded sedimentary basin that probably formed by extensional reactivation of a Variscan thrust. Breccias in this sequence formed largely on alluvial fans; the common occurrence of debris flows and a down fan passage from gravity flows into fluvially deposited sediments is typical of deposition on semi arid fans. The upper (Late Permian) sequence is more widespread but includes similar deposits

overlain, at the top of the Exeter Group, by aeolian dune and interdune,deposits, Correlation within the laterally variable facies associations which comprise these sequences has been achieved using a combination of sedimentary facies analysis, sedimentary geochemistry, and petrographical and geochemical clast typing. The stratigraphy revealed within the Exeter Group is broadly comparable with that recognized in the early post Variscan Rotliegend successions elsewhere in Europe. This similarity may, however, be deceptive; the upper part of the Exeter Group may be coeval with the Zechstein, and apparently correlatable major unconformities in the group and the Rotliegend may reflect different events in the Variscan fold belt and Variscan Foreland areas, respectively.

EL TABAKH, M., RICCIONI, R. and SCHREIBER, B.C., 1997. Evolution of Late Triassic rift basin evaporites (Passaic Formation): Newark Basin, eastern North America. Sedimentology, 44: 767-790.

The Passaic Formation of the Late Triassic Newark Supergroup is 2700 m thick and was deposited in series of wide, deep to shallow lacustrine environments in the Newark rift basin (eastern North America). The Passaic Formation can be divided into lower, middle, and upper sections based on depositional structures, composition and the distribution and morphology of its evaporites. Evaporites formed as a result of syndiagenetic cementation and/or displacive processes. Evaporitive minerals now include gypsum and anhydrite, although other mineral species, such as glauberite, may have originally existed. Most of the evaporites of the Passaic Formation occur within massive red mudstone and siltstone lithologies in the form of diffuse cements, void fillings, euhedral crystals, crystal clusters and nodules. These evaporites grew displacively within the fine siliciclastic matrix as a result of changes in the hydrochemical regimes of the rift basin. A well developed upward increase in the amount of evaporite material is present in the Passaic Formation. This resulted from: (1) long term, progressive increase in aridity, and (2) significant increase in evaporation surface area of the basin during its tectonic evolution. A nonmarine source for the evaporites is evident from the isotopic data. Sulphate $\delta^{34}S$ ranges from 11 parts per thousand to 3.3 parts per thousand CDT, while $\delta^{18}O$ ranges from +15.1 parts per thousand to +20.9 parts per thousand SMOW, indicating derivation from early diagenetic oxidation of organic sulphur and pyrite within the organic rich, lacustrine deposits. The $^{87}Sr/^{86}Sr$ ratios in sulphate are radiogenic (average 0.71211), showing the interaction of basin waters with detrital components and that the Newark Basin was isolated from the world ocean. Most of the original evaporites show evidence of diagenetic change to polycrystalline and polymineralic pseudomorphs now filled with recrystallized coarse grained anhydrite (1-3 mm size) and low temperature albite. Homogenization temperatures of fluid inclusions within the coarse grained anhydrite indicate crystallization temperatures for anhydrite in the range of 150° to 280° C. Such elevated temperatures resulted from circulation of hot water in the basin. Later exhumation of these rocks caused partial to total replacement of anhydrite by gypsum in the upper part of the section. The resulting increase in volume due to hydration of anhydrite at shallow depths also emplaced non evaporative satin spar veins (fibrous gypsum) along bedding planes and in fractures. While the local geology of the Newark rift basin controlled the distribution of facies, the sedimentological development of the Passaic Formation evaporites resulted from the world wide climatic aridity that prevailed during the late Triassic.

ENOS, P., WEI, J.Y. and YAN, Y.J., 1997. Facies distribution and retreat of Middle Triassic platform margin, Guizhou Province, South China. Sedimentology, 44: 563-584.

The southern margin of the vast Yangtze platform in central Guizhou Province, China, retreated during the Anisian (early Middle Triassic) by shedding skeletal debris and boundstone blocks into the margin of the adjacent basin. Anisian platform deposits are shoaling up cycles that commonly terminated in subaerial exposure. Platform margin facies are obscured by massive dolomitization and mechanical erosion. Distal basin deposits are terrigenous mudstone and siltstone. At the basin margin a wedge of mixed carbonate and terrigenous rocks consists of

(A) thin bedded dolostone and limestone, (B) lime breccia with thin bedded mudstone, and (C) lime mudstone with breccia. Blocks within the breccias indicate that the shelf margin contained extensive boundstone formed by 'Tubiphytes,' encrusting organisms, and early marine cement. Interspersed thin beds of skeletal packstone represent unlithified skeletal debris at the platform margin. The profile of the shelf margin from detailed mapping indicates 1.7-2.7 km of platform margin retreat during deposition of a basin margin wedge 250 m thick. Intertonguing of various basin margin facies reflects alternating minor episodes of advance and retreat of the margin. Near parallelism of the tongues suggests low relief at the platform margin. An upward stratigraphic progression to more distal, carbonate free, terrigenous basin facies indicates a cessation of carbonate production on the platform owing to emergence during early Anisian time. Retreat may have occurred entirely by collapse of blocks less than 100 m wide and 30 m thick, the largest observed dimensions. A re entrant in the margin 7 km wide and 10 km deep could also reflect collapse. Retreat occurred along 175 km of the platform margin. The lack of platform margin facies along this front suggests 3-7 km of retreat and a total area of 875 km^2. The Anisian platform margin retreat in Guizhou is one of relatively few examples of platform margin retreat in the geological record.

ETTENSOHN, F.J., 1997. Assembly and dispersal of Pangea: large scale tectonic effects on coeval deposition of North American, marine, epicontinental, black shales. J. Geodyn., 23: 287-309.

Both before and after inclusion of Laurussia in Pangea, the continent was a site of extensive epicontinental, marine, black shale deposition, but from Pennsylvanian to Jurassic time when North America was an integral part of Pangea, the pattern of black shale deposition was one of long term decline. In North America the decline seems to have been greatest in Late Permian and Triassic times. Although this decline could have reflected a period of global cooling and a related decrease in organic productivity brought on by conditions associated with the super-continent state, mapping the distribution of black shales in time and space on North American parts of Pangea suggests that the restricted availability of suitable repositories for organic rich sediments may have been an equally important cause. In fact, mapping shows that the distribution of North American, Pangean, marine, black shales was greatest during Mississippian assembly of Laurussia when foreland basin type repositories were abundant and again during Late Jurassic fragmentation when rift basin type repositories were abundant. In both cases, tectonically conditioned basins formed the major repositories and promoted certain conditions that enhanced early basin anoxia. During Late Permian and Triassic time, when Pangea had been assembled, neither compressive orogenies nor crustal extension were major influences on North America. Consequently, suitable repositories were minimal and so was the extent of black shale deposition. However, the continued presence of even a few major black shale deposits during this time of minimum suggests that even low organic productivity was not a primary cause of decline and points to the possible significance of active continent assembly and breakup in generating tectonic basin repositories conducive to accumulation and preservation of the organic matter that is nearly always present in quantities great enough to form major black shale deposits.

ET-TOUHAMI, M., 1996. Le Trias évaporitique du bassin de Khémisset (Maroc central) : géometrie des corps sédimentaires et environnements de dépôt. In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 181-199.

The Khémisset basin appears as a half-graben oriented NE-SW, bounded by Paleozoic uplifts of the Moroccan Meseta, deformed during the Hercynian orogeny. It is filled by a thick evaporitic and detrital series (1000 m in the center of the basin), of Late Triassic age, which can be subdivided, in borings, into: a Lower Clay Formation (40 to 259 m) ; a Lower Salt Formation (194,5 m in the thickest part) subdivided, in turn, into two units; a Basaltic Formation (over 100 m) ; an Upper Salt Formation (550 m) subdivided into three units; and an Upper Clay

Formation (50 m). Deposition of this series has taken place within a variety of environments that are mappable throughout the basin: internal marine platform with carbonates, mainly cryptalgal dolomicritic laminite; brine-pan depression system with laminated gypsum, layered and clastic salt, and magnesian and potassic salts, which formed in shallow hypersaline waters such as those of closed lagoons or supratidal salines; saline flats with chaotic mixtures of phenoblastic halites and clays; and mudflats related to systems of alluvial plains that provided red detrital deposits, mainly silts and clays. Br geochemistry of halites shows that concentration of Br in the lowermost part of the Lower Salt Formation, lower than that predicted from modem seawater, indicates either syndepositional recycling of halite or inflow of non-marine waters less rich in Br, whereas the lower Br values recorded in the bottom of the Upper Salt Formation in primary chevron halites clearly show the meteoric origin of mother waters. The upward increase of Br in halites of both the lower and upper salt formations is consistent with a marine origin of the mother waters.

EZAKI, Y., 1997, The Permian coral *Numidiaphyllum*: new insights into anthozoan phylogeny and Triassic scleractinian origins. Palaeontology, 40: 1-14.

The Permian coral *Numidiaphyllum*, having an unusual septal arrangement and an aragonitic skeleton, has been classified in the Rugosa. The type species of Numidiaphyllum shows high intraspecific morphological variability and distinct granulation on septal faces. Ontogenetic development indicates that corallites show hexameral septal arrangement and cyclic mode of insertion. The genus has no specific morphologies that deny scleractinian affinities. *Numidiaphyllum* is believed to have originated in sponge algal reefs in the Permian tropics but possesses a basic scleractinian form which was already established in Early Palaeozoic times. Whatever their variation might be, the zoantharians, which may be closely related to *Numidiaphyllum*, survived the end Permian extinction in 'deep water' refuges as Permian holdovers, retaining their body plan, and they are possible scleractinian ancestors in the Triassic. Scleractinia have no immediate phylogenetic relationship to Rugosa. This study provides evidence about Permo-Triassic anthozoan phylogeny in terms of Permian survivors and their relationship to Triassic scleractinian origins.

FICHTER, J. and LEPPER, J., 1997. Die Fährtenplatte vom Heuberg bei Gieselwerder. Philippia, 8: 35-60.

A new find of a sandstone slab displaying reptile tracks is described. The slab comes from the lowest part of the Hardegsen Formation (Middle Buntsandstein) near Gieselwerder (Germany, North-Hesse). It shows a pair of manus-pes imprints of moderate size, which can be assigned to *Isochirotherium sanctacrucense* Ptaszynski 1990. In addition to this there are also numerous small to very small manus-pes imprints which are thought to be those of juvenile reptiles. Among them a pair of manus-pes imprints is identified as Rhynchosauroides schochardti (Rühle v. Lilienstern 1939), others are believed to belong to juvenile *Isochirotherium sanctacrucense* Ptaszynskl 1990. Beside these tracks, there are skin impressions which possibly belong to the animal that produced the *Isochirotherium sanctacrucense* footprints. The pattern of weight distribution and the morphology of the last mentioned footprints suggests a foot construction that shows certain similarities with that of a euparkeriid.

GAETANI, M., 1997. The Karakorum Block in central Asia, from Ordovician to Cretaceous. Sed. Geol., 109: 339-359.

The Karakorum Block records a predominantly marine Ordovician to Cretaceous sedimentary history. Six major sedimentary cycles are recognised. The oldest sediments, Early Ordovician, transgress over a crystalline basement. The I km thick Ordovician Silurian mostly shaly succession contains rare carbonate intercalations. In the Early Devonian, a wide peritidal platform spread over the craton. Sedimentation rates were low, 10 20 m/Ma, and Upper

Devonian probable Lower Carboniferous carbonates and clastics rest unconformably on the Early Devonian carbonates. No evidence has been found for either Late Carboniferous or glaciogenic deposits. Sedimentation rates increased during the Permian up to 50 m/Ma, with thicknesses between 1 and 2.5 km. Three steps are identified. (1) A huge alluvial to marginal marine terrigenous prism aggraded during the Asselian Sakmarian. (2) The Artinskian Murgabian is characterised by local emergence and erosion, linked to extension with block rotations. (3) Greater differentiation occurred from Late Permian to Middle Triassic, when a peritidal carbonate flat developed in the southwest, facing a deeper basin to the northeast. Carbonate sediments prevailed throughout the Camian Norian. The Permo-Triassic evolution is interpreted as the passive margin stage of the Karakorum Block, which previously belonged to the Perigondwanian fringe, when, like Mega-Lhasa, it drifted northward on the Tethyan Transit Plate. Mega-Lhasa is considered as a collage of blocks possibly separated by thinned crust or short lived seas with ocean crust. Quartzo-lithic sandstones with grains of mafic volcanics and serpentinite, overlain with gentle unconformity by Pliensbachian Toarcian red sandstones with sedimentary and metasedimentary clasts, record the Eo-Cimmerian deformation in the Karakorum. This orogenic episode was over by the Aalenian, when a shallow water carbonate ramp aggraded onto the previously emergent area. The pre-Barremian, Upper Jurassic and Lower Cretaceous are poorly documented. In post-Barremian times the sedimentary succession of N Karakorum was severely deformed in huge thrust sheets, including slabs of crystalline basement. A coarse conglomerate of mid Cretaceous age sealed the thrust sheet edifice. Finally, isolated Campanian pelagic mudstones are recorded. Anticlockwise rotation of Mega-Lhasa followed the Late Triassic docking of the Iranian Spur, using the latter as pivot. The rotation was completed during the Middle Jurassic, when SE-Pamir, Shaksgam and Karakorum joined the Qiangtang, more closely assembling Mega Lhasa as it approached the Asian margin.

Galton, P.M., 1997. Comments on sexual dimorphism in the prosauropod dinosaur *Plateosaurus engelhardti* (Upper Triassic, Trossingen). N. Jb. Geol. Paläont., Mh., 1997(11): 674-682.

Proportional differences in the femora of *Plateosaurus engelhardti* from the Knollenmergel of Trossingen, Germany probably represent a sexual dimorphism. More marked differences occur in appendicular bones of the Upper Triassic prosauropods *Thecodontosaurus antiquus* (England) and *Melanorosaurus readi* (South Africa). Presumed male characters of skulls of *P. engelhardti and Massospondylus carinatus* (Lower Jurassic, South Africa) probably represent individual variations.

Góczán, F., 1997. New organic framework plant microfossils in the Lower Rhaetian beds of the Csővár Limestone Formation. Acta Geol. Hung., 40: 197- 239.

Acid treatment revealed that grains appearing like disseminated poppy-seeds on the bedding plane of 3-4 cm thick, light grey, hard, calcareous marls in the basal layers of the Upper Triassic formations (exposed in 1961) of the Big Quarry of Csővár are large, thick-walled organic framework plant microfossils. They represent 4 genera and 7 species. Among them, three genera and six species proved to be new. In introducing them, the names *Oraveczia hungarica* nov.gen. et sp., *O. doliola* nov. sp., *O. galeata* nov.sp., *Vadaszia cavernosa* nov.gen. et sp., *Sulcodiscus trisulcatus* nov.gen. et sp. and *Tytthodiscus tubulatus* nov.sp. are recommended. *Oraveczia faveola* (Morbey 1975) nov. comb. et emend. is also discussed. The stratum typicum of the described microfossils belongs to the Csővar Limestone Formation the age of which proved to be lowermost Rhaetian on the basis of the sporomorph association occurring together with the microfossils. Characteristic sporomorph taxa are as follows: *Riccisporites tuberculatus* Lundblad 1954, *Rhaetipollis germanicus* Schulz 1957, *Classopollis tarsus* (Reiss. 1950) Balme 1957, and *Corollina meyeriana* (Klaus 1960) Venk. et Gócz. 1962.

GODEFROIT, P., 1997. Reptilian, therapsid and mammalian teeth from the Upper Triassic of Varangéville (northeastern France). Bull. Inst. Roy. Sci. Nat. Belg., Sci de la Terre, 67: 83-102.

Microvertebrate remains have been discovered at a new Late Triassic locality in Varangéville (northeastern France). The material includes reptilian (Ichthyosauria indet., Phytosauridae indet., the pterosaur aff. *Eudimorphodon,* Archosauria indet.), therapsid (advanced Cynodontia) and mammalian (Haramiyidae, Morganucodontidae, Sinoconodontidae and Woutersiidae) teeth, described in the present paper. The faunal composition, closely resembling that of the neighbouring locality of Saint-Nicolas-de-Port, suggests a coastal or a deltaic depositional environment.

GODEFROIT, P. and BATTAIL, B., 1997. Late Triassic cynodonts from Saint-Nicolas-de-Port (north-eastern France). Geodiversitas 19: 567-631.

Numerous isolated cynodont teeth have been collected from the Late Triassic of Saint-Nicolas-de-Port (north-eastern France). The material is very diversified and the following taxa are recognized: *Pseudotriconodon wildi* Hahn, Lepage et Wouters, 1984; *Tricuspes tuebingensis* E. v. Huene, 1933; *Tricuspes sigogneauae* Hahn, Hahn et Godefroit, 1994; *Tricuspes tapeinodon n.sp.; Meurthodon gallicus* Sigogneau-Russell et Hahn, 1994; *Hahnia obliqua* n.g., n.sp.; *Gaumia longiradicata* Hahn, Wild et Wouters, 1987; *Lepagia gaumensis,* Hahn, Wild et Wouters, 1987; *Maubeugia lotharingica* n.g., n.sp.; *Rosieria delsatei* n.g., n.sp. and aff. *Microscalenodon.* This cynodont fauna mainly includes small insectivorous forms, more particularly represented by Dromatheriidae; tiny herbivorous are represented by rare dwarf Traversodontidae. The study of the palaeogeographical and stratigraphic distribution of the Late Triassic to Early Jurassic cynodonts indicates that the fauna discovered in Saint-Nicolas-de-Port is characteristic of the Late Norian-Rhaetian period and is actually the most representative of this period for Western Europe. Granulometric analysis of the bone-bed reveals that they accumulated in a nearshore shallow marine environment.

GÖTZ, A.E., 1996. Fazies und Sequenzanalyse der Oolithbänke (Unterer Muschelkalk, Trias) mitteldeutschlands und angrenzenden Gebiete. Geol. Jb. Hessen, 124: 67-86.

The long established detailed lithostratigraphic subdivision of the German Lower Muschelkalk (Middle Triassic, Anisian) provides an ideal basis for basin-wide facies analysis. The lateral facies distribution of the Oolith-beds reflects a shallow SSE-sloping homoclinal carbonate ramp. This ramp was subdivided from NW to SE into a shallow lagoonal, intertidal and subtidal zone, each showing characteristic sediment types. The cyclic sedimentation of the Lower Muschelkalk is documented by vertical facies successions consisting of characteristic facies units. The metre-scale minor cycles recognized are interpreted as high-frequency sequences in terms of sequence stratigraphy.

GÖTZ, A.E., 1996. Palynofazielle Untersuchungen zweier Geländeprofile im Unteren Muschelkalk Osthessens und Westthüringens. Geol. Jb, Hessen 124: 87-96

In the western German Basin two outcrop sections of the Lower Muschelkalk (Middle Triassic, Anisian) have been studied palynologically. Palynofacies and palynomorph associations are discussed. Palynological data are first applied to sequence analysis of the Lower Muschelkalk giving valuable evidence in the characterization of systems tracts. Significant changes in the palynomorph associations, especially the relative abundance of marine plankton, indicate the major transgressive and regressive trends within the Lower Muschelkalk sequence.

GOWER, D.J., 1997. The braincase of the early archosaurian reptile *Erythrosuchus africanus*. J. Zool., 242: 557-576.

The first detailed description of the braincase of the Triassic early archosaurian reptile *Erythrosuchus* is presented. Features plesiomorphic for archosaurs that are described include an

ossified laterosphenoid, a 'semilunar depression', posteroventrally positioned internal carotid foramina, a basisphenoid 'inter tuberal plate', an un or incompletely ossified medial wall of the otic capsule and channel for the perilymphatic duct, a metotic foramen undivided by bone, and a short lagenar recess. Among the earliest archosaurs, the braincase of *Erythrosuchus* is considered to share more derived similarities with the erythrosuchid *Shansisuchus* than with other taxa, although further study is required to ascertain whether these similarities are homologous. An understanding of non-crown group archosaur morphology is important for resolving controversial questions of homology concerning braincase features in extant archosaurs, as well as for improving estimates of archosaur phylogeny. The most recent common ancestor of crocodiles and birds is hypothesized to have lacked a 'semilunar depression' and basisphenoid 'intertuberal plate', and to have had laterally positioned internal carotid foramina, a short lagena, an undivided metotic foramen, an unossified eustachian system, and elements of the tympanic cavity that were not pneumatized.

GOWER, D.J. and SENNIKOV, A.G., 1997. *Sarmatosuchus* and the early history of the archosauria. J. Vertebr. Paleont., 17: 60-73.

A detailed description of the early archosaur *Sarmatosuchus otschevi* Sennikov, 1994, from the Middle Triassic Donguz Formation of southern European Russia, is presented. New morphological data forms the basis of a preliminary investigation of the phylogenetic relationships between a selection of the earliest archosaurs. A parsimony analysis based on 9 taxa and 35 characters recovers two most parsimonious trees that support the referral of *Sarmatosuchus* and *Fugusuchus* to a proterosuchid clade, as well as the paraphyly of the *Proterosuchia*. Characters from the structure of the braincase are more homoplastic than those from the rest of the skeleton. The presence of *Sarmatosuchus* in the Middle Triassic affords evidence that the proterosuchids were a more diverse and persistent clade than has been previously envisaged. Evidence suggesting that proterosuchids may have existed with erythrosuchids and early crown group archosaurs in the Middle Triassic requires a revision of our understanding of the early part of the archosaurian radiation.

GRAMBERG, I.S., 1997. Barents Sea Permian-Triassic paleorift and its meaning for oil and gas content of Barents-Kara Platform. Dokl. Akad. Nauk, 352: 789-791.

HAAS, J., TARDI-FILÁCZ, E., ORAVECZ-SCHEFFER, A., GÓCZÁN, F. and DOSZTÁLY, L., 1997. Stratigraphy and sedimentology of an Upper Triassic toe-of-slope and basin succession at Csővár, North Hungary. Acta Geol. Hung., 40: 111-177.

In North Hungary east of the Danube, small outcrops of the Mesozoic basement are known. They are generally considered to belong to the Transdanubian Range Unit. The basement block in the vicinity of Csővár is made up of Triassic carbonates of platform and basin facies, respectively. The 1200 m deep Csővár (Csv)-1 well exposed a significant part of the basin facies, and entered into strongly tectonized dolomites beneath it. The succession exposed by the Pokolvölgy quarry completed the sequence upward and offered an excellent opportunity for detailed sedimentological observations. Re-investigation of the Csv-1 core led to the conclusion that the approximately 600 m thick lower part of the sequence, consisting of dolomites inserted by thin slices of extremely varied lithology and age (Triassic to Cretaceous) is not a part of the normal stratigraphic succession. The upper part of the Csv-1 core and the section of the Pokolvölgy quarry exposed an Upper Carnian-Rhaetian succession of basin and toe-of-slope facies. The latter is indicated by gravity-flow deposits and redeposited fossils of carbonate platform origin, and in the large amount of remnants of Rhaetian terrestrial plants.

HAGDORN, H., 1996. Palökologie der Trias-seelilie *Dadocrinus*. Geol. Paläont. Mitt. Innsbruck, 21, 19-45.

Dadocrinus with its geographical range covering the eastern part of the Germanic Muschelkalk basin and the Alpine realm during Lower Anisian times occurs in four morphotypes (species ?). *Dadocrinus* fossil sites in the Vicentinian Alps (Recoaro) and in the Gogolin Beds of Upper Silesia indicate the same habitat type. Like their close relatives, the encrinids, dadocrinids with their terminal discoid holdfasts needed solid anchoring grounds. Nevertheless, sedimentological and synecological evidence from conservation lagerstätten rather indicate soft ground habitats. The crinoids mostly settled as single individuals or in bundles on the rear ends of mudsticking bivalves or on stalks of other individuals. Hardground fixation is less common. Their preference for soft substrates caused a size limitation to about 20 cm, because the bivalve byssus would not have been able to fix larger crinoids in the muddy grounds. The morphologically similar encrinids with their preference for solid grounds, during Pelsonian and Illynian times reached more than one meter in length. This increase became possible by an overall environmental change from endobenthos dominated soft ground habitats during Lower Anisian times to epibenthos dominated coquinoid bottoms during Upper Anisian times.

HAGDORN, H., 1996. Trias-seelilien. Geol. Paläont. Mitt. Innsbruck, 21: 1-17.

Since the appearance of the crinoid volumes of the Treatise on Invertebrate Paleontology in the year 1978, many new research papers have been published dealing with Triassic crinoid morphology, systematics, phylogeny, functional morphology, paleoecology, paleobiogeography and stratigraphy. The Triassic was the most crucial period for the phylogeny of modern crinoids. The paper references 102 single publications and points out current projects and desiderata objects for future research.

HAGDORN, H. and SCHULZ, M., 1996. Echinodermen-Konservatlagerstätten im Unteren Muschelkalk Osthessens. 1. Die Bimbacher Seelilienbank von Grogenlüder-Bimbach. Geol. Jb. Hessen, 124: 97-122.

The macrofauna of the Bimbach Crinoid Bed (Middle Wellenkalk Member, muW2-B; cycle mulld; Anisian, Pelsonian) of eastern Hesse (central Germany) contains outstandingly well preserved echinoderms. 246 individuals of *Encrinus* sp. cf. *E. brahli* of 3 to 64 mm crown length allow a detailed description of the morphology, ontogeny and variability of this most common Lower Muschelkalk *Encrinus* which occupies an intermediate position between *Encrinus brahli and E. aculeatus*. For the first time, the apical system of the early euechinoid *Serpianotiaris* sp. cf. *S. coaeva* is described. The obrutional fossil lagerstaette of the Bimbach Crinoid Bed is covering a regional area. At Bimbach, the rare adult crinoids represent a pioneering generation settling on erosional firm substrate surfaces (hard grounds, intraclasts, big shells). The dominating juveniles represent the second generation. The crinoids were smothered by catastrophic deposition of mud before they could grow larger.

HAGDORN, H., GŁUCHOWSKI, E. and BOCZAROWSKI, A., 1996. The crinoid fauna of the *Diplopora* dolomite (middle Muschelkalk, upper Anisian) at Piekary Śląskie in Upper Silesia. Geol. Paläont. Mitt. Innsbruck, 21: 47-87.

The diverse crinoid fauna described from the *Diplopora* Dolomite (Middle Muschelkalk, Triassic, Anisian, Lower Ilyrian; assemblage zone with *Neoschizodus orbicularis and Judicarites; silesiacus* zone) of Piekary Śląskie (Upper Silesia, Poland) is represented by isolated sclerites exclusively. The fauna comprises at least 5 crinoid genera. With 87% of the sclerites, encrinids are dominating, while holocrinids (7%) and millericrinids (1%) are less abundant. The encrinids *Encrinus aculeatus* and *Chelocrinus carnalli* may be only distinguished by their cup and arm elements. Their columnals are distributed into 5 morphotypes belonging to definite parts of the stalk. Descriptions of the holocrinids *Holocrinus meyeri* (stalk, cup, arms) and *Eckicrinus*

radiatus (stalk) and of the millericrinid *Silesiacrinus silesiacus* are given in more details. Relations and occurrence of these taxa in the Germanic and the Alpine Triassic are extensively discussed. They are useful index fossils for biostratigraphic correlation of different Peritethys basins. Finally, several indefinite crinoid scierites are described.

HAKENBERG, M. and SWIDROWSKA, J., 1997. Propagation of the southeastern segment of the Polish Trough connected with bounding fault zones (from the Permian to the Late Jurassic). C.R. Acad. Sci., Sér. II, A, 324: 793-803.

Sedimentary thicknesses and fault patterns give evidence for longitudinal propagation of the southeastern segment of the Polish Trough towards the SE during the late Permian to Middle Jurassic times. The multiphase tectonic history includes three discrete episodes of accelerated subsidence: Late Permian-Early Triassic, Early Jurassic and Late Jurassic. Two of them were connected with increasing activity on basin bounding faults: the Holy Cross fault and the Nowe Miasto Ilza fault, which parallels the Tornquist Teisseyre zone. The geometry of basin infill indicates a transverse asymmetry of the trough, activity of one transfer fault and an accommodation zone. The Late Jurassic was an episode of overall subsidence not coupled with major thickness gradients. This basin developed mainly in subhorizontal transtensional conditions in the NNE direction except for the phase (Middle and Upper Triassic) associated with gravity tectonics.

HALLAM, A., 1997. Estimates of the amount and rate of sea-level change across the Rhaetian-Hettangian and Pliensbachian-Toarcian boundaries (latest Triassic to early Jurassic). J. Geol. Soc., 154: 773-779.

An attempt is made to determine the amount and rate of sea level change for two major events in the latest Triassic to early Jurassic, both of which are associated with mass extinctions, using the best available facies evidence and time scale. The amount of marine deepening across the Pliensbachian-Toarcian boundary, based on analysis of the excellent Yorkshire coast section, is likely to have been a few tens of metres, at a rate of between 1 cm 1.2 ka^{-1} and 1 cm 0.4 ka^{-1}. The change across the Rhaetian-Hettangian (Triassic-Jurassic) boundary was different in that the sea level rise was immediately preceded by a sea level fall, effectively a 'regression transgression' coupler. The earliest Jurassic sea level rise is likely to have been much more rapid than that across the Pliensbachian-Toarcian boundary, at a rate of at least 1 cm 0.2 ka^{-1}. Whereas the speed of Pliensbachian-Toarcian change is consistent with the growth of oceanic ridges, the appreciably more rapid Triassic-Jurassic change is suggestive of a different tectonoeustatic mechanism involving stress induced changes in plate density.

HANEBUTH, T., 1997. Ein Bonebed im höheren Keuper am Westrand des Thüringer Beckens. N. Jb. Geol. Paläont., Abh., 204: 185-200.

A bonebed in the Netra Graben (west of the Thuringian Basin) described the first time here is developed at the base of the 'Rhätkeuper'. A detailed analysis of the elastic and geochemical content allows the interpretation of the mechanisms of sedimentation and diagenesis. The 18 determinable species of Selachii, Osteichthyes and Reptilia represent a typical faunal association of the Upper Keuper beds. The thin layer of vertebrate-sand as an enriched horizon of reworked material marks the transition from terrestrial to the transgressive shallow water environment of the Rhaetian, probably with influences of episodic freshwater influx and variation in salinity.

HAYCOCK, C.A., MASON, T.R. and WATKEYS, M.K., 1997. Early Triassic palaeoenvironments in the eastern Karoo foreland basin, South Africa. J. Afr. Earth Sci., 24: 79-94.

The Beaufort Group sediments of the Karoo Supergroup in southern Karoo were deposited in a Permo-Triassic foreland basin associated with the development of the Cape Fold Belt. The

eastern parts of this basin are often overlooked in palaeoenvironmental reconstructions. During the Early Triassic, deposition occurred in this region on a braided alluvial plain. Vegetation, although restricted to areas adjacent to water bodies, supported a healthy vertebrate population, notably *Lystrosaurus* and *Thrinaxodon*. Pulses of sedimentation produced interfingering of sandy Katberg Formation sediments and muddy Palingkloof Member sediments (Balfour Formation), as well as a lateral shifting of facies belts. The cause of these was episodes of tectonic activity associated with the development of the Cape Fold Belt. The source of the sediments was the Proterozoic basement of the Maurice Ewing Bank, which lay to the southeast of the area prior to Gondwana break up. The exposure of the basement at this time is in marked contrast to the downward flexing of basement in areas further to the west. It defines the eastern side of the Karoo Basin and may account for the very thin sedimentary succession in Dronning Maud Land, Antarctica.

HEERDEN, J. VAN and Calton, P.M., 1996. The affinities *of Melanorosaurus, a* Late Triassic prosauropod dinosaur from South Africa. N. Jb. Geol. Paläont. Mh., 1997 (1): 39-55.

New material of *Melanorosaurus readi* Haughton, 1924 from the Carnian of the Cape Province represents two incomplete specimens of this early prosauropod. The species is more lightly built than the somewhat younger *M. thabanensis* Gauffre, 1993 a from Lesotho and the South American melanorosaurid *Riojasaurus* Bonaparte, 1969. The sixth cervical vertebra has an inclined anterior articular surface, pointing to a natural curvature in the neck. The forelimbs are shorter and more slender than in *Riojasaurus. M. readi* also has four sacral vertebrae, the additional one being incorporated from the dorsal series. The pubes are long, slender elements compared to the same in *Riojasaurus. M. readi* was probably facultatively bipedal, whereas *Riojasaurus* was probably an obligatory quadruped.

HIPS, K., 1996. Stratigraphic and facies evaluation of the Lower Triassic formations in the Aggtelek-Rudabánya Mountains, NE Hungary. Acta Geol. Hung., 39: 369-411.

Thanks to a complex examination of the Lower Triassic formations of the Aggtelek-Rudabánya Mountains, the lithostratigraphic sub-division, outlined previously only in a general way, could be performed more accurately. In the uppermost part of the Bódvaszilas Sandstone Formation, a characteristic limestone horizon was distinguished, while within the Szin Mart Formation, seven lithologic units could be separated. During the Scythian sediments were deposited on a homoclinal ramp. Sedimentation had proceeded over a wide area from the supratidal zone of the inner shelf, through the lagoon, the zones of washover fans, shoals, and mid-ramp storm sheets, to the outer ramp. On the basis of the water depth changes during the Scythian, four third-order relative sea-level change cycles could be detected within the sequence. They are well correlatable with cycles of Scythian sequences in other areas. The entire Scythian sequence could be divided into five biozones. These are as follows: *Claraia clarai*, *Claraia aurita*, *'Eumorphotis'*, *Tirolites cassianus*, and *Tirolites carniolicus* Zones. With the help of the biozones, the age of the formations and their members could be determined more accurately. It was found that the Perkupa Evaporite Formation reaches up to the Upper Griesbachian. The Bódvaszilas Sandstone Formation extends from the Upper Griesbachian to the end of the Smithian, while the Szin Marl and the Szinpetri Limestone Formations correspond to the Spathian. Due to the poor fossil content of the formations, the Permian/Triassic and Scythian/Anisian boundaries cannot be drawn unambiguously.

HUANG, K. and OPDYKE, N.D., 1997. Middle Triassic paleomagnetic results from central Hubei Province, China and their tectonic implications. Geophys. Res. Lett., 24: 1571-1574.

Twenty one sites consisting of 4 to 7 samples per site were drilled from the redbeds of the Middle Triassic Badong Formation from central Hubei province, China. These samples were subjected to progressive thermal demagnetization which revealed two components of

magnetization. The low temperature (A) component was probably acquired at a late stage of folding and is similar in direction to the late Mesozoic overprint widely observed in the eastern Yangtze Block. The high temperature (B) component is prefolding with dual polarity. Unlike the prefolding paleomagnetic directions observed id eastern Sichuan, western Hubei and northwestern Hunan, the B component resolved from central Hubei indicates no significant rotation with respect to other parts of the Yangtze Block. Since one of the two sampled sections is in the strongly deformed foreland fold thrust belt of the Qinling Fold Belt, this would seem to negate the possibility that the differential rotations observed in the border area between Sichuan, Hubei Hunan and Guizhou are associated with the collision of the Yangtze Block with the North China Block.

IANNACE, A. and ZAMPARELLI, V., 1996. The serpulid-microbialite bioconstructions of the "Scisti Ittiolitici" basin of Giffoni Vallepiana (Upper Triassic, Southern Apennines). Palaeopelagos, 6: 45 - 62.

This paper illustrates microbial-serpulid bioconstructions occurring in the Giffoni Vallepiana area (Salerno) associated to the Norian organic rich dolomites known as *Scisti Ittiolitici.* The dominant facies is by far represented by the microbialite-serpulid bindstone and especially their derived breccias. Small sphinctozoan sponges, bivalve and brachiopod are the only other significant biota. Micro and megaquartz, representing the recrystallization of an earlier chalcedonic phase is frequent. A reappraisal of a previous study by Sgrosso (1965) in the Monti Mai, some km to the NW, allows to conclude that the depocenter of the Norian *Scisti Ittiolitici* basin is represented in those areas and that the sedimentary history of the Scisti Ittiolitici basin lasted at least until Middle Jurassic. Similar facies are also described for the SW sector of the Lattari Mountains. The association of serpulids, bivalvs and cyanophyta and the correlative absence of the main Upper Triassic reef constructors is indicative of some environmental stress (eutrophy?) leading to the formation of the organic-rich facies of the basin. Similar paleoenvironments developed from Lombardy Basin to Northern Calabria as a consequence of Norian ensialic rifting. This evolution represents the earlier phase of rifting proceeding the formation of the Jurassic Penninic-Ligurian ocean.

IGO, H., 1996. Silurian to Triassic conodont biostratigraphy in Japan. Acta Micropalaeont. Sinica, 13:143-160.

This paper gives a general review on the research history and present information of conodonts in Japan. Since very few conodonts have been found from Silurian, no conodont zones have been established in this system. However, 32 conodont zones or assemblages have been found from Devonian to Triassic in Japan, including 5 Early Devonian, 8 Carboniferous, 5 Permian and 14 Triassic conodont zones or assemblages.

ISOZAKI, Y., 1997. Contrasting two types of orogen in Permo-Triassic Japan: accretionary versus collisional. Island Arc, 6: 2-24.

Proto-Japan originated from a continental margin of the Neoproterozoic Yangtze (South China) craton. It represents a unique Permo-Triassic tectonic setting in western Panthalassa, where two distinct types of orogenic belt occurred side by side. There was an accretionary orogen between the Yangtze craton and the Proto-Pacific (Farallon) Plate and a collisional orogen between the Sine Korean (North China) and Yangtze cratons. This article reviews results of the latest on land geological studies concerning Permo-Triassic tectonics in Japan and proposes a new plate tectonic interpretation as well as a paleogeographic reconstruction of this particularly unique geotectonic regime. Special emphases are given to (i) the accretion processes and products derived by collision subduction of the Permian Akiyoshi paleoseamount and Maizuru paleo oceanic plateau; (ii) the field occurrence of 220 Ma Sangun high P/T schists and its implication for the exhumation process and 'tectonic sandwich' structure; (iii) the extensive

development of a subhorizontal nappe of the pre-Jurassic rocks and their bearing on the orogenic edifice; and (iv) the restricted occurrence of the 250 Ma collision complex in the Hida and Oki belts and the relevant connection to the Precambrian cratons and collision suture in East Asia. The newly proposed paleogeographic reconstruction is also tested by faunal provinciality of Permo Triassic fossils from shallow water sediments.

ISOZAKI, Y., 1997. Timing of Permian-Triassic anoxia. Science, 277: 1748-1749.

JALIL, N.-E., 1996. Les vertebrés permiens et triasiques de la Formation d'Argana (Haut Atlas occidental) liste faunique préliminaire et implications stratigraphiques. In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 227-250.

The Argana Formation crops out in the western part of the High Atlas mountains, southwest of Marrakech (Morocco). It extends for 75-85 km from Ameskroud in the south to Imi n'Tanoute in the north. It consists of eight lithostratigraphical units (T1 to T8). Three of these levels (T2, T4 and T5) are fossiliferous, whereas T1, T3 and T7 have yielded fragmentary and indetermined remains only. From 1962 to 1975, the Argana Formation was extensively explored (particularly level T5) and has yielded numerous vertebrate fossils from at least 23 localities. A preliminary faunal list of the taxa reported from osseous remains is as follows: T2: Amphibia, Nectridea (*Diplocaulus minimus*; Amniota, Captorilinidae (*Acrodonta irheri*, Moradisaurinea indet.); T4: Amphibia, Capitosauridae (*Cyclotosaurus* sp.). T5 (base): Actinopterygii, Colobodontidae (*Dipteronolus gibbosus*, cf. *Procheirichthys*, cf. *Perleidus*) and Redfieldiidae (*Mauritanichthys rugosus*; Sarcopterygii, Dipnoi (*Arganodus allaniis*, *Ceratodus arganensis*) and a Coelacanthidae indet.; Amphibia, Almasauridae (*Almasaurus habbazi* and Metoposauridae (*Meioposaurus ouazzoui*; Amniota, Dicynodontia (*Moghreberia nmachouensis*, *Azarifeneria barrati*, '*azarifeneria robustus*'), Rauisuchia indet., Parasuchia (*Paleorhinus magnoculus* and Dinosauria, Prosauropoda (*Azendohsaurus laaroussii*). T5 (top): Amphibia, Metoposauridae (*Metoposaurus lyazidi*, *Metoposaurus azerouali*); Amniota, Parasuchia (*Angistorhinus talainti* and a large-sized and indeterrnined taxon). Comparison of the fauna of the upper part of level T2 with the other faunas from Euramerica and Gondwana fauna suggests a Late Permian age (Kazanian) for this part of the Argana Formation. The co-occurence of the phytosaurs *Paleorhinus magnoculus*, *Angistorhinus talainti* and a third, large-sized and indetermined taxon suggests a Late Triassic age (Middle to Late Carnien) for level T5. This age is supported by the presence of a large metoposaurid (*M. ouazzoui* and *M. lyazdi*) in T5 and a cyclotosaur in T4. Ongoing investigations of the avalaible and hitherto undeseribed material, and a cladistic analysis of the reporte d taxa would improve the knowledge on the stratigraphy of the Argana Formation and the paleobiogeographical affinities of its fauna.

JALIL, N.-E., 1997. A new prolacertiform diapsid from the Triassic of North Africa and the interrelationships of the Prolacertiformes. J. Vertebr. Paleont., 17: 506-525.

A new diapsid reptile, *Jesairosaurus lehmani*, gen. et sp. nov., is described on the basis of cranial and postcranial remains from the base of the Zarzaitine Series (Triassic) of Algeria. *Jesairosaurus* is a small prolacertiform with a low skull and an elongated neck; the snout is narrow and elongated and the post orbital region short and narrow; the quadratojugal is lost; the posterior process of the jugal is reduced and spur shaped: the hind limb is large in comparison with the forelimb and the rest of the postcranial skeleton. The relationships of basal archosauromorphs and the interrelationships of the prolacertiforms are examined. The analysis of 71 binary characters lends to the identification of *Jesairosaurus lehmani* as a prolacertiform and suggests that Prolacertiformes forms a monophyletic group within the Archosauromorpha. The analysis indicates that the Rhynchosauria is the sister group of a clade comprising *Trilophosaurus*, *Prolacertiformes*, and *Proterosuchus*. The Choristodera is the most

plesiomorphic taxon within the archosauromorphs. *Jesairosaurus* is most closely related to *Malerisaurus langstoni* while *Boreopricea* is closely related to the (*Cosesaurus* (*Tanystropheus longobardicus*, *Tanytrachelos*)) clade, and *Langobardisaurus* and *Macrocnemus* are the successive out groups of this clade. *Protorosaurus* is the most plesiomorphic of the best known Prolacertiformes. The relationships of the poorly known prolacertiforms *Kadimakara*, *Prolacertoides*, *Malutinisuchus*, and probably *Trachelosaurus* remain unresolved.

JASIN, B., 1997. Permo-Triassic radiolaria from the Semanggol Formation, northwest peninsular Malaysia. J. Asian Earth Sci., 15: 43-53.

A total of 32 species of radiolaria were identified from 20 chert samples at eight localities of the Semanggol Formation in north and south Kedah. Three assemblages of radiolaria were recognised representing the Early Permian *Pseudoalbaillella scalprata m. rhombothoracata*, Late Permian *Albaillella levis*, and Middle Triassic *Triassocampe deweveri* Assemblage Zone. The *Pseudoalbaillella scalprata m. rhombothoracata* Assemblage Zone is discovered from Bukit Kampung Yoi and Bukit Larek, north Kedah. The *Albaillella levis* Assemblage Zone is recorded from Bukit Tok Bertanduk, north Kedah and Merbau Pulas, south Kedah. The Triassocampe deweveri Assemblage Zone is found from the Lanjut Malau area, north Kedah. The radiolarian assemblages indicate that the age of the chert sequence in the Semanggol Formation ranges from Early permian to Middle Triassic.

JUNGHANS, W.-D., AIGNER, T. and RICKEN, W., 1997. Fluviatile Architektur des Mittleren Stubensandsteins am südwestlichen Schönbuch (Trias, Baden-Württemberg). N. Jb. Geol. Paläont., Abh., 204: 285-320.

The geometry and genesis of fluvial architectural elements are analysed in detail for the first time in the Stubensandstein (Norian). The depositional environment represents the distal part of terminal alluvial plain systems, where ephemeral processes (sheet floods, crevasse splays) are widespread. An ideal vertical succession, analogous to the Bouma-sequence of turbidites, is presented for crevasse splay deposits, together with regular lateral variations across the crevasse fan.

JASIN, B., 1997. Permo-Triassic radiolaria from the Semanggol Formation, northwest peninsular Malaysia. J. Asian Earth Sci., 15: 43-53.

A total of 32 species of radiolaria were identified from 20 chert samples at eight localities of the Semanggol Formation in north and south Kedah. Three assemblages of Radiolaria were recognised representing the Early Permian *Pseudoalbaillella scalprata* m. *rhombothoracata*, Late Permian *Albaillella levis*, and Middle Triassic *Triassocampe deweveri* Assemblage Zone. The *Pseudoalbaillella scalprata* m. *rhombothoracata* Assemblage Zone is discovered from Bukit Kampung Yoi and Bukit Larek, north Kedah. The *Albaillella levis* Assemblage Zone is recorded from Bukit Tok Bertanduk, north Kedah and Merbau Pulas, south Kedah. The *Triassocampe deweveri* Assemblage Zone is found from the Lanjut Malau area, north Kedah. The radiolarian assemblages indicate that the age of the chert sequence in the Semanggol Formation ranges from Early Permian to Middle Triassic.

KLIM, A., 1997. Brachiopod bivalve assemblages of the Middle Triassic *Terebratula* Beds, Upper Silesia, Poland. Acta Palaeont. Polonica, 42: 333-369.

Five types of brachiopod bivalve assemblages occur in Terebratula Beds and in the lower part of the Karchowice Beds (Middle Triassic, Muschelkalk) from the Strzelce Opolskie Quarry (Upper Silesia). These are: (1) Brachiopod Coquina Assemblage dominated by the terebratulid brachiopod *Coenothyris vulgaris*; (2) Crumpled/Wavy Limestone Assemblage including bivalves and brachiopods; (3) Bivalve Coquina Assemblage dominated by pseudocorbulid bivalves; (4) Hardground Assemblage dominated by the brachiopod *Tetractinella trigonella*; and (5) Crinoid

Limestone Assemblage dominated by crinoid columnals and the brachiopod *Punctospirella fragilis*. The distribution of the assemblages correlates with the eustatically controlled lithological variation in the carbonate dominated sequence of the Upper Silesian Muschelkalk. The brachiopod coquinas are parautochtonous remnants of terebratulid banks which thrived during the high bioproductivity but low oxygen conditions. Those conditions were caused by the biogenic influx generated from the terrains flooded during the Middle Triassic transgression. During the regressive phase, that resulted in the gradual decrease in bioproductivity and parallel increase in oxygen levels, the terebratulid banks were replaced by pseudocorbulid banks. With the further regression and thus, the further increase in oxygen level pseudocorbulid banks were replaced by the assemblages indicative of well oxygenated oligotrophic environments (Hardground and Crinoid Limestone Assemblages). The observed changes in the faunal composition reflect mainly differences in metabolism and feeding strategy among dominant taxa.

Kassan, J. and Fielding, C.R., 1996. Evolving depositional environments in the Triassic of the South-West Bowen Basin, Queensland, Australia. Cuard. Geol. Ibérica, 21: 171-201.

Sedimentation in the Bowen Basin during the Triassic occurred in a foreland setting between cratonic stable areas to the west and the active New England Orogen in the east. Sediment was accumulated in continental environments, which were predominantly fluvial, and much of the sediment was derived from the active orogen. Typical exposures from each of the three major Triassic stratigraphic units (Rewan Group, Clematis Group and Moolayember Formation) were studied, to illustrate the variations in depositional style throughout the evolution of the basin. The basal Triassic Rewan Group is dominated in the study area by poorly interconnected and sharply bounded channel sands of moderate width (tens of meters), with height to width ratios of individual channel bodies around 1:7. Sandbodies are separated by abundant chocolate brown to red mudrocks (siltstone and claystone) which shows evidence of soil formation and desiccation. The overlying quartzose Clematis Group represent a re-organisation of drainage in the basin and was derived from the stable craton to the west during a time of relative tectonic quiescence. Much of the Clematis Group accumulated in large sandy braidplains and now forms a cliff-forming sheet sandstone. Thickness to width ratios estimated for Clematis deposits in the area range from 1:30 to 1:70. The uppermost part of the unit records a rapid change to lacustrine conditions associated with a major lacustrine flooding event affecting the southern Bowen Basin (Snake Creek Flooding).

Kelber, K.-P., Okrusch, M. and Nikel, S., 1997. Exotische Kristallingerölle aus dem süddeutschen Schilfsandstein (mittlerer Keuper, Trias). N. Jb. Geol. Paläont., Abh., 206: 93-131.

At the Leippersberg Hill near Kottspiel (Northern Württemberg), the basal part of the Upper Triassic Schilfsandstein (Stuttgart group, km,) is developed as a conglomeratic sandstone that contains a variety of reworked rock fragments together with fragments of permineralized wood and sauropod bones. For the first time, exotic clasts of metamorphic and igneous rocks have been recorded, i.e. phyllites to quartz phyllites, albite gneisses and aplitic gneisses as well as cataclastic granites, tonalites and granite porphyries. Microprobe analyses revealed that the phyllites and albite gneisses contain phengitic white micas testifying to metamorphism under elevated pressures. A combination of the garnet-phengite geothermometer with the phengite geobarometer, applied to one sample of albite gneiss, yielded temperatures of 480-500 °C and pressures of 13-14 kbar. A distinctly lower P-T combination of about 6 kbar and 330 °C was estimated for an aplite-gneiss sample. These findings indicate a considerable regional extent or a marked metamorphic field gradient for the source region of the exotic clasts. Several modes of long distance transport mechanism are discussed. Among these, we regard a transportation of entrapped rocks within root structures of floating trees as the best explanation, whereas a transport as gastroliths in vertebrates seems rather unlikely. judging from the dominating

Schilfsandstein river system, Fennoscandia or, more probably, the north-western part of the Bohemian Massif can be considered as possible source areas.

KELLEY, S.P. and SPRAY, J.G., 1997. A Late Triassic age for the Rochechouart impact structure, France. Meteor. Planet. Sci., 35: 629-636.

$^{40}Ar/^{39}Ar$ laser spot fusion dating of pseudotachylyte from the similar to 25 km diameter Rochechouart impact structure of western central France yields a matrix age of 214 ±8 Ma (2σ). Field evidence indicates that the pseudotachylyte was generated during the modification stage of the impact process, probably during transient cavity collapse. This new age is considerably older than the previously accepted age of 186 ±8 Ma for this structure, which was obtained from hydrothermally altered melt sheet samples. The new age is in accordance with earlier paleomagnetic and fission track data, which indicated that Rochechouart was formed during the late Triassic. Moreover, the new determination is in agreement with the regional geological setting and field relations of the structure. The new age of 214 ±8 Ma falls within the Norian stage of the Triassic system.

KERN, A. and AIGNER, T., 1997. Faziesmodell für den Kieselsandstein (Keuper, Obere Trias) von SW-Deutschland: eine terminale alluviale Ebene. N. Jb. Geol. Paläont., Mh., 1997(5): 267-285; Stuttgart.

Within the continental Middle European Keuper Basin, the South German Kieselsandstein was studied sedimentologically in selected outcrops and borehole cores along a transect from the basin margin to more central locations. Facies types, architectural elements and petrophysical parameters (gamma-ray, permeametry) reveal distinct trends from 'proximal' to 'distal". The suggested depositional model comprises a terminal alluvial plain, that interfingers basinwards with continental playa deposits. The 'dynamic stratigraphy' of the Kieselsandstein shows a progradation of the alluvial plain, followed by its retrogradation.

KIRDA, N.P. and FRADKINA, A.F., 1997. New data on the stratigraphy of West-Siberian Triassic sediments. Geol. Geofiz., 38: 1062-1069.

The West-Siberian Triassic sediments are analyzed with the emphasis given to their composition and stratigraphic subdivision based on large size remains of fauna, flora and microfossils. The Triassic sediments penetrated by deep wells and containing bivalvia shells, spores and pollen are stratigraphically considered here. A specific palynocomplex is found in the sediments, allowing recognition of the Olenek Stage, Because of the great number of acritarchs (one of the dominant of the stage) the sedimentation is supposed to occur in rather a huge saline water basin. New data on the stratigraphy of new Triassic sections are important for detecting the geological structure of the West-Siberian pre Jurassic complexes and for assessment of their oil and gas potential.

KNIPPER, A.L., SATIAN, M.A. and BRAGIN, N.Y., 1997. Upper Triassic-Lower Jurassic volcanogenic and sedimentary deposits of the Old Zod Pass (Transcaucasia). Strat. Geol. Corel., 5: 257-264.

Upper Triassic-Lower Jurassic volcanogenic and sedimentary deposits refered to the upper part of the section of the Ipyak ophiolite nappe (the Sevan Akera zone, Lesser Caucasus) were studied and described for the first time. The section of these deposits on the Old Zod Pass is found to be represented by sedimentary volcaniclasic breccias with horizons of lavas, sandstones, jaspers and limestone blocks. Jaspers comprise radiolarians of two stratigraphic levels: upper Carnian and Toarcian. These data suggest that the plutonic part of the Sevan Akera complex is not younger than the late Carnian.

KOLAR-JURKOVŠEK, T. and JURKOVŠEK, B., 1996. Contribution to the knowledge of the Lower Triassic conodont fauna in Slovenia. Razprave IV. Razreda Sazu, 37: 3-21.

Lower Triassic beds in the Igka and Draga valleys, central Slovenia have been examined for conodonts. The fauna consists of *Ellisonia* sp., *Foliella gardenae* (Staesche), *Hadrodontina* sp., *Pachycladina obliqua* Staesche and *Parachirognathus ethingtoni* Clark. Two morphotypes of *F. gardenae* are distinguished. The recovered conodont fauna is marked by shallow-water elements, and is Smithian in age.

Kolar-Jurkovšek, T. and Jurkovšek, B., 1997. *Valvasoria carniolica* n.gen. n.sp., a Triassic Worm from Slovenia. Geol. Croat., 50: 1-5.

Carnian limestones exposed from Mojstrana to Triglav, are very important biostratigraphically, and especially for the palaeogeographic interpretation of the Upper Triassic. Outcrops can be traced in the Vrata Valley extending in a narrow belt several kilometres in a NE-E direction. A very quiet depositional environment, with reducing conditions at the sea floor, permitted the preservation of soft-bodied animals. *Valvasoria carniolica* is a new genus and species. It has a cylindrical body with an expanded anteriormost portion. The systematic position of *Valvasoria* is unknown, however it might be related to Nematoda or Sipunculida.

Kovács, S., 1997. Middle Triassic rifting and facies differentiation in northeast Hungary. in: Sinha, A.K. (ed.), Geodynamic domains in the Alpine-Himalayan Tethys. Oxford & IBH Publ. Co., pp. 375-397.

The middle to early Late Triassic formations of the Gemer-Bükkk units (Northeast Hungary and Southeast Slovakia) bear evidence of the opening of a Red Sea-type. young oceanic basin (Meliaticum) and the shaping of its continental margins. In connection with the rifting, remarkable facies differentiation developed. as reflected by these formations. In the 'northern' margin, the transition from the outer shell through the slope into the deep basin has been fairly well preserved in the different tectofacial units. The depositional area of the Gemer-Bükk units was originally located near to the northwest end (the remnants of which are now dispersed in Carpatho-Pannonian terrane collage) of the Dinaric-Alpine Neotethys branch. A connection to the extra-Carpathian Palaeotethys (e.g., via the Median Dacidic-Serbo-Macedonian continental margin) was improbable.

Kozur, H.W., Mock, R. and Ožvoldová, L., 1996. New biostratigraphic results in the Meliaticum in its type area around Meliata village (Slovakia) and their tectonic and paleogeographic significance. Geol. Paläont. Mitt.Innsbruck, 21: 89-121.

New radiolarian data show that the Meliaticum consists mostly of Middle Jurassic siliciclastic flysch (Bathonian-Callovian distal turbidites overlain by an Early Oxfordian coarsening upwards sequence). Triassic rocks of the oceanic Meliaticum sequence (e.g. dismembered ophiolites, Anisian red pelagic limestones, Ladinian-Cordevolian red ribbon radiolarites, Late Triassic dark and variegated radiolarites and grey cherty limestones) form blocks, olistoliths or melanges within the Middle Jurassic turbidites and olistostromes. Early Anisian light coloured recrystallized limestones and Scythian limestones, marls and shales of a pre-rift sequence are likewise blocks within Middle Jurassic flysch. Melanges are often present. The Meliaticum in its type area is a Middle Jurassic to Lower Oxfordian accretionary complex. This is also the case for all other occurrences of the Meliaticum in the Western Carpathians and Eastern Alps except for Meliaticum remnants from salinar melanges in Late Permian hypersaline rocks at the base of higher nappes, in which parts of an accretionary complex have been involved during thrusting of nappes. The geological evolution of the Meliaticum excludes a connection of the Meliata Ocean and its slopes and outer shelves with the Vardar Zone and originally more southernly oceans and their slopes and outer shelves. The South Tethyan oceans and their slopes and shelves are characterized by dominantly andesitic Scythian to Ladinian volcanism and Late Triassic and Jurassic sea-floor spreading. Their final closing was in post-Jurassic time. The Middle Anisian to Jurassic development of the Cimmerian Ocean (= Paleo-Tethys sensu

Şengör, 1984) is identical to the development in the Meliata Ocean. Therefore, only a connection with this ocean is possible.

KRAMM, E., 1997. Stratigraphie des Unteren Muschelkalks im Germanischen Beeken. Geologica et Palaeontologica 31: 215-234.

Numerous detailed lithostratigraphical sections in Lower Muschelkalk strata were recorded in the area between northern Badenia, Brandenburg and eastern Westphalia. Using the subdivision based on sedimentary cycles described by Schulz (1972) from northern Hesse, 20 marker horizons have been determined which are also present in Hesse, Thuringia and southern Lower Saxony. Based on this cyclic subdivision, the correlation of sections in Hesse, Thuringia, Lower Franconia, Westphalia, Lower Saxony and in the Subhercynian Basin is refined. For the first time, small scale sedimentary cycles sensu Schüller (1967) could be recognized in the Schaumkalk Beds of Rüdersdorf and correlated with sections in central Germany.

KRASSILOV, V.A., 1997. Syngenesis of xeromorphic plant communities in the Late Paleozoic to Early Cenozoic. Paleont. Zhurn., 1997(2): 3-12.

Methods and terminology of the plant community reconstruction are considered successive late Paleozoic to early Cenozoic xeromorphic coniferoid-peltasperm, bennettite-brachyphyll and debeyo-dryophyll communities are briefly described. They sequentially replaced each other within the coastal-littoral facies domain forming a continuous syngenetic series. Their xeromorphism was related to the helophyte and littoral habitats rather than arid climates. Xeromorphic communities played a significant evolutionary role as a cradle of new higher taxa, in particular angiosperms. Evolution of xeromorphic communities apparently corresponds to the general model of plant syngenesis.

LAPO, A.V., DAVYDOV, V.I., PASHKEVICH, N.G., PETROV, V.V. and VDOVETS, M.S., 1997. Geological objects of global significance in European Russia. Strat. Geol. Correl., 5: 290-298.

Geological heritage, as part of natural heritage, includes the in situ located geological reference objects (sites) visualising geological phenomena with high information potential. Forty objects of geological heritage of worldwide significance in the territory of European Russia are briefly described. From the viewpoint of the specific geological structure of the territory, the most numerous are the stratigraphic, paleontological, geohistorical, and geological mining objects. The stratigraphic type objects are represented mainly by strato types and key sections of different Upper Paleozoic units, whereas the paleontological type objects include localites with fossil remains of Permian and Triassic tetrapods.

LEE, Y.S., NISHIMURA, S. and MIN, K.D., 1997. Paleomagnetotectonics of East Asia in the proto-Tethys ocean. Tectonophysics, 270: 157-166.

Seven paleomagnetic poles are obtained from Early Ordovician, Late Carboniferous, Permo Triassic, Jurassic, Early Cretaceous, Miocene and Quaternary rocks in Korea. These poles define the apparent polar wander path for the southern part of Korean Peninsula. The comparisons of APWPs from the North China Block, Yangtze Block and Korea reveals that the East Asia is comprised of two blocks, the North Sino-Korean and South Sino-Korean, which were parts of Gondwana during the Paleozoic time. The North Sino-Korean Block was migrated northwards in Late Permian and accreted with Laurasia in Triassic time. During Middle-Late Triassic time, the North Sino Korean Block collided with the South Sino-Korean, and subsequently divided into two. The western part of the North Sino-Korean Block suffered counter clockwise rotation, while the eastern part rotated clockwise until Jurassic time. Complicated shear senses of the Early Mesozoic fault systems in East Asia are well matched by this scenario.

LEPPER, J., and UCHMANN, A., 1995. Marine Einflüsse im Mittleren Buntsandstein der Hessischen Senke - dargestellt am Beispiel des Weserprallhanges an der Ballertasche bei Hann. Münden. Zbl. Geol. Paläont. Teil I, 1994(1/2): 175-186.

The abundant occurrence of the trace fossil *Diplocraterion parallelum*, rare *Phycodes triadicum*, as well as occurrence of the bivalve *"Avicula" murchisoni* suggest marine influence in a section of the Detfurth-Folge (Middle Buntsandstein, Lower Triassic) in the Weser Valley of Lower Saxony, Germany. Presumably, the sedimentation took place in a tidal-protected brackish(?) lagoon. The top 5 m of the Detfurth-Folge and the overlying lower part of the Hardegsen-Folge are dominated by fluvial deposits containing rare facies-crossing trace fossils (*?Skolithos, Phycodes ?curvipalmatum)*, as well as by forms typical of non-marine environments (*?Siskemia* isp., *Stiallia pilosa*, *"Cylindricum"* isp.).

LI, P.J., HOU, Q.L., LI, J.L. and SUN, S., 1997. Isolated olistoliths from the Lower Triassic Xikou Formation in southwestern Fujian and its geological significance. Chin. Sci. Bull., 42: 137-140.

LIU, H.F., 1996. New materials of Late Triassic Kazacharthra from Xinjiang. Acta Palaeont. Sinica, 35: 492-494.

First discovered in the Aiding Lake Coal Mine, about 15 km northwest of Daheyan, during a petroleum geological survey in a period from 1988 to 1989, the Kazacharthra illustrated in this paper, symbiotic with the Yanchang Flora, are of Late Triassic, and its corresponding strata equal to the Huangshanjie Formation. With well-preserved and completed carapace bearing striking venous ornament and distinct mandibular groove ridge and dorsal organ,some even preserved with thoracic appendages, somites and telsons, *Almatium* and other fossils, overlapping one and other, richly occur parallel to the bedding plane. The finding of this fauna provides new fossil materials not only for making subdivision and correlation of this set of oil-producing formation in Turpan-Hami Basin and its marginal areas, but also for expounding the evolution of Crustacea.

LOPEZ-GARRIDO, A.C., PEREZ-LOPEZ, A. and DEGALDEANO, C.S., 1997. Presence of Muschelkalk facies in the Alpujarride units of the Murcia region (Betic Cordillera, southern Spain) and palaeogeographic C.R. Acad. Sci, Sér. II, A, 324: 647-654.

The presence of Muschelkalk facies limestones, outcropping in the Triassic carbonate series of the Alpujarride units in the region of Murcia, has palaeogeographic consequences that are analysed in the present paper. These very shallow marine Muschelkalk facies present calcareous fossiliferous levels and sedimentary facies analogous to those described in the External Betic (Prebetic and Subbetic) Zone.

LUCAS, S.G., 1997. Upper Triassic Chinle Group, western United States: a nonmarine standard for late Triassic time. In: Dickins, J.M. (Ed.), .Late Palaeozoic and Early Mesozoic circum-Pacific events and their global correlation. Cambridge University Press, pp.209-228.

Nonmarine Upper Triassic strata of the Chinle Group are exposed over a 2.3-million km^2 outcrop area in the western United States (Idaho, Wyoming, Utah, Nevada, Colorado, Oklahoma, Texas, New Mexico, and Arizona). Chinle Group strata were deposited during most of the late Triassic (late Carnian-Rhaetian) in a single depositional basin (Chinle Basin) with a regional palaeoslope down to the west-northwest. The Chinle Group is as much as 600 m thick and consists of fluvial, lacustrine, and minor eolian facies of siliciclastic sediments that are mostly redbeds. Chinle Group fossils have been collected for more than 140 years and include palynomorphs, megafossil plants, charophytes, invertebrate trace fossils, ostracods, conchostracans, insects, decapod crustaceans, bivalves, gastropods, tetrapod footprints, fishes, and tetrapod-body fossils. Magnetostratigraphic characterization of many Chinle Group intervals has been undertaken, but Chinle volcanic detritus has not provided reliable syn-depositional numerical

ages. Lithostratigraphy supported by diverse biostratigraphy provides a precise correlation of Chinle Group strata across their outcrop belt. This correlation identifies three intragroup depositional sequences bounded by basinwide unconformities. The two older sequences have a genetic relationship to late Carnian-Middle Norian marine shelfal rocks in northwestern Nevada. This relationship allows selected late Triassic ammonite zones to be correlated to Chinle Group strata. Nonmarine biochronology, especially of palynomorphs, megafossil plants, and tetrapod vertebrates, and magnetochronology indicate that the oldest Chinle strata are of late Carnian (Tuvalian) age. Younger Chinle Group strata are of early Norian-Rhaetian age. The Chinle Group has an extensive outcrop area, is relatively thick, and is very accessible. However, it does not represent all of late Triassic time - no early Carnian (Julian) strata are present, and the two intragroup unconformities represent hiatuses of unknown duration. Nevertheless, its extensive fossil record, replicatable magnetostratigraphy, and potential for numerical age dating make the Chinle Group an excellent standard for correlation of the nonmarine Upper Triassic strata of Pangaea.

LUCAS, S.G., 1997. Fossils provide a Pennsylvania standard for part of Late Triassic time. Pennsylvania Geology: 27(4): 8-14.

LUCAS, S., ESTEP, J.W., GONZALEZ-LEON, C., PAULL, R.K., SILBERLING, N.J., STEINER, M.B. and MARZOLF, J.E., 1997. Early Triassic ammonites and conodonts from Sonora, northwestern Mexico. N. Jb. Geol. Paläont., Mh., 1997(9): 562-574.

The authors document Early Triassic (Spathian) ammonites and conodonts from a 150-m-thick interval of the lower Antimonio Formation in northwestern Sonora, Mexico. The lower Antimonio Formation contains two unconformity-bounded Triassic sequences, one of probable Smithian age and the other of Spathian age. It thus resembles Lower Triassic strata in the southwestern United States (especially southern Nevada and adjoining areas), in recording only two of the three known Early Triassic eustatic cycles.

LUCAS, S.G., HECKERT, A.B. and ANDERSON, O.J., 1997. Triassic stratigraphy and paleontology on the Fort Wingate quadrangle, west-central New Mexico. New Mexico Geol., 19: 33-42.

Triassic strata on the Fort Wingate quadrangle are nonmarine red beds assigned to the Moenkopi Formation and Chinle Group. The Middle Triassic Anton Chico Member of the Moenkopi Formation is as much as 20 m of dominantly grayish-red, trough-cross-bedded micaceous litharenite that disconformably overlies the Middle Permian San Andres / Glorieta Formations and is disconformably overlain by the Upper Triassic Chinle Group. The Chinle Group is as thick as 350 m and consists of (ascending): mottled strata, Shinarump Formation, Blue-water Creek Formation, Blue Mesa, Sonsela, and Painted Desert Members of Petrified Forest Formation, and Owl Rock Formation. Fossil vertebrates from the Bluewater Creek Formation on the quadrangle include *Buettneria*, *Desmatosuchus*, *Stagonolepis*, and a large phytosaur and indicate an Adamanian (latest Carnian) age for the formation. The Painted Desert Member is not fossiliferous locally but produces Revueltian (early mid-Norian) tetrapods elsewhere on the Colorado Plateau.

LUCAS, S.G., HECKERT, A.B., ESTEP, J.W. and ANDERSON, O.J., 1997. Stratigraphy of the Upper Triassic Chinle Group, Four Corners Region. New Mexico Geol. Soc. Guideb., 48th Field Conf., Mesozoic Geology and Paleontology of the Four Corners Region, pp. 81-107.

Upper Triassic strata exposed in the Four Corners region belong to the Chinle Group of late Carnian-Rhaetian age. Chinle Group strata can be divided into eight lithostratigraphic intervals: (1) mottled strata / Temple Mountain Formation - as much as 31 m of mostly color mottled, deeply pedoturbated siltstone, sandstone and conglomerate; (2) Shinarump Formation - up to 76 m of trough-crossbedded sandstone and siliceous extrabasinal conglomerate; (3) Monitor

Butte / Cameron / Bluewater Creek Formations - up to 84 m of varied lithofacies ranging from green bentonitic mudstones (Monitor Butte) to sandstones (Cameron) to red-bed mudstones (Bluewater Creek); (4) Blue Mesa Member of Petrified Forest Formation - up to 100 m of blue, gray, purple and red variegated bentonitic mudstone; (5) Moss Back Formation / Sonsela Member of Petrified Forest Formation - up to 50 m of trough-crossbedded sandstone and intrabasinal conglomerate; (6) Painted Desert Member of Petrified Forest Formation - up to 150 m of mostly red-bed bentonitic mudstone and siltstone; (7) Owl Rock Formation - up to 150 m of pale red and orange siltstone interbedded with ledges of pedogenic calcrete limestone; (8) Rock Point Formation - up to 300 m of reddish brown, cyclically-bedded sandstone and non-bentonitic siltstone. In southwestern Colorado, the base of the Chinle Group is the Moss Back Formation resting on Lower Permian strata. We abandon the term Dolores Formation and correlate its informal members as follows: (1) lower member = Moss Back Formation; (2) middle member = Painted Desert Member of Petrified Forest Formation: and (3) upper member = Rock Point Formation. The informal term "Kane Springs strata," applied to some Chinle Group coarse-grained strata in southeastern Utah, is also abandoned. Church Rock Member (Formation) is a synonym of Rock Point Formation, and the term Church Rock should not be applied to nearly all the Chinle Group section in southeastern Utah. Palynomorphs, megafossil plants and fossil vertebrates support the following age assignments for Chinle Group strata in the Four Corners region: late Carnian = mottled strata/Temple Mountain Formation, Shinarump Formation, Monitor Butte/Cameron/Bluewater Creek Formations and Blue Mesa Member of Petrified Forest Formation; early-middle Norian = Moss Back Formation/Sonsela Member of Petrified Forest Formation, Painted Desert Member of Petrified Forest Formation and Owl Rock Formation; and Rhaetian = Rock Point Formation. The Chinle Group consists of three unconformity-bounded sequences: Shinarump-Blue Mesa sequence of late Carnian age; Moss Back-Owl Rock sequence of early-middle Norian age; and Rock Point sequence of Rhaetian age. Facies architecture and biostratigraphy support a genetic relationship between Chinle Group strata on the Colorado Plateau and shallow marine strata of the Mesozoic marine province of western Nevada. This relationship suggests that eustasy was the primary allochthonous control on Chinle Group sedimentation. At Big Indian Rock in the Lisbon Valley of southeastern Utah, a skull of the phytosaur *Redondasaurus* is in a thin, discontinuous mud-pebble conglomerate near the base of the Wingate Sandstone. *Redondasaurus* is an index fossil of the Late Triassic Apachean (Rhaetian) land-vertebrate faunachron. Unabraded surface texture, large size and preservation of thin, fragile bone suggest that the phytosaur skull is not reworked, so the Triassic-Jurassic boundary is stratigraphically above it. No unconformity surface is present in the lower Wingate Sandstone above the skull. Thus, at Big Indian Rock, the J-0 unconformity is not at the base of the Wingate Sandstone. If the basal Wingate is of Late Triassic age, then the Moenave Formation, with which it intertongues laterally, must also include Triassic strata. This suggests the Triassic-Jurassic boundary on the Colorado Plateau is relatively transitional - not a profound unconformity - within the Wingate-Moenave lithosome.

LUCAS, S.G., KIETZKE, K.K. and GOODSPEED, T.H., 1997. Paleontology of nonmarine Cretaceous - not marine Triassic - limestone in the salt anticline, southeastern Utah. New Mexico Geol. Soc. Guideb., 48th Field Conf., Mesozoic Geology and Paleontology of the Four Corners Region, pp. 157-161.

A thin limestone in the Salt Valley, northeast of Moab, Utah. was assigned to the Early Triassic Sewemup Member of the Moenkopi Formation based on the supposed presence of juvenile specimens of the Smithian ammonoid *Meekoceras*. Most workers view this outcrop as the easternmost extent of the Sinbad Formation, and thus the eastern limit of the Smithian seaway. We collected silicified micro- and macrofossils from this unit. The planorbid freshwater gastropod *Gyraulus veternus* superficially resembles juvenile specimens of *Meekoceras*, and dominates the assemblage. Other macrofauna includes the gastro*pods Reesidella, Mesopyrgium, Ph*ysa and *Zaptychius?* and the bivalve *Unio?* Microfossils are the charophytes

Atopochara trivolvis and cf. *Obtusochara* and the ostracods *Cypridea compta, Bisulcocypris persulata and Cyclocypris?* These fossils are clearly of freshwater origin and indicate an Early Cretaceous (Aptian) age. Age and lithology suggest the limestone in the Salt Valley is in the Cedar Mountain Formation. The easternmost extent of the Sinbad Formation is along the Colorado River in the Canyonlands, 39 km southwest of the Salt Valley.

Magganas, A., Kyriakopoulos, K. and Lekkas, E., 1997. Early Alpine rift volcanism in continental Greece: the case of Glykomilia area (Koziakas Mountains). Chemie der Erde, 57: 243-255.

Petrographic, geochemical and mineral chemistry data are presented for the mid Triassic volcanic rocks of Koziakas mountains, western Thessaly, Greece. These extrusive rocks are associated with pyroclastics, and underlain cherts, radiolarites and limestones of Carnian age. The textures of the volcanics are mainly porphyritic and glomeroporphyritic. Phenocrysts and microlites of zoned plagioclase, K feldspar and clinopyroxene can be distinguished as principal primary phases. Pumpellyite, calcite, chlorite and albite are the predominant secondary phases formed during very low grade metamorphism. The volcanics belong to the transitional alkaline - subalkaline series and are classified as trachyandesites. On the basis of major and trace element whole rock chemistry, clinopyroxene composition and stratigraphy, the lavas erupted in the pelagic abyssal marine rift environment of Pindos basin and show certain subduction related characteristics, which, however, either originated from a back are basin or they are inherited and the rift setting was of continental or mid ocean type. Greater assimilation of crustal rocks by the parent magmas and more complicated magma chamber processes may have taken place in the Triassic volcanics of the eastern margin of Pindos basin, under which Koziakas volcanics were generated, than in the westernmost margin volcanics.

Maheshwari, H.K. and Bajpai Usha, 1996. Ultrastructure of the 'cuticular membrane' in two Late Triassic corystospermaceous taxa from India. Palaeobotanist, 45: 41-49.

Ultrastructure of the cuticular membrane in two types of corystospermaceous pinnae, referred to *Dicroidium gouldii (=D. coriaceum* sensu Pal 1984) and *Dicroidium sp. (=D. zuberi* sensu Pal 1984) has been studied. It is observed that while the epidermal pattern in the two species shows only minor variation, at the ultrastructure level the cuticular membranes of the two species show significant differences.

Manatschal, G. and Nievergelt, P., 1997. A continent ocean transition recorded in the Err and Platta nappes (eastern Switzerland). Eclog. Geol. Helv., 90: 3-27.

Kinematic inversion of the Alpine deformation in the Lower Austroalpine Err nappe and the Upper Penninic Platta nappe in the eastern Central Alps allows one to reconstruct the continent ocean transition of a segment of the Mesozoic Tethys that is characterized by a rift related detachment system. The age of the low angle detachment system is constrained by the following observations: (1) the detachment faults truncate high angle normal faults and associated tilted blocks comprising Triassic dolomite, (2) syn rift sediments of post Early Toarcian age seal the fault planes, and (3) fault rocks derived from these detachment faults occur as clasts in the syn-rift sediments. Hence, the detachment faults had to be active after or during tilting of the blocks and the formation of the Middle Jurassic depositional basins but had to be exhumed at the sea floor before the deposition of the youngest syn rift sediments and the sedimentation of the upper Middle to Upper Jurassic Radiolarite Formation which is the first one deposited on both continental and oceanic basement.

Martini, R., Vachard, D., Zaninetti, L., Cirilli, S., Cornée, J-J., Lathuilière, B. and Villeneuve, M., 1997. Sedimentology, stratigraphy, and micropalaeontology of the Upper Triassic reefal series in eastern Sulawesi (Indonesia). Palaeogeogr. Palaeoclimat. Palaeoecol., 128: 157-174.

An Upper Triassic (Upper Norian-Rhaetian) carbonate complex, composed of open marine to reefal deposits, has been investigated for the first time in Eastern Sulawesi. The age is based on the occurrence of benthic foraminifera, and also of the Upper Sevatian to Rhaetian conodont *Misikella posthernsteini* Kozur and Mock. Palynological assemblages contain Upper Triassic-Lower Jurassic palynomorphs. The scleractinian coral *Retiophyllia seranica* and the chaetetid sponge Blastochaetetes intabulata, together with Solenoporacean algae, are the main frame-builders of the reefal facies. The entire carbonate series, composed of conodont bearing limestones, reefal deposits, and intertidal/supratidal cryptalgal laminites, shows a general regressive trend from a marginal to an inner platform environment. The relationship between microfaunal distribution and sequence analysis is discussed. The Upper Triassic foraminifers and palynomorphs of Eastern Sulawesi show affinities to microfaunas of the Australian-Indonesian southern Tethyan domain, and the general organisation of the platform should be investigated through further studies from Banda Sea dredgings.

MASTANDREA, A., NERI, C. and RUSSO, F., 1997. Conodont biostratigraphy of the S. Cassiano Formation surrounding the Sella Massif (Dolomites, Italy): implications for sequence stratigraphic models of the Triassic of the Southern Alps. Riv. Ital. Paleont. Strat., 103: 39-52.

The stratigraphy and age of the S. Cassiano Formation outcropping around the Sella Massif (Dolomites, Northern Italy) were investigated. The unit interfingers with slope deposits pertaining to the Cassian carbonate platform of the Sella Massif. Several stratigraphic sections were analysed from a sedimentologic and biostratigraphic perspective. Three sections (Sella Pass Ia and Ib, Gardena Pass) yielded stratigraphically significant conodont faunas referable to the *diebeli* Assemblage Zone sensu Krystyn (1983) of latest Ladinian age. Therefore, the Sella Cassian Platform traditionally regarded as a typical Carnian buildup, is also latest Ladinian in age. The occurrence of post volcanic carbonate platforms older (e.g. Denti di Terra Rossa) and younger (e.g., the Nuvolau and Lagazuoi platforms) than the Sella Platform, suggests that : a) the post volcanic and Cassian succession of the Dolomites is far more complex than traditionally thought and b) a sequence stratigraphic model of the Middle Upper Triassic of the Dolomites based on two generations of Cassian platforms is clearly inadequate to describe the actual succession.

MASTANDREA, A., IETTO, F., NERI, C. and RUSSO, F., 1997. Conodont biostratigraphy of the Late Triassic sequence of Monte Cocuzzo (Catena Costiera, Calabria, Italy). Riv. Ital. Paleont. Strat., 103: 173-182.

Preliminary results are reported from an investigation of the conodont associations found in the Late Triassic carbonate succession of the so-called "Catena Costiera Calabrese" that crops out in the tectonic window of Monte Cocuzzo. The succession of Colle del Crapio consists of alternating carbonate mud, breccia and calciturbidites deposited in a toe-of-slope to basin setting and contains rich and well-preserved conodont faunas pertaining to two biozones. The lower zone is characterised by the occurrence of *Epigondolella slovakensis* and may be referred to the Late Norian (Sevatian). The upper zone is characterised by *Misikella hernsteini* associated with *M. posthernsteini*. The chronostratigraphic setting of the latter zone is more controversial, as it may be regarded as latest Sevatian (Upper Norian) according to Krystyn (1990) and Golebiowski (1990), while according to the zonation of Kozur & Mock (1991) the first occurrence of *M. posthernsteini* marks the beginning of the Rhaetian stage.

MCKINNEY, F.K. and TAYLOR, P.D., 1997. Life histories of some Mesozoic encrusting cyclostome bryozoans. Palaeontology, 40: 515-556.

Single layered, multiserial cyclostome bryozoans are almost ubiqitous as encrusters of Mesozoic hard substrata but little attention has been paid previously to the attributes of their life histories obtainable from their fossil skeletons. Colonies from 'populations' of one Triassic,

five Jurassic and nine Cretaceous species from England and Slovakia are here studied using an image analyser to record colony size and shape, and the number, location and sizes of larval brood chambers. Survivorship curves relative to colony size demonstrate varying patterns of mortality for different species. None of the species shows evidence of a fixed maximum colony size. Some species were capable of producing frontal, or more commonly, peripheral subcolonies. These species typically have smaller colonies than species without subcolonies. Colony size at the onset of female sexual reproduction was found to be relatively constant in some species but variable in most, possibly indicating that an environmental cue triggered reproduction. Most colonies reproduced only once (semelparity) and apparently died shortly afterwards, but a few survived to reproduce a second time (iteroparity). No correlation among species was found between skeletal measures of reproductive effort and colony size. Flexibility in life history patterns predominate in the 15 studied species, the one notable exception being Actinopora disticha which was relatively deterministic.

McLoughlin, S., Lindström, S. and Drinnan, A.N., 1997. Gondwanan floristic and sedimentological trends during the Permian-Triassic transition: new evidence from the Amery Group, northern Prince Charles Mountains, East Antarctica. Antarctic Sci., 9: 281-298.

The Permian-Triassic boundary within the Amery Group of the Lambert Graben is placed at the contact between the Bainmedart Coal Measures and overlying Flagstone Bench Formation, based on the first regular occurrence of *Lunatisporites pellucidus* and the first appearance of *Aratrisporites* and *Lepidopteris* species. The Permian Triassic boundary is marked by the extinction of glossopterid and cordaitalean gymnosperms, and by the disappearance or extreme decline of a range of gymnospermous and pteridophytic palynomorph groups. Earliest Triassic macrofloras and palynofloras of the Flagstone Bench Formation are dominated by peltasperms and lycophytes; corystosperms, conifers, and ferns become increasingly common elements of assemblages through the Lower Triassic part of the formation and dominate floras of the Upper Triassic strata. The sedimentary transition across this boundary is conformable but marked by a termination of coal deposits; overlying lowermost Triassic sediments contain only carbonaceous siltstones. Typical red bed facies are not developed until at least 100 m above the base of the Flagstone Bench Formation, in strata containing ?Middle Triassic palynofloras. Across Gondwana the diachronous disappearance of coal deposits and appearance of red beds is suggestive of a response to shifting climatic belts, resulting in progressively drier seasonal conditions at successively higher palaeolatitudes during the Late Permian to Middle Triassic. The abrupt and approximately synchronous replacement of plant groups at the Permian Triassic boundary suggests that factors independent of, or additional to, climate change were responsible for the turnover in terrestrial floras.

Medina, F., 1996. Le Trias du Maroc: introduction. In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996. pp. 139-153.

In Morocco, the synrift Triassic formations appear within several outcrops which constitute the visible part of large basins that are hidden by the postrift deposits. The few paleontological elements, particularly palynomorphs, collected within these basins yield ages ranging from the Carnian to the Rhetian; however, most of the levels located beneath the fossiliferous beds remain undated. From the sedimentological point of view, two main types of facies are observed in the Meseta and Atlas chain: (i) a siliciclastic facies, restricted to the Atlas, which reflects fluvial, lacustrine and partly marine environments; and (ii) a marine evaporitic facies in the Meseta. In the Rif, the carbonated facies, of Alpine type, are different and reflect a marine environment. The Triassic sediments of the Moroccan basins were deposited within half-grabens bounded by syndepositional normal faults that merge in depth into shallowlydipping detachments. The direction of extension measured from slickensides is NW-SE, and the amount of extension evaluated from normal faults is about 15%; however, the deep structure remains

poorly constrained. To this extensional tectonism is associated an extensive magmatic activity, with volcanic rocks dated at 200 Ma, of tholeiitic character. Mineralogical assemblages indicate that the magma was probably generated at the base of the crust. The rifting models that best account for the evolution of the Moroccan Triassic basins are those involving simple shear mechanisms at the onset of rifting, and pure shear afterwards.

MEDINA, F., MUSTAPHI, H., JABOUR, H., AHMAMOU, M. HOEPFFNER, C., EL FARIATI, A. and ERRAMI, A., 1996. Structure des formations triassiques le long du segment occidental de la zone de faille du Tizi n'Test (Haut Atlas occidental, Maroc). In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 291-305.

The Triassic formations located along the western part of the Tizi n'Test Fault Zone, which is generally considered as a strike-slip fault zone, were deposited within half grabens controlled by the activity of normal faults, unconformably overlain by the Jurassic deposits. The Triassic formations, which extend from the Souss valley to Tine Mellil, show variable thickness, ranging from 4 km in Souss and Argana to about 300 m at Tine Mellil. Major faults, such as the El Klea, Biougra and Tine Mellil faults, have an ENE trend and dip gently towards the NNW. In the Argana area, other faults have a N-S trend and a gentle easterly dip. Analysis of striations shows that most faults are dip-slip with a small or negligible lateral component, and that the extension is NW-SE in Argana and NNW-SSE at Tine Mellil. The amount of extension, estimated from restored cross-sections, is about 1.1 to 1.19 only. In depth, a seismic profile in the Souss area reveals that the ENE-trending faults merge into a N-dipping detachment, that we interpret as a probable former decollement plane between the Paleozoic and the Precambrian series of the Anti-Atlas. In this context the Tizi n'Test Fault zone appears as an oblique transfer fault.

MEDLIN, L.K., KOOISTRA, W.H.C.F., GERSONDE, R., SIMS, P.A. and WELLBROCK, U., 1997. Is the origin of the diatoms related to the end-Permian mass extinction? Nova Hedwigia, 65: 1-11.

Small subunit ribosomal RNA (ssu-rRNA) coding regions from 30 diatoms, nine other heterokont algae, three oomycetes, one thraustochytrid and one heterotrophic flagellate were used to construct a molecular clock from maximum likelihood trees, and from linearized trees using a neighbor joining analysis. Taxa with fast and/or aberrantly evolving ssu rRNAs were not included in our molecular clock calculations. First appearance dates of diatom taxa from the fossil record were regressed against their corresponding branch lengths to infer the average and earliest possible age for the origin of the heterokont algae. The earliest age estimates (based on the median evolving diatom taxon in the maximum likelihood tree or on the average branch length in a linearized tree) suggest that the secondary endosymbiotic event leading to the divergence of pigmented heterokonts from their non pigmented ancestors is unlikely to have occurred much before the Permian Triassic boundary. The trees also show that the diatoms, one of the major groups of pigmented heterkonts, must have inherited their diplont life cycle and the ability to form resting stages from the last common ancestor shared with the oomycetes and the other pigmented heterokonts. We hypothesize that non pigmented, diploid heterokonts, capable of forming resting stages and of stably maintaining a photosynthetic organism within their cytoplasm, had an adaptive advantage over other organisms during the intense climatic tectonic and geochemical changes that led to a mass extinction close to this boundary. After the mass extinction, many niches in the marine and aquatic realms were opened and the heterokont algae, including the diatoms, appear to have diverged after this time.

MENG FANSONG, 1996. Middle Triassic lycopsid flora of South China and its palaeoecological significance. Palaeobotanist, 45: 334-343.

in recent years, a flora characterized by Lycopsida has been found from the Middle Triassic Badong Formation In Yangtze Gorge area, China, and may be subdivided Into two plant

assemblages, i.e., Anisian *Pleuromeia marginulata-Annalepis sangzhiensis assemblage* and Ladinian *Annalepis latiloba-Scytophyllum* assemblage. Of them, the former assemblage, containing 18 genera and 30 species, is one of the typical floras of the tidal flat in the world during Anisian. In addition, the character and ecology of the Anisian plant assemblage are discussed In this paper.

Minikh, M.G. and Minikh, A.V., 1997. Ichthyofaunal correlation of the Triassic deposits from the northern Cis-Caspian and southern Cis-Urals regions. Geodiversitas 19: 279-292.

All the known data on the Triassic ichthyofauna from south-cast European Russia are summarized. The material studied comes from thirty-nine localities from the Lower and Middle Triassic reference and stratotype sections of the South Cis-Urals and northern Cis-Caspian regions. Data on terrestrial vertebrates, ostracodes, and charae are used as well as paleomagnetic sampling results. A certain stratigraphic importance of the Triassic gnathorhiza and ceratods is demonstrated relative to lungfish, the one of hybodontids relative to squaliforms and the one of saurichthiids among actinopterygians. Two super-ichthyocomplexes were revealed within the Triassic sections according to dipnoan distributions: those of gnathorhiza and ceratods. Their change in the region occurs in the middle of the Olenekian age and is associated with the rather short Akhtuba time in the Cis-Caspian and with the synchronous Fyodorovka time in the South Cis-Urals. Considering the data on other fish groups, three independent ichthyocomplexes are recognized in the Triassic ichthyofauna: the Vetlugian and Yarenian ones in the Early Triassic and another one in the Middle Triassic. The Yarenian ichthyocomplex comprises two clearly manifested groups of different ages (the Akhtuba and Bogdo ones in the Cis-Caspian and the Fyodorovka and Camskaya ones in the South Cis-Urals). The Middle Triassic ichthyocomplex comprises the Donguz and Bukobaj fish groups. The regularities revealed in fish-taxa changes with time, are traced within the sections across the adjacent territories from the Cis-Urals to the Cis-Caspian. The Lower Triassic Akhtuba suite from the Cis-Caspian Bogdo section was correlated by fish with the lowermost part of the Petropavlovka suite, and the overlying Bogdo suite with the rest of the Petropavlovka section from the Orenburg region. The Middle Triassic Donguz and Bukobaj suites from the Cis-Urals are stratigraphically analogous to the Elton and Inder suites from the Middle Triassic section in the northern Cis-Caspian. The succession revealed in the Triassic ichthyofauna development is maintained all over the territory of European Russia. it is traced in the adjacent regions and may serve as the basis for stratigraphic divisions and interregional correlations of different-facies marine and non-marine sections of the Triassic.

Misik, M., 1997. The Slovak part of the Pieniny Klippen Belt after the pioneering works of Andrusov, D. Geol. Carpathica, 48: 209-220.

The progress of investigations concerning the Pieniny Klippen Belt in the last twenty years is discussed and the actual state of opinions about its evolution presented. This most complicated zone of the Western Carpathians is remarkable for the complete separation of tile unknown Paleozoic-Triassic basement from the Jurassic-Cretaceous strata. A nappe pile from shallow water as well as deep water successions resulted from the first compression. More rigid Jurassic-Lower Cretaceous limestones were during the following transpression torn of in tile lenses (klippen) amidst the plastic sediments of tile Upper Cretaceous strata ('envelope'). A critical analysis of 15 successions (and their varieties) discerned up till now in the Slovak segment is given and their mutual position within tile ancient sedimentary area is discussed. The following problems remain open: tile origin of tile exotic material in the Cretaceous and Paleogene conglomerates, the existence of a transform possessing oceanic crust, the place of Haligovce, Nizna and Michalova Hora successions in the sedimentary area, the presence of the Magura succession (Grajcarek Unit) on the Slovak territory, the possible provenance and transport of tile Manin, Drietoma and Kostolec successions from the Central Carpathian nappes.

MIYAMOTO, Y., SAKAMOTO, K. and MINGQING, W., 1997. Neutron activation analysis of Permian-Triassic boundary layer samples at the Selong site in China. J. Radioanal. Nucl. Chem., 216: 183-190.

Thirty samples from a limestone stratum across the Permian Triassic (P-Tr) boundary layer in China were analyzed for 30 elements by instrumental neutron activation analysis, wavelength dispersive X-ray fluorescence and ICP-MS, and also for mineral compositions with a powder X-ray diffractometer, The depth profile was found to indicate a sudden change of elemental and mineral compositions across the P-Tr boundary. Also the profile showed several peaks in elemental concentrations in the lower Permian layered samples as well as in the overlying Triassic strata, which are associated with the change of mineral compositions. Elemental profiles were found to be classified into four groups and to give some insights in the geochemical records. Ir is far less abundant (0.1 ppt) compared with that of the K-T boundaries (10 ppb), and the Ir/Co ratio is outside the K-T and C1 chondrite trends. This change of elementary profile is suggestive of the internal causes rather than the external ones such as an asteroid impact for the mass extinction at the P-Tr boundary.

MOGUTCHEVA, N.K., 1996. Evolutionary stages of Triassic flora in Siberia (Angarida). Palaeobotanist, 45: 329-333.

The Triassic flora of Siberia has been studied from three series of Triassic system in continuous sections. Therefore, its successive alterations and stages in the evolution throughout Triassic from the P/T boundary may be traced. Due to alternation of floristic complexes and marine deposits, the age of floristic complex may be precisely determined. The most ancient complex is studied from Induan deposits. In a single section Permian Cordaitean flora is replaced. In Siberia, the Early Triassic flora is heterogeneous. Two major floras, occupying different ecological niches, are distinguished: the lycopod flora (dominated by *Tomiostrobus* and *Pleuromeia*) being confined to marine plain, and the conifer fern *(Korvunchanskaya)* flora is distributed within intracontinental areas where intense volcanism had occurred at that time. The Middle Triassic flora is scanty in Siberia. The Early Ladinian flora differs from both the Early Triassic and Late Triassic ones, whole the Late Ladinian flora is closely related to the Late Triassic flora.

MOTANI, R., 1997. New information on the forefin of *Utatsusaurus hataii* (Ichthyosauria). J. Paleont., 71: 475-479.

Utatsusaurus hataii, an Early Triassic ichthyosaur from Japan, is represented by exceptionally well preserved materials but is poorly known because of incomplete preparation. Further preparation of the holotype and one of the paratype specimens has revealed nearly complete forefins that are pentadactyl, with no more than five phalanges in any of the digits. The first digit is not well developed, and the fifth distal carpal appears to be absent. The phalanges along the fin margin tend to be lunate; others are flattened cylinders. These findings indicate that the relationship of *Utatsusaurus* with other Early Triassic ichthyosaurs must be reconsidered.

MOTANI, R., 1997. New technique for retrodeforming tectonically deformed fossils, with an example for ichthyosaurian specimens. Lethaia, 30: 221-228.

A new technique is devised with which to retrodeform two dimensional images of tectonically deformed fossils. As opposed to traditional methods, by which the strain ellipse is found directly, with the present method the two by two matrix that represents the retrodeformation is calculated first, using simple algebra. This method is widely applicable in the cases of various kinds of deformed fossil specimens, including isolated ones, as long as at least two sets of measurements, each comprising dimensions or angles that were equal to each other prior to tectonic deformation, are available. Application of this method in the case of ichthyosaurian

specimens from the Lower Triassic of British Columbia, formerly assigned to the genus *Grippia*, reveals that the fins of the specimens are wider than previously described, invalidating the ratios and angles that were used for taxonomic argument. It is not possible to assign the specimens either to *Grippia* or *Utatsusaurus*, based on available information.

MUDRENOVIĆ,V., 1995. Cephalopods from the Bulog Limestones of Sirogojno. Ann. Géol. Penins. Balk., 59: 203-214.

The Red Bulog Limestones of Sirogojno and ist contained abundant fossil association of cephalopods, some of which are characteristic of the Illyrian stage, *Paraceratites trinodosus* zone, in the Dinarides, are presented in this paper.

NYAMBE, I.A. and UTTING, J., 1997. Stratigraphy and palynostratigraphy, Karoo Supergroup (Permian and Triassic), mid-Zambezi Valley, southern Zambia. J. Afr. Earth Sci., 24: : 563-583.

The Karoo Supergroup outcrops in the mid-Zambezi Valley, southern Zambia. It is underlain by the Sinakumbe Group of Ordovician to Devonian age. The Lower Karoo Group (Late Carboniferous to Permian age) consists of the basal Siankondobo Sandstone Formation, which comprises three facies, overlain by the Gwembe Coal Formation with its economically important coal deposits, in turn overlain by the Madumabisa Mudstone Formation which consists of lacustrine mudstone, calcilutite, sandstone, and concretionary calcareous beds. The Upper Karoo Group (Triassic to Early Jurassic) is sub divided into the coarsely arenaceous Escarpment Grit, overlain by the fining upwards Interbedded Sandstone and Mudstone, Red Sandstone; and Batoka Basalt Formations. Palynomorph assemblages suggest that the Siankondobo Sandstone Formation is Late Carboniferous (Gzhelian) to Early Permian (Asselian to Early Sakmarian) in age, the Gwembe Coal Formation Early Permian (Artinskian to Kungurian), the Madumabisa Mudstone Late Permian (Tatarian), and the Interbedded Sandstone and Mudstone Early or Middle Triassic (Late Scythian or Anisian). The marked quantitative variations in the assemblages are due partly to age differences, but they also reflect vegetational differences resulting from different paleoclimates and different facies. The low thermal maturity of the formations (Thermal Alteration Index 2) suggests that the rocks are oil prone. However, the general scarcity of amorphous kerogen, such as the alga *Botryococcus* sp., and the low proportion of exinous material, indicates a low potential for liquid hydrocarbons. Gas may have been generated, particularly in the coal seams of the Gwembe Coal Formation, that are more deeply buried.

OGORELEC, B. and BUSER, S., 1997. Dachstein Limestone from Krn in Julian Alps (Slovenia). Geologija, 39: 133-157.

The Dachstein Limestone from Krn is characterized by Lofer development. The section encopasses 30 cyclothems, on average 3-4 m thick. The intra- and supratidal environment of deposition is evidenced by stromatolites. Loferite and tempestite breccias, all locally affected by early diagenetic dolomitization. Biomicritic limestone with several horizons of megalodont clams was deposited in a shallow and restricted shelf environment. Basal members A of the Lofer cyclothems are developed onl developed in exceptional cases. The limestone was deposited on the Julian platform near the passage to the southward positioned Slovenian basin.

OGORELEC, B. and DOZET, S., 1997. Upper Triassic, Jurassic and Lower Cretaceous Beds in eastern Sava folds. Budarsko-metal. Zborn., 44: 223-235.

South of Sevnica at Sava, along the road Konjsko-Križ the the deeper water pelagic sedimentary succession of Upper Triassic, Jurassic and Lower Cretaceous sediments is exposed. The lower part of the stratigraphic sequence consists of thick-bedded dolomites with chert nodules and layer comparable with the Bača Dolomite of Late Triassic age. This dolomites is overlain by different Jurassic and Lower Cretaceous beds.

OKAMURA, S., WU, G.Y., ZHAO, C.H., KAGAMI, H., YOSHIDA, T. and KAWANO, Y., 1997. Geochemistry of Mesozoic intracontinental basalts from Yunnan, southern China: implications for geochemical evolution of the subcontinental lithosphere. Mineral. Petrol., 60: 81-98.

Southwestern Yunnan, comprising the Yangtze and Shan Thai microcontinents and the Simao block, has successively undergone subduction of an oceanic plate, followed by a collision of the microcontinents and intracontinental rifting associated with basaltic volcanism during Late Paleozoic to Mesozoic. The Triassic Nanjian basalts, erupted on the Yangtze microcontinent, have more enriched isotopic ratios and higher LREE/HFSE and LREE/HREE ratios. This suggests the existence of an enriched subcontinental lithosphere under the Yangtze microcontinent which stabilized over long periods of the earth's history (>2 Ga). The Middle Jurassic Simao basalts have more depleted geochemical features and also have element enrichments characteristic of a subduction zone environment, although the basalts were erupted in an intracontinental graben. It may be inferred that the lithospheric mantle of the Simao block was modified by subduction processes during Latest Carboniferous to Late Triassic prior to the onset of the Middle Jurassic continental rifting. The lack of correlation between depletion of HFSE, Y and HREE, and relative enriched Nd isotopic ratios suggests that the source depletion of the Simao basalts is not an old feature and has been contemporaneous with the subduction related enrichment through mantle metasomatism shortly before the basalts were produced.

OKAY, A.I. and MONIE, P., 1997. Early Mesozoic subduction in the eastern Mediterranean: evidence from Triassic eclogite in northwest Turkey. Geology, 25: 595-598.

An eclogite forms a 40 m long tectonic lens enveloped in serpentinite within a metabasite phyllite marble unit of Permian-Triassic age in northwest Turkey. The eclogite consists mainly of garnet, omphacite, glaucophane, and epidote. It is associated with other lenses of serpentinite and metagabbro. Single grain laser probe $^{40}Ar/^{39}Ar$ dating of phengites from the eclogite gives ages of 203 to 208 Ma, corresponding to the Triassic-Jurassic boundary. Regional geologic considerations also suggest a latest Triassic to earliest Jurassic metamorphic age for the eclogite and the enclosing metabasite marble phyllite unit. The eclogite, along with serpentinite and gabbro lenses, were probably emplaced as diapirs into the metabasite phyllite marble unit during Late Triassic subduction. The eclogite provides evidence for the often elusive Triassic subduction history of the Paleo-Tethys in the eastern Mediterranean area.

OLSEN, P.E., 1997. Stratigraphic record of the early Mesozoic breakup of Pangea in the Laurasia-Gondwana rift system. Ann. Rev. Earth Planet. Sci., 25: 337-401.

Rift basins of the Central Atlantic Margins (CAM) of North America and Morocco preserve largely continental sequences of sedimentary strata and less important minor basalt flows spanning much of the early Mesozoic. The best known is the Newark basin of New Jersey, New York, and Pennsylvania where an astronomically calibrated magnetic polarity time scale is developed. Lacustrine cycles of Milankovitch origin are commonly present in CAM basins, with the period changing from 10 ky (paleoequator with coals), to 20 ky (4-10° N), to perhaps 40 ky northward with evaporites. Cycles of similar to 100 ky, 413 ky, and similar to 2 my are also important. Four mostly unconformity bounded tectonostratigraphic sequences are present. The Anisian TS I is fluvial and eolian. TS II TS IV (Late Triassic to Early Jurassic) consist of 'tripartite' lacustrine sequences caused by extension pulses. The Newark basin accumulation rate history allows comparison with quantitative rift basin models. The North American plate's slow northward drift resulted in a relative shift of climate, although the rapid humidification during the latest Triassic and Early Jurassic is associated with a sea level rise. The Triassic Jurassic mass extinction is of independent origin, plausibly impact related.

OUJIDI, M., 1996. Evolution tectono-sédimentaire des Monts d'Oujda (Maroc oriental) au cours du Trias et du Lias basal. In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 201-212.

The early Mesozoic red "Volcano-sedimentary Complex" of Oujda Mountains consists of five lithostratigraphic units that show important differences in facies and thickness. The first formation, the "Lower red beds" is characterized by fluvial deposits which were rapidly sealed by marine mudflat clays related to a sea-level rise, while evaporites were deposited in Tiouli and J. Hamra subsiding basins. The first volcanic event, the "Lower dolerites", led to the extrusion of basalt flows, which constitute the second formation. Lavas were extruded under subaerial or shallow water conditions. The third formation, the "Carbonated bar", is sedimentary and reflects the development of a shallow marine carbonated platform; however, the corresponding marine incursion did not attain Tiouli subbasin. The fourth unit, the "Upper dolerites", corresponds to a second volcanic event. The uppermost formation, the "Upper redbeds" shows an irregular palaeotopography related to a re-arrangement of the basin. Indeed, alluvial fans grading into coastal sebkhas, imply rejuvenation of relief and isolation of the sea. Afterwards, marine incursions (the Liassic transgression) progressed from the northeast to the southwest, and were guided by faults. The structure of the Oujda Mountains was controlled during the early extension episodes, in the Triassic and earliest Liassic, by the activity of conjugate faults of Atlasic (N70-N90), Hercynian (N150-N160) and Late Hercynian (N10-N30) trends, that are inferred from the analysis of the isopach map. This regime led to differentiation of small subbasins: Oujda, Oued El Himer, Tiouli, Jerada and Metroh sub-basins. A N-S synthetic section shows the geodynamic evolution of the area. The infilling of these sub-basins was accomplished through five stages that correspond to the five formations that constitute the "Volcano-sedimentary Complex".

OYARZUN, R., DOBLAS, M., LOPEZRUIZ, J. and CEBRIA, J.M., 1997. Opening of the Central Atlantic and asymmetric mantle upwelling phenomena: implications for long-lived magmatism in western North Africa and Europe. Geology, 25: 727-730.

The Mesozoic to present evolution of the central Atlantic realm is interpreted as a two stage tectonomagmatic scenario involving long-lived asymmetric mantle upwelling phenomena and magmatism within its eastern margin. The first, a pre drift tholeiitic stage of Triassic Jurassic age, resulted from the interaction between several elements: (1) a thinned, weakened corridor along the collapsed southern branch of the Variscan belt between eastern North America and western North Africa; (2) a central Atlantic plume located in the triple junction between Africa, North America, and South America; (3) a progressive asymmetric continental breakup between northwest Africa and North America characterized by detachment systems; and (4) a highly thinned European realm pervaded by rift type basins that we interpret as a large thin spot type domain. These conditions would have induced north northeast directed large scale sublithospheric plume channeling from the central Atlantic plume site to the European large thin spot, leading to widespread early tholeiitic magmatism (Triassic-Jurassic) within a giant irregular zone of similar to 3000 x 4000 km. plume activity and channeling continued afterward during a Cretaceous to present second tectonomagmatic stage (passive margin alkaline stage) leading to the onset of alkaline magmatism along a general north northeast trend in the eastern Atlantic margin (Late Cretaceous) and Europe (Paleocene-Oligocene). As a whole, a north northeast directed propagating magmatic vector can be defined from the Mesozoic to the present.

PANTIĆ-PRODANOVIĆ, S., 1995. Lower and Middle Triassic microfossils in southwestern areas of Bosnian Podrinje. Ann. Géol. Penins. Balk., 59: 155-178.

This work presents Lower and Middle Triassic developments in a part of the southwestern Bosnian Podrinje (Sheet Ljubovija 53), the Jadar River valley, general area of Srebrenica.

Micropaleontological and biostratigraphical studies have been carried out. Faunas dated as Campilian (Lower Triassic) and Anisian and Ladinian (Middle Triassic) are described.

PAPIER, F., NEL, A., GRAUVOGEL-STAMM, L. and GALL, J.-C., 1997. La plus ancienne sauterelle Tettigoniidae, Orthoptera (Trias, NE France): mimétisme ou exaptation? Paläont. Z., 71: 71-77.

The authors describe *Triassophyllum leopardii* nov.gen. nov. sp. from the upper Buntsandstein of the Vosges (France). The range of family Tettigoniidae is thus be from the Cenozoic to lower Anisian. The venation of the wings is discussed and interpreted as exaptation.

PATRULIUS, D., 1996. La faune du Rhaetien supérieur des Monts Perşani (Carpates Orientales). Mem. Inst. Geol. Rom., 36: 3-12.

The Upper Rhaetian fauna from the Perşani Mountains (East Carpathiaqs). From an olistolithe in the left bank of the Vârghiş Valley, downstream the Mereşti Gorges, a faunal assemblage has been identified, attesting the presence of the Uppermost Triassic (Upper Rhaetian) in the Perşani Mts. 18 brachiopod species are described and figured, 10 of which are new species, as well as 14 bivalve species, six of which are new species.

PATRULIUS, D., 1996. The Triassic and Lower Jurassic formations of the Transylvanian nappe system (East Carpathians-Romania). Mem. Inst. Geol. Rom., 36: 21-30.

PAUL, R.K., CAMPBELL, J.D. and COOMBS, D.S., 1997. The age of Triassic fossils near Kaka Point, South Island: reply. New. Zeal. J. Geol. Geophys., 40: 403-404.

PEVNÝ, J. and SALAJ, J., 1997. The Anisian-Ladinian boundary at Zakazant (Slovak Karst, western Carpathians). Zemni plyn a nafta, 42: 97-149.

The article deals with the microbiostratigraphical zonation of the bed sequence at the locality Zakázané on the Silica Plateau from the point of view of conodonts, holothurians and foraminifers. The locality is situated 2 km north of the village Silica. The bed sequence is part of the Silica nappe, includes the Steinalm Limestones, crinoidal limestones (= Zakázané Fm., new name), micritic limestones and nodular limestones of Schreyeralm type with the macrofauna. The stratigraphic range of the sequence is Pelsonian-Illyrian to Fassanian.

POORT, R.J., CLEMENT-WESTERHOF, J.A., LOOY, C.V. and VISSCHER, H., 1997. Aspects of Permian palaeobotany and palynology. 17. Conifer extinction in Europe at the Permian-Triassic junction: morphology, ultrastructure and geographic/stratigraphic distribution of *Nuskoisporites dulhuntyi* (prepollen of Ortiseia, Walchiaceae). Rev. Palaeobot. Palynol., 97: 9-39.

The genus *Ortiseia* is the youngest representative of the Walchiaceae, a presently well defined family of Late Carboniferous/Permian conifers, characterized by zoidogamy. Species of *Ortiseia* are a prominent component in the xerophilous Late Permian flora of the Southern Alps. These species produced pollen grains corresponding to the palynological species *Nuskoisporites dulhuntyi*. In order to minimize the risk of correlating similar but not identical dispersed pollen with *Ortiseia*, controversies and uncertainties as to the morphological organization of *N. dulhuntyi* are resolved by applying both light and electron microscopy (SEM, TEM). An emended diagnosis is presented. Ultrastructural analysis verifies the absence of a distal aperture; a prepollen condition is therefore emphasized. Confirmed occurrences of *N. dulhuntyi* remain restricted to the Upper Permian of western, central and southern Europe. First occurrences are not earlier than Wordian times. Last occurrences approximate the Permian-Triassic boundary and match worldwide evidence of dieback of arboreous vegetation in the terrestrial biosphere. The deduced extinction of Ortiseia exemplifies the effects of the Permian-Triassic biotic crisis on gymnosperm diversity in the European part of the late Palaeozoic Euramerican floral realm.

POINSSOT, C., GOFFE, B. and TOULHOAT, P., 1997. Geochemistry of the Triassic-Jurassic Alpine continental deposits: origin and geodynamic implications. Bull. Soc. Géol. France, 168: 287-300.

Mid-Triassic to mid-Jurassic Alpine continental deposits are known all along the former Brianconnais peninsula. They constitute small karstic pockets on the thick Triassic calcareous series and their chemistry evolves between bauxites s.s. and aluminous argillites. Most of them were deeply buried during the Alpine orogenesis as recorded by HP-LT metamorphism. Only the deposits of the Prealps were submitted to lower PT conditions (diagenesis anchizone boundary) during their incorporation in the thrust wedge of the 'Prealpes Medianes'. These formations are known for containing traces of light elements (Li, F) and heavy elements (Zn, REE...). In order to understand the possible origin of these elements, we studied the geochemistry (major and trace elements) of two representative deposits, one in Vanoise which underwent a HP-LT metamorphism, the other one in the Prealps, which was only submitted to diagenesis. Trace elements patterns allow us to preclude an autochthonous origin for these formations as well as the intervention of metasomatism, and demonstrate a granitic origin. Moreover, discrimination diagrams for granites indicate an obvious alkaline granitic origin for these deposits. In the framework of the Alpine palaeogeography, we then discuss the possible granitic sources. Two main sources can be invoked: either a Brianconnais s.s. formation (crystallines or sediments), which supposes a more intense erosion as classically admitted, or more distant sources such as the Corso-Sardinian alkaline acid rocks, which supposes a complex palaeohydrography. This confirms the sedimentary origin of the light elements in these rocks and precludes the intervention of light elements rich hydrothermal fluids migrating through Alpine metamorphic units.

PUGLIESE, A., 1997. Middle-Late Triassic dasycladales (green algae) from Brenta Dolomites (Giudicarie Alps, Italy). Riv. Ital. Paleont. Strat., 103: 71-80.

Dasycladalian assemblages collected from Middle-Late Triassic carbonate rocks of the Brenta Dolomites (Giudicarie Alps) are illustrated and described. Particular attention is devoted to reproductive organs of Dasycladales observed in one sample coming from the Rhaetian sequence of Croz dell'Altissimo. A new parataxon *Terquemella brentai* n.sp. is established.

QI, Y.P., 1997. Conodonts from Permian-triassic boundary beds of Dalishan section, Dantu, Jiangsu. Acta Micropalaeont. Sinica, 14: 350-356.

The author gives a brief report on the conodonts (including 13 species and 3 indeterminable species in 7 genera) and other fossils from the Permian-Triassic boundary beds of the Dalishan section, Dantu Jiangsu, with a discussion on the Permian-Triassic biostratigraphic boundary, and a description of 3 indeterminable species.

QIAN L.J., 1996. On distribution of *Riccisporites* in China and its stratigraphical significance. Acta Palaeont. Sinica, 35: 473-474.

Under review is the general morphology of *Ricciisporites* with its leading species *R. tuberculatus* Lundblad and *R. umbonatus* Felix and Burbridge. Most forms so far recorded by Chinese Palynologists may be assigned to these two species. Due to its peculiar morphology, relatively stable vertical range and abundant content in most cases, *Ricciisporites* is one of the most important palynomorphys in Mesozoic strata. On a global scale, this genus is mainly distributed within the Rhaetic and lower Liassic Stages of the Northern Hemisphere. In China, it is mainly concentrated in the Norian-Rhaetian Stage of Late Triassic, with only occassional occurrences in the Carnian Stage, but no record has yet been known in Liassic. Therefore, *Ricciisporites* is one of the index forms for the division of Upper Triassic and Lower Jurassic. Since it is usually found in the deposits of littoral and lagoonal facies, its parent plants might have grown in sites not far from these environments.

RADZINSKI, K.H. and SEIDEL, G., 1997. Regionaler Vergleich der Profile des Unteren und Mittleren Buntsandsteins zwischen dem Thüringer Becken und dem nordöstlichen Harzvorland. Geowiss. Mit Thüringen, 5: 117-132.

Core Profiles allow a correlation of the Lower and Middle Bunter Sandstone (Lower Triassic) between the northeastern Harz Mountain foreland and the Thuringian Basin. Identical delimitations of formations and smaller scale cycles could be established and the subdivision into single beds was refined.

RAMOVŠ, A., 1997. *Solenopora ladinica* n.sp. und *Solenopora suhadolica* n.sp. (Rotalgen) und *Paragondolella ?trammeri* (Kozur 1972) (Conodonta) aus dem Ladin (Mitteltrias) bei Shadole, östlich von Ljubljana, Slowenien. Geologija, 39: 79-90.

SE of the village of Suhadole, east of Ljubljana, reef limestone is exposed with a thickness of ±20 m. The rock consists of small patch reefs of fan-shaped red algae *Solenopora ladinica* n.sp. and *Solenopora suhadolica* n.sp., and small patch reefs of phaceloid corals *Tropidendron rhopalifer* Cruif. 1957. Small Inozoa are abundant in reefal limestone. Black platy limestones enclosing the reefs yielded the condont *Paragondolella ?trammeri* (Kozur 1972) which indicates a Ladinian (Middle Triassic) age of the algal and coral limestone.

RAUSCHER, R., HILLY, J., HANZO, M. and MARCHAL, C., 1995. Palynologie des couches de passage du Trias supérieur au Lias dans l'est du bassin parisien. Problèmes de datation du 'Rhétien' de Lorraine. Sci. Géol. Bull., 48: 159-185.

In the eastern part of the Paris Basin, the 'Rhétian' is usually. defined and subdivided by means of purely lithostratigraphical criteria whose chronostratigraphical value has still to be demonstrated. Therefore, several new sections in Lorraine have been palynologically analysed. From the top of the 'Marnes irisées supérieures'(Upper Keuper) to the Lower Hettangian, five successive palynological episodes are distinguished. This microfloristic evolution is firstly compared to the palaeoenvironment evolution. Moreover, the chronostratigraphical interpretations of these palynological data are discussed and compared to those proposed for other fossils (*Rhaetavicula contorta,* Vertebrates), in order to clear up the datingproblems of the transition beds from the Upper Triassic to the Lias in Lorraine.

RETALLACK, G.J., 1997. Earliest Triassic origin of *Isoetes* and quillwort evolutionary radiation. J. Paleont., 71: 500-521.

Isoetes beestonii n.sp. is the most ancient known species of this living genus. In earliest Triassic shales of the Sydney and Bowen Basins of Australia it is locally abundant as circlets of transversely wrinkled leaves. It was heterosporous with megaspores of Maiturisporites rewanensis and microspores of *Lundbladispora* sp. cf. *L. springsurensis*. *Isoetes* thus predates *Pleuromeia* from which it has been thought to have evolved. Australian *Pleuromeia* like subarborescent lycopsids are here reviewed as whole plants, with names based on fertile structures, and include *Cylostrobus sydneyensis* Helby and Martin from the Sydney Basin, *Pleuromeia dubia* (Seward) Retallack from the Sydney and Canning Basins, and *Cylostrobus* indicus (Lele) nov. comb. and *Pleuromeia sternbergii* (Münster) Corda for Germar, newly recorded from the Canning Basin. There are in addition an array of cormose lycopsids that formed compact conelike plants when fertile, intermediate in stature between *Isoetes* and *Pleuromeia*. One of these is *Tomiostrobus australis* (Ash) Sadovnikov, formerly regarded as a cone, but here reinterpreted as a small pioneering plant of oligotrophic lakes and ponds, like Isoetes. Its megaspores are Horstisporites and its microspores are the stratigraphically important *Aratrisporites tenuispinosus*. Other similar forms are *Tomiostrobus polaris* (Lundblad) nov. comb. from the early Triassic of Greenland, *T. mirabilis* (Snigirevskaya) nov. comb. from the early Triassic of the Tunguska Basin of Siberia, *T. taimyrica* (Sadovnikov) nov. comb. from the Early Triassic of the Taimyr region of Siberia, *Lepacyclotes ermayinensis* (Wang) nov. comb.

from the middle Triassic of China, *L. convexus* (Brik) nov. comb. from the middle Late Triassic of Kazachstan, and *L. zeilleri* (Fliche) nov. comb. from the middle Triassic of France and Germany. The diversity of isoetaleans in early Triassic floras and the weak vascular system of permineralized *Tomiostrobus* and *Pleuromeia* contradict the traditional view that *Isoetes* evolved by reduction in size from *Pleuromeia* and that its opportunistic life style allowed it to avoid plant competition. It is now more likely that Isoetaceae were weedy survivors of Permian-Triassic extinctions. The adaptive radiation and decline of Triassic quillworts matches the recovery from near extinction, then decline of therapsid reptiles, for which these plants may have been an important food.

RETALLACK, G.J., 1997. Palaeosols in the Upper Narrabeen Group of New South Wales as evidence of Early Triassic palaeoenvironments without exact modern analogues. Austral. J. Earth Sci., 44: 185-201.

Early Triassic palaeosols in the sea cliffs north of Sydney are evidence of a cool temperate, seasonal, humid palaeoclimate. As is typical in such climates, the palaeosols include Ultisols, Inceptisols and Entisols. These ancient soils supported a variety of broadleaf, deciduous and needle leaf forests, as well as oligotrophic heaths, coastal marshes and vegetation early in ecological succession to colonise disturbed ground. Their fauna of earthworms, crayfish, insects, amphibians and reptiles is now known from a variety of trace fossils. Although many of these palaeosols show evidence of waterlogging and include ganisters, sphaerosiderite and siderite nodules typical of coal measures palaeosols, no coal has been found in this sequence. Other palaeosols are strongly oxidised and were well drained, and yet were copiously rooted and presumably densely forested. Thus, upland environments were well vegetated by Early Triassic time, if not earlier. The parent material of these ancient soils included fertile volcanic sands and oligotrophic quartz sands. Many of the palaeosols represent times for formation of only hundreds to thousands of years but some formed over tens to hundreds of thousands of years and represent times of very slow sediment accumulation. Several aspects of Early Triassic palaeosols can now be seen as peculiar compared with soils of today. None of the palaeosols are thought to have been Spodosols now common in humid temperate regions, perhaps because strongly podsolising plants had not yet evolved. A global lack of coal, even In humid wetlands represented by these palaeosols, is an outstanding anomaly of the Early Triassic that has been called the 'coal gap'. The profound chemical weathering of some of these palaeosols is comparable to that of midlatitude soils (24-38°), and is anomalous compared with soils now at the high latitudes (65-70°) postulated for the Sydney Basin during the Early Triassic. The coal gap and anomalous polar warmth may be legacies of the Permian Triassic life crisis and ensuing CO_2 greenhouse.

RETALLACK, G.J. and HOLSER, W.T., 1997. Timing of Permian-Triassic anoxia. Science, 277: 1748.

RIEPPEL, O., 1997. Sauropterygia from the Muschelkalk of Djebel Rehach, southern Tunisia. N. Jb. Geol. Paläont., Mh., 1997(9): 517-530.

A small collection of sauropterygians from the Muschelkalk of Djebel Rehach is re-described, and their paleobiogeographic affinities are discussed. The fauna comprises a cyamodontoid placodont, two species of *Nothosaurus,* and a possible pistosaur. The presence of *Nothosaurus giganteus,* or of a species closely related to the latter, as well as of a possible pistosaur, indicate affinities to the Germanic Triassic.

ROBERTS, D.L., BAMFORD, M. and MILLSTEED, B., 1997.Permo-Triassic macro-plant fossils in the Fort Grey silcrete, East London. South Afr. J. Geol., 100: 157-168.

The Fort Grey silcrete near East London was reported in the earlier part of this century to contain Tertiary macro-plant fossils. The scarcity of evidence concerning the age and palaeo-

environments of weathering profile silcretes in the southern Cape prompted a reinvestigation of the site. The silicified gymnospermous wood is now assigned to Permo Triassic genera in the *Araucarioxylon/Dadoxylon* and *Podocarpoxylon/Mesembrioxylon* groups described from India and Germany, and is not comparable to extant Tertiary forms as previously indicated. It also lacks the high Ti-signature of the host silcrete. The fossil wood was evidently reworked from Permo Triassic Beaufort strata and incorporated in Tertiary fluvial debris flow deposits which were subsequently silcretized. The Fort Grey silcrete is typical of other southern Cape non fossil bearing silcretes in terms of geological context, composition, texture, and high titanium signature. Since the fossil wood was reworked from older (Beaufort) strata, no useful inferences concerning the age of the silcrete can be drawn.

ROGHI, G., 1997. Indagini palinologiche nella sezione della Val Gola (Trento). Stud. Trent. Sci. Nat., Acta Geol., 71: 91-105.

A preliminary set of Fassanian (Middle Triassic) palynofloral assemblages from the Trentino area (southeastern Alps) is described. Only samples from ammonoid controlled rocks were collected. Quantitative data and the botanical affinities and palaeoecology of selected taxa are discussed.

ROGHI, G. and DALLA VECCHIA, F.M., 1997. The palynology and palaeonvironment of the Upper Triassic dolomitic-marly sequence of Dogna Valley (Udine, Friuli-Venezia Giulia, NE Italy) with reptile trackways. Riv. Ital. Paleont. Strat, 103: 183-192.

New data and considerations about the biostratigraphy and the palaeoenvironment of a section in the Late Triassic dolomitic-marly sequence which crops out in the Dogna valley (Udine, Friuli, NE Italy) are reported. In particular a unit with a surface bearing tracks of archosauromorph terrestrial reptiles has been investigated. In the layer immediately overlaying the track-bearing one, a rich palynological assemblage with *Enzonalasporites vigens*, *Vallasporites ignacii*, *Patinasporites densus*, *Zonalasporites cinctus*, *Pseudoenzonalasporites summus*, *Samaropollenites speciosus*, *Camerosporites secatus* and *Partitisporites* spp. was found, indicating a Tuvalian age (late Carnian). Microfloral and sedimentological evidence indicate a dry climate and a coastal depositional environment subject to repeated emersions.

RÜFFER, T., 1995. Karbonat-Plattform: Fazies, Kontrollfaktoren und Sequenzstratigraphie in der Mitteltrias der westlichen Nördlichen Kalkalpen (Tirol, Bayern). Gea heidelbergensis 1: 1-282.

The sedimentation of the north alpine Middle and early Upper Triassic passed through three stages, the homoclinal ramp in the late Anisian, the distal steepened ramp in the Fassanian, and the rimmed platform in the Longobardian and early Julian. The evolution from homociinal ramp to rimmed platform was a continuous, dynamic process, resulting in a morphological more distinctive depositional basin. The late Anisian is characterized by shallow marine, mainly calcareous sediments of a homoclinal ramp (Steinalm and Virgioria Fm.). Together with almost absent early diagenetic cementation, the dominance of micritic sediments in all depositional zones leads to a non-stable soft substratum. Encrusters are predominant in shallow water areas, and organisms capable of building reefs are missing. In this stage, the depositional facies within individual systems tracts were constant over long time intervals, where the rates of accommodation and accumulation were similar (vertical ramp stack). High frequency sealevel changes were insignificant for the sedimentation, because ramp organisms were not capable of vertical construction sufficient enough to react to short-term sea-level changes. The most striking features of the north alpine Anisian are third order transgressive intervals, causing a ramp stacking. During the late Anisian to early Ladinian time interval a distally steepened ramp evolved as a precursor for the rimmed platform (early Wetterstein Fm.). In contrast to the homoclinal ramp, where the rates of production and accumulation were similar for all depositional environments, a considerable differentiation started during the distally steepened phase. On the one hand the gradual deepening of the outer ramp led to a deep ramp slope, on the

other hand shoals and buildups started to separate the increasingly restricted inner ramp from the open marine mid-ramp. In the Fassanian, most reefs evolved during rising or stablised high sea-levels. This pronounced topography led to better water circulation and intensive early diagenesis with fibrous cements. Within the shoals and buildups the intensity of the marine cementation is similar to the later Longobardian to Julian platform margin. The organic and inorganic stabilization laid the foundation for a further increase of the topography, with the conditions improving for organisms requiring stable substratum, especially bafflers and framebuilders. Compared to the homoclinal ramp, a distinct faunal diversification occurred. Sediment transport and reworking gained additional importance, with tempestites and turbidites reaching the distal mid-ramp. High rates of carbonate production from shoals and buildups supplied neighbouring lagoonal areas with carbonate detritus even during rising sea-level. Therefore, sedimentation within the inner ramp balanced third-order sea-level rises. Previous models for the evolution of the Ladinian reefs have only considered local tectonic controls. However, the initial conditions for the transformation from a homoclinal to a distally steepened ramp comprising the first north alpine reefs were caused by a basinwide or global sea-level rise (late Anisian to early Ladinian transgression). The gradual transition from distally steepened ramps to rimmed platforms occurred during late Fassanian to early Longobardian times, where the margin and upper slope of the rimmed platform were characterized by sediments deposited above the normal wave base. In the early Longobardian, an extensive platform margin with reefs started to develop. Encrusters and particularly marine cements prevailed over framebuilders (corals, *Tubiphytes,* sphinctozoan). Typical encrusters are sponges (sphinctozoan, inozoan), bryozoan and microproblematics such as *Tubiphytes and Ladinella porata.* Downslope buildups (microbial mounds) are also common during the late Ladinian to early Carnmian stage of the platform development. In addition to calcareous basin (Reifiing Fm.) and platform deposits (Wetterstein Fm.) an influx of terrigeneous sediments (Partnach Fm.) started from the middle and especially from the late Longobardian, which is complementary with strong platform progradation. The direction of platform progradation and shedding during the early Wetterstein Fm. and the environment of the Fassanian Reifling Fm. in the Mieming Range indicate two high energy platform margins in the late Fassanian to early Longobardian separated by an intra-platform basin. This pattern is to be explained with spatial different rates of subsidence. This means, that tectonically induced reef growth in the (late) Fassanian existed beside reefs, which were independent from local tectonics. Distributional patterns of the onset of slope sedimentation (Wetterstein Fm.) verify depositional environments crossing the boundaries of the Inntal and Lechtal nappes. This is in contrast to common paleogeographic models with two platforms in the central part of the western Northern Calcareous Alps. The Middle Triassic of the western part of the Northern Calcareous Alps comprises eight third-order depositional sequences. Regional controls on water depth have been eliminated to extract a sequence stratigraphic model representing basinwide controls on sedimentation. The presence of many different sequences does not imply a global eustatic control on all these systems tracts. Global sea level changes can only be assessed, when comparing data from different basins not tectonically related with one another. Local, regional and global controls have been determined by comparing own data with data from the literature. The depositional model, based on field and thin section data, was checked by using a stratigraphic simulation program.

RÜFFER, T. and ZAMPARELLI, V., 1997. Facies and biota of Anisian to Carnian carbonate platforms in the Northern Calcareous Alps (Tyrol and Bavaria). Facies, 37: 115-136.

During the Middle and early Late Triassic carbonate ramps and rimmed platforms developed at the northwestern margin of the Tethys ocean. In the Northern Calcareous Alps, Anisian stacked homoclinal ramps evolved through a transitional stage with distally steepened ramps to huge rimmed platforms of Late Ladinian to Early Carnian age. Middle Triassic to early Late Triassic facies and biota of basin, slope and platform depositional systems are described. Special

emphasis is given to foraminifers, sponges, microproblematic organisms and algae. The Ladinian to early Carnian reef associations are characterized by the abundance of segmented sponges, microproblematica, biogenic crusts and synsedimentary cements. Among the foraminifers, recifal forms like *Hydrania dulloi* and *Cucurbita infundibuliformis* (Carnian in age) are reported from the Northern Calcareous Alps for the first time. Some sphinctozoid sponges like *Paravesicocaulis concentricus* were known until now only from the Hungarian and Russian Triassic.

RUSSO, F., NERI, C., MASTANDREA, A. and BARACCA, A., 1997. The mud mound nature of the Cassian platform margins of the Dolomites: a case history: the cipit boulders from Punta Grohmann (Sasso Piatto Massif, northern Italy). Facies, 36: 25-36.

The sedimentological features and the microbiofacies of the Cassian platforms (Late Ladinian Carnian) of the Dolomites can be studied only on the basis of the so called 'Cipit boulders', that are platform derived olistoliths and clasts fed to the basin and escaped to the extensive dolomitization affecting the buildups. This paper deals with the Cipit boulders occurring in the Punta Grohmann section (Wengen and S. Cassiano formations, Late Ladinian, Archelaus and Regoledanus Zones). The dominant microfacies are represented by boundstone, consisting of nearly 60% of micritic limestone occurring both as peloidal or aphanitic micrite, mostly organized into stromatolitic laminites or thrombolites. The skeletal organism (Tubiphytes, skeletal cyanobacteria, sphinctozoan sponges, etc.) represent only a minor component of the rock (usually less than 10%). Early cements are widespread and consist both of fan shaped calcite (replacing former aragonite), bladed isopachous magnesian calcite and radial fibrous calcite (neomorphic after Mg calcite). The carbonate platforms from which the olistoliths derive were made up mainly of carbonate mud that underwent early lithification, as witnessed by the considerable amount of early cements: therefore they may be regarded to as mud mounds, and more precisely as microbial mud mounds, due to the clearly accretionary, organic controlled nature of most micrites. The micrites, subdivided into auto and allomicrite on the basis of micromorphological and fabric characteristics, have been tested for epifluorescence. The results confirm the organic control on the deposition of automicrite, also in the cases in which a microbial influence is not obvious (i.e., aphanitic micrite without internal organization).

SABAOUI, A., 1996. Les formations rouges du Trias-Lias inférieur de la region de Tazekka (Moyen-Atlas, Maroc). In: Medina, F. (ed.): Le Permien et le Trias du Maroc: état des connaissances. Editions PUMAG, Marrakech, 1996, pp. 213-225.

The Tazekka area shows a Triassic series overlying the Hercynian terrains with an angular unconformity. The series located beneath the basalt flows can be subdivided into six formations. The first three (t1 to t3), 28 to 70 m-thick, are composed of coarse detrital deposits which are largely present at the southeastern border of the Tazekka Massif (Beni Mkoud and El Rhar sections). They characterize continental basins related to an early activity of the Northern Middle Atlas Fault. However, they remain poorly dated, and may be Triassic in age, since : (1) there is no unconformity between them and the overlying formations ; (2) no volcanic rocks are observed ; (3) they are quite thin. All these features do not correspond to those of the classical Permian deposits in Morocco. The other three formations (t4 to t6) consist of 70 m of silts and clays with evaporites, ending by grey mudstones that yielded a Carnian microflora, with *Paracirculina and Camerosporites secatus.* Within the basalt flows, there are several sedimentary levels of small extent and of different composition. A lignite level was dated as early Liassic on the base of the presence of *Corollina* (85%) associated with *Trachysporites fuscus.* The deposits above the basalts are red clays with evaporites overlain by grey clays. The top of the latter has been dated as Hettangian-Sinemurian because of the presence of *Corollina chateaunovi and Corollina yvesi.* According to the palynological results, a relatively precise interval can be assigned to these formations: they start in the Carnian and end

at the Hettangian, probably reaching the Sinemurian. The extrusion of basalts corresponds to several episodes separated by periods of inactivity. The idea that the central part of the Tazekka Massif was an emerged land during the Triassic and the early Liassic is not certain. The transition from the grey clays to the Jurassic dolomites is progressive, but can be rarely followed in the field because of the decollement of the cover.

SALAJ, J. and M'ZOUGHI, M., 1997. Données nouvelles sur la microbiostratigraphie (foraminifères) et paleogeographie du Trias de Tunisie. Zemni plyn a nafta, 42: 3-29.

The new biostratigraphical data of the Triassic permitted to establish sufficiently detailed zonation of several Tunisian boreholes. These results complete the old works compiled about the Triassic of the Germanic facies (Solignac, 1927) and equally of the Tell facies (Castany, 1951; Salaj and Bajaník, 1972) with Alpine influence, present in some regions of Tunisia (Salaj and Stráník, 1970, 1971; Salaj, 1978, Kamoun et al., 1994a,b) and Libya (Tripolitania, Adloff et al., 1986).

SAMANKASSOU, E., 1996. Conodonts from the Ladinian Buchenstein Formation (Southern Alps, Italy). Jb. Geol. B.-A., 139: 523-531.

The Ladinian Buchenstein (Livinallongo) Formation has been studied near Vigo di Fassa, Dolomites, Southern Alps (Italy). The well-preserved conodont fauna includes representatives of the family Ellisonidae Müller, 1956 with *Ellisonia triassica* Müller, 1956? and *Gladigondolella tethydis* (Huckriede, 1958), the family Gondolellidae Lindström, 1970 with *Neogondolella navicula* (Huckriede, 1958), and the problematic *Enantiognathus petraeviridis and Enantiognatus ziegleri* (Diebel, 1956)?. The quantitative analysis of the conodont elements shows a clear predominance of Enantiognathiform elements and Neogondolellacean forms compared to *Ellisonia* and *Gladidondolella*, with a probable implication on biofacies or/and evolution.

SANDER, P.M., RIEPPEL, O.C and BUCHER, H., 1997. A new pistosaurid (Reptilia, Sauropterygia) from the Middle Triassic of Nevada and its implications for the origin of the plesiosaurs. J. Vertebr. Paleont., 17: 526-533.

A new pistosaurid sauropterygian, *Augustasaurus hagdorni*, gen. et sp, nov., is descriebd from the Middle Triassic of Nevada. The specimen was collected in Muller Canyon. Augusta Mountains, from a late Anisian laminated mudstone unit in the Fossil Hill Member of the Favret Formation. *Augustasaurus hagdorni* is based on a partial articulated skeleton consisting of the posterior neck, trunk, shoulder girdle, and both forelimbs. In comparison to Pistosaurus from the Muschelkalk Beds of central Europe, the neural spines of the new pistosaurid are lower and longer with autapomorphic saw cut rugosities and double facets of unfinished bone. *Augustasaurus hagdorni* has reduced front limbs with relatively short distal elements and a phalangeal formula of 1-1-3-3-1. This condition is very different from that in plesiosaurs, the presumed sister group of pistosaurids.

SASHIDA, K., ADACHI, S., IGO, H., NAKORNSRI, N. and AMPORNMAHA, A., 1997. Middle to Upper Permian and Middle Triassic radiolarians from Eastern Thailand. Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B, 18: 1-17.

Moderately well-preserved Middle to Late Permian and Middle Triassic radiolarians are discriminated in siliceous sedimentary rocks that occur in the Sra Kaeo and Trat areas, Eastern Thailand. These radiolarians are identical to the faunas of the upper Middle to lower Upper Permian *Follicucullus porrectus* Assemblage and the Triassic *Triassocampe deweveri* Assemblage reported in chert sequences of Japan. The radiolarians also show close similarity to those reported from the Philippines and the Far East of Russia. Our present discovery provides significant data to reconstruct the paleobiogeography of Mainland Thailand during Late Permian to Triassic times. Sixteen species belonging to 12 genera are systematically

investigated. Among them, the genus *Srakaeosphaera* is newly proposed, and *Srakaeosphaera minuta* is described as new to science in the present paper.

SCHAUER, M. and AIGNER, T., 1997. Cycle stacking pattern, diagenesis and reservoir geology of peritidal dolostones, *Trigonodus* Dolomite, Upper Muschelkalk (Middle Triassic, SW-Germany). Facies, 37: 99-113.

Peritidal dolostones (*Trigonodus* Dolomite) characterize the back bank environment of the Upper Muschelkalk (Middle Triassic) carbonate ramp of SW Germany. These deposits represent the Late Highstand Systems Tract (HST) of the 'Third Order' Middle to Upper Muschelkalk depositional sequence. The HST forms an overall shallowing upward trend and is build by a progradational stack of 1-2 m thick shallowing upward cycles. The latter vary from subtidal to intertidal cycles at the base of the investigated section to intertidal to supratidal cycles at the top of the section. Six major facies types can be recognized: subtidal associations are characterized by oolithic grainstones, lagoonal oncolithic wackestones and peloidal mudstones. Intertidal associations are characterized by ostracod wackestones and laminated mudstones, supratidal facies consist of laminated mudstones with tepee horizons and flat pebble conglomerates as well as paleosol horizons. Thin section petrography, cathodoluminescence microscopy and stable isotope geochemistry reveal a complex dolomitization history (evaporative dolomitization; burial dolomitization). The strong negative oxygen isotope signatures (-3.28 to -5.85 ‰) point out burial dolomitization as the dominant stage. The *Trigonodus* Dolomite shows intercrystalline porosity and some vuggy porosity. Subtidal dolograinstones with idiotopic texture at the base of the investigated section have fair permeabilities (5 30 mD) and high porosities (14-32 %). Inter to supratidal dolo wackestones and dolo mudstones with xenotopic texture at the top of the section have very low permeabilities (0.3-1.0 mD) and lower porosities (11-16 %). The reservoir characteristics with lateral continuity of porous and permeable zones at the base of the section and less porous and impermeable zones at the top again reflect the stacking pattern of shallowing upward cycles within the overall shallowing upward trend of the HST. Primary facies and dolomitization processes thus control the distribution of porosity and permeability.

SCHUBERT, J.K., KIDDER, D.L. and ERWIN, D.H., 1997. Silica replaced fossils through the Phanerozoic. Geology, 25: 1031-1034.

A systematic survey of 1863 papers on macrobenthic assemblages reveals that an average of 21% of published Paleozoic papers concern silicified fossils, but that average drops tb just 4% for post Paleozoic papers, During the Paleozoic, silicified fossil occurrences do not significantly correlate with the amount of shelf chert, outcrop area, time, duration of geologic intervals, or carbonate rock volume. This substantial drop in numbers of silicified fossils coincides temporally with increased importance of aragonite faunas following the end Permian extinctions, However, qualitative measurements of secular changes in abundance and diversity of siliceous sponges are consistent not only with the post Paleozoic decline in fossil silicification, but also with fluctuations in the amount of silicified fossils throughout the Paleozoic, The facies distribution of silicified fossils in the Permian of West Texas also suggests that the distribution of silicified fossils may reflect the occurrence of siliceous sponges, The decline in silicified fossils after the Permian may be related to a concomitant rise in offshore bedded chert deposition and movement of the locus of biogenic silica formation from nearshore to offshore regions beginning in the Triassic, rather than with the expansion of diatoms in the Cretaceous.

SCHWEIGL, J. and NEUBAUER, F., 1997. Structural evolution of the central Northern Calcareous Alps: significance for the Jurassic to Tertiary geodynamics in the Alps. Eclog. Geol. Helv., 90: 303-323.

The geological and structural evolution of the central Northern Calcareous Alps (NCA), Eastern Alps, has been investigated in order to constrain the geodynamic setting and sequence of deformations. The central NCA comprise three nappe complexes with different lithologies and facies due to distinct Triassic to Cretaceous geodynamic evolution: (i) The Tirolic nappes with mainly Triassic shallow water deposits represent the footwall plate on which a Late Jurassic to Early Cretaceous peripheral foreland basin developed (Oberalm to Rossfeld formations) after the closure of the Meliata/Hallstatt ocean. (ii) The overlying Lower Juvavic nappes comprise Triassic continental slope and oceanic deposits, whereas (iii) the Upper Juvavic nappes include Triassic shallow water deposits of the assumed opposite shelf. The presence of Late Cretaceous to Paleogene Gosau basins allows division into pre-, syn- and post-Gosauian tectonic events: (1) Crustal extension in approximately N-S direction during Early Jurassic is documented by Neptunian dykes (D-1) and breccias. (2) Afterwards a top to NNE-NE emplacement of both Lower and Upper Juvavic nappes combined with formation of NW trending folds (D 2) occurred. The Upper and Lower Juvavic nappes west of the Salzach valley were thrust over the Tirolic nappes during middle Cretaceous, while Lower Juvavic nappes east of the Salzach valley were transported by submarine sliding processes from Late Jurassic to Early Cretaceous. Syn- to post-Gosau deformations were: (3) formation of Gosau basins within a transtensive wrench corridor mainly documented by Syn-Gosauian orthogonally NNE and E trending extensional joints and dip slip faults due to subvertical extension (D-3); (4) syn- to post-Gosauian NE-SW shortening (D-4): (5) post Gosauian NW-SE contraction (D-5). (6) Subsequent Neogene N-S contraction (D-6) and (7) a younger E-W contraction (D 7) affected the entire nappe pile along the northern margins of the Eastern Alps.

SERENO, P.C., 1997. The origin and evolution of dinosaurs. Ann. Rev. Earth Planet. Sci., 25: 435-489.

Phylogenetic studies and new fossil evidence have yielded fundamental insights into the pattern and timing of dinosaur evolution and the emergence of functionally modern birds. The dinosaurian radiation began in the Middle Triassic, significantly predating the global dominance of dinosaurs by the end of the period. The phylogenetic history of ornithischian and saurischian dinosaurs reveals evolutionary trends such as increasing body size. Adaptations to herbivory in dinosaurs were not tightly correlated with marked floral replacements. Dinosaurian biogeography during the era of continental breakup principally involved dispersal and regional extinction.

SIGOGNEAU-RUSSELL, D. and GODEFROIT, P., 1997. A primitive docodont (Mammalia) from the Upper Triassic of France and the possible therian affinities of the order. C.R. Acad. Sci., II, A, 324: 135-140.

The locality of Saint Nicolas de Port (Lower Rhaetian) has recently yielded a few teeth which show characters of the symmetrodont *Woutersia* on the one hand and derived features of the earliest docodonts on the other. This leads the authors to recognize the most primitive member of docodonts, *Delsatia rhupotopi* n.gen. n.sp., and to suggest a possible relationship of this order with *Theria*.

SILBERLING, N.J., GRANT-MACKIE, J.A. and NICHOLS, K.M., 1997. The Late Triassic bivalve *Monotis* in accreted terranes of Alaska. U.S. Geol. Surv. Bull., 2151.

Late Triassic bivalves of the genus *Monotis* occur in at least 16 of the lithotectonic terranes and subterranes that together comprise nearly all of Alaska, and they also occur in the Upper Yukon region of Alaska where Triassic strata are regarded as representing non-accretionary North America. On the basis of collections made thus far, 14 kinds of *Monotis* that differ at the species or subspecies level can be recognized from Alaska. These are grouped into the subgenera *Monotis (Monotis), M. (Pacimonotis), M. (Entomonotis),* and *M. (Eomonotis).* In places,

Monotis shells of one kind or another occur in rock-forming abundance. On the basis of superpositional data from Alaska, as well as from elsewhere in North America and Far Eastern Russia, at least four distinct biostratigraphic levels can be discriminated utilizing *Monotis* species. Different species of *M. (Eomonotis)* characterize two middle Norian levels, both probably within the upper middle Norian Columbianus Ammonite Zone. Two additional levels are recognized in the lower upper Norian Cordilleranus Ammonite Zone utilizing species of *M. (Monotis) or M. (Entomonotis),* both of which subgenera are restricted to the late Norian. An attached-floating mode of life is commonly attributed to *Monotis;* thus, these bivalves would have been pseudoplanktonic surface dwellers that were sensitive to surface-water temperature and paleolatitude. Distinctly different kinds of *Monotis* occur at different paleolatitudes along the Pacific and Arctic margins of the North American craton inboard of the accreted terranes. Comparison between these craton-bound *Monotis* faunas and those of the Alaskan terranes indicates that all of the Monotis-bearing terranes in southern Alaska south of the Denali fault were paleoequatorial in latitude during Late Triassic time. Among these terranes, the Alexander terrane was possibly in the southern hemisphere at that time. Terranes of northern Alaska, on the other hand, represent middle, possibly high-middle, northern paleolatitudes.

SOPEÑA, A., DOUBINGER , J., RAMOS, A., and PÉREZ-ARLUCÉA, M., 1995. Palynologie du Permien et du Trias dans le centre de la péninsule Ibérique. Sci. Géol., Bull., 48: 119 - 157.

Palynological data from the carbonatic and siliciclastic sediments in the Central System and western Iberian Ranues has allowed us to make some age-dating for most of the sediments unconformably overlying the lower Paleozoic metamorphic basement. Twelve palynological assemblages have been identified. They range in age from early Permian (Autunian) to late Triassic (Carnian). Early Permian consists mainly of grey-black sediments filling small isolated half graben basins. Saxonian facies unconformably overly Autunian or early Paleozoic rocks. Paleontological data for Saxonian facies point to a middle to late Permian age. The overlying lower Buntsandstein is also late Permian (Thuringian) in age in some areas in south-western Iberian Range. The overlying Triassic rocks (upper Buntsandstein, Muschelkalk and Keuper) contain several palynological assemblages: Anisian, Anisian-Ladinian, Ladinian s.l., late Ladinian and Carnian. Some ages have been also compared with ammonoids and conodont datings in the same areas.

SOTÁK, J. and PLAŠIENKA, D., 1996. Upper Triassic - Lower Jurassic sediments of the Lučatín Unit in the Northern Veporicum: facial diversity and tectonic stacking. Slovak Geol. Mag., 1996(3-4): 273-277.

The Lučatin unit is a transitional tectonic element between the Krížna nappe and the Veporic superunit, analogous to the Vel'ky Bok unit. It consists of three partial nappe subunits differing in structural positions and litbofacial characteristics of especially the Lower Jurassic syn-rift sediments. The lowermost subunit crops out only in small tectonic windows and it facially closely approaches the Zliechov basinal succession of the Krížna nappe, the structurally highest subunit is confined to the North Veporic basement. The paper concentrates on the middle, Farbište subunit, with peculiar Upper Triassic-Lower Jurassic strata. Middle to Upper Liassic variegated limestones point to the deposition in an elevated and dissected domain rapidly subsiding during the Middle and Late Jurassic. Several facies uncommon in the Western Carpathians (Rhaetian reefal Jakub Limestones, lowermost Dogger Neptunian dykes filled up with Bositra Limestones) indicate 'southern' affinities of the Lučatin shelf.,

TIETZE, K.-W., 1997. Ein Buntsandstein-Profil am Westrand der Hessischen Senke (Raum Marburg). Geologica et Palaeontologica 31: 285-294.

A vertical section across the Buntsandstein (Lower Triassic) from the area around Marburg/ Lahn is presented in combination with gamma ray logs (scale 1: 1000). It is composed of the

results from 5 wells and 1 outcrop. The total thickness of the Buntsandstein is about >535 m, possibly up to >565 m. Lithologically the Buntsandstein of this marginal position is dominated by red sandstones, with a relatively low content of mudstones and siltstones. The fluvial environment is predominant. Eolian sands start occurring in the uppermost Lower Buntsandstein. They increasingly accumulate in the Volpriehausen Formation and finally predominate in the Detfurth Formation with the growth of eolian dunes. The occurrence of eolian sands is restricted to the eastern boundary of the today's Rhenish Massif, thus indicating some paleorelief or tectonic faulting. The biggest paleo-rivers built up the sandstones of the Solling Formation which unconformably overly the Hardegsen Formation. This Solling unconformity is a major sequence boundary in the Lower Triassic. The Upper Buntsandstein starts with a transgressive system of muddy silt and sandstones, and some evaporates, mainly followed by sandy siltstones and some clay. Paleotectonic movements may be indicated by the variation of the flow directions of the Buntsandstein rivers and by the accumulation of eolian sands. Relative sea level highstands might have controlled the deposition of the Volpriehausen *Avicula* beds and the transgression of the Upper Buntsandstein, whereas a relative sea level lowstand might have been responsible for the Solling unconformity.

TONG, J., 1997. Lower Triassic sequence stratigraphy of Chaoxian, Anhui. Acta Geosci. Sinica, 18: 215-219.

Because of the significant paleo-tectonic and paleogeographic position, the Triassic section of Chaoxian, Anhui is of great importance in study of the regional sequence stratigraphy of the LowerYangtze. Based on the integrated analysis of sedimentology, cyclostratigraphy, ecostratigraphy and the related sciences and referring to the features of the regional sequence stratigraphical pattern of the Lower Yangtze, this paper summarized the sequence stratigraphy of the section, including the structural pattern and characteristics of the sequences and the development. In addition, the principal methods to study outcrop sequence stratigraphy of the individual sections have been mentioned in the light of the study of this section.

TONG J., 1997. A study on the Griesbachian cyclostratigraphy of Meishan Section, Changxing, Zhejiang Province. Int. Conf. Strat. Tect. Evol. SE Asia and S Pacific, Bangkok, Thailand, 1997, pp. 158-163.

The Griesbachian of Meishan Section, Changxing County, Zhejiang Province, Southeast China is composed of a series of multilevel cycles of the mudrock-limestone bundles. The composition of the bundles and their stacking patterns are the excellent markers to distinguish and identify the sequence and systems tracts in sequence stratigraphy. The time series analysis on the carbonate contents of the bundles shows that the formation of the bundles and the higher cycles was closely related to the astronomical Milankovitch climate cycles, so that the resolution of the studied strata is greatly improved up to the scale of 10^4 years.

TORCQ, F., BESSE, J., VASLET, D., MARCOUX, J., RICOU, L.E., HALAWANI, M. and BASAHEL, M., 1997. Paleomagnetic results from Saudi Arabia and the Permo-Triassic Pangea configuration. Earth Planet. Sci. Lett., 148: 553-567.

The Pangea configuration for the interval of Late Carboniferous to Early Jurassic is still debated: was it similar to the well known Wegenerian Pangea or did Gondwanaland move with respect to Laurussia along a major right lateral lineament of several thousand kilometres during the Triassic, as suggested by Irving? The authors try to answer this important question with the paleomagnetic study of well dated Permo-Triassic sediments from a borehole in Saudi Arabia. Sediments of the same age have also been sampled at the surface, but proved to be remagnetized, probably by a strong desert alteration. The paleomagnetic study of the bore hole core yielded a high temperature component magnetization thought to be of primary origin carried either by magnetite (Late Permian limestones) or hematite (Early Triassic red shales) with

antipodal normal and reversed inclinations. Its co-latitude and pole directions compare well with those from a selection of South American, African, Madagascar, and Moroccan poles. A new reliable pole for west Gondwana with a mean age of 244 ±11 m.y. is derived ($\lambda = 53.4°N$, $\phi = 259.4°E$, $A^{95} = 3.6$ in West African coordinates), acid its comparison with the Laurussian poles of same age window strongly suggests a Pangea in which the northern part of South America was facing the east of North America (Pangea B of Irving) at the Permo-Triassic boundary. A large right lateral strike slip movement of some 3500 km during the Triassic is thus required to reconstruct Pangea to its Jurassic pre-Atlantic opening position.

TORTI, V. and ANGIOLINI, L., 1997. Middle Triassic brachiopods from Val Parina, Bergamasc Alps, Italy. Riv. Ital. Paleont. Strat., 103: 149-172.

The Middle Triassic Esino Limestone of Val Parina yields a rich brachiopod fauna associated with bivalves, gastropods, corals, and ammonoids. The brachiopod fauna of the Esino Limestone includes ubiquitous species (*P. fragilis*, *A.* aff. *posterior*, *M. mentzeli*, *D.* cf. *dinarica*, *L. praepunctata* and *A. angustaeformis*), species exclusive to the back reef (*T.* cf. *intervallata*, *A.* aff. *ladina* and *A.* aff. *raxana*) and species exclusive to the shelf margin (*C.* aff. *altaplecta*, *V. vivida*, *A.* aff. *dilatata*, *H.* aff. *ambitiosa*, *T. trigonella*, *M. ampla*, *A.* aff. *canaliculata*). The age of the Val Parina brachiopods spans from ?latest Anisian to Late Ladinian.

TRAMMER, J., KAIM, A. and MAŁOWSKI, K., 1996. Disturbance rings and shell shape in the Triassic brachiopod *Coenothyris vulgaris*. N. Jb. Geol. Paläont., Abh., 201: 95-105.

Coenothyris vulgaris (Von Schlotheim) shows a correlation between the number of disturbance rings occurring on the shell resulting from environmental disturbance, and the shell shape. Increase in the number of disturbance rings is associated with a decreasing length/thickness ratio, and an increasing lenght/width ratio of the shell. Similar differences between Lower and Upper Muschelkalk populations are probably caused by evolutionary transformation rather than environmental modification.

TRIPATHI, A., 1997. An Acritarch Assemblage from Triassic Sediments of the Talcher Coalfield, Orissa, India. Acta Univ. Carolinae Geol., 40: 677-680.

In the present paper the acritarch assemblages from Late Permian and Early Triassic subsurface sediments of Talcher Coalfield, Orissa, India are reported. The record of *Micrhystridium* in Late Permian and the dominance of *Meruticavea* in late Early Triassic palynoassemblages is noteworthy.

UROŠEVIĆ, D., 1995. *Glomogallerum* n.gen. Triassic foraminifers of eastern Serbia, Yugoslavian Carpatho-Balkanides. Ann. Géol. Penins. Balk., 59: 193-202.

Foraminfera from Triassic sediments of eastern Serbia are described. Some new taxa (one genus and three species) are introduced: *Glomogallerum* n.gen., *G. fungus* n.sp., *G. gazdzickii* n.sp., and *G. mlavicensis* n.sp.

VASILEV, Y.R. and PRUSSKAYA, S.N., 1997. New data on large volume appearance Permo-Triassic intrusive traps in cover of Siberian Platform. Dokl. Akad. Nauk., 354: 216-219.

VENKATESAN, T.R., KUMAR, A., GOPALAN, K. and ALMUKHAMEDOV, A.I., 1997. ^{40}Ar-^{39}Ar age of Siberian basaltic volcanism. Chem. Geol., 138: 303-310.

Five of six samples representing the entire stratigraphic sequence (similar to 3700 m thick) of basaltic flows in the Noril'sk section in the northwestern part of Siberian flood basalt province, Russia yield ^{40}Ar-^{39}Ar plateau ages between 248.3 ± 1.7 Ma and 246.9 ± 2.5 Ma relative to an age of 520.4 Ma for the hornblende standard, MMhb 1. These results clarify some discrepancies in existing data and confirm that eruption of the bulk of Siberian basalts was

close to 248 Ma and possibly lasted less than 2 Ma, Although the violence of this volcanism may have caused the massive extinctions at the Permo-Triassic boundary, the onset of changes across this boundary seems to have been distinctly earlier.

WANG, X.P., HAO, W.C. and YANG, S.R., 1997. Ni-Ir anomaly and fusulinid extinction across the Permian-Triassic boundary in Dongluo, Guangxi. Chin. Sci. Bull., 42: 1117-1119.

WANG ZHI-HAO, BAESEMANN, J.F., LANE, H.R. and HARRIS, A.G., 1996. Conodont Color Alteration Index (CAI) maps of Ordovician through Triassic rocks In central and north China. Acta Micropalaeont. Sinica, 13: 161-194.

This paper compiles and describes 15 conodont CAI maps from several important Chinese oil and gas exploration and production areas using the standards established by Anita Harris. They are of significance for oil and gas exploration in China.

WATERHOUSE, J.B., 1997. The age of Triassic fossils near Kaka Point, South Island: comment. New. Zeal. J. Geol. Geophys., 40: 401-403.

WILKINSON, B.H., DRUMMOND, C.N., ROTHMAN, E.D. and DIEDRICH, N.W., 1997. Stratal order in peritidal carbonate sequences. J. Sed. Res., 67 B: 1068-1082.

Speculation on the depositional origins and geological significance of meter scale cycles in peritidal carbonates is becoming an increasingly prominent facet of sequence stratigraphic theory, the understanding of which bears directly on their appropriateness as chronostratigraphic entities as well as their usefulness as records of periodic extrabasinal forcing during sediment accumulation, In spite of the generally wide acceptance of the stratigraphic importance and interpretational significance of meter scale parasequences, little has been done to quantitatively document the stratigraphic nature of regularly recurring lithologic associations or to verify the predominance of such cyclicity in shallow water limestone/dolostone sequences. In order to determine the statistical extents and stratigraphic scales of stratal order in such sequences, we have examined several long sections of peritidal carbonate both with respect to the presence or absence of Markovian lithologic transitions and with respect to the 'upward shallowing' character of lithofacies associations, In contrast to common wisdom, these measures of stratal order suggest that lithologic manifestation of meter scale cyclicity is relatively uncommon, AU of the several sequences deemed 'cyclic'' via qualitative inspection in fact contain relatively few intervals of demonstrable lithologic order, and even fewer exhibit any tendency for contained units to shallow upsection, In reality, most parts of most shallow mater carbonate sequences exhibit Little more stratal order than would be apparent in random sequences of peritidal lithologies. On the basis of these considerations, we suggest that discrimination of meter scale cyclicity in epicratonic carbonates is perhaps more perceptional artifact than stratigraphic reality, Imminent and future efforts intended to fruitfully evaluate the importance of intrabasinal versus extrabasinal processes of sedimentation in shallow low latitude settings should perhaps eschew more generic perceptions of periodic paleoclimatic forcing in favor of a less regimented view toward the importance of stochastic processes of carbonate accumulation.

WURM, F., FRANZ, M., SEUFERT, G. AND ETZOLD, A., 199 Die Schichtenfolge des Unter- und Mittelkeupers (ku-km3) im Südwesten der Strombergmulde (Baden-Württemberg). Jh. Geol. Landesanst. Baden-Württemberg, 36: 65-115.

Based on numerous drill cores a complete, gamma-ray-log supported profile from the 'Obere Bunte Mergel' to the Keuper/Muschelkalk boundary in the area between Vaihingen/Enz and Bretten is presented. The primary thickness of about 250 m was reduced to 200 m by locally different subrosion of gypsum.

XIAO, W.J., LI, J.L., HE, H.Q. and CHEN, H.H., 1997. A preliminary study of NW Zhejiang foreland fold and thrust belt in southeast China. Science in China, Ser. D, Earth Sci., 40: 418-423.

The Upper Permian Dalong Formation (P(2)d) and Changxing Formation (P(2)c), and the Lower Triassic Zhengtang Formation (T(1)z) are deep water turbidites. The sedimentary features of the NW Zhejiang are of SE dipping passive continental margin from the Paleozoic to the Early Triassic. Together with the foreland molasse basin during the late Triassic (T(3)w), the tectonics of the NW Zhejiang is characterised by a tectogenesis which took place in the middle Triassic. From SE to NW, the structural style varies from multi duplex, antiformal stack to imbricate fans, and then to Jura Mountain type fold zone with fold style varying gradually from large scale tight fold to midscale chevron fold, then to cylindrical fold, reviewing a preliminary scenario of foreland fold and thrust belt. The space distributed structures and the tectonic vergence indicate the significance of deformation in (T 1-T 3).

YAROSHENKO, O.P., 1997. Palynology and phytogeography of the Early Triassic. Paleont. Zhurn., 1997(2): 47-57. (= Paleont. J., 31: 168-177).

The distribution analysis of the Early Triassic characteristic palynofloras conforms to the palaeofloristic areas: Angaran, Subangaran, Euramerian, Gondwana, which have been proposed on plant fossils. The climatic peculiarities of these areas are marked by several groups of miospores, belonging to xerophytic and hygrophytic plants peculiarity.

YAROSHENKO, O.P. and LOZOVSKY, V.R., 1997. Modification of palynoflora in the Moscow syneclise at the Permian-Triassic boundary. Strat. Geol. Correl., 5: 243-256.

Three microfloral assemblages are distinguished among palynomorphs occurring in Upper Permian (Vyatka Horizon) and Lower Triassic (Vokhma Horizon) terrestrial deposits of the Moscow syneclise. One of them, typical of the middle Vyatka Horizon (Luptyug Member), is distinct from another, confined to Lower Triassic beds of the Vokhma Horizon, whereas the third one, occurring in the upper Vyatka beds (Moloma Member), is transitional in composition. The data obtained suggest that a hiatus in sedimentation corresponding to the boundary epoch between the terminal Permian and earliest Triassic did not have identical time spans in different areas of the Moscow syneclise. According to the character of palynoflora and associated vertebrate fauna, it was minimal in the Vetluga River basin. The paper is supplemented with a description of the new pollen species *Ephedripites permasensis* Yaroshenko sp. nov. collected from the Krasnye Baki Subformation of the Vokhma Horizon.

YIN, H.F., 1997. Triassic biostratigraphy and Paleobiogeography of East Asia.

East Asia occupies the key position in the Triassic correlation of the circum-Pacific region, Tethys, and marginal Gondwana, because it includes important areas from all of those realms. This chapter presents biostratigraphic correlations for the major Triassic groups of organisms.

ZAKHAROV, V.A., BOGOMOLOV, Y.I., ILYINA, V.I., KONSTANTINOV, A.G., KURUSHIN, N.I., LEBEDEVA, N.K., MELEDINA, S.V., NIKITENKO, B.L., SOBOLEV, E.S and SHURYGIN, B.N., 1997. Boreal zonal standard and biostratigraphy of the Siberian Mesozoic. Geol. Geofiz., 38: 927-956.

The authors present a boreal zonal standard scale in order to achieve an effective panboreal correlation and efficient geological dating of Mesozoic boreal sediments. The necessity for establishment of boreal standard is caused by difficulties of the direct zonal correlation between most boreal stratigraphic sections with the Mesozoic type sections that are located in Western Europe. The standard section of boreal Mesozoic represents the most complete succession of mollusk (mainly ammonites) zones that are known on the territory of the boreal realm. It is composed of fragments of zonal successions that are established on more than 30 Triassic, Jurassic, and Cretaceous sections from northern Eurasia, North America and

Greenland. Boreal standard of the Triassic system consists of 36 ammonite zones and 2 bivalve zones; Jurassic 70 ammonite zones; Cretaceous 37 zones, subzones and beds on ammonite, 6 bivalve zones, and 11 zones and subzones on belemnites. Siberia and northeastern Asia provide stratigraphic sections many of which are the best in the boreal realm regarding their stratigraphic completeness and detailed zonal subdivision. In addition, there is a type section of the Olenekian stage and one of the most complete boreal sections of the Indian stage. Infrazonal scales are constructed for both Indian and Olenekian stages as well as for the Middle and Upper Anisian. Successions of ammonite zones from Hettangian, Sinemurian, Toarcian, and Upper Pliensbachian sections, which are located in NE Asia as well as Lower Oxfordian substage from Northern Siberia and Kimeridgian stage of subpolar Urals, are selected as boreal standards. There is a more complete ammonite zonal scale of the upper Volgian substage in Northern Siberia than that of the Gorodishche type section from Volga River region. The most complete and continuous successions of ammonite zones in boreal Berriassian and Valanginian are established in northern Siberia. They are accepted as a composite boreal standard. Studies of the North Siberian Upper Cretaceous sections in stratigraphical interval from Upper Cenomanian to Santonism Campanian boundary revealed equivalents of all the East and West European Inoceramid zones. In addition to ammonoid zones for all the Mesozoic systems in Siberia and Northeastern Asia, we used the same sections to construct independent parallel zonal scales on the parastratigraphical groups of fauna and flora. We also constructed a bivalve based 'through' scale which was incorporated into the boreal standard for some intervals such as Upper Triassic and Upper Cretaceous. For the entire Triassic interval we offer zonation based on nautiloids as well as those on conadonts and foraminifera for some other intervals. For Jurassic interval we developed a system of the following biostratigraphic scales: on belemnites, foraminifera, ostracods, dinocysts, spores and pollen, dinocysts and foraminifera scales are available for the Cretaceous interval. In combination, the parallel scales mag. provide a very detailed regional correlation. However, many of them like a zonal bivalve based scale make it possible to achieve a direct panboreal, and even boreal peritethyan correlation for the intervals such as Upper Triassic, Lower Liassic, Upper Jurassic, Neocomian, and Upper Cretaceous. The here presented boreal Mesozoic zonal standard needs an improvement and calibration. In particular this is true for a greater part of a zonal scale of Cretaceous system. Nevertheless, even in the present version it is useful as a tool to improve panboreal and boreal tethyan correlation, It is also particularly useful far operative stratigraphic work on boreal sections in specific regions.

ZHANG, H.C., 1996. Mesozoic insects of Orthophlebiidae (Insecta, Mecoptera) from Junggar Basin, Xinjiang, China. Acta Palaeont. Sinica, 35: 442-454.

Ten species of the family Orthophlebiidae are described from the Lower Jurassic Badaowan Formation in Tuzigou of Karamay and the Upper Triassic Xiaoquangou Group in Harsala to the south of the Four Trees Coal Mine, Wusu County in the Junggar Basin, Xinjiang. They are referred to three genera, with 5 species recognized as new, including *Orthophlebia exculpta* sp.nov. *O. colorata* sp.nov., *Mesopanorpa densa* sp.nov., *M.monstrosa* sp.nov. and *Protorthophlebia strigata* sp.nov. Some genera and species of the family were reported in China over the past ten years, but mostly with some problems in classification. This paper gives a detailed discussion on the Orthophlebiidae in China.

ZHANG, S.X., ALDRIDGE, R.J. and DONOGHUE, P.C.J., 1997. An Early Triassic conodont with periodic growth. J. Micropalaeont., 16: 65-72.

Elements of a new Triassic conodont genus *Parapachycladina*, from the Lower Triassic Beisi Formation of western Guangxi Province, China, show a characteristic pattern of lamellar edges in the recessive basal margin. The lamellae are grouped in sets of 8-10, with broad interlamellar

spaces between each set. If this apparent periodicity reflects annual cycles, the specimens were not more than four years old when they ceased growing.

ZHIDOVINOV, S.N., GROSHEV, V.G., VOLOZH, Y.A. and LIPATOVA, V.V., 1997. Stratigraphy and formation environments of the Upper Permian-Triassic sequence in the Aksu-Kendyrli flexure area (southern Mangyshlak). Strat. Geol. Corr., 5: 449-457.

Based on complex and voluminous geologic geophysical data, relationships of pre-Jurassic sedimentary sections in the southern flank of the Southern Mangyshlak depression are outlined. Regional unconformities were established in the section, the main one of which (pre-late Olenekian) divides Upper Permian-Triassic deposits into two structural stages. It is shown that the Aksy-Kendyrli flexure comprises three carbonate members of different age (Early, Middle, and Late Triassic), every one of which is of interest for oil and gas prospecting. Description and correlation of local stratigraphic units are given and their formation environments are characterized.

Erratum:

The paper by Kozur, Ramovš, Wang and Zakharov (see ALBERTIANA, 18: 63) was published in 1996 and not 1994/95 as was erroneously indicated. Contributors are kindly requested to supply correct citations.

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Special attention should be paid to grammar and syntax. Because the editor's administrative assistance has been reduced to virtually zero, 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 'Annotated Triassic Literature'. The use of names of biostratigraphic units should be in accordance with the International Stratigraphic Guide:

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- "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 mention, the genus name may be abbreviated to its initial letter if there is no danger of confusion with some other genus beginning with the same 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.*

The deadline for the submission of contributions for ALBERTIANA 21 is June 30th, 1997

ADRESSES OF CONTRIBUTORS TO ALBERTIANA 20

Nicu-Viorel Atudorei	Musee Geologique, UNIL-BFSH2, CH-1015 Lausanne, Switzerland. E-mail: Nicu-Viorel.Atudorei@sst.unil.ch. Tel: (41) (21)692.44.74; Fax: (41) (21)692.44.75
Gerhard H. Bachmann	Institut für Geowissenschaften und Geiseltalmuseum, Martin-Luther-Universität Halle-Wittenberg, Domstraße 5, D-06108 Halle (Saale), Germany
Aymon Baud	Musee Geologique, UNIL-BFSH2, CH-1015 Lausanne, Switzerland. E-mail: aymon.baud@st.unil.ch
Tamás Budai	Geological Institute of Hungary, Stefánia str. 14, 1143 Budapest, Hungary
János Haas	Academical Research Group, Department of Geology, Eötvös Loránd University of Sciences, Múzeum str. 4/a, 1088 Budapest, Hungary
Hans Hagdorn	Schloßstraße 11, D-74653 Ingelfingen, Germany. E-mail: Encrinus@t-online.de
Andrew B. Heckert	Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, New Mexico 87131, U.S.A. E-mail:heckerta@unm.edu
Hans Kerp	Abt. Paläobotanik, WWU, Hindenburgplatz 57-59, D-48143 Münster, Germany. E-mail: kerp@uni-muenster.de
Sándor Kovács	Academical Research Group, Department of Geology, Eötvös Loránd University of Sciences, Múzeum str. 4/a, 1088 Budapest, Hungary
Lai Xulong	Faculty of Earth Sciences, China University of Geosciences, Wuhan 430074, P.R. China
Spencer G. Lucas	New Mexico Museum of Natural History and Science, 1801 Mountain Road NW, Albuquerque, New Mexico 87104-1375, U.S.A.
Emő Márton	Eötvös Loránd Geophysical Institute of Hungary, Columbus str. 17-23, 1145 Budapest, Hungary
M.J. Orchard	Geological Survey of Canada, 101-605 Robson Street, Vancouver, B.C. Canada, V6B 5J3. E-mail: morchard@gsc.NRCan.gc.ca
Rachel K. Paull	Dept. of Geosciences, University of Wisconsin-Milwaukee, Milwaukee, WI 53201, USA. E-mail: rpaull@csd.uwm.edu
Imre Szabó	Villányi str. 56, 1113 Budapest, Hungary
E.T. Tozer	Geological Survey of Canada, 101-605 Robson Street, Vancouver, B.C. Canada, V6B 5J3. E-mail: ttozer@gsc.nrcan.gc.ca
Henk Visscher	Laboratory of Palaeobotany and Palynology, Budapestlaan 4, NL-3584 CD Utrecht, The Netherlands. E-mail: hvisscher@boev.biol.ruu.nl
Attila Vörös	Geological and Paleontological Department, Hungarian Natural History Museum, 1370 Budapest, P.O. Box 330, Hungary
Yin Hongfu	Palaeontology Laboratory, China University of Geosciences, Wuhan, Hubei, 430074, China. E-mail: hfyin@dns.cug.edu.cn
Yuri D. Zakharov	Far Eastern Geological Institute, Far Eastern Branch, Russian Academy of Sciences, Prospect Stoletiya Vladivostoka 159, 6900022 Vladivostok, Russia. E-mail: fegi@online.marine.su

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A NEW EDITOR FOR ALBERTIANA

see page 30 of this issue for further details

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