Permophiles

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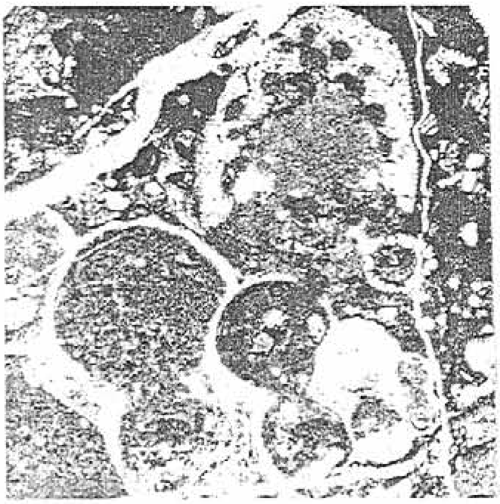

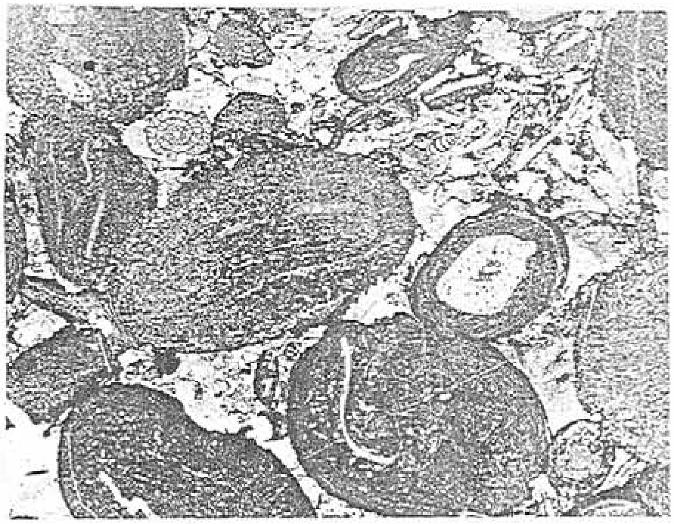

SUBCOMMISSION ON PERMIAN STRATIGRAPHY

INTERNATIONAL COMMISSION ON STRATIGRAPHY

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

COVER PAGE

Some fossils of the Permian of the Anatolian Platform of Gondwana, Hadim Nappe, Turkey. Top left *Permocalculus anatoliensis* Güvenç, 1966, centre *P. dikenliderensis* Güvenç, 1966, right *P. anatoliensis* Güvenç, 1966 with three segments and *Gymnocodium hortubelensis* all of Upper Permian (Upper Pamirian), above the Girvanella Limestone. Tubes of *Girvanella* encompassing different fossil fragments of Gzhelian age (bottom left) and of Asselian age (bottom right). Photographs provided by T. Güvenç.

CONTENTS

1. SECRETARY'S NOTE

I should like to thank all those who contributed to the issue of "Permophiles". The next issue will be in June 1995; please submit contributions by May 1.

Contributors may send in reports by mail, FAX or E-mail. "Permophiles" is prepared using WordPerfect 5.1 for those wishing to send in 5¼" or 3½" IBM computer discs (please also send printed hard copy). Files can also be sent in their native format with an ASCII version.

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2. MINUTES OF THE SUBCOMMISSION ON PERMIAN STRATIGRAPHY BUSINESS MEETING GUIYANG AUGUST 28, 1994 (7.30 - 9.30 P.M.)

A. Attendance

Jin Yu-gan, Chairman
J. Utting, Secretary
B. Glenister, Chairman of Carboniferous/Permian boundary Working Group
B. Wardlaw, Secretary of Carboniferous/Permian boundary Working Group
Sheng Jin-zhang, China
Yang Qun, China
J. Fedorowski, Poland
M. Kato, Japan
E. Leven, Russia
G. Kotlyar, Russia
F. Remane, Switzerland
K. Gohrbandt, U.S.A.
T. Güvenç, Turkey
Mei Shi-long, China
Yin Hongfu, China
T. Grunt, Russia
R. Grant, U.S.A.
H. Kozur, Hungary
A. Baud, Switzerland
M. Dickins, Australia
I. Metcalfe, Australia
V. Lozovsky, Moscow
V. Davydov, Russia

B. Agenda

The following agenda was proposed and accepted.

- Introduction and welcome (Jin, Chair, SPS)
- Reports of Working Groups
- General Discussion
- Straw votes
- Invitation to send in comments concerning "An operational scheme of Permian chronostratigraphy"

C. The chairman welcomed members to Guiyang, China and hoped that the meeting would prove beneficial to all. He summarized the agenda and pointed out that a tremendous amount of activity was going on in the Permian Subcommission and that the working groups were very active.

D. Reports of Working Groups

All chairmen had previously been contacted by mail and encouraged to send in a written report of their progress and to present results of their work at the conference. The following reports, which are reproduced in the next section of the current issue of "Permophiles", were submitted:
Carboniferous/Permian Boundary; Permian Stratotypes; Lopingian Series; Continental sequence of Permian and Permian/Triassic Boundary

All Chairmen (or a substitute) were asked to summarise the main points concerning working group activities.

Wardlaw summarized two presentations illustrating work in progress by members of the Guadalupian Working Group. These were discussed in detail during the later poster and oral sessions of the conference. The presentations were entitled "*Clarkina* species successions in the Middle and Upper Permian (Wardlaw and Mei Shi-long) and "Cathedralian conodont biostratigraphy of the Glass Mountains, Texas" (Wardlaw and Glenister). Glenister also brought to members attention a recent open file report (94-000) released by the U.S. Geological Survey on the Guadalupian Symposium (Wardlaw, Grant and Rohr, 1994). This contains 19 chapters by various authors concerning the Guadalupian.

E. General discussion followed concerning these reports and voting on the C/P boundary and the basal boundary of the Guadalupian.

Kozur proposed that we were ready to hold a straw vote where all members present expressed their opinion.

Baud said he understood that the problem of access to one of the stratotype areas of the Guadalupian has been resolved. He pointed out however, that much of the detailed work on the Guadalupian had not been published, although some had appeared in "Permophiles".

Wardlaw replied that the access problem had indeed been resolved. He admitted that some critical data had not yet been published, but that they would be soon.

Dickins stated that in his view the Aidaralash section was very suitable for the C/P Boundary stratotype and it should be put to a vote. However, he believed more data were required from the basal Guadalupian, or for that matter the whole of the Guadalupian before a decision should be made.

Remane pointed out that it was quite permissable to use one fossil group to define a boundary, but one needed other events on either side of the boundary to aid in its recognition. As a guiding principle there should be solid criteria for defining the base of each series.

Remane and **Gohrbandt** stressed to members that there was some urgency in making boundary decisions. Some members of IUGS, who were not stratigraphers, were critical of the fact that many subcommissions failed, or took too long, to make decisions. It might be a good idea to establish a timetable for decision making. Perhaps some firm decisions could be made by the autumn of 1995 so that they could be scheduled for approval at the 30th International Congress, Beijing, China, 1996

Glenister stressed the value of conodont clines in defining boundaries, and outlined how the basal boundary of the Guadalupian could be defined in this way. He also acknowledged that there was merit in recognising a Lower and Upper Permian Series with the Permian being subdivided into four subseries.

Leven said that he did not support the subdivisions proposed up to now, and had elaborated on this in his comments on "An operational scheme of Permian chronostratigraphy" which are reproduced later in this newsletter. In his view the only place where there was a continuous marine deposition was in Tethys. He believed that the Chihsian, Maokoan and Lopingian can be well recognised, and their boundaries well established.

Kotlyar stated that the lower boundary of the Guadalupian was well defined by ammonoids and that correlations could be made with the boreal realm in the Canadian Arctic, Nova Zemlya and Eastern Siberia.

Straw votes were then held. These are informal votes simply to obtain an impression of members viewpoints.

Question i) Is this the correct time for the Subcommission on Permian stratigraphy to formalise a proposal on the Carboniferous/Permian Boundary?
Result: 21 For
0 Against
2 Abstentions

Question ii) Is this the correct time for the Subcommission on Permian stratigraphy to formalise a proposal on the basal boundary of the Guadalupian?
Result: 10 For
2 Against
9 Abstentions

F. The secretary brought to all members attention the publications in Palaeoworld 4, 1994 (eds. Jin Yu-gan, Utting, and Wardlaw). Of especial interest is the first article "An operational scheme of Permian chronostratigraphy" by Jin Yu-gan, Glenister, Kotlyar and Sheng Jin-zhang. Members were asked to comment on the scheme presented in this paper and to send their written replies to the secretary. These replies are reproduced in the current issue of "Permophiles" under the heading "An operational scheme of Permian chronostratigraphy".

3. GENERAL REPORT ON THE CARBONIFEROUS—PERMIAN BOUNDARY WORKING GROUP

Impressive progress in understanding of biostratigraphic relationships across the Carboniferous—Permian boundary has occurred in the past year. Particularly noteworthy is research in the three areas noted below.

Southern Urals

The Southern Urals project has involved a team of Russian, Kazakhstan and United States geologists working to update, revise, and expand understanding of the Late Paleozoic succession of the Southern Urals Mountains. Work to date has focused on the biostratigraphy and sedimentology of Upper Carboniferous and Lower Permian units. Members of the 1993 and 1994 field parties included L.Z. Akhmetshina, P. Belasky, M.F. Bogoslovskaya, V.V. Chernykh, V.I. Davydov, D.M. Gallegos, T.B. Leonova, S.M. Ritter, W.S. Snyder and C. Spinosa. B.F. Glenister, B. Murchey and B.R. Wardlaw were additional members of the research team. A summary of results was presented at the International Symposium on Permian Stratigraphy, Environments and Resources, August 28-31, Guiyang, China.

Of particular interest from the past two summers study is the assessment of conodont successions near the Carboniferous—Permian boundary at Aidaralash, northern Kazakhstan, the favoured site for international definition of the base of the Permian and the Carboniferous—Permian GSSP. A summary statement by Chernykh and Ritter appears in the present issue of Permophiles. Consensus on taxonomy and nomenclature of *Streptognathodus* near the Carboniferous—Permian boundary is still to be achieved, but there is agreement that morphoclines are recognized world-wide. The Southern Urals team (Chernykh and Ritter, herein) recommends that the base of the Permian be defined on the first appearance of "isolated nodular streptognathodids" 27 m above the base of Bed 19 at Aidaralash. This horizon is 28 m beneath the classic (Ruzhencev, 1936) ammonoid boundary (contact between *Shumardites—Vidrioceras* Genozone below and *Juresanites—Svetlanoceras* Genozone above) and only a few metres from the consensus for the fusulinid boundary (base of the *Sphaeroschwagerina vulgaris—S. fusiformis* zone). A detailed account of the ammonoid successions across the Carboniferous—Permian boundary at Aidaralash is currently in press (Bogoslovskaya, Leonova, and Shkolin, Journal of Paleontology).

The Guiyang report (South China, herein) of the Russian—American research team suggests that highest Carboniferous through Lower Periam stratigraphy of the pre-Uralian Foredeep reflects paleotopographic control of a series of sub-basins. The southernmost of these, the Aqtöbe (Aktyubinsk) sub-basin includes the proposed stratotype of the Carboniferous—Permian boundary. A large and persistant delta complex developed on the northeast edge of this sub-basin. It furnished the sand-rich mass gravity flows that periodically moved southwestward to the Aidaralash area, producing coarsening-upward fine to coarse grained sandstones with abundant wood debris. Fusulinids may have been redistributed in the process, but show no evidence of reworking in time. Similarly, conodont reworking is minimal. The deeper water Ural sub-basin immediately to the north, including the Usolka and Belaya River sections, is characterized by basinal shale and limestone turbidite sequences and siliciclastic submarine fan complexes. Conodonts are more abundant in these condensed sequences than at Aidaralash, but both ammonoids and fusulinids are relatively rare. Usolka could serve as a "paratype" reference for the GSSP.

Midcontinent U.S.A.

Carboniferous—Permian Boundary Strata in Manhattan, Kansas region were the subject of the 1994 Spring Field Trip, Pennsylvanian Working Group, Midcontinent Section, S.E.P.M. Field trip leaders were Darwin R. Boardman II (Geology Department, Oklahoma State University, Stillwater), Keith Miller and Merlynd Nestell. The Guidebook includes numerous detailed stratigraphic sections, most notably the super Tuttle Creek Spillway section exhumed by the flood of 1993. Seventeen plates of conodonts are included, but unidentified taxonomically—many identifications were volunteered belatedly by Bruce R. Wardlaw. The Carboniferous—Permian boundary sequence of streptognathodids documented for the Aidaralash GSSP is readily recognizable in the Manhattan area, with the systemic boundary falling at the base of the Bennett Shale Member of the Red Eagle Formation (lower Council Grove Group).

Scott M. Ritter has recently published on "New Species and Subspecies of *Streptognathodus* (Conodonta) from the Virgilian (Late Carboniferous) of Kansas" (Jour. Paleontology 68-4, p. 870-878). His additional study on "Upper Missourian—Lower Wolfcampian (Kasimovian—Asselian) Conodont Biostratigraphy of the Midcontinent U.S.A." is currently in press (Jour. Paleontology).

South China

Numerous papers and posters bearing on the Carboniferous—Permian boundary were presented at the International Symposium on Permian Stratigraphy, Environments and Resources (August 28-31, 1994, Guiyang, China. The eight day post sessional field trip visited classic Permian carbonate successions in Guizhou and Guangxi provinces. Two sections that include Carboniferous—Permian boundary beds are notable. The Luodian section near Nashui village, Guizhou, is a thick sequence of slope carbonates that represents most of the Carboniferous and Permian. Both fusulinids and conodonts are abundant in the boundary beds; there is little apparent reworking at this level, although detailed additional study is needed. Higher in the Permian section, Leonardian and Guadalupian strata show clear evidence of reworking of older faunas into indigenous assemblages. The Malashan section in the outskirts of Liuzhou, eastern Guangxi, is the type for the basal Permian Mapingian regional stage. Carboniferous—Permian boundary beds comprise inner shelf carbonated containing sporadically abundant corals as well as fusulinids and conodonts.

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4. CARBONIFEROUS/PERMIAN BOUNDARY IN RUSSIA WORKING GROUP

During the last year we came closer to solving the problem of the Carboniferous/Permian boundary. It was already reported that a joint Russian—American team had restudied the Aidaralash section in 1993 (Spinosa and Snyder, 1993). Detailed sedimentological study confirmed the preliminary data concerning gradual sedimentation and the absence of breaks in the boundary beds. The most important results are those of the conodont specialists, Valeriy Chernykh and Scott Ritter ("Permophiles", No. 23), who defined the boundary in the phylogenetic line of development of *Streptognathodus* according to the first occurrence of their isolated nodular representatives. This level of the boundary is best correlated globally, this was confirmed in the talk given by D.R. Boardman, M.K. Nestell and B.R. Wardlaw (1994) at the Chinese Symposium (Guiyang, 1994). All members of the Working Group agree to have the boundary defined in the conodont scale and at that the position of the boundary ("a golden spike") should be established.

The same Russian—American team went on to study boundary deposits in other South Uralian sections — Usolka and Nikolsky — this summer. Sedimentology of the deposits was thoroughly studied; detailed sampling of rocks for conodonts and radiolaria and additional sampling for fusulinids and ammonoids was done.

At the present time material from the Aidaralash section collected previously, and by the joint Russian—American group, are being studied (sedimentology, ammonoids, conodonts, fusulinids, miospores and paleomagnetic data). The results are expected soon. A series of publications on the Aideralash section is planned for the near future: on sedimentology; with descriptions of new taxa of ammonoids, conodonts and fusulinids from Carboniferous/Permian boundary deposits; with the characteristic of the main trends in the distribution of fusulinids, ammonoids and conodonts in the Carboniferous/Permian boundary beds. Later, publication of the special volume, containing full paleontological, sedimentological, etc. characteristics is planned.

Last year the results were obtained for recognizing the Carboniferous/Permian boundary by fusulinids in Spitsbergen (Nilsson, Davydov, 1993) and in the Carnic Alps. It should be noted that in the Chinese sections Carboniferous/Permian boundary is placed lower, than in the stratotypical region, approximately at the base of *Ultradaixina bosbytauensis—Schwagerina robusta* Zone. Sometimes Chinese specialists draw it approximately at the base of the Ghzelian.

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5. PRELIMINARY BIOSTRATIGRAPHIC ASSESSMENT OF CONODONTS FROM THE PROPOSED CARBONIFEROUS—PERMIAN BOUNDARY STRATOTYPE, AIDARALASH CREEK, NORTHERN KAZAKHSTAN

Introduction

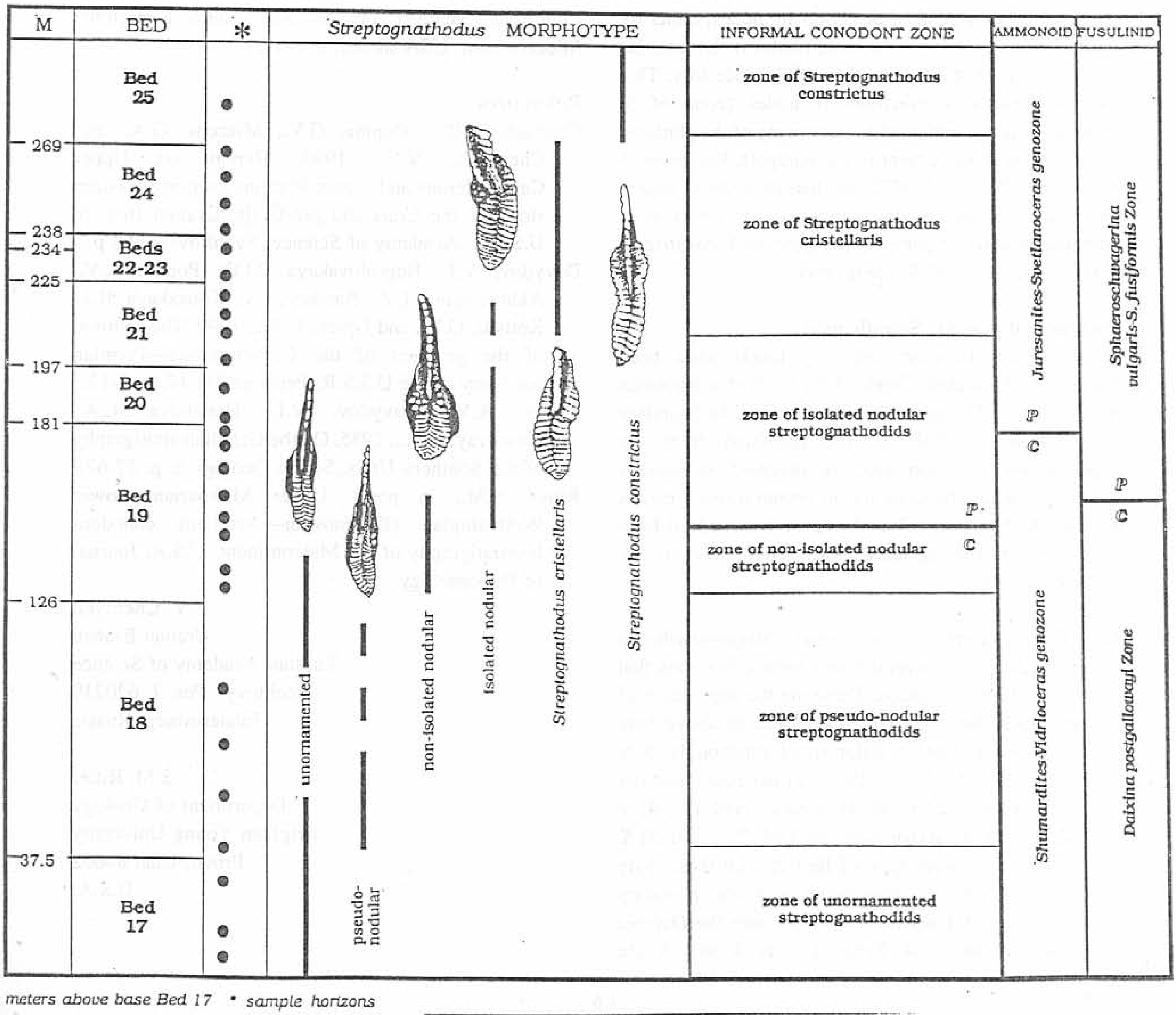
The Aidaralash section of northern Kazakhstan has been proposed as the stratotype for the boundary between the Carboniferous and Permian systems. Over 600 m of upper Gzhelian—lower Sakmarian prodeltaic shales and sandstones crop out on the north side of Aidaralash Creek. Although some intervals are covered, this section constitutes one of the few nearly continuous exposures of boundary strata in the entire south Ural region. Furthermore, these sediments contain a unique association of three stratigraphically significant faunal groups; ammonoids, fusulinids, and conodonts. Potential boundary horizons have been proposed previously on the basis of ammonoids (Popov et al., 1985) and fusulinids (Davydov et al., 1990). Until recently, however, conodonts were too poorly understood to contribute to the boundary problem. The purpose of this brief contribution is to elucidate the stratigraphic distribution of conodonts at the Aidaralash section and recommend a suitable conodont-based boundary horizon.

During the summer of 1993 we made collections from all suitable horizons (totalling 53) from Beds 3 through 37. Many horizons produced well-preserved conodont elements with abundances ranging from five to over 100 specimens per kilogram. Faunas at all levels are dominated by Pa elements of *Streptognathodus* with minor occurrences of *Caenodontus* and *Ellisonia*. A small number of reworked Late Devonian and Moscovian conodont elements were noted in some faunas.

Phyletic Development of *Streptognathodus*

The appearance and subsequent phyletic development of nodose streptognathodids provides the means for subdividing the boundary interval (Beds 9—25) at Aidaralash Creek into six informal zones reflecting sequential developmental stages (Fig. 1). Because no universally accepted taxonomy exists for Late Carboniferous—Early Permian *Streptognathodus*, especially with regards to nodose forms, descriptive terms are used to designate some of these zones. The first zone (zone of "unornamented" streptognathodids, Beds 9—17) is characterized by a complex of narrow, elongate *Streptognathodus* morphotypes that lack accessory nodes. Pending detailed taxonomic work, we provisionally assign these forms to *S.* aff. *S. simplex*. The second zone (Bed 18—lower part of Bed 19) is distinguished by the development (from *S.* aff. *S. simplex*) of streptognathodids with one or two nodes, not on the oral surface, but attached to the inner platform margin. This developmental stage and node configuration are termed "pseudo-nodular".

In Bed 19, a more advanced group of nodose streptognathodids, those with nodes on the upper platform surface, appears. Node development is accompanied by a broadening and flattening of the platform. Three varieties of "nodular" streptognathodids are present. The earliest appears 8 m above the base of Bed 19. These primitive forms bear a variable number of



irregular nodes that develop through disruption or fragmentation of the transverse ridges and parapets. Because the node field merges with other morphological features on the platform surface, this node pattern is termed "non-isolated nodular". A second morphotype, descended from that just described, is characterized by localization of nodes on a lateral lobe separated from the carina and other platform features by a shallow moat-like trough. The localization represents an advanced stage of node development (termed "isolated nodular") that appears 27 m above the base of bed 19. A relatively small number of nodular streptognathodids possess yet a third type of nodular pattern, termed "breached", characterized by a distinct break in the parapet. The acme of nodular morphotypes is represented in faunas from Beds 19 and 20.

Subsequent development of the nodular complex in Beds 21—24 follows a trend of disappearing nodes, either by re-attachment of nodes to the other platform elements (as typified by *S. cristellaris*) or by simple node loss. This stage of gradual elimination of nodes (zone of *S. cristellaris*) is accompanied by narrowing of the platform and increased development of the parapets. Beginning 5 m above the base of Bed 25, the loss of nodes is nearly complete and faunas are dominated by forms with exaggerated anterior parapets assigned to *S. constrictus* and *S. fusus*. (zone of *S. constrictus*).

Chronostratigraphic Significance

Carboniferous—Permian boundary levels have been proposed at Aidaralash Creek on the basis of ammonoids and fusulinids. The earlier proposal placed the boundary at the base of Bed 20, the transition from the *Shumardities—Vidrioceras* to *Juresanites—Svetlanoceras* genozones, while the more recent proposal recommends drawing the boundary 33 m above the base of Bed 19 at the base of the *Sphaeroschwagerina vulgaris—S. fusiformis* Zone.

The first occurrences of novel *Streptognathodus* morphotypes define several characteristic horizons that may be used for correlation. These are the appearance of 1) pseudo-nodular streptognathodids (22 m above base of 18), 2) non-isolated nodular streptognathodids (8 m above base of Bed 19), 3) isolated nodular streptognathodids (27 m above base of Bed 19), 4) *S. cristellaris* (19 m above base of Bed 21), and 5) *S. constrictus* (5 m above base of Bed 25). Of these, only levels 2 and 3 are considered suitable boundary candidates. Level 1 occurs well down into the *Daixina postgallowayi* fusulinid Zone. Levels 4 and 5 are younger than intervals currently being considered for the Carboniferous—Permian boundary. The appearance of streptognathodids with non-isolated nodes (level 2) marks a readily distinguishable and correlatable datum, but it is preceded by a barren interval corresponding to the upper part of Bed 18 and lower part of Bed 19. Hence the exact level of introduction of this morphotype at Aidaralash is uncertain. As a result we suggest that the appearance of isolated nodular *Streptognathodus* 27 m above the base of Bed 19 be considered a suitable conodont-based Carboniferous—Permian boundary level. This represents the development of a distinct feature within a conodont cline that can be correlated with conodont sequences from other stratigraphic sections. Isolated nodular streptognathodids first occur within a similar developmental context in the lower part of Bed 16 at the Usolka River section near Sterlitimak, Russia (Chuvashov et al., 1990) and in the Glenrock Limestone Member of the Red Eagle Limestone, Midcontinent, USA (Ritter, in press).

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6. PROGRESS REPORT OF PERMIAN STRATOTYPES WORKING GROUP

A. New stratigraphical charts of the Urals Permian have been prepared for publication. I hope these charts will be published by the end of this year.

The Lower Permian chart was compiled by B. Chuvashov, the Upper Permian one by V. Molin. New material including data concerning stratotypes have been used for these charts.

General editing responsibility of these charts fell to B. Chuvashov.

B. Recent work on Kungurian biostratigraphy and possibilities for adopting boundaries of this stage for interbasin correlation have been discussed in a special paper written by B. Chuvashov. The main results of this paper are:

a) adopted boundaries of the Kungurian stage and its horizons have different significance. Part of them (Fig. 1) could be treated like lithostratigraphical, others look like event, eco- and biostratigraphical.

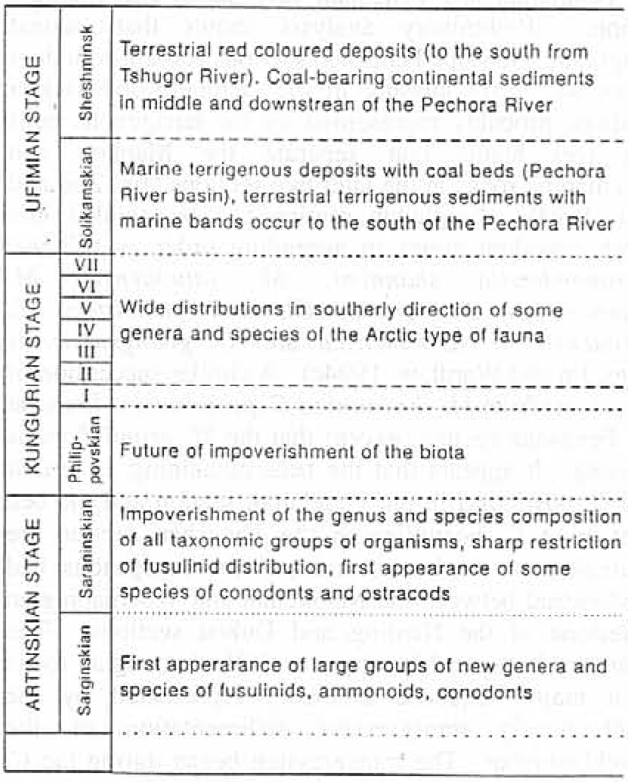

Figure 1. Classification of the boundaries of the Kungurian and adjacent stages. 1-biostratigraphical boundary with interbasin possibility; 2-biostratigraphical boundary which could be used for part of basin; 3-lithostratigraphical boundary which could be used for part of the sedimentary basin; 4-event boundary for whole basin. Latin numbers I-VII are the bands within the Irenskian horizon.

b) According to this conclusion the age range of the Kungurian stage could be a modified age range (Fig. 2) which could be used for interbasin correlation.

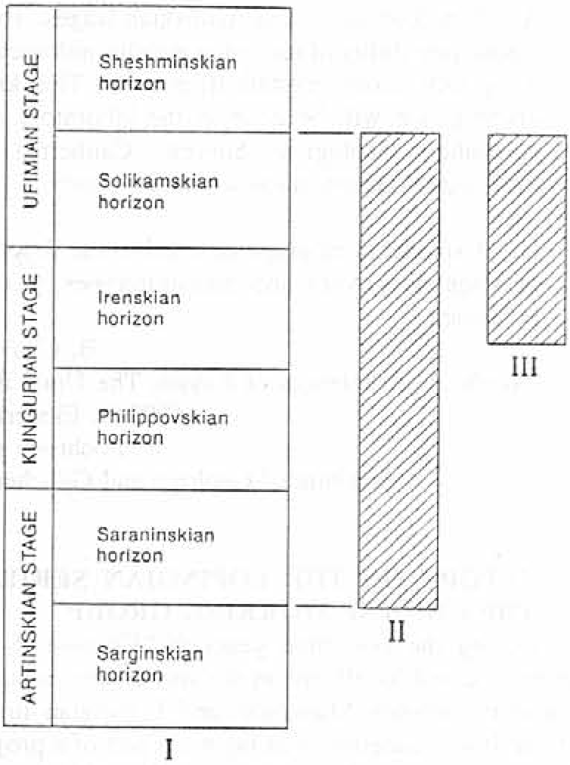

Figure 2. Adopted volume of the Kungurian stage now (I); II, III-different versions of Kungurian stage volume which could be used for interbasin correlation.

C. The stratotype of the Artinskian stage has been defined by A.P. Karpinsky, who considered one in two remote sections. The sequence of essentially terrigenous (flysh) rocks along the Sakmara River (South Urals) has been suggested for the lower part (lower belt after Karpinsky) and similar deposits along the Ufa River (Middle Urals) Karpinsky adopted as the stratotype for the Upper Artinskian. This part of the section has not been described by Karpinsky.

Both parts of the Artinskian stratotype have been studied by B. Chuvashov and colleagues. As a result of this investigation a special paper or monograph should be presented next year.

D. Joint group of Russian and USA specialists is studying the Asselian stage parastratotype in the West slope of the South Urals (Aidaralash section). New data about conodonts and ammomoids biostratigraphy will be presented in the near future.

E. Some groups have been organized for restudy of other stage stratotypes: Sakmarian, Ufimian, Kazanian, Tatarian.

F. Numerous levels of tuff interlayers are within the sequence of stratotypes and parastratotypes. Tuff samples have been collected from Gzhelian, Asselian, Sakmarian and Artinskian stages. There is a good possibility of receiving geochronological data using tiny zircon crystals from tuffs. This kind of investigation will be done in the laboratory of the Australian Geological Survey (Canberra). First results on Asselian stage we have already.

G. A special monograph devoted to the description of stage stratotypes and parastratotypes should be published.

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7. REPORT ON THE LOPINGIAN SERIES BY THE CHINESE WORKING GROUP

During the last three years the Chinese Working Group focused its efforts on the successions around the boundary between Maokouan and Lopingian in South China. It was undertaken as the main part of a project on "the pre-Lopingian Benthos Crisis" (Jin, 1993) and other projects on the Permian paleongeography of China financed by NSF China and Academia Sinica.

It used to be considered that the pre-Lopingian regression resulted in a major depositional gap between the Maokouan and the Lopingian successions all over South China. In terms of the biostratigraphic successions of neighbouring areas such as Japan, the *Lopidolina kumaensis* Zone of the earliest Lopingian is absent in South China. An unconformity between Maokouan and Lopingian sequences has been reported in most areas of South China. And the faunal change around this boundary is usually distinct in spite of the upper member of the Douling Formation (Jin, Zhang and Shang, 1994). This unit contains ammonoid fossils dated as the Maokouan by Zhou (1987) and others and abundant brachiopods with a Lopingian aspect.

However, around the eastern margin of the Yangiza shelf sea, and the western margin of Huanan shelf seas during the time interval from the late Maokouan to early Lopingian, the slope and basinal depositional environments prevailed. The sedimentation of this period in these areas is least influenced by the pre-Lopingian worldwide regression, and consequently they contain the most complete record of this interval.

Late Maokouan—Early Lopingian slope and basinal sequences deposited around the eastern margin of Yangiza shelf sea were investigated in Dukou, Nanjiang of Sichuan Province and Zuan'en of Hubel Province. The conodonts from Dukou section not only contain the conodont succession of the complete Guadalupian sequence but also younger conodont zones (Mei, Jin and Wardlaw, 1994a). The Wuchiapingian rock of the Dukou section also contains the most complete condont succession (Mei, Jin and Wardlaw, 1994b). But the conodont succession of the Maokouan and Wuchiapingian at the Dukou section is still interrupted by a terrigenous layer (3 m) correlative to the Wangpo Shale which is related to the pre-Lopingian worldwide regression. This conodont succession indicates that the *M. attudaensis* Zone of the Uppermost Gaudalupian in southwest USA is apparently not correlated to the Wuchiapingian in South China as suggested previously. The newly established conodont zones in the Dukou section *Musogondolellà attudaensis, Xuanhanensis* and *prexuanhanensis* zones occur in association with *Musogondolella*, which is common in the uppermost Moakouan sequences in southern Jiangsu and Anhui in association with *Eopolydiexondina*. This proves that these three zones are essentially contemporaneous with the *Metadoliolina—Popolydioxodina* Zone which is higher than the *Yabeina* Zone.

The Late Maokouan—Early Wuchiapingian slope and basinal sequences of Huanan block were investigated in the Penglaitan and Fengshan sections of the Guangxi region. Preliminary analysis shows that basinal Penglaitan and slope Fengshan sections contain conodont zones which are missing in the Nanjiang and Dukou sections, probably represented by the terrigenous beds and (or) hiatus that separate the Maokou and Wuchiaping rocks in the later two sections (Jin, Zhu and Mei, 1994). Penglaitan section can be divided into seven conodont zones in ascending order as follows: *Mesogondolella shannoni*, *M. attudaensis*, *M. xuanhanensis*, *M. granti*, *Clarkina postbitteri*, *C. dukouensis*, *C. asymmetrica* and *C. guangyuanensis* (Mei, Jin and Wardlaw, 1994c). A similar succession of conodonts from *M. shannoni* to *C. postbitteri* is found at the Fengshan section, except that the *M. granti* Zone is missing. It appears that the beds containing *M. granti* and *C. postbitteri* in the Penglaitan section and the bed containing *C. postiullen* in the Fengshan section are equivalent to the hiatus and (or) the terrigenous bed sandwiched between the Maokouan and Wuchiapingian limestone of the Nanjing and Dukou sections. The boundary between Maokouan and Wuchiapingian rocks is a major sequence boundary represented by the diachronously transgressive sedimentation of the Wuchiapingian. The transgression began during the *C. postbitteri* Zone and initial limestone sedimentation is found only in the basinal section of Penglaitan and the distal slope section of Fengshan. It is missing in the proximal slope (or ramp) sections at Dukou and Nanjing.

It is noteworthy that with the cooperation from Mr. Gong Yuhong of Huana Bureau of Coal Geology, samples have been repeatedly collected for conodonts from the uppermost part of the Douling Formation in Xlaoyuangcong of southern Huanan. This part consists of argillaceous limestone less than one metre thick at the top of coal-bearing series. The coal bearing series is in turn bracketed by the Lopingian and Moakouan basinal deposits and so can be referred as the basin floor fan deposited during the end-Guadalupian regression. The basal part of Lopingian basinal deposits contain the ammonoids of *Andoissonoceras—Protoceras* Zone. The ammonoid assemblage of the Douling bed differs in composition from all other Permian ammonoid faunas previously reported. Zhou (1987) referred it to an independent ammonoid zone of Maokouan age, namely the *Roadocorae Doulingoceras* Zone. The bivalves (Fang, 1987) of that bed show a transitional feature between the Maokouan and typical Lopingian faunas. The brachiopods (Jin, Meng and Sun, in press) is overwhelmingly dominated by Lopingian elements. Preliminary identification on the conodonts from this part in Xiaoyuangcong and Matran was made by Z.H. Wang and S.L. Mei respectively, and reported by Zhou and Gong (1994). A close study of these specimens led Mei to conclude that they are rather rare and poorly preserved, but still well qualified to determinate the precise stratigraphic level in term of the conodont succession of the Penglaitan and the Fengshan section. They are characterized by a dominance of *Clarkine postbitteri* and accordingly, this member is apparently corresponding with the basal level of the Lopingian series (Mei, Jin and Gong, in press).

The available data have enabled the working group to propose defining the Maokouan—Lopingian boundary at the base of the *C. postbitteri* Zone (Jin, Zhu and Mei, 1994). It falls at a level immediately above that of the pre-Lopingian extinction, and the main sedimentary marker of this level is the top of the distinctive level known in South China as the white massive limestone of the Maokou Formation. The ease of international correlation based on the faunal and depositional changes led the group to propose this level as the boundary rather than selecting a level away from the sudden faunal and sedimentary change.

In order to gather adequate data for recommending the GSSP of the basal boundary of the Lopingian, this group is increasing comprehensive research on the boundary succession on the Penglaitan section in Laibin of Guangxi Region. A cooperative investigation on the boundary succession in Iran is going to take place next year since the matter cannot be said to be resolved before a correlation between the areas with best Lopingian marine sequences has been demonstrated based on the refined stratigraphic successions.

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8. CONTINENTAL SEQUENCE OF PERMIAN AND PERMIAN/TRIASSIC BOUNDARY WORKING GROUP

In recent years the interest in Permian stratigraphy, in particular continental facies has intensified. This was demonstrated during the "International Congress on the Permian System, Perm, 1991", organized in honour of the 150 anniversary of the establishment of the Permian system in Russia by R. Murchison. At this Congress it was emphasized that the upper part of the Russian

Permian is represented by the continental series. This series comprises significant parts of Permian sections in other continents. The main emphasis of previous SPS's activity was concentrated on the study of marine facies. The problems of investigating the Permian/Triassic boundary marine series and others in the Continental Permian were not coordinated. The proposal for a creation of new Working Group was published (Lozovsky, 1991), and it was of interest to many Permian workers (Jin Jugan, 1992). The decision about the creation of this Working Group was recently adopted during the Meeting of SPS, August 16, 1993, Pangea Conference, Calgary, Alberta, Canada (Utting, 1993).

Earlier during the meeting of the Subcommission on Triassic Stratigraphy at the 29th IGC, Kyoto, Japan the analogous Triassic Working Group was created by the proposal of Lucas et al. (1992). Dr. Spencer G. Lucas (New Mexico Museum of Natural History and Science) was nominated as Chairman of this Working Group on the "Nonmarine Triassic Timescale", and I am vice-chairman. Based on the rules of the "International Commission on Stratigraphy", the problems and the boundary between two systems are in the competence of the "younger" Subcommission. That is why the Permian/Triassic boundary is under the jurisdiction of the Subcommission on Triassic Stratigraphy. Consequently my chief mission concerning this problem is to coordinate the work of the two above-mentioned Working Groups for its successful decision. With regards to the problems of the Continental Permian Stratigraphy, these are fully within the sphere of the activity of our Working Group.

In October 17 through 19, 1993 in Albuquerque, New Mexico, U.S.A. the International Nonmarine Triassic Symposium took place with a 5-day post-symposium field trip on the classic nonmarine Triassic and partially Permian strata of New Mexico and Arizona (Colorado plateau). During the Symposium approximately 50 presentations were made, covering a wide range of questions on stratigraphy, paleontology (especially vertebrate), paleobotany, paleogeography, paleomagnetism and other problems of the continental Triassic and Permian. All reports were published in the 500-page volume "The Nonmarine Triassic", edited by S. Lucas and M. Morales (1993). Twelve articles were specially dedicated to the problems of Permian/Triassic boundary in continental series. The more interesting of these concerns the description of the famous section, discovered by the Chinese investigators in the Dalongkou area, Xinjiang, northwest China, where uninterrupted (?) transitional Permian/Triassic beds are exposed (see the articles of Cheng Zheng-Wu, Liu Shuwen, Pang Qiquing and S. Lucas in the above-mentioned volume). These continental beds are characterized by vertebrates, palynomorphs, ostracods, and conchostracans.

Of great interest are the articles concerning the general questions of the biota evolution at the Permian/Triassic boundary, in particular tetrapods (M. Shishkin, V. Ochev, Russia), flora (I. Dobruskina, Israel), palynomorphs (R. Tiwari, India).

During the Symposium the first meeting of the "Working Group on the Nonmarine Triassic Timescale" took place, where the following questions, proposed by S. Lucas, were discussed: 1) Nomenclature of Triassic time intervals based on nonmarine chronology. 2) Relative significance of different fossil groups to Triassic biochronology. 3) Nonmarine type areas or type section for intervals of Triassic time. 4) Integration of radiometric ages and magnetochronology with biochronology. 5) Relationship of work of continental Working Group to work on the marine timescale for the Triassic. It was decided that all members of the Working Group should present a list of important sections for nonmarine Triassic with which they are familiar.

I believe that all of these questions are also extremely important for the study of continental Permian, which are represented mainly, as the Triassic ones, by redbeds and coal measures. For its subdivision one may apply the various lithologo-sedimentological methods, but the biostratigraphical ones are the more important. Among the latter, the succession of tetrapods assemblages play a leading role, especially for intercontinental correlations, as it was emphasized at the Albuquerque meeting. Such assemblages are known from the Permian of European Russia, Northern China, Northern and Southern America and Southern Africa. Among invertebrates, the more important groups are: ostracods, conchostracans, freshwater and brackish water molluscs, rare insects, megafossil plants, charophytes and especially palynomorphs. Therefore I call the specialists on these groups to participate in the work of our Working Group, particularly: Prof. R. Reisz (Canada), Dr. M. Shishkin, Dr. M. Ivachnenko, Dr. Ph. Novikov (Russia), Dr. S. Lucas, Dr. Gaffney (USA), Dr. B. Rubidge (S. Africa), Dr. R. Caroll (England) — **tetrapods**; Dr. H. Kozur (Hungary), Dr. Kuchtinov (Russia), Dr. Pang Qiqing (China) — **ostracods**; Dr. Jones (Australia), Dr. Liu Shuwen (China) — **conchostracans**; Dr. M. Monich, Dr. Ph. D. Esin (Russia), Dr. C.D. Johnson (USA) — **fishes**; Dr. Gomankov, Dr. M. Durante, Dr. N. Esaulova (Russia), Dr. H. Kerp (Netherland), Dr. S. Mamay (USA), Dr. J. Broutin (France) — **flora**; Prof. Vischer (Netherland), Dr. J. Utting (Canada), Dr. R. Tiwari (India), Dr. C. Foster (Australia), Dr. Yang Jiduan, Dr. Ouyang Shu (China), Dr. O. Yaroshenko, Dr. N. Koloda (Russia) — **palynomorphs**; Dr. L. Saidakovsky, Dr. F. Kiselevsky (Russia) — **charophytes**; Dr. A. Ponomarenko (Russia) — **insects**.

The paleomagnetic data are very important to the stratigraphy of Upper Permian, where one of the more distinctive boundaries between Kyama (reversed polarity) and Illawara (alternative of normal and reversed polarity zones) magnetic hyperzones passes, known from the section of European Russia (Upper/Lower Tatarian boundary), Australia (inside of Illawara coal measures), North America (inside of Capitan) etc. That is why the presence in the Working Group of the paleomagnetologists is necessary: Dr. M. Steiner, Dr. R. Molina Garza (USA), Dr. M. Menning (Germany), Dr. E. Molostovsky, Dr. V. Boronin (Russia). The Working Group should be completed by the stratigraphers: Dr. C. Virgili (Spain), Dr. E. Movshovich (Russia), Dr. R. Wagner (Poland), Dr. S. Janev (Bulgaria), Dr. R. Smith (S. Africa), Dr. Cheng Zheng-Wu (China).

Certainly this list is not complete. All Permian workers, who wish to participate in the work of the Working Group must communicate as soon as possible with the Chairman by Mail or by Fax. I ask you to send the proposals about the aims and tasks of the work of the Working Group and the means of its decisions. I think that the principal goals of the activity of the Working Group on the immediate years are the following:

A. Creation of a "World Continental Standard of the Permian system", parallel to existing marine one on the basis of identification and study of the "Regional Continental Standards", proposed by the members of the Working Group, and choose the best of these. This Standard must integrate all biochronological, radiometric and paleomagnetic data.
B. Identification of the most complete continental section, which spans the Permian/Triassic boundary. The above mentioned Dalongkou section is the best candidate for it. This problem must be discussed and decided by the joint efforts of two Working Groups, created by SPS and STS.
C. The detailed study of the diverse nonmarine organisms and plants including palynomophs, especially the mutual reinvestigation of the collections by the specialists of different countries. The final aim will be the publication of the results.
D. The mutual correlation of the Continental and Marine Standards of Permian System.

The following meetings of the Working Groups, associated with other meetings of the SPS are planed for 1995-1996.

a) The meeting during XIII International Congress on Carboniferous—Permian, August 28—September 2, 1995, Krakow, Poland.
b) The meeting during 30th IGC, August 4—14, 1996, Beijing, China with the post-Congress field trip at the Permian and Triassic sequences of continental facies in Dalongkou area, Xinjiang. A discussion on the problem of the choice of stratotype section for Permian/Triassic boundary in continental series.

Really the activity of the Working Group has already begun. It is necessary to note especially the activity of palynological "section" (J. Utting, C. Foster, A. Gomankov, N. Esaulova, O. Yaroshenko) which held the joint Seminar on the Upper Permian palynomorphs at Kazan, Russia, August 23—29, 1993 (see J. Utting, C. Foster, 1993). unfortunately the Conference "The Upper Permian deposits of the Volga—Ural region" are planned as the continuation of the above mentioned Seminar at the Kazan University was cancelled as a result of financial difficulties. The results of some recent palynological works are published in the last number of Permophiles and in this volume.

All programs of the Working Group can only be successfully accomplished on condition of economic support. Thus it is necessary to elaborate as soon as possible the special project "The World Continental Standard of the Permian System" as part of the International Geological Programs.

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9. REVISED OPERATIONAL SCHEME OF PERMIAN CHRONOSTRATIGRAPHY *

Introduction

The original statement of the present topic was drafted by Jin Yu-gan in collaboration with Sheng Jin-zhang. Brian F. Glenister and Galina V. Kotlyar suggested modifications, many of which were incorporated, and the manuscript was published (Jin et al., 1994) for distribution at the International Symposium on Permian Stratigraphy, Environments and Resources (August 28-31, 1994, Guiyang, China). Relevant topics were discussed extensively during the meeting. The original statement remains basically intact, but significant modifications were developed during the course of the congress and its field trips, and in subsequent discussions. Consequently, the present revision was prepared, and major contributors added as authors. In its present form, it was written by Brian F. Glenister and Bruce R. Wardlaw. Early presentation recognizes the importance of timely continuing progress toward consensus on international standards for chronostratigraphic subdivision of the Permian System and definition of its lower boundary. It represents a working document, and inevitably not even contributing authors will agree with all details (Figure 1).

Readers are invited to suggest modification of the present statement, as well as to express approval of some or all segments. Permophiles is the logical outlet for statements on philosophy and topics of comprehensive scope, but other correspondence can be cleared through Glenister, who will transmit items to those responsible for individual topics. Timing is critical, since proposals for many of the Permian boundaries are currently in preparation. For example, the Russian/American team is intending to present a draft proposal for the GSSP defining the base of the Permian in Permophiles no. 26, and the first paper ballot to Titular Members of the Carboniferous/Permian Boundary Working Group is scheduled for mid-year 1995.

Series-level subdivisions

Stages and their subdivisions remain the basic units for communication of correlations. However, stage groupings into subseries and series are convenient for expression of larger intervals. The Permian has traditionally been subdivided into a Lower and Upper Permian Series, and we propose to maintain this usage. However, stage groupings now suggest recognition of four subseries, Lower Permian Cisuralian and succeeding Leonardian, and Upper Permian Guadalupian and Lopingian. If the proposals that follow are adopted, only three general geographic locations will be involved in definition of all Permian stages and its systemic boundaries: Southern Urals, Southwestern North America, and South China. Within each of these areas, stage references succeed each other in objective stratigraphic succession, thereby obviating necessity for some difficult interpretive correlations between different provinces.

* In view of the overwhelming response from members to accept the invitation made at the Guiyang meeting to comment on the operational scheme published in Palaeoworld 4 (see following articles in this issue of "Permophiles"), it was decided to include a revision of the scheme here. Unfortunately there was insufficient time before printing of "Permophiles" for comments to the incorporated from Jin Yu-gan and Sheng Jin-zhang.

Cisuralian subseries

The GSSP for the base of the Permian should remain in the Southern Urals, and there is virtual unanimity for retention of succeeding Asselian, Sakmarian, and Artinskian stages as international standards. Uralian has been the most common name for this subseries. However, the term has been utilized in so many contradictory senses that we now favour a subsequent substitute, the Cisuralian Subseries (Waterhouse, 1982).

The Russian/American team working in the Southern Urals has provided a recommendation (Chernykh and Ritter, herein) for definition of the base of the Permian and coincident GSSP for the Carboniferous/Permian Boundary within Bed 19, Aidaralash, northern Kazakhstan. Definition is at an arbitrarily-selected point within the chronomorphocline of the conodont genus *Streptognathodus*. The level corresponds closely to traditional boundary proposals based on other groups, lying 28 m below the ammonoid boundary (Ruzhencev, 1936) and a few metres beneath that of the evolving consensus of fusulinacean workers. Conodonts offer the best choice for boundary definition because they combine readily quantifiable rapid evolution with ubiquity in time and space to a degree not achieved by other prospective groups. However, morphometrics for the conodonts await statistical verification before the boundary proposal can be formalized. All other means of correlation can be employed once this definition is finalized.

Leonardian subseries

The Kungurian and superjacent intervals in the Urals have been utilized widely as stage references. However, restricted sedimentary facies and consequent paucity or absence of the more useful biostratigraphic groups (conodonts, ammonoids, fusulinids) precludes utilization of these stages as international standards. Two attractive alternatives are available for a post-Cisuralian Lower Permian subseries. A Tethyan sequence, the Chihsia (Huang, 1932; Sheng, 1962) has its stratotype in South China, but references for the component stages (Bolorian and Kubergandian) are defined on fusulinacean successions in Middle Asia (Leven, 1963, 1979). The

SYSTEM	SERIES	STAGE	AMMONOID ZONE	CONODONT ZONE	FUSULINID ZONE	
Triassic			*Ophiceras* *Otoceras*	*Hindeodus parvus*		
Upper Permian	Lopingian	Changhsingian	*Rotodiscoceras* *Pseudotirolites-* *Pleuronodoceras* *Pseudostephanites-* *Tapashanites* *Paratirolites - Shevyrevites* *Iranites - Phisonites*	*Clarkina changxingensis* *C. subcarinata*	*Palaeofusulina sinensis* *Palaeofusulina minima*	
		Wuchiapingian	*Sanyangites* *Araxoceras - Konglingites* *Anderssonoceras-* *Prototoceras* *Roadoceras-Doulingoceras*	*C. orientalis* *C. transcaucasica* *C. leveni* *C. asymmetrica* *C. dukouensis* *C. postbitteri*	*Gallowayinella meitiensis* *Nanlingella simplex-* *Codonofusiella* *kwangsiana*	
	Guadalupian	Capitanian	*Timorites*	*M. xuanhanensis* *M. prexuanhanensis* *M. altudaensis* *M. shannoni* *M. postserrata*	*Paraboultonia* *Reichelina* *Paradoxiella* *Polydiexodina* *Codonofusiella*	*Yabeina-* *Lepidolina* *N. margaritae*
		Wordian	*Waagenoceras*	*M. aserrata*	*P. antimonioensis* *P. sellardsi*	*N. deprati* *N. simplex*
		Roadian	*Demarezites* *Paraceltites elegans*	*M. nankingensis*	*P. rothi* *P. boessi*	*C. cutalensis* *M. ovalis*
Lower Permian	Leonardian	Cathedralian	*Stacheoceras discoidale* *Sosiocrimites* *Perrinites ex. gr. hilli*	*N. sulcoplicatus* *M. zsuzsannae*	*P. fountaini* *P. durhami* *P. setum*	*M. parvicostata* *M. claudiae*
		Hessian	*Pseudovidrioceras dunbari* *P. compressus* *Propinacoceras busterense*	*N. prayi* *M. idahoensis* *N. pnevi/N. exsculptus/M. gujioensis*	*P. leonardensis* *Skinnerella spp.* *Schwagerina spp.*	*Brevaxina dyhrenfurthi*
	Cisuralian	Artinskian	*Uraloceras fedorowi* *Aktubinskia notabilis-* *Artinskia artiensis*	*N. pequopensis* *S. whitei - M. bisselli*	*P. sollidissima* *Pseudofusulina juresanensis* *P. pedissequa*	*Ch. vulgaris* *Pamirina* *Ch. solita*
		Sakmarian	*Sakmarites inflatus* *Svetlanoceras strigosum*	*S. primus-M. visibilis* *S. merrilli* *M. longifoliosa*	*P. uralensis* *P. verneuili* *P. moelleri*	*R. schellwieni-* *P. mira*
		Asselian	*S. serpentinum* *S. primore*	*S. postfusus* *S. fusus* *S. constrictus* *S. barskovi*		*S. sphaerica-* *P. firma* *S. moelleri - P. fecunda* *S. vulgaris - P. fusiformis*
Carboniferous		Gzhelian	*Shumardites confessus-* *Emilites plummeri*	*S. nodulinearis* *S. wabaunsensis*		*Daixina robusta -* *D. bosbytauensis*

Figure 1. Chronostratigraphic subdivisions of the Permian System, and selected zonal references. Regional fusulinid zones on left side, Tethyan fusulinid zones on right side of column. North American regional zones for the Leonardian and Guadalupian are generalized after Ross and Ross (1994) and Wilde and Rudine (in press). Uralian regional zones and Tethyan zones from Levin and Kozur (pers. commun., 1994)

alternative Leonardian Subseries (Series of Adams et al., 1939) has its type area in the American Southwest, in objective stratigraphic succession directly beneath the basal Guadalupian Roadian Stage. Component stages are Hessian (Ross, 1986) and the succeeding Cathedralian (Ross and Ross, 1987). Chihsian has clear priority. However, we favour use of the Leonardian because of the relationship to the Guadalupian standard, the probable choice for the basal Upper Permian subseries, as well as for the abundance of well-documented fusulinaceans, ammonoids, conodonts, and other groups. Additionally, the sedimentology of the Leonard succession has been studied intensively in type outcrops and in the adjacent subsurface.

Five conodont zones are recognized in the type Leonardian (Wardlaw and Glenister, in press), the basal three representing the Hessian Stage. The *Mesogondolella gujioensis—Neostreptognathodus exsculptus* Zone near the base of the Hessian is defined by first appearance of *N. exsculptus*, but contains *N. pnevi* and other conodonts that should permit precise correlation to horizons at or near the top of the Upper Artinskian Baigendzhinian Substage of the Southern Urals. Thoughtful final selection and definition of the base of the Hessian Stage, consistent with ability for precise correlation to the Urals, should therefore maintain the integrity of the classic Cisuralian standard.

Guadalupian subseries

The Guadalupian was one of the first units to be proposed formally (Girty, 1902) for chronostratigraphic "series" rank. Since that time, both biostratigraphic and lithostratigraphic relationships for the type area of West Texas have been studied to the extent that this is one of the best understood of all complex sedimentary successions. It is conveniently situated within Guadalupe Mountains National Park, with access guaranteed, internationally (Permophiles no. 23, p. 20—21), to appropriately qualified researchers. The Guadalupian has been proposed formally (Glenister et al., 1992) as international standard for the "Middle Permian Series". However, as noted earlier (Glenister, 1993) "The question of two, three or four-fold subdivision of the [Permian] System is yet to be resolved (Permophiles no. 21, p. 8—10), but this need not and should not preclude early agreement on selected combinations of stages."

The base of the Guadalupian Subseries and coincident basal Guadalupian Roadian Stage is defined (Lambert, 1994) at an arbitrarily-chosen point within the conodont chronomorphocline from *Mesogondolella idahoensis* to *M. nankingensis* (senior synonyn. of *M. serrata*). Morphometric confirmation of the chronocline is in preparation (Lambert and Wardlaw). Bases for the remaining Guadalupian stages, Wordian and Capitanian, are susceptible to similar treatment, and will be the focus of the Guadalupian Symposium II (April 4—6, 1996; announced herein). A synthesis of occurrence data for all major fossil groups known from the Permian of West Texas is under preparation, and range charts will be available for Guadalupian II.

Lopingian subseries

Post-Guadalupian facies restriction in the North American Southwest precludes use of that interval for international reference. However, recognition there of diversely fossiliferous strata above the uppermost Guadalupian (Capitanian) Lamar Limestone allows eventual confident correlation to sections elsewhere, and the ability to redefine the upper boundary of the Guadalupian to coincide with the base of the succeeding subseries.

Post-Guadalupian successions in Transcaucasia, the Dzhulfian and succeeding Dorashamian stages, have been used widely as international standards. However, progressive upward restriction of sedimentary facies towards the Permian-Triassic boundary detracts seriously from utility of the sections, and there is growing consensus that the South China Lopingian Subseries provides the better reference for both the uppermost Permian and the erathem boundary.

In the type Guadalupian, the Capitanian Stage is represented by the conodont chronocline from *Mesogondolella postserrata* through *M. shannoni*. Succeeding strata continue the evolutionary succession with the descendant *M. altudaensis*. The first appearance of the latter species within the chronocline would therefore serve conveniently to define the base of the Lopingian. However, it is uncertain how widespread *M. altudaensis* is in South China, and the probable common correlatives of the *M. altudaensis* Zone in that area are the conodont succession *M. prexuanhanensis* to *M. xuanhanensis*. The latter species is followed by a species succession of the conodont genus *Clarkina*, beginning with *C. postbitteri*, which provides conodont zonation for the entire Lopingian. Since the Guadalupian is characterized by species of *Mesogondolella*, and the Lopingian by the *Clarkina* succession, the base of the *C. postbitteri* Zone would also serve effectively to define the base of the Wuchiapingian. Correlations must be refined, perhaps by reference to other fossil groups, before definition of this base. However, any prudent choice for the South China base would eventually permit precise correlation with the American Southwest, and subsequent redefinition of the top of the Guadalupian.

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10. COMMENTS ON THE PROPOSED OPERATIONAL SCHEME OF PERMIAN CHRONOSTRATIGRAPHY BY M.F. BOGOSLOVASKAYA AND T.B. LEONOVA

The creation of a global scheme of Permian chronostratigraphy based on marine sections is very timely. It is a very important process which requires careful consideration. For this reason the scheme proposed by Jin Yu-gan, B.F. Glenister, G.V. Kotlyar, Sheng Jin-Zheng and considered at the ISPS meeting (August 28, 1994) in Guiyang (China) should be widely discussed. Now it is not necessary to prove that a chronostratigraphical scheme should demonstrate the basic milestones in the development of marine organisms, that are directly dependant on global geological events. However, this scheme does not satisfy completely the above requirement. Sometimes such a discrepancy could be found even at the level of divisions. In our opinion too much confidence in this scheme is placed on conodonts, but their zonal scale is yet to be confirmed by time. At the same time, such groups as ammonoids and fusulinids that are important for Permian chronostratigraphy are used insufficiently despite their reliable phylogenetic schemes and classifications.

In the proposed scheme the Series boundaries do not always reflect the main events in the development of ammonoids and fusulinids, and do not always correlate with the most radical reconstructions in their complexes, which are very often synchronous in time for both groups. The excellent correlative potential of ammonoids are not used enough in consideration of complicated correlation problems. Some correlations made on the basis of a single conodont are not persuasive. We think that considering the Chihsian Series as a global element of a chronostratigraphical scheme and including the Chhidru Formation into Changxingian stage are the most disputable.

Chihsian Series

The upper and lower boundaries of the Series, including Bolorian, Kubergandinian and part of the Murgabian reflect not very important events in historical development of ammonoids and fusulinids. This is confirmed by material from the sections of the rocks of these ages in the stratotypical area (Middle Asia: Darvas, Pamir, Afghanistan). The lower boundary of the Chihsian Series correlated with the Jachtashian/Bolorian boundary divides into parts two very close ammonoid complexes (Lenova and Dmitriev, 1989; Leven et al., 1992). The difference between these ammonoid complexes could be observed at the species level only. The generic renewal is not so sufficient. The genera which appears in the Bolorian for the first time (excluding *Sicanites* of Bolorian—Wordian age) did not obtain further development and distribution. These genera cannot indicate the beginning of a new great period within ammonoid history. Fusulinid development was similar (Leven et al., 1992). The even less significant upper boundary of the Chihsian Series is proposed inside the Murgabian at the roof of the fusulinid *Neoschwagerina simplex* Zone. Unfortunately, the deposits of this age are dated by fusulinid fauna and not by ammonoids in the stratotypical area. The nearest place with coeval deposits characterized by ammonoids is the river Marta in Crimea. The ammonoids known from this locality (Toumanskaya, 1931) are closest to Wordian (in our opinion to late Wordian) ammonoids of Sicily. There is not any objective evidence for separating these complexes and placing them into different Series. Thus, both considered boundaries of the Chihsian Series reflect insignificant events in development of ammonoids and, apparently, of fusulinids, and do not merit the high boundary rank assigned to them. In contrast to these borders the middle boundary of discussed Series corresponding to Bolorian/Kubergandinian boundary could be observed very clearly. That may be shown by ammonoids and fusulinids from the stratotypical area. Here a polytaxonic Bolorian ammonoid complex (38 genera) is replaced by a relatively poor Kubergandinian complex (14 genera) revealed in its stratotype at the Kubergandy river in southeast Pamir (Chedija et al., 1982) and at the territory of Afghanistan, in section Tezak (Termier et al., 1972). Ten genera out of 14 continued their existence after the Bolorian (8 from them are known from later deposits). Four genera have appeared for the first time in Kubergandinian (*Paraceltites*, *Stacheoceras*, *Epiglyphioceras*, *Tauroceras*) which are typical of the Guadalupian Series. The most important genus of these four is *Paraceltites* the first representative of ceratitids. The role of this ammonoid order was increasing from the beginning of Late (or Middle) Permian to Triassic. Species of *Paraceltites*, *Stacheoceras*, *Epiglyphioceras* were found at the bottom of the stratotypical section of Kubergandinian stage within the fusulinid zone *Miselina parvicostata—Armenina*. The same genera plus *Tauroceras* are indicated in the younger deposits within zone *Cancellina cutalensis* of the Tezak section (Termier et al., 1972). Mass extinction of ammonoids at the end of Bolorian, replaced by the appearance of the first ceratitids and Guadalupian genera of goniatitids in the Kubergandinian, unquestionably indicate the main reconstruction of their biota and of the very important event in their historical development. Hence it appears, that the Chihsian Series in the published volume does not have natural boundaries, reflecting some important events in ammonoid evolution. The analogous conclusions one could make from analysis of development of fusulinids (Leven, 1992).

We believe that the problems concerning the Chihsian Series have arisen as a result of misunderstanding of the mutual relationship of the Kubergandinian and Roadian. It is really difficult problem to prove the different ages and sequence of ammonoid complexes contained in these stages. The authors of the proposed scheme indirectly confessed this fact themselves and by this reason the lower boundary of Guadalupian was highly "weakened". In our opinion both complexes are coeval. To defend this point of view the comparison of these complexes may be made on material from stratotypes and additionally with ammonoids from an age analogue of the Roadian — the so-called "goniatite beds" of the Phosphoria Formation in Wyoming (Miller and Cline, 1934), as it is widely known that there are a few ammonoids in the Roadian stratotype. Both complexes contain the first ceratitids (close species of *Paraceltites*), close species of *Bamyaniceras*, the species of *Stacheoceras* with identical extent of suture complexity, the first Late Permian (Guadalupian) genera — *Altudoceras*, *Daubichites* in the sections of USA, *Epiglyphioceras*, *Tauroceras* in sections of Middle Asia.

Chhidru Formation

The geological age of the Chhidru Formation is under discussion. The ammonoids of the genus *Cyclolobus* found here are the closest to the Early Dzhulfian species of this genus from Armenia and Far East by extent of suture complexity (Zakharov, 1983). *Changsingoceras* is found in the Changsingian stage of China which is probably next after *Cyclolobus* step in historical development of the family Cyclolobidae. This step is characterized by some morphologic degeneration of the suture. Special research is required to estimate the age of Chhidru Formation.

Summary

A. The proposed operational scheme is not convincingly argued within all its divisions, therefore additional discussion and revision are needed.
B. The primary task is to achieve some coordination in correlation of the Series boundary deposits, it is the main frame of the scheme.
C. The Chihsian division has a lot of problems and its definition as it is proposed now, is very questionable.
D. The four folded division of Permian seems to be premature. In our opinion, the three fold Permian is more established now: Lower, Middle and Upper Permian, with the lower boundary of the Upper Series at the level of Guadalupian/Lopingian boundary of the proposed scheme.

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11. COMMENTS BY E.Y. LEVEN ON THE PROPOSED OPERATIONAL SCHEME OF PERMIAN CHRONOSTRATIGRAPHY

At the ISPS meeting, which was held on August 28, 1994 in Guiyang, China, a Permian chronostratigraphy scheme Jin-Yu-gan et al., 1994) was proposed for discussion by Jin Yu-gan, B. Glenister, G.V. Kotlyar and Sheng Jin-zhang. The present paper continues the discussion, which we decided should be documented in "Permophiles".

We agree with the authors of the scheme, that creation of a global stratigraphical scheme, based on marine sections is now possible. Creating such a scheme has become possible now mainly owing to the successful study of the Uralian, North American and South Chinese sections and fauna. However, in my opinion, the scheme under discussion has a somewhat formal and hasty character. The only thing we agree on is the definition of the Permian System boundaries, which could be recommended to be established by ISC. All the rest is still under discussion, though notable progress is outlined in solving a number of questions.

What makes the scheme vulnerable and debateable is its compound character (the Urals, N. America, Tethys). Precise correlation both between different regions and between different fossil groups is very much required. The authors base their scheme mainly on conodonts, however the major part of the Permian beyond the Midcontinent is characterized poorly by them. Besides, conodont zonality is quite formal, as it is based on the consequent temporal change of some species without taking into account general development of the group as a whole, or that of other faunal groups. That is why the boundaries drawn by conodonts often do not respond to large biotic events.

I will now dwell on the more specific problems of correlation which should be solved first before discussing the scheme as a whole.

A. The problem of correlation of the Kubergandian and Roadian. In the scheme under discussion the Kubergandian is placed under the Roadian, the fact is that at the very base of the stratotype an assemblage of typical Roadian ammonoids (Chedia et al., 1986) is being completely ignored.

The opinion that the Roadian is younger than the Kubergandian is based on the data from Luodian section, China, where Roadian conodonts (*Mesogondolella nankingensis*) are recorded in beds, higher than the fusulinid *Neoschwagerina simplex* Zone, i.e., inside the Murgabian. The available data do not solve the contradiction between the ammonoid and conodont dating. As far as there is no reason to doubt any of these conclusions, we should suggest the possibility of redeposition either of fusulinid in the Kubergandian Stratotype, which could distort dating of the ammonoid beds in the subdivisions of the fusulinid scale, or of the Roadian conodonts in the Luodian section, which could have been transferred into Murgabian beds from the underlying Kubergandian. It is obvious, that without answering these questions the problem of the Kubergandian and Roadian, and consequently the problem of the boundary between the Chihsian and Guadalupian series cannot be solved.

B. The problem of recognizing and tracing the Roadian, Wordian and Capitanian beyond the stratotypical region.

The authors of the scheme under consideration indicate that the position of the boundaries of the enumerated stages of the Guadalupian series in relation to the Tethyan stages needs clarifying. It would be more precise to say that in the Tethys, and moreover beyond it, these stages cannot be distinguished. The Roadian has been discussed already. The boundary between it and the Wordian is somewhere inside the Murgabian stage of the Tethyan scale and even the authors of the scheme are not able to name the criteria for placing it.

The Capitanian stage is correlated with the Midian. The authors associate its beginning with the first occurrence of the fusulinid genus *Polydiexodina* and the ammonoid genus *Timorotes*. The former is not known in the Tethys, as for the latter, it is extremely rare, and the moment of its first occurrence is not fixed precisely. The lower boundary of the Capitanian is not recorded. Kozur (Kozur, 1994) believes it to be at the base of *Mesogondolella postserrata* Zone. Within Tethys the only section where the zonal species occurs in the assemblage with fusulinids is the Fengshan section in the south of China (Excursion guidebook, 1994). Based on fusulinids, we can speak only about approximate correspondence of the first occurrence of the zonal species to the Murgabian/Midian boundary.

As for the correspondence of the upper boundaries of the Capitanian and Midian stages, it is not clear at all. Chinese specialists record *Mesogondolella altudaensis, M. praexuanhanensis* and *M. xuanhanensis* conodont zones in the upper part of the Maokou Formation (Mei et al., 1994). In the Fengshan section zonal species occur in the assemblage with Midian fusulinids. However, it is difficult to correlate this part of the Chinese section with the Capitanian stage of the Delaware Basin by conodonts. Kozur suggests two variants of such a correlation. According to one of them, at least two of the enumerated three zones are post-Capitanian (Kozur, 1994). In this case the Capitanian will be only a part of the Midian.

Placing the boundary between the Guadalupian and Lopingian series depends on whichever variant is selected. One variant suggests that it coincides with the Maokou/Wuchiaping boundary, the other places this boundary inside the former formation, i.e. inside the Midian stage.

From the discussion so far, one can see that stages of the Guadalupian series are difficult to correlate even with faunally well characterized Tethyan sections; to say nothing of the Boreal and Notal regions, where fossils, characterizing the Guadalupian stages are practically absent.

On the series of the Permian System

Two years ago I suggested recognizing 2 subsystems (or subseries) and 4 series in the Permian System (Leven, 1992) as a counterbalance to the scheme where the Permian is divided into three series (Glenister et al., 1992). Such a subdivision would mainly correspond to the largest events in Permian history and at the same time would not contradict the traditional two-fold Uralian scale.

The variant of the scale under discussion also suggests dividing the Permian System into 4 series. However the series boundaries are placed differently. As a result, the scheme has lost the advantages it had in the variant proposed by me.

Indeed, the currently accepted Lower/Upper Permian boundary at the base of the Ufimian turns out to be inside the Chihsian series which contradicts the Uralian scale. The Bolorian and Kubergandian are united into one series, though the Bolorian/Kubergandian ages boundary is characterized by an abrupt renewal of all the biota (Leven, 1993; Leven, 1994; Leven et al., in press). At the same time the Bolorian and Yahtashian (Artinskian) finished up in a different series in spite of their faunal resemblance; there fusulinid assemblages differ only in that *Misellina* begins to occur in the Bolorian.

Such a great event as the Early Artinskian regression, changed by the Late Artinskian (Yahtashian) transgression (Leven, 1993) is not reflected in the scheme under consideration. This event everywhere caused a close connection of Early Artinskian and Late Sakmarian assemblages and consequently of the Late Artinskian and Bolorian (Kungurian) assemblages. Here rises the question of dividing Artinskian into two independent stages. In this case Yahtashian may correspond to the upper one, and not to the whole Artinskian as is supposed now.

CONCLUSIONS

A. The proposed variant of the Permian chronostratigraphical scale cannot be accepted because of a number of unsolved problems of correlation which have a bearing on the understanding of the vertical stratigraphic distribution and the boundaries of its units. Consideration of the scale should be preceded by the discussion of the correlation schemes and their co-ordination in ISPS.

B. The question of the number of stages and their boundaries should be solved according to the correlation schemes. When naming stages the principle of priority should be observed.

C. When grouping stages in the series the largest events of Permian history should be taken into consideration, so that the boundaries of the series correspond to the natural borders. It is also desirable to preserve a succession with the traditional 2-fold scale. In comparison with the scheme under discussion, the scheme proposed by me in 1992 is I believe preferable as a base for division of the Permian into series.

D. Preference should be given to scale based on Tethyan sections except in the lowermost part - where it is based on South Uralian sections. The compound scale is not recommended.

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12. COMMENTS BY V.I. DAVYDOV ON THE PROPOSED OPERATIONAL SCHEME OF PERMIAN CHRONOSTRATIGRAPHY

The proposed operational scheme (Jin Yu-Gan et al., 1994) reflects significant progress in Permian stratigraphy in recent years. Such a scheme will serve a useful purpose. The scheme under discussion presents a synthesis of the three most widely used scales (American, Chinese and Russian) but already at its base it is compromising and not without problems.

In my view stage units will be valid if the following conditions are observed:

A. Every stage should be of a geohistorical nature, i.e., associated with the events of the geological history.

B. Every stage should as far as possible be characterized in the stratotype. This characteristic will enable tracing the stage in the main sections of the world (global correlation).

C. When naming units the principle of priority should be observed. Estimating the scheme from this point of view the following conclusions can be made.

All three stages (Asselian, Sakmarian and Artinskian) in the lower "Uralian" (a better term is Yaikian or Cis-Uralian) series possess the characteristics that enable global recognition. The names of the stages have priority and are not disputed. The boundaries of the stages, with the exception of the Ghzelian, need clarification.

Both stages of the uppermost "Lopingian" series of the Dzhulfian (lower than *Clarkina leveni* Zone) should be recognized as a special stage. The middle part of the Permian is most debatable. The contradictions of the middle part of the proposed variant point out that it is the middle part of the Permian that the efforts of specialists should be focused on in the near future.

It is difficult to agree with placing the boundary between Chihsian and Guadalupian series at the top of *N. simplex* Zone, as it is not characterized by more or less considerable renewal of fossil assemblages. This conclusion was made by the authors of the scheme based on the data from Chinese sections, according to which Roadian conodont species *M. nankingensis* first occurs higher than beds with *N. simplex*. However, as was mentioned already, these data need revision, they contradict the data of the presence of Roadian ammonoids at the base of Kubergandian. Besides, the problem of the boundary between series can hardly be solved by basing it only on one conodont species and ignoring the character of development of all the other fauna.

The proposal of giving proper names to the Permian series can be maintained. However it should be done only after co-ordination of the questions of correlation. Incidentally, we now think the name "Uralian" for the lower series is not appropriate, as it was used in several different meanings. I would like to remind readers of an earlier proposed name - "Yaikian" (from Yaik - ancient name of the Ural-river) (Leven, 1974).

Some general considerations on the Permian chronostratigraphical scale

A vexed question of whether the general geochronological scale is conventional or natural is being discussed since first variants of the scale were proposed at Sessions II and VIII of the International Geological Congress. However all the history of the scale testifies to the domination of natural criteria. It can be seen even in the names of some systems, such as Carboniferous, Triassic, Cretaceous and it could not be otherwise. The biostratigraphical approach, which is the foundation of the general scale, is based on the fact that the organic world evolves by steps, which directly depend on geological events changing the environment.

It is evident that the Permian System scale should not contradict the existing traditions. These subdivisions and the boundaries between them, should be closely connected with the events of Permian history. Such events are in the first place the Early Artinskian regression and transgression which took place at the end of the Artinskian - at the beginning of the Bolorian. Considerable renewal of all the marine biota is connected with these events. Changes in the composition of the marine biota are not confined only to the Kubergandian and Midian transgressions. A strong biotical crisis connected with the regression occurred at the end of the Midian.

Conventionality can not be avoided when fixing boundaries. For this purpose some groups of the most cosmopolitan fossils could be chosen, for instance conodonts, ammonoids, radiolaria, for tracing the boundaries regionally. However "hammering in golden nails" should not be carried out in isolation and the fixed conventional boundaries should be possibly close to the natural borders. As we have seen the scale under consideration does not fully observe this principle. As was mentioned the scale in the proposed scheme is compound. This can only cause difficulties when using the scale, some examples of such difficulties were given above. It is obvious that the scale, based on the sections of one and the same başin is preferable to the compound one, certainly, if these sections are complete, represented by marine facies, and faunally well characterized. Tethyan sections answer all these requirements, and the Tethyan scale could well serve as the base for the general scale. The operation of removing its middle part and changing it for the Guadalupian series with its stages does not make any sense. The part of the Tethyan series, corresponding to the Guadalupian can be recognized as distinctly as in the Delaware Basin. Indeed, the upper boundary in the South Chinese sections is based on the same conodonts as in America and with the same degree of precision. The lower boundary is characterized by conodonts very poorly defined as yet. But as in America this boundary is confined to the change of quite comparable ammonoid assemblages.

As for the stages of the Guadalupian series, the difficulty of recognizing them beyond the Delaware Basin has already been pointed out. The use of Kubergandian, Murgabian and Midian is no more complicated than using the American stages in Tethys. The boundaries between the Tethyan stages are as yet insufficiently characterized by conodonts, but in the American scale the boundary between the Roadian and Wordian is also based only on ammonoid data. Besides, the data received recently from the sections of South China enable one to hope that all the Upper Permian stages will be well characterized by conodonts in the near future.

I would also like to mention the considerable advantage of the Tethyan scale over the American one. This advantage is based on the wide connection of the Tethyan with the basins of the Boreal and Notal regions. This opens up the possibility of tracing the Tethyan stages beyond the Tethys. It is evident that it will be less difficult than tracing the American stages, based on the sections and fauna of a relatively isolated basin. Conodonts, abundant in the American sections, will be of no use here, as they are rare in the deposits corresponding to the Guadalupian either in the Boreal or in the Notal region.

I am in favour of the four-membered subdivision of the Permian System in general, but against the subdivision in the proposed scheme, as the boundaries of the series are not confined to the main geological events, including paleobiological. Such scale of stages of the Middle Permian cannot be valid mainly because these stages are not traced globally. Bolorian and Kubergandian are well traced in the Tethyan, but are not correlated on the American continent. The same with the Roadian, Wordian and Capitanian. It is difficult to correlate these stages with the Tethyan. Russian ammonoid specialists have always considered Kubergandian ammonoids similar to Roadian (Ruzhentsev, Bogoslovskaya, 1978; Bogoslovskaya, 1984). In the proposed scale based on conodonts (Mei et al., 1994) the Roadian overlies Kubergandian. Data on radiolaria give the same correlation (Wang et al., 1994). If this correlation were correct, fusulinids of *Armenina-M. ovalis* Zone accompanying Roadian ammonoids in the stratotype of the Kubergandian in the Pamirs should be reworked. However, repeated investigation of the stratotype and other Kubergandian sections in the Pamirs did not show any younger fusulinid fauna in the *Armenina-M. ovalis* Zone. Besides, in Northern Afghanistan Roadian ammonoids are also accompanied by Kubergandian fusulinids (Termier et al., 1978). This enables one to conclude that Roadian ammonoids in the USA characterize not only the Roadian stage throughout the stratotype, but also more ancient deposits, which are erroneously correlated with the Roadian.

The Wordian is usually correlated with the Murgabian or with *Neoschwagerina* Genozone. However, in all the locations, where Wordian ammonoids are accompanied by fusulinids (Cache Creek, Sicily, Oman), the latter indicate the Midian, its lower *Yabeina archica-Neoschwagerina margaritae* zones. Thus both Capitanian and Wordian stages are likely to correspond to the Midian. But in this case it will be very difficult to recognize both these stages in the Tethys.

CONCLUSIONS AND COMMENTS

A. The lower and the uppermost series of the proposed scale and their stages are more or less appropriate.
B. The middle part of the scale needs much consideration and possibly changing. The stages of this part should be traced globally.
C. The scale should be accepted as a whole.

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13. STANDARD PERMIAN BIOSTRATIGRAPHIC SCALE WITH RESPECT TO PERMIAN MARINE BIOGEOGRAPHY

A. The general scale of the Permian system is based on sections of the Urals and the Russian Platform. It is not satisfactory enough as a global standard now, as it is difficult to trace the Kungurian, Ufimian and Tatarian stages outside the type area, the latter having been established in brackish-water basins or in red bed terrestrial facies.
B. The Permian is the period with the highest biogeographical differentiation during the Palaeozoic (Figure 1). It is possible to differentiate three climatic zones clearly: the Antiboreal, the Tropical and the Boreal with up to five separate maritime biogeographical regions within them. All five are characterized by independent development of biota.

These are: a) the Australian Basin in the Antiboreal zone; b) the South American (Andean) Basin in the Antiboreal zone; c) the basins of the North American Platform and Palaeotethys including the Cathaysian basin in the Tropical zone; d) the basins of the Russian Platform and the Urals being situated in low latitudes of the Boreal climatic zone; e) the basins of North—East Russia were situated in high latitudes of the Boreal zone.

Original stratigraphic scales have been elaborated for three of them. The increase of the basins' isolation towards the end of the Permian makes it possible to trace some intercontinental stratigraphic levels only.

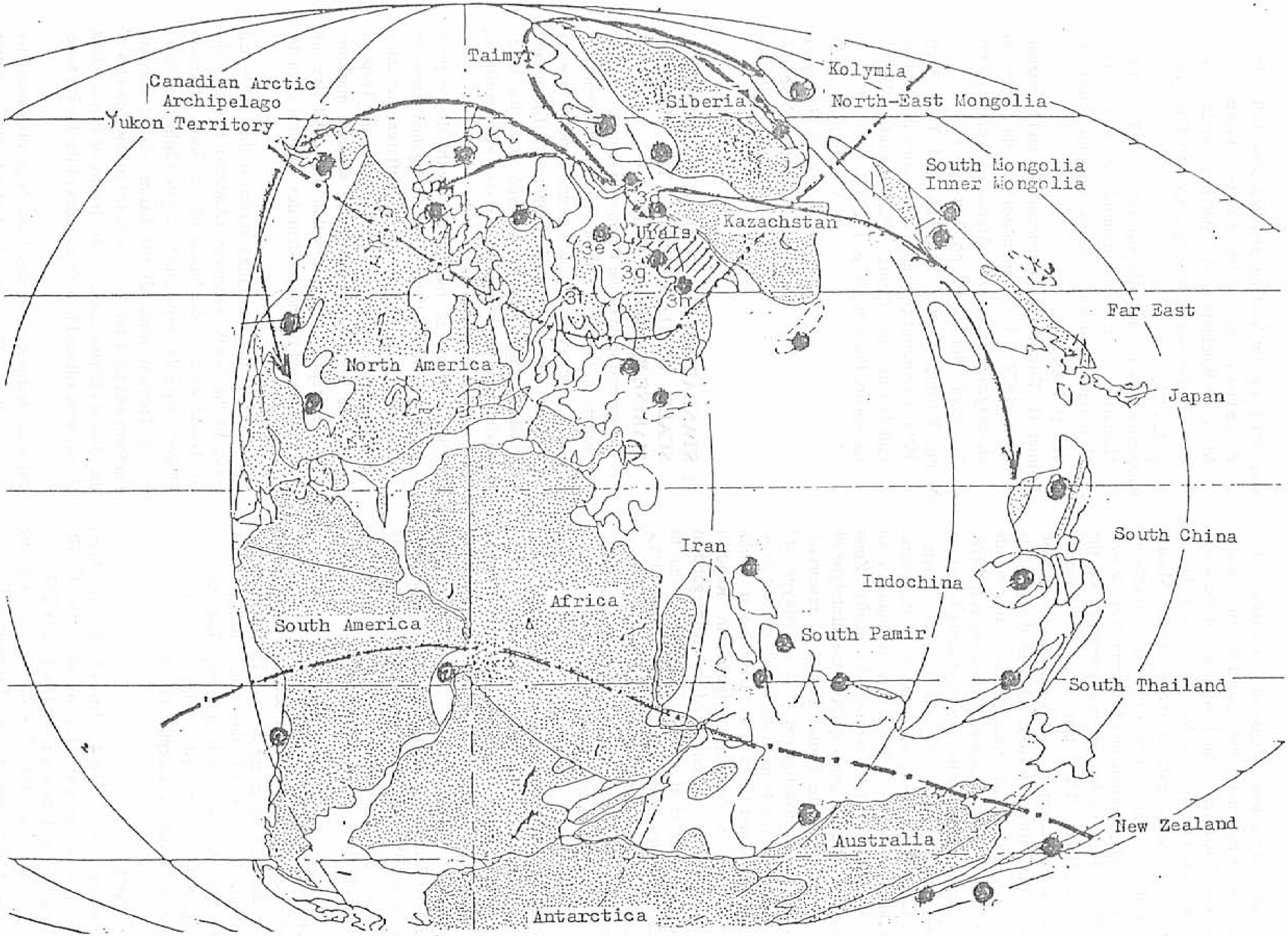

Figure 1. Paleoposition of the continents in the beginning of the Late Permian.
→ shows the biogeographical connections between different basins (adopted from Dr. Scotese and Dr. McKerrow, 1990).
• shows the most important brachiopod localities
—·—·— shows the boundaries of climatic zones

C. Consequently, some different alternative scales were proposed. Prof. Leven (1992) elaborated an original stage-scale for the Palaeotethys based mainly on the replacement of fusulinid assemblages. American paleontologists have more than once suggested that we include the Guadalupian North American Series into the world standard of the Permian system as overlying the Artinskian stage of the Uralian scale (Glenister, Furnish, 1961; Glenister et al., 1992). This point of view was supported by Russian specialists working on ammonoids (Ruzhencev, 1965).

D. It is possible to propose a different approach to this problem and try to examine the situation around the standard Uralian scale once more.

a. At first sight it seems that all the possibilities of detailed correlations based on the Kungurian and Ufimian stratotypes are exhausted. In fact the situation is not so hopeless. The great regression was widely spread on the territories of the South and Middle Urals during the Kungurian and Ufimian. Some active salting and draining processes were developed there owing to that regression. But a major transgression with a gradual subsidence of the basin occurred simultaneously in the northern regions of the Russian Platform, and in the Northern and Polar Urals. That is why some Russian research workers proposed different stage names such as the Svalbardian or Paikhoyan for the layers in normal-marine facies which they considered to be analogous to the Kungurian and Ufimian stages. However, later in the eighties, the northern sections of the Russian Platform were studied in greater detail and the presence of the Kungurian and Ufimian stages was established there. So there is no longer any necessity to maintain the above mentioned stage names. The section of the Kozhim river situated in the south part of the Pechora coal basin was proposed as a key section by a group of specialists from Syktyvkar for this territory (The base section of the Lower Permian of Kozhim river, 1980). It was prepared for demonstration during the International Congress on the Permian System in the town of Perm in 1991. This unique section includes marine sediments from the Asselian to the Ufimian in continuous sequence. It contains abundant remains of different groups of marine invertebrates. Six brachiopod assemblages from the Kungurian—Ufimian levels were recognized by Dr. Gizatulin (1987). Bryozoan assemblages were established by Dr. Lisitzyn (1989). Some ammonoids from different parts of the section have been collected there also. The study of those has just been completed by Mr. Voronov. Permian brachiopods from the north of the Russian Platform were studied by Dr. Kalashnikov (1993). Six characteristic brachiopod assemblages from the Asselian up to the Kazanian indicating the most important stratigraphic levels were established by him. Conodonts from the Lower Permian deposits of the Urals have been studied by Prof. Chernykh. Sixteen conodont assemblages from the Upper Carboniferous (Gzhelian) to Lower Permian (Kungurian) stage were recognized by him (Chernykh, 1989).

b. Traces of this transgression were discovered in the northeastern basins of Russia. A group of Russian specialists examined the section of Vodopadny Creek (Permian key section of the Omolon massif, 1990). In this section the middle—*Megousia kulikii* brachiopod local zone of the Jigdalinian Formation has been found to correspond to the Kungurian stage with certainty, while the uppermost—*Kolymaella ogonerensis*—brachiopod local zone of the Jigdalinian formation is considered to be coeval with the Solikamskian substage of the Ufimian. The Kunguro—Ufimian transgression was traced also in the basins of Northeastern and Central Mongolia.

c. At the same time a broad transgression took place along the wide strait between the Siberian and Kazakhstanian continents in the direction of the South Mongolian and Inner Mongolian basins according to palinspastic reconstruction of Dr. Scotese and Dr. McKerrow (1990). The Khubsugal (Kungurian) and Zaganula (Ufimian) brachiopod assemblages were described from the territory of the South Mongolia by Dr. Pavlova and Dr. Manankov (Permian invertebrates of Southern Mongolian, 1991). Both these assemblages demonstrate very close similarity to those from the western part of the Arctic Basin (Pechora-land, Pai-Khoi, Spitsbergen, Greenland, Canadian Arctic Archipelago) with the presence of different boreal brachiopod genera, such as: *Arctitreta*, *Yakovlevia*, *Kochiproductus*, *Waagenoconcha*, *liosotella*, *Cancrinella*, *Spiriferella*, *Kaninospirifer* and so on. The Kungurian age of the Khubsugul brachiopod assemblage is confirmed by the presence of the ammonoid *Neouddenites orientalis* as it has been reported by Dr. Bogoslovskaja (1991). The overlying Zaganula brachiopod assemblage belonging to the Dalanulian—Lugingolian structural zone is widespread in South Mongolia. The presence of *Kolymaella ogonerensis* in this brachiopod assemblage allows one to correlate corresponding layers with those of Solikamskian substage of Ufimian stage with confidence.

One more brachiopod assemblage was established in the section of Jirem—Ula hill also belonging to Dalanulian—Lugingolian structural zone. The latter is very similar to the Zaganula assemblage in its systematic content, but may be slightly younger. It contains exactly the same brachiopods as those from the Jisu Formation of the North Chinese (Inner Mongolian) sections. Those are: *Yakovlevia mammatiformis, Kochiproductus saraneanus, Spiriferella* ex gr. *rajah, Fusispirifer nitiensis, Echinauris jissuensis, E. gobiensis, Paramarginifera*. The Ufimian (Roadian) age of this assemblage is proven by the presence of the ammonoid genus *Daubichites*. The latter was discovered in the brachiopod assemblage as it was reported by Dr. Liang Xi-Luo (1981). This brachiopod assemblage was discovered in the middle part of the Jisu—Hongour section (in the layers with *Marginifera* of Grabau, 1931) (Jin Yu-gan, pers. comm.). The upper part of these layers contains abundant *Echinauris jissuensis, E. gobiensis, Paramarginifera* sp. nov. This distinctive horizon is traced throughout the territory of Southern Mongolia and in the section of Jirem—Ula hill; it was studied by myself, together with Prof. Leven and Dr. Manankov, during the field trip in 1990. The section of Jirem—Ula hill is located 80 km northwards from the Jisu—Hongour one. The layers with Marginiferids in the section of Jisu—Hongour are overlain by beds with an abundant brachiopod fauna containing a lot of typical tropical forms. Together with them the fusulinoid genus *Pseudodoliolina* was found. This genus proves that the uppermost part of the Jusu—Hongour section is of Murgabian age. So we can see how the Uralian and Tethyan stratigraphic scales are linked up.

d. The Kungurian—Ufimian transgression can be traced from the Polar Urals to the north and northwest also. It is manifested clearly in the sections of Novaja Zemlya, Spitsbergen, Greenland, Canadian Arctic Archipelago, where the boreal Kungurian—Ufimian brachiopod assemblages of the North—Uralian type are widely distributed.

E. Now, it is possible to select some key sections which can help connect the Uralian and Tethyan scales on the one hand and the Uralian with the North American ones on the other. It seems that the promising sections would be:

a. The section of the Kozhim river in the territory of the north of the Russian Platform and probably the section of Vodopadny Creek for the northeastern parts of Russia and Mongolia.
b. The section of the Jisu—Hongour in the territory of North China and probably the section of Jirem—Ula hill as an additional one in the territory of the South Mongolia.
c. And finally one or two sections in the territory of Canadian Arctic Archipelago could be proposed. As the Permian sections of this region are described in the terms of the North America stage scale it is possible to select there a section for the confident correlation of the Uralian and North American scales.
d. Based on the key section of the Kozhim river it is possible to characterize the Artinskian—Kungurian boundary, the Kungurian stage itself and the Kungurian—Ufimian boundary in the marine facies of a single basin. The subdivision of part of the Uralian scale which is discussed here is elaborated in much detail. As the Artinskian stage is divided into four substages and both the Kungurian and Ufimian into two substages it gives one the opportunity to make correlations more precisely than at the stage level.

   The Lower Permian scale of the Urals is used successively in the sections of North—East Russia, Mongolia and Australia. The continental sections of the Russian Platform and Urals could be especially good as stratotypic ones because they contain abundant palynological and floristic assemblages as well as different groups of Tetrapoda. It enables us to elaborate parallel marine and continental scales in a single region, those two being connected very closely.
e. Concerning the South Mongolian and Inner Mongolian sections it is very important that it is possible to interpret those both in the terms of the Uralian and the Tethyan scales. These two scales can be connected precisely at the level of the Kungurian (Bolorian or Chihsian) and the Ufimian (Kubergandian or Roadian) boundary. The same sequence can be observed in the sections of the South—Eastern Pamir where the Kungurian (Bolorian) ammonoid assemblage is being replaced with the Kubergandinian (Ufimian or Roadian) one as it was reported by Dr. Leonova and Mr. Dmitriev (1989) and by Prof. Leven, Dr. Leonova and Mr. Dmitriev (1992). Upwards the scale can be built up easily in the Tethyan and South Chinese sections as was proposed by Prof. Leven (1992) and the Permian stratigraphic subcommission. This allows one to exclude any kind of stratigraphic gaps when changing from the Uralian scale into the Tethyan one.

F. The basins of the North American Platform throughout the Upper Paleozoic were characterized by a very high degree of biogeographic isolation; the biota was highly endemic and the most faunistic groups, fusulinids and brachiopods being among them, were characterized by specific evolutionary rates. We should not forget also that conodonts and fusulinids are absent in the sections of North—East Russia, Mongolia and Australia as well as in the Upper Permian sections of the Russian Platform and Urals. That is why direct transcontinental correlations between North American sections and Euro—Asian ones are as a rule very tentative. So it seems to me that including the Guadalupian series into the standard scale of the Permian system could bring a lot of difficulties in the process of detailed interregional correlations.

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14. PERMIAN STRATIGRAPHY IN THE SOUTHERN ALPS (ITALY): NEW CONTRIBUTIONS

INTRODUCTION

Two up-to-date and exhaustive papers on various aspects of the Permian stratigraphy in the Southern Alps have been recently published. They concern respectively a) the bio- and chronostratigraphy of the continental successions by means of tetrapod footprints and palynomorphs (Conti, Mariotti, Nicosia and Pittau, 1994, still in press); b) the sedimentology and sequence stratigraphy of the upper Permian succession (Val Gardena Sandstone, Bellerophon Formation) of the eastern sector of Southern Alps (Fig. 1) (Massari, Neri, Pittau, Fontana and Stefani, 1994). The latter work also contain original data on palynostratigraphy of the Upper Permian formations with detailed range-charts of selected taxa.

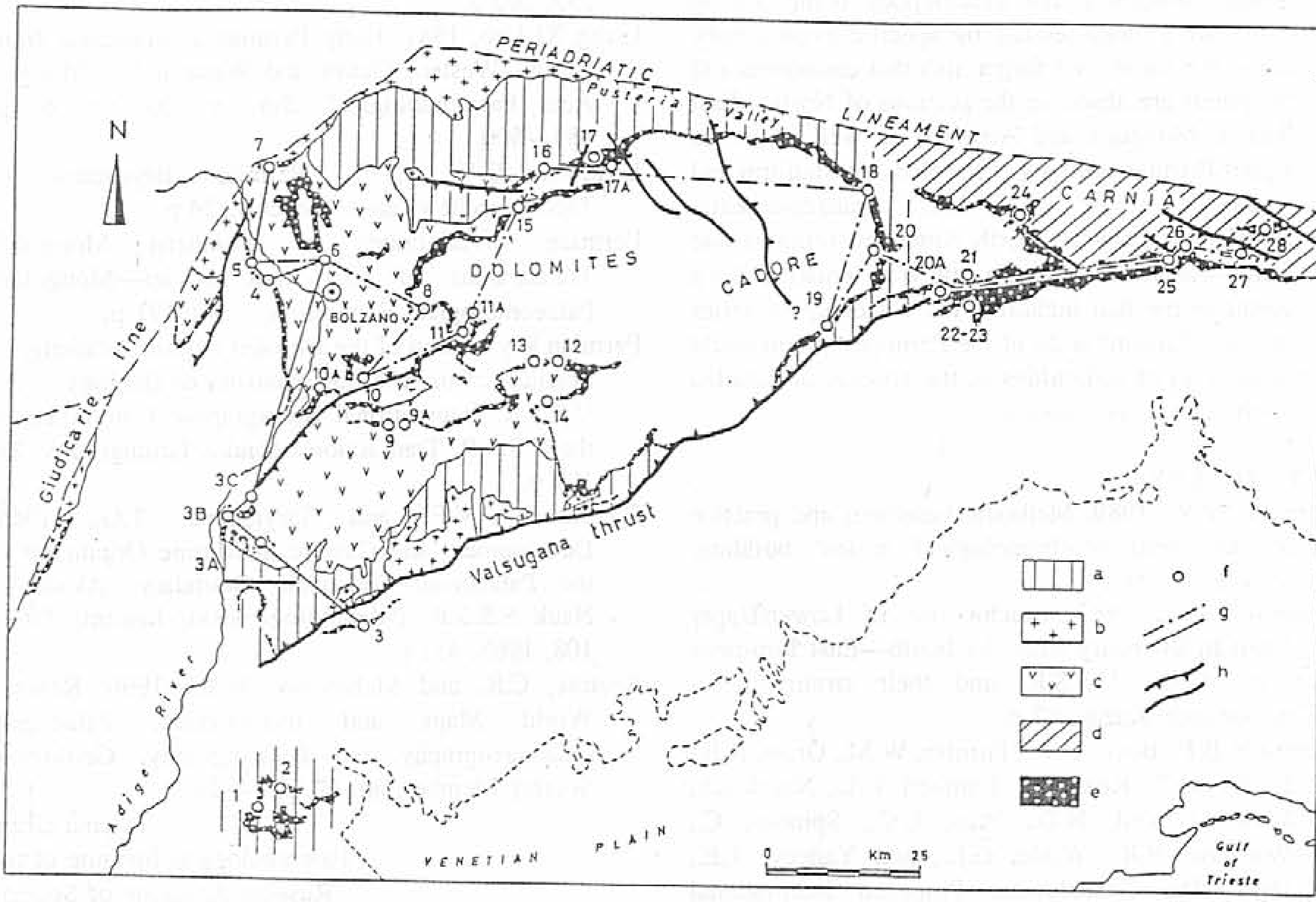

Figure 1. Schematic outcrop distribution of Upper Permian deposits and their substrata in eastern Southern Alps. Location of the localities and sections quoted in the text are indicated by numbers: 3B) M. Rosà; 5) Rio del Bavaro; 6) S. Genesio; 7) Merano 2000; 8) Tires; 10) Bletterbach; 11) Rio Barbide; 15) M. Seceda; 16) Putia Massif; 18) Ponte Pissandolo; 19) Lozzo; 20) Auronzo; 22) Sauris; 24) Forni Avoltri; 25) Torrente Chiarsò; 26) M. Dimon; 27) Rio del Museo and Rio das Barbacis; 28) Reppwand.

Symbols:
a: metamorphic basement (mainly phyllites);
b: post-Variscan granitoids;
c: Permian volcanics;
d: Paleocarnic chain and post-Variscan Pontebba Supergroup;
e: outcrops of Upper Permian succession (Val Gardena Sandstone and Bellerophon Formation);
f: stratigraphic sections reported in Massari et al., 1994;
h: present-day trends of some important faults and overthrusts, representing Alpine reactivation of presumed paleo-lines controlling Upper Permian sedimentation. (From Massari et al., 1994).

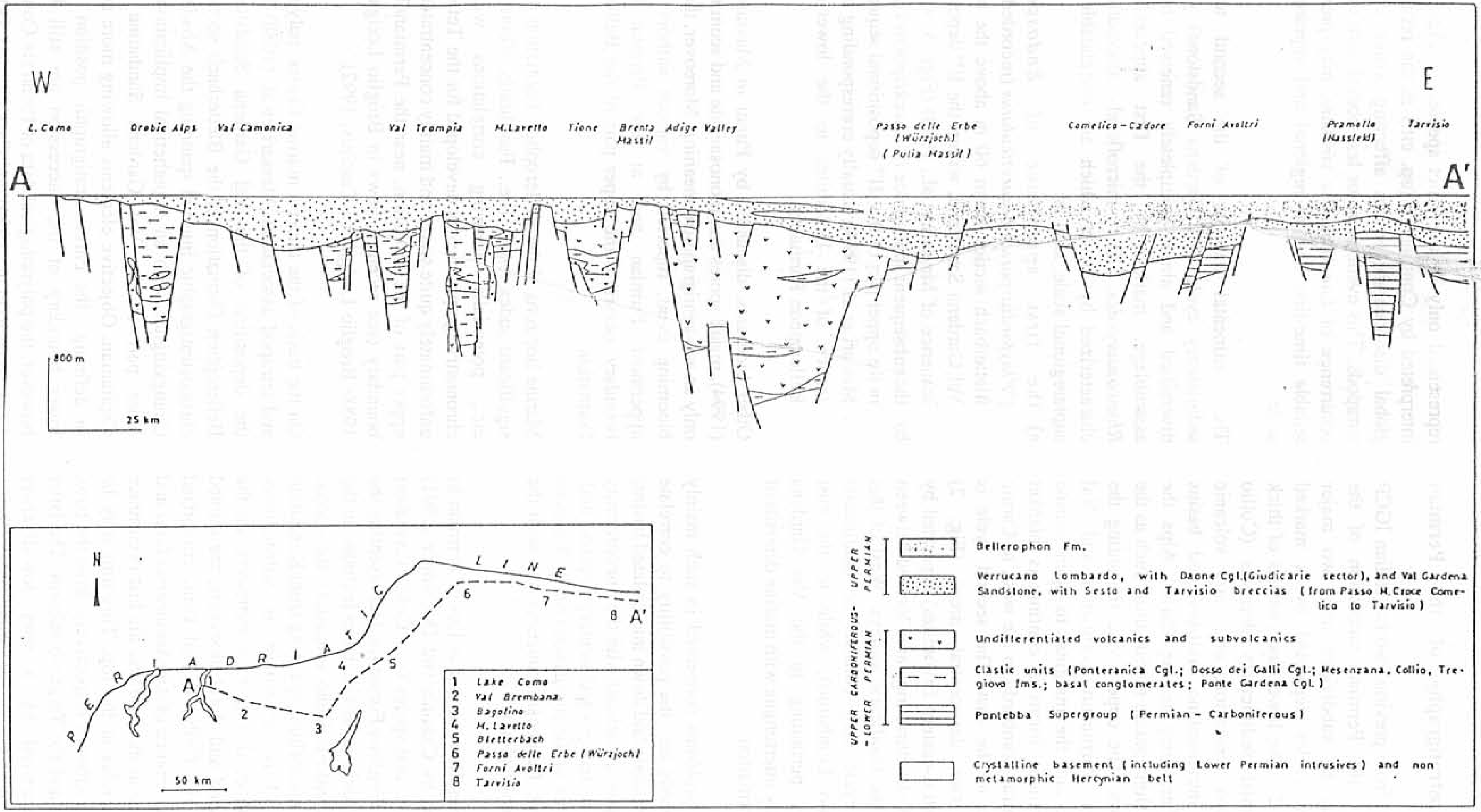

Figure 2. Schematic non-palinspastic profile across the Permian deposits of the Southern Alps (dashed trace in the inset). Datum; base of the Werfen Formation (Permian/Triassic boundary). Latest Carboniferous and Early Permian tectonics generated a series of highly subsiding intramontane basis separated by swells. A distinct unconformity marks the base of the Upper Permian cycle, characterized by more blanket-like geometry and less pronounced thickness variations. (From Massari et al., 1994).

Bio- and chronostratigraphy of the Permian succession

As it is well known from previous works (Italian IGCP 203 Group, 1986), the Permian succession of the Southern Alps may be subdivided into two major tectono-sedimentary cycles separated by a marked unconformity (Fig. 2). The lower one consists of thick prisms of continental sedimentary deposits (Collio Formation, Tregiovo Formation, etc.) and volcanic products infilling intramontane fault-bounded basins isolated one another. Only in the Carnic Alps the sedimentary succession contain marine units such as the Trogkofel Formation. The upper cycle (including the continental clastics Verrucano Lombardo and Val Gardena Sandstone and the marginal to open marine Bellerophon Formation) forms a continuous blanket extending from central Lombardy to the west, to Carnic Alps and Slovenia to the east. The second cycle is characterized by two depocentral areas (Fig. 2) (Lombardy and central-eastern Dolomites) separated by a wide and complex structural-high area located between Adige Valley and the Giudicarie valleys. West of this high the second cycle only consists of continental deposits (Verrucano Lombardo), while to the east continental clastics pertaining to the Val Gardena Sandstone repeatedly intertongue with marine deposits of the Bellerophon Formation

Main stratigraphic problems concerned in such mainly continental successions are: the possibility to correlate each other the successions laid down into isolated basins; the extent of the hiatus associated with the unconformity separating the two tectono-sedimentary cycles and, finally, the correlation of the successions of the Southern Alps with the classic European sequences and with the standard chronostratigraphic scale.

The first cycle, generally regarded as Lower Permian in age, has been dated by Cassinis and Doubinger (1991) on the basis of pollen and spores from Collio Formation (type section) and Tregiovo Formation (representing the deposit of a small fluvio-lacustrine basin included in the upper part of the Trento-Bolzano volcanics): the quoted formations yielded microfloras spanning from Kungurian to Ufimian p.p. This attribution is substantially confirmed by Conti et al. (op. cit.); moreover, on the basis of both tetrapod and floral bioevents, the quoted authors recognize the Collio Faunal Unit, comprised between the first occurrence of *Amphisauropus latus* and *Ichniotherium cottae* at the base and the last occurrence of *Dromopus didactylus* at the top. This unit may be subdivided into two subunits respectively, from the base, the Pulpito subunit and the Tregiovo subunit. The latter subunit is characterized by a very low-diversity assemblage (the ichnofacies is monotypic, being represented only by the relict species *D. didactylus*), interpreted by Conti et al. (op. cit.) as the result of a global disappearance event affecting lower Permian tetrapods. This event more or less coeval with the first occurrence of *Lueckisporites virkkiae*, may provide a reliable time-line both at regional and supraregional scale.

The continental deposits of the second tectono-sedimentary cycle (Val Gardena Sandstone) yield a diversified and almost completely renewed tetrapod assemblage, marked by the first appearance of *Rhyncosauroides*. The microfloral association is characterized by events which are correlatable on a supraregional scale, such as:

a) the first appearance of *Endosporites* ("*Playfordiaspora*") *hexareticulatus* (recorded in the Bletterbach section about 60 m above the base of Val Gardena Sandstone, within the II[nd] depositional sequence of Massari et al., 1994) (Figs. 3, 4);
b) the subsequent appearance of *Lueckisporites parvus*, in the upper part of the III[rd] depositional sequence of Massari et al. (1994), usually corresponding in most section of the Dolomites to the lower-middle Bellerophon Formation.

Other bioevents, discussed by Pittau *in* Massari et al. (1994), regard spores and monosaccate and seem to have only an eco-stratigraphical meaning. Moreover, the fungi blooming event, reported by various authors in the uppermost Permian and at the Permian/Triassic boundary, occurs in the upper part of the Bellerophon Formation.

Marine horizons of the Bellerophon Formation yielding significant index-fossils (i.e., Fusulinids, *Comelicania*, etc., potentially allowing correlations with the chronostratigraphic scales developed for the Tethys) are unfortunately quite scarce and mainly concentrated in the upper part of the formation, near the Permian/Triassic boundary (see recent reviews in Broglio Loriga et al., 1988; Broglio Loriga and Cassinis, 1992).

On the basis of the data on marine faunas, palynofloras and tetrapod association, Massari et al. (1988) referred the deposition of the Val Gardena Sandstone and Bellerophon Formation of the Bletterbach section to a chronostratigraphic interval spanning the Abadehian to Changxingian, with an hypothetical implication of the older part of the Val Gardena Sandstone in the Capitanian. Objective elements allowing more accuracy in defining the chronostratigraphic position of the lower boundary of the succession are still lacking; however, the palynological data of Pittau (*in* Conti et al., 1994; Massari et al., 1994) and Cassinis and Doubinger

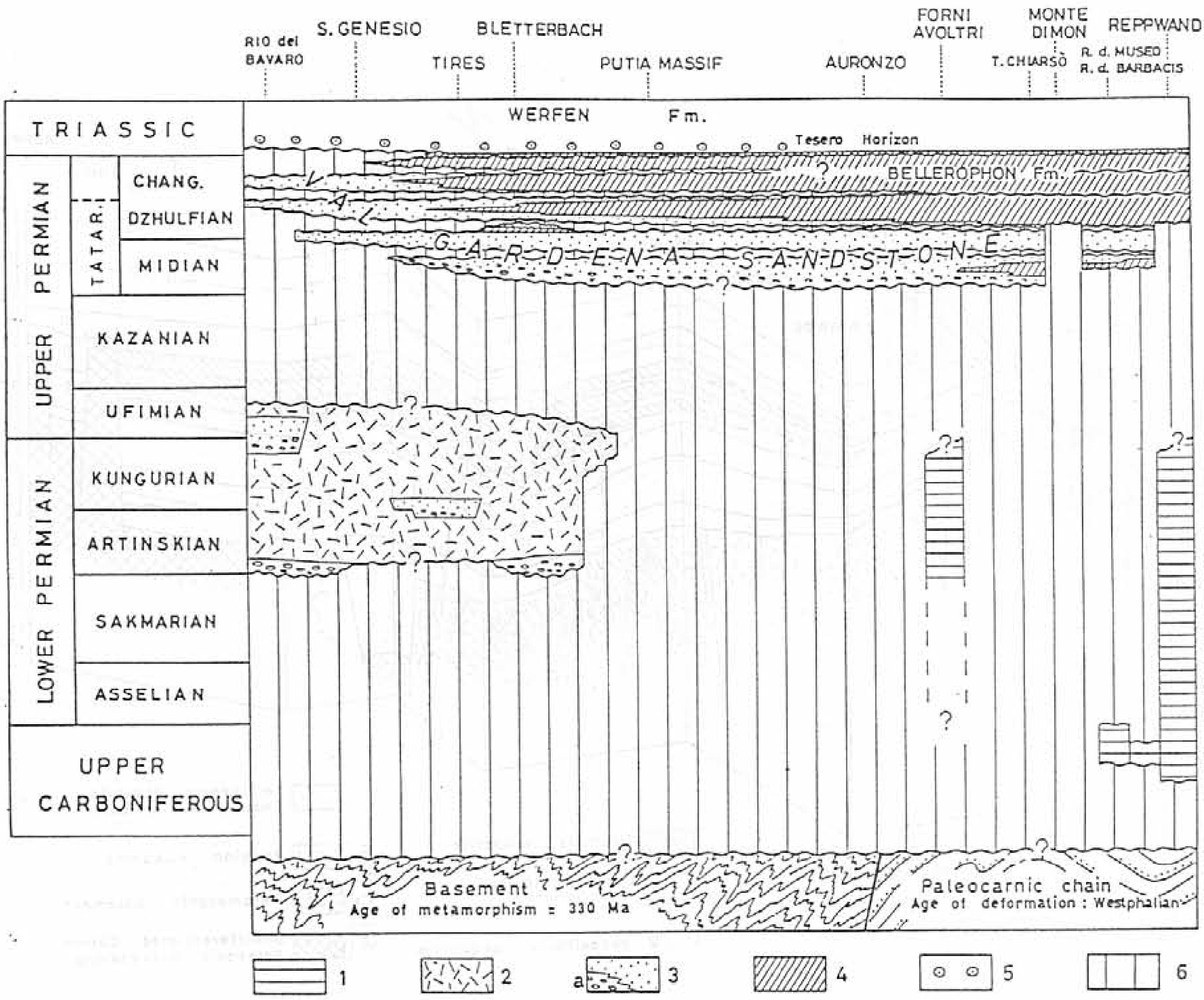

Figure 3. Chronostratigraphic framework of the Permian deposits in the eastern Southern Alps. 1: Pontebba Supergroup; 2: volcanics; 3: terrigenous clastics (a: conglomerates); 4: Bellerophon Formation; 5: hiatus; 6: unconformity. (From Massari et al., 1994).

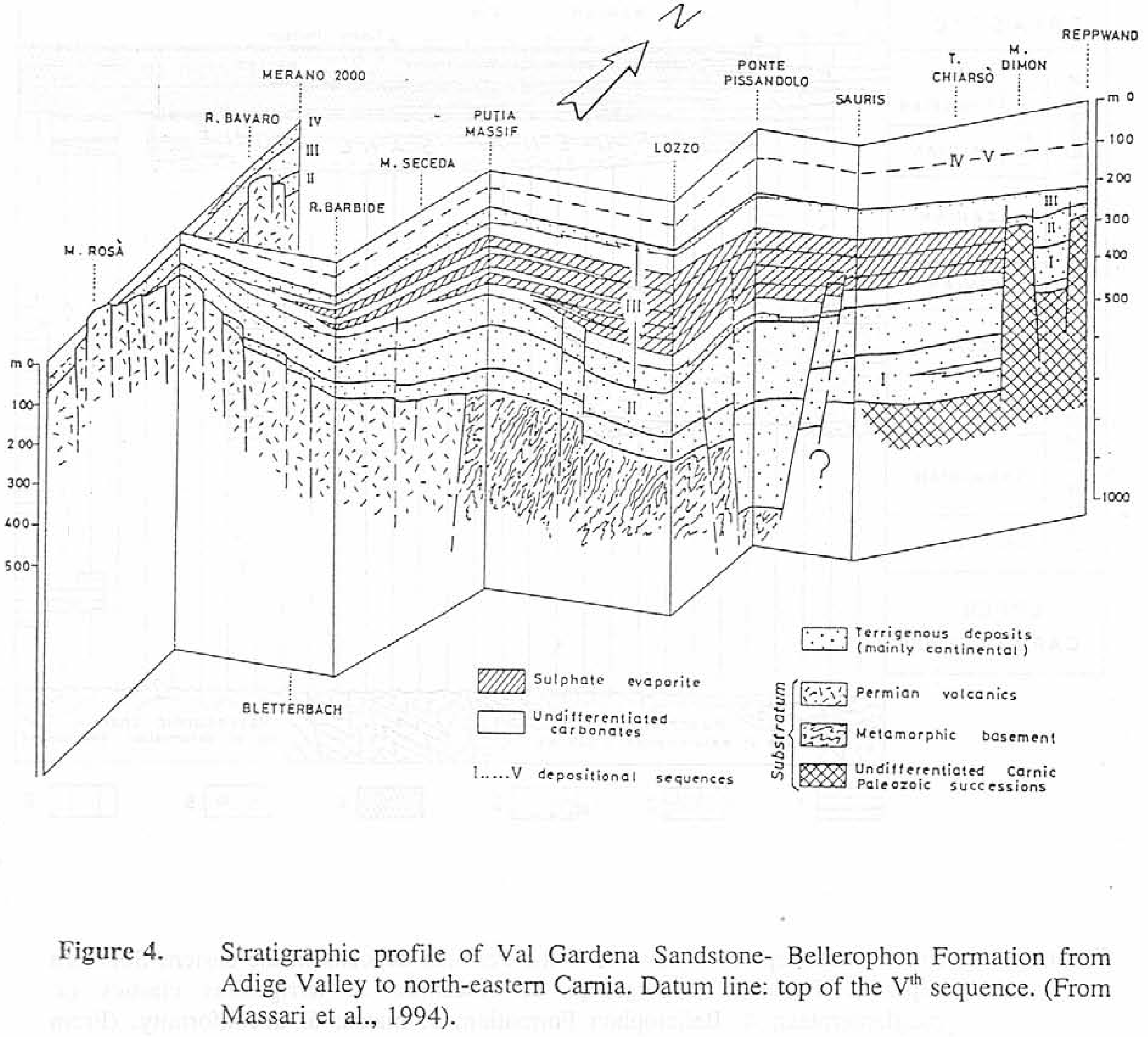

Figure 4. Stratigraphic profile of Val Gardena Sandstone- Bellerophon Formation from Adige Valley to north-eastern Carnia. Datum line: top of the Vth sequence. (From Massari et al., 1994).

(1991) argue for the post-Kazanian age of the base of the second cycle. The bulk of the succession may be referred to the Dzhulfian and Changxingian, although its lower part may pertain to the Midian (Fig. 3). In fact, the lower Tatarian Illawara reversal has been reported in the Val Gardena Sandstone of the Dolomites (Dachroth, 1988) and Carnia (Mauritsch and Becke, 1983). According to Massari et al. (1994), the stratigraphical interval in which the reversal occurs may be referred to the lower part of their IInd depositional sequence, below the first significant palynofloras and tetrapod association discussed above. This implies that part of the Val Gardena Sandstone should be attributed to the Lower Tatarian. Thus, the hiatus between the two major Permian tectono-sedimentary cycles spans at least the whole Kazanian. Wider hiatuses can obviously occur on paleostructural highs of Adige Valley and some sectors of Carnics Alps (Figs. 3, 4).

Facies analysis and sequence stratigraphy of the Val Gardena Sandstone and Bellerophon Formation

The work of Massari et al. (1994) represents a synthesis of the physical stratigraphy of the Upper Permian deposits (Val Gardena Sandstone and Bellerophon Formation) of the eastern Southern Alps (Figs. 1, 2). The two units are repeatedly interfingered and grade each other; marine deposits of the Bellerophon Formation prevail in the eastern-most sections (Carnia, eastern Dolomites) and grade westward into marginal marine-sabkha deposits and finally into continental red beds, which prevail in western-most sector of the Dolomites and Adige Valley.

The whole stratigraphic sequence displays features strongly suggestive of an early rift setting: onset of sedimentation after a long period of subaerial erosion, and upward fining trend from red beds, through evaporites to marine carbonates, with backstepping pattern of component sequences. These are thought to be part of a second-order Upper Permian-Scythian rift-related sequence. A change from trough-and-swell to blanket-like sedimentation patterns within the second order-sequence probably reflects the transition from fault-controlled to thermal subsidence. The regime change may have taken place near the Permian/Triassic boundary, which marks the broadening out of the basin from the earlier rift troughs.

Facies analysis. The facies associations identified in the Val Gardena Sandstone suggest a fluvial regime subject to rapid and erratic fluctuations in discharge. The fluvial system is characterized by progressive downstream decrease in channel dimension and average discharge, and final transition into a network of terminal-fan distributaries merging into coastal sabkha mud-flats. Paleosols are represented by calcic soils, locally with vertical features, and suggest a warm to hot, semi-arid or dry-subhumid climate with a strongly seasonal rainfall distribution. A drying tendency is suggested by the upward disappearance of vertical features.

The composition of arenites reflect first the type of substratum, then deeper sources, such as plutonic and medium-grade metamorphic rocks, suggesting progressive unroofing of source areas.

The Bellerophon Formation essentially consists of two units: a lower evaporite-bearing unit, deposited in a tectonically-barred basin, and an upper shallow marine carbonate unit, laid down on a very low-energy, low-gradient ramp, whose shallowness restricted water circulation in the innermost areas.

Sequence stratigraphy. Five third-order sequences and the lower part of a sixth sequence have been identified and correlated across the study area.

Sequence boundaries in the Val Gardena Sandstone are essentially identified by abrupt changes in channel patterns and geometries (inferred valley fills) and by the presence of more or less mature, well-drained paleosols (inferred interfluves). Amalgamated channel sandstones, inferred to represent incised valley fills, fine upward into increasingly isolated and thinner channel sandstones encased in growing volumes of overbank fines. This trend reflects: 1) the change from a confined geomorphic setting, limiting the area of potential avulsion to an unrestricted setting, leading to freedom of rivers to move extensively; 2) the above-mentioned transition from a perennial or semi-perennial fluvial system to an ephemeral network of terminal-fan distributaries, through a drastic downstream decrease in channel depth and discharge. The resulting FU complex may reflect the relative rise in base level, and in most cases makes up the bulk of the depositional sequence. Identification of the landward equivalent of marine maximum flooding is obvious in cases of marine or marginal-marine deposits inserted within a nonmarine succession, but may be very difficult in more landward-located areas, where it relies on the identification of faint traces of tidal influence. Highstand packages in the Val Gardena Sandstone sequences are characterized by progradational patterns and upward increase in paleosol density, thought to result from progressive decrease in accommodation space.

Among the five depositional sequences recognized within Val gardena Sandstone and Bellerophon Formation, the two lowest sequences are mainly represented by continental red beds, upward evolving from alluvial fan to terminal-fan, through braided- and meandering river facies associations. Only in northeastern Carnia (I[st] sequence) and in Bletterbach section (II[nd] sequence) minor marine deposits also occur, respectively represented by alternating marls and dolostone with marginal marine microfauna and by a thin hummocky-laminated sandstone band with a distinctive Nautiloid fauna.

As a result of the eastward encroachment of the Bellerophon transgression, the III[rd] sequence shows complex facies interfingering and pronounced lateral transitions, being fluvial-dominated in the westernmost (landward) area and grading eastward (seaward) firstly to terminal-fan and coastal sabkha facies associations and then to subtidal evaporite-bearing complex. The latter is characterized in the Dolomites by cyclic alternations of dolostone and laminated, subtidal gypsum, thought to reflect alternating conditions of under- and hypersaturation with respect to calcium sulphate, as a response to small climatic/eustatic changes. This cyclical unit grades eastwards (Cadore and Carnia, corresponding to the depocentral area of the III[rd] sequence, Fig. 4) into a thick complex consisting of chemically precipitated subtidal laminated gypsum, with minor dolomite intercalations, which in turn wedges out rapidly further eastwards, being replaced by shallow-water carbonates of relative high energy, deposited on structural highs characterized by relatively thin successions (i.e., Reppwand section, Fig. 4). These relationships suggest that the evaporitic deposits where laid down in a tectonically barred basin subject to differential subsidence, bounded to the east by carbonate shoals localized on structural highs in the Carnic area.

The upper two sequences (IV[th] and V[th]) are characterized by a more uniform subsidence rate, leading to significant changes in paleogeography, a low-gradient homoclinal ramp replacing the previously existing barred basin. The successions are dominated by open-marine shelf limestones, rich in fossils such as foraminifers, calcareous algae, bivalves, gastropods, etc., with marly or marly mudstone interbeds. In the western-most sector of the Dolomites, marginal-marine facies associations (characterized by marly-silty dolostones with rare gypsum) prevail, grading further westwards (Adige Valley) into thin packages of continental red beds.

The Permian/Triassic boundary in the study area is not thought to correspond to a sequence boundary. The brachiopod-bearing "*Comelicania* Beds" (a CU parasequence 0.5-2 m thick) of the uppermost Bellerophon Formation, referred to latest Permian, and the overlying lowermost Triassic Tesero Horizon are regarded as backstepping parasequences pertaining to the transgressive systems tract of the VI[th] sequence. However, the base of the Tesero Horizon records an abrupt increase in the average hydrodynamic energy of the environment (the so-called "current-event" of Brandner, 1988); this event is widespread and coeval in the western Tethys and is probably related to a major change in overall marine circulation.

The sequence-stratigraphic organization may supply additional tools for correlation at the scale of the South-Alpine domain and, potentially, of other areas of Alpine Europe (i.e., the Trans-Danubian Mid-Mountains of Hungary, according to Majoros, 1983, and direct analysis of some stratigraphical bore-holes drilled by the Hungarian Geological Service; Neri, unpublished data).

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15. PALYNOLOGICAL CORRELATION OF THE TYPE TATARIAN: CONTINUING THE DISCUSSION

The article by Drs. C.B. Foster and P.J. Jones in "Permophiles", no. 24, 1994 impressed me very much by the fact that it indicated the possibility of recognizing the Tatarian outside its type region. Still I would like to make some comments on the topic based on the more precise stratigraphy of the Tatarian proper.

A. It is uniformly accepted that the Tatarian of the Russian platform is subdivided into three horizons (from below upwards): Urzhumsky, Severodvinsky and Vyatsky. The main level traced by Foster and Jones is chiefly marked by the first appearance of two miospore species *Scutasporites unicus* Klaus and *Playfordiaspora cancellosa* (Playford et Dettmann) Maheshwari et Banerji. Applied to the type Tatarian sequence at the Russian platform this level corresponds with the appearance of *Lueckisporites virkkiae* Potonié et Klaus and the lower boundary of the Tatarian. Agreeing with a possible high correlation potential of the above species it should be noticed however that the first appearance of *S. unicus* at the Russian platform occurs much higher than that of *L. virkkiae* and if the latter event may coincide with the base of the Tatarian, then the appearance of *S. unicus* would be somewhere in the middle of the Severodvinsky horizon. So the level traced by Foster and Jones is not the base of the Tatarian but corresponds approximately to its middle.

B. In all samples studied so far from the type sequence of the Tatarian *S. unicus* appears in significant amounts (5—7% of total assemblage), while in the Martinia Shale, East Greenland and this species was reported by B.E. Balme (1979) only in one sample and with abundance of less than one per cent of the total count. This suggests that the Martinia Shale may be slightly older than the *S. unicus*-containing units of the Russian Tatarian. Conventionally it should be correlated with the lower part of the Severodvinsky horizon. On the other hand Unit 4 of the Salt Range was reported by Balme (1970) as yielding some very "young" forms, i.e., *Nevesisporites fossulatus* Balme, *Kraeuselisporites* spp., *Densoisporites* spp., *Lunbladispora obsoleta* Balme, *Osmundacidites senectus* Balme, *Calamospora landiana* Balme, *Gnetaceaepollenites sinuosus* (Balme et Hennelly) Bharadwaj, *Taeniaesporites noviaulensis* Leschik, which appear at the Russian platform not earlier than in the Vyatsky horizon. Thus if the Unit 4 of Salt Range could be correlated with some part of Tatarian, it obviously must be regarded as younger than the Martinia Shale (Fig. 1).

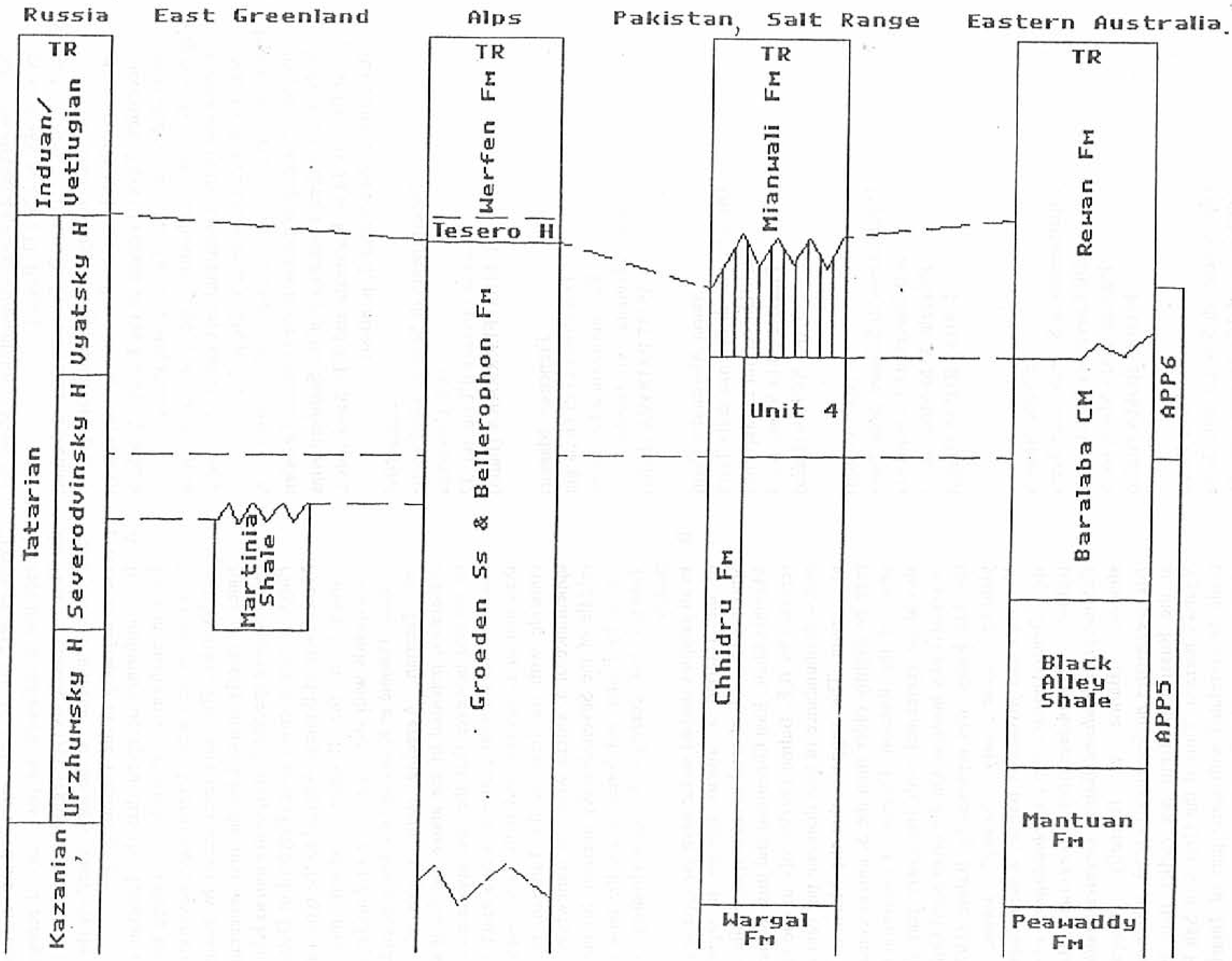

Fig. 1. Correlation of the Tatarian with Greenland, Austrian, Salt Range and Australian sections.

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16. UPPER PERMIAN MONOGRAPH

Geologists of Kazan University and institutes of Moscow, St. Petersburg and Saratov have been preparing a monograph "Typical stratigraphic sections of the Upper Permian of the Volga—Ural region". It is planned to give detailed description of typical stratigraphic sections of the Ufimian, Kazanian and Tatarian stages of Volga and Kama regions and the basin of Vyatka River with complete paleontological, petrographic and paleomagnetic characteristics.

The monograph will include:

- Introduction

Chapter 1. Main developments in the study of the Upper Permian deposits (Esaulova, N.)

Chapter 2. Typical stratigraphic sections of the Upper Permian
 a. Ufimian stage (Bogov, A., Silantiev, V.)
 b. Kazanian stage (Esaulova, N.)
 c. Tatarian stage (Gusev, A., Lukin, V.)

Chapter 3. Brief petrographic description of the Upper Permian (Mukhutdinova, N.)

Chapter 4. Facies changes of the Upper Permian in Volga and Kama regions (Ignatiev, V.)

Chapter 5. Biostratigraphy analysis of the main groups of organic remains. Stages of development and methods of application; pelecypods, ostracods, brachiopods, bryozoans, corals, foraminifera, fishes, charophyta, flora, miospores, vertebrates (Gusev, A., Lukin, V., Igonin, V., Gomankov, A., Silantiev, V., Shelekhova, G., Koloda, N., Kisilevsky, F., Minikh, M., Molostovskaya, I., Esaulova, N., Ivakhnenko, P.)

Chapter 6. Paleomagnetic characteristics of typical sections of the Upper Permian
 a. Magneto-stratigraphical sections (Burov, B.)
 b. Fine structure of geomagnetic field (Nurgaliev, D.)

Chapter 7. Boundary between the Permian and Triassic (Lozovsky, V.)

Chapter 8. Prospects of correlation of the Upper Permian
 a. In the Eastern—Europe subregion (Gusev, A., Molostovskaya, I., Esaulova, N.)
 b. With Biarmian, Tethyan and Angarian regions (Kotlyar, G.)
 c. With the regions of Barents sea — Kolguyev Island; using miospores (Fefilova, L.)
 d. With Canadian Arctic; using miospores (Utting, J.)

Chapter 9. Main problems of further study of the Upper Permian (Kotlyar, G.)

Chapter 10. Description of organic remnants of pelecypods, ostracods, bryozoans, brachiopods, corals, foraminifera, fishes, charophyta, flora, terrestrial vertebrates (Gusev, A., Lukin, V., Silantiev, V., Bogov, A., Igonin, V., Esaulova, N., Gomankov, A., Koloda, N., Shelekhova, G., Molostovskaya, I., Kisilevsky, F., Minikh, M., Ivakhnenko, P.)

- Literature references

- Paleontological plate

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17. PERMIAN—TRIASSIC BOUNDARY WORKING GROUP Newsletter no. 3, October 1994

The Permian—Triassic Boundary Working Group proposed four candidates for the stratotype of this boundary during the 1993 meeting. In the past year vigorous work has been carried out on three of the candidate sections (Yin et al. in cooperation with Hallam et al. and Hansen, Li et al.; Wang, Geldsetzer and Shen, Orchard). Work on the fourth one (Guryul Ravine) was blocked by the unstable conditions in Kashmir. Two workshop meetings have been held in Guiyang, China (August 30, 31 attended) and Albrechtsburg, Austria (September 10, 23 attended) respectively. Fifteen non-Chinese, including Remane (Chairman of ISC), Gohrbandt (General Secretary of ISC) and 5 PTBWG members, participated in the field excursions of Meishan and Shangsi in South China (August 21—27). In addition, work was continued by members in important areas such as Arctic Canada (Henderson, Baud et al.), Iran (Golshani et al.) and South China (Yang et al., 1994). Results have been published in Albertiana 12, 13 and Permophiles 24, and also reported in about ten presentations in two 1994 meetings (International Permian Symposium, Guiyang; Shallow Tethys 4, Albrechtsburg). Census (including members and non-members) were made in PTBWG workshops held in the two meetings. The results of sections being favoured are Meishan (22), Guryul (1), and Meishan (4), Guryul (3) respectively, with sections of Shangsi and Selong receiving no support. A distinct tendency is to apply the presence of the conodont (*Hindeodus parvus*) instead of the ammonite (*Otoceras*) as the index of Permian—Triassic boundary. A workshop on the definition and lineage of *H. parvus* took place at the Guiyang meeting, chaired by Yin. The majority seems agreeable on the nomenclature and definition (sixmembrante apparatus) of this species, and a lineage was suggested (*latidentatus-parvus-isacica*) by Kozur and Wardlaw. During the Permian meeting (August 28—31, Guiyang), Professor Remane, chairman of the International Commission of Stratigraphy, gave a very positive evaluation on the progress of Permian—Triassic boundary research.

Meishan section. Yin et al. (1994) made a comprehensive review and recommended the D section of Meishan and the first appearance of *Hindeodus parvus* at the base of Bed 27c as GSSP of Permian—Triassic boundary. Wang (1994) suggested the Zhongxin Dadui section of Meishan and the first appearance of *H. parvus* morphotype 1 as the GSSP. The Meishan sections are so far the only sections of Permian—Triassic boundary candidates where integrative stratigraphic have been investigated. Chrono-, chemo-, and evento- stratigraphic results have been widely reported. Researches on eco- and sequence stratigraphy will soon be published. This is the only Permian—Triassic boundary candidate where relatively accurate isotopic data has been obtained (Claoué-Long et al., 1991; Zhang et al., 1992). However, finding of *Otoceras* is not confirmed, and magnetostratigraphy done by Li, 1987—1989 and Hansen et al., 1993 is so far fruitless.

Guryul Ravine section. This is the only Permian—Triassic boundary candidate where both *H. parvus* and *Otoceras* are presented. Unlike Selong this section is not condensed. The boundary lies within Khunamuh E1 and E2 which is considered lithologically continuous by some authors. However, the political uncertainty of Kashmir prevents further investigation on that section. Contacts with Indian organizations for further cooperation have so far been unsuccessful. Here we call attention to the shortcomings noticed by Wang (1990, Palaeontologia Cathayana, 5), some of which was reiterated by Baud in the workshop meeting, i.e., the turbiditic nature of Khunamuh Formation; metamorphism (>300°C) judged by black colour of conodonts; lack of chrono-, chemo- and magneto- stratigraphic data; and lack of ammonoids in E1. Moreover, the Changxingian (Dorashamian) age of Zewan and/or Khunamuh E1 is not confirmed. The discontinuity between Zewan and Khunamuh, 2.6 m below the suggested Permian—Triassic boundary between Khunamuh E1 and E2, poses another problem. During the workshop meeting in Guiyang, Drs. Remane and Gohrbandt emphasized that the Permian—Triassic boundary should not be placed in a section where discontinuity has already been recognized within such short distance from Permian—Triassic boundary and that a considerable thickness of continuous sequence above and below Permian—Triassic boundary is needed for security.

Shangsi section. Displays a continuous and well-exposed Wujiapingian—Dienerian sequence, and can be correlated in detail with the Meishan section. Work has been continuing in 1993 and 1994, partly with Hallam and Wagnall. The main problem is the lacking of both *H. parvus* and *Otoceras* at the basal beds. Samples collected in the last two years have been barren.

Selong section. Geldsetzer et al. reported in the Guiyang workshop that the 'clay bed' between 'Changxingian' and 'Prechangxingian' is a fracture fill by fibrous calcite. The 7 cm thick 'Changxingian' is a reworked band with matrix derived from underlying 'Prechangxingian' crinoidal grainstones. Jin and Shen reported that 80 per cent of the brachiopods are fragmental but the species composition are the same as those in the 'Prechangxingian'. No typical

Changxingian conodonts or ammonoids have been reported yet. The negative excursion of carbon (and oxygen also) isotope occur at 1.5 cm from the base of 'Changxingian'. The contact with overlying *Otoceras* level is an uneven surface. The coexistence of *H. parvus* and *Otoceras* is reconfirmed by Orchard (1994) at this level, although he reported that *Isacicella isarcica* occurred slightly higher in the same bed, not on the same sample containing *Otoceras* as reported by Rao and Zhang (1985). Previous work reported *N.* (or *Clarkina*) *changxingensis* and *deflecta* at the same level, but this was not confirmed by Orchard.

It is now clear that there is no confirmed Changxingian in this section. The 'Changxingian' may be reworked sediments deposited in earliest Triassic judging from the location of carbon excursion. The *Otoceras* level may also be reworked or condensed and discontinuities existed close to or even right below it.

Other sections. Important work on the Sverdrup Basin of Arctic Canada has been carried out by Henderson, Baud et al. Italian and Hungarian colleagues are working on the Permian—Triassic boundary of southern Alps and Bueck Mts. A Sino-Iranian team (Golshani, Jin et al.) will do work in central and northwestern Iran next year. Kotlyar, Kozur and Zakharov have published a paper suggesting the Dorashamian section 2 and the Sovetashen section as parastratotypes of Permian—Triassic boundary (Albertiana, 12). Yang et al. (1994) reported coexistence of *Hypophiceras* and *H. changxingensis, H. deflecta* at the lower transitional bed of the Lower Yangtze.

Work plan

Work on Meishan and Shangsi will be continued by a Chinese group and partly in cooperation with Hallam, Erwin and Hansen. A search of the conodonts near the Permian—Triassic boundary, especially the boundary clay and shale, as well as the *parvus* lineage, are emphasized. Jin, Geldsetzer and others will do laboratory work on the Selong section from 40 m below the Permian—Triassic boundary to 50 m above it. Contacts have been made with Kapoor to continue work on Guryul Ravine. Results will be published in a book before the 30th IGC (1996).

Many members clamour for speeding up of the solution to the Permian—Triassic boundary and stressed that otherwise still more of them will have retired before they see the results. This newsletter asks all members to express opinions on this subject in Albertiana or Permophiles and call for additional candidates if any. We will have to take some action before and during the 30th IGC.

Membership

Besides the 21 members mentioned in Newsletter No. 1, the chairman suggested 4 members and 4 corresponding members in Newsletter No. 2. Following Kozur's proposal the chairman suggests Dr. Wang Chenyuan (Nanjing Institute of Palaeontology), who is now actively working on the Permian—Triassic boundary, as member of the PTBWG. This nomination has to be verified pending comments from the existing members and acceptance by the recommended person himself.

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18. ANNUAL REPORT OF TETHYAN, CIRCUM-PACIFIC AND MARGINAL GONDWANAN LATE PALEOZOIC AND EARLY MESOZOIC CORRELATION (BIOTA, FACIES, FORMATIONS, GEOCHEMISTRY AND EVENTS)

IGCP Project 359 (1993-1997)
Newsletter no. 5, October 1994

1. Summary of major past achievements of the project

The project has involved 180 members from 25 countries and established cooperation with IGCP Projects 306, 321, 335, and GSGP Project (Pangea). In 1993, two meetings were held with participation of 42 members from 15 countries; 4 books, 20 papers, 30 abstracts and 4 maps were published. Permian—Triassic boundary, evento- and sequence stratigraphy for Permian and Triassic as well as Tethyan Permian—Triassic palaeogeographic maps have made considerable progress during 1993. The project obtained 'excellent' evaluation and 'high' funding from the assessments of the IGCP Scientific Board for 1993.

2. Achievements of the project in 1994

2.1. General Scientific achievements

In view of the main objectives proposed by this project, our recent ef*f*orts are concentrated on two tasks: research on boundaries and zonations of Permian and Triassic systems, series and stages which are the premises of regional stratigraphy and integrated regional stratigraphic charts which are the basis for interregional correlation.

1. Progress conducted by project members on boundaries and zonations of Permian and Triassic systems, series and stages.

The Permian—Triassic Boundary Working Group (chaired by H.F. Yin and Y. Zakharov) proposed four candidates for stratotype of this boundary during 1993 meeting. In the past year vigorous work has been carried out on three of the candidate sections (Yin et al., in cooperation with Hallam et al., and Hansen, Li et al., Wang, Geldsetzer and Shen, Orchard). Work on the fourth one (Guryul Ravine) was blocked by the unstable conditions in Kashmir. In addition, work was also carried out by members in important areas such as Arctic Canada (Henderson, Baud et al.) and Iran (Golshani et al.). Results have been reported in about ten presentations in the two 1994 meetings of this project (see 2.2). Census were made in the workshops of the two meetings. The results of sections being favoured are Meishan (22), Guryul (1), and Meishan (4), Guryul (3) respectively, with sections of Shangsi and Selong receiving no support. A distinct tendency is to apply conodonts (*Hindeodus parvus*) instead of ammonites (*Otoceras*) as the index for the Permian—Triassic boundary. A workshop on the definition and lineage of *H. parvus* took place at the Guiyang meeting chaired by Yin. The majority seems agreeable on the nomenclature and definition (sixmembrante apparatus) of this species, and a lineage was suggested (*latidentatus-parvus-isacica*). During the Permian meeting (28—31, Guiyang), Professor Remane, Chairman of the International Commission of Stratigraphy, gave a very positive evaluation on the progress of Permian—Triassic boundary research.

In previous years the Permian—Triassic boundary and the Asselian—Sakmarian— Artinskian boundaries were nearly established, and Chihsian or Cathedralian has been proposed for post-Artinskian, pre-Guadalupian. This year B. Glenister reiterated his proposal on the Guadalupian as a series. Finding of relatively complete Maokouan—Wujianpingian conodont sequence enables connection between the Guadalupian and Lopingian. On this basis Y.G. Yin (Chairman of Subcommission of Permian Stratigraphy) et al. proposed a four-fold subdivision of the Permian system and its stage scheme which received widespread attention. However the idea of three-fold subdivision still persists (Yang, Ueno on Shallow Tethys meeting, 1994).

M. Gaetani (Chairman of Anisian—Ladinian Boundary Working Group) reported the fruitful results of the Anisian—Ladinian boundary field workshop (1993). He and his colleagues (Black, Rieber, Muttoni, Voros et al.) set forth suggestions for the candidates of Olenekian—Anisian boundary (Chios, Dobrudgea?) and Anisian—Ladinian boundary (Bogolino, Felsoors). A section in Somerset, UK, was proposed as the Triassic—Jurassic boundary candidate by G. Warrington (Chairman of Jurassic—Triassic Boundary Working Group). Y. Zakharov presented the Induan—Oleneking boundary in the Tethys and Boreal realm.

In summary, 1993—1994 was a productive year for progress in research of Permian and Triassic boundaries.

2. Progress conducted by project members on regional stratigraphical charts of Permian and Triassic.

After the 1993 workshop meeting (Calgary) a panel was formed to establish an integrative stratigraphic chart of the Permian and Triassic of different regions with Tethyan, Circum-Pacific and marginal Gondwana. In the books 'Zonal subdivision and interregional correlation of Palaeozoic and Mesozoic of Russia and adjacent territories' (1994), G. Kotlyar and V.A. Gavlirova played a major role in compiling the parts of marine Permian and Triassic. G. Stanley and G. Kotlyar presented preliminary regional stratigraphic correlation charts for Permian—Triassic of North American terranes and Permian of Russia respectively. Y. Ezaki (leader of Japanese group) showed the preparatory scheme of deep sea radiolarian zonation of Permian—Triassic and its correlation with shallow sea biozonation based on Japanese data, which has the potential of development in a very important domain. Australian, Turkish, Iranian, Indian, Vietnamese and New Zealand colleagues have been organized to establish the charts of marginal Gondwana regions. In order to coordinate the form of charts, H.F. Yin presented in the workshop meetings the regional stratigraphic charts of the Triassic of South China, which consists of five charts (chrono-, magneto-, evento- and sequence stratigraphy) and an explanatory text with interregional correlation. These will be distributed to all panel members.

Important contributions dealing with specific disciplines of Permian and Triassic have been made by Jin et al. (1994) on Permian palaeontology and stratigraphy, S.G. Lucas et al. (1993) on nonmarine Triassic, D. Erwin (1993) on Permian—Triassic extinction and Feng, Jiang, Mi (1993—1994) on Permian—Triassic paleogeography, as well as vigorous discussions on Middle—Upper Triassic biostratigraphy and buildups. These have greatly enlarged our knowledge of respective areas.

3. With compilation of data it becomes gradually clear that Permian—Triassic was a geologic interval of intensive global change. The changes on the surface of earth were related to the forming and breakup of Pangea which caused semi-synchronous worldwide regression and transgression, transformation of geophysical regimes, continental volcanism, glaciation and deglaciation, oceanographic anomalies and mass extinction, possibly also strengthened by extraterrestrial impact. This global change represented an episodic phase of earth's evolution, and should have deeply rooted causes in the earth's mantle and core and evolution of the cosmos. We will pursue this subject after completion of Permian and Triassic stratigraphic subdivision and correlation.

2.2. List of meetings with approximate attendance and number of countries

1. International Symposium on Permian Stratigraphy, Environments and Resources (Guiyang, China, 28—31, August), co-sponsored by IGCP Projects 359 (our project) and 306, Pangea Project of GSGP. Pre-excursion: Permian—Triassic Boundary of Meishan, Hushan (21—24, August) and Shangsi (25—27, August); post-excursion: Permian sequences in Guizhou, Guangxi and northern Tianshan. Eighty participants of 12 countries attended this meeting and 84 papers were presented for oral and poster sessions. A workshop meeting of our project (33 attended) and another affiliated workshop meeting on the index conodont (*Hindeodus parvus*) of Permian—Triassic boundary (11 attended) were held.

2. Fourth International Symposium on Shallow Tethys in association with our project, Permian—Triassic Boundary Working Group and Subcommission on Triassic Stratigraphy (Albrechtsberg, Austria, 8—11, September). Pre-excursions 1) Salzburg— Tirol and 2) Southern Alps; post-excursion, Northern Calcareous Alps; emphasizing on Late Permian, Triassic and Cretaceous. Seventy-seven participants of 15 countries attended this meeting and 61 papers presented, of which 33 dealt with Permian and Triassic. A workshop meeting (27 attended) and a special plenary session of our project took place.

3. A workshop meeting was held during the 9th International Gondwana Symposium (January, 1994, Hyderabad, India). Nine members participated, chaired by Dr. Dickins. This workshop emphasized the Late Paleozoic—Early Mesozoic correlation of the northern margin of Gondwana with other parts of the world. More effective participation of Indian and Argentina are discussed. A Triassic Symposium in Australia (1996) was proposed (see 3.2).

4. A workshop meeting of the Chinese Group was held in April, Beijing. Eleven persons participated. The meeting listed new contributions made by members, celebrated the important publications of the group (see 2.3) and discussed preparations for the Permian meeting (1994), special session in 30th IGC (1996), their field excursions and a possible international meeting in 1997.

5. Newsletter nos. 1—5 have been distributed among members and published (condensed) in Albertiana and Permophiles.

2.3. Number of Publications (including maps): list of major or most important publications

Books 9, papers about 50, abstracts about 120. Formal publications: Erwin, D.H., 1993. The great Paleozoic crisis: life and death in the Permian. Columbia University Press, New York, 327 p.

Feng, Z.Z., Jin, Z.K., Yang, Y.G., Bao, Z.D., Xin, W.J., 1994. Lithofacies and paleogeography of Permian in Yunnan—Guizhou—Guangxi region. Geol. Publ. House, Beijing, 146 p., 18 pls. (in Chinese).

Guex, J. and Baud, A. (eds.), 1994. Recent developments of Triassic stratigraphy: Proceedings of the Triassic Symposium Lausanne (1991). Memoires de Geologie (Lausanne), no. 22, 182 p., 10 pls.

Jiang, N.Y. et al., 1994. Permian palaeogeography and geochemical environment in Lower Yangtze region, China. Petroleum Industry Press, Beijing, 206 p., 8 pls. (both in Chinese and English).

Jin, Y.G., Utting, J., and Wardlaw, R. (eds.), 1994. Permian stratigraphy, environments and resources, v. 1, Palaeontology and Stratigraphy. Palaeoworld, no. 4 (spec. issue), 262 p., 9 pls.

Lucas, S.G. and Morals, M. (eds.), 1993. The nonmarine Triassic. New Mexico Mus. Nat. Hist. Sci., Bulletin, no. 3 (spec. issue), 478 p.

Mi, J.R., Zhang, C.B., Sun, C.L. et al., 1993. Late Triassic stratigraphy, paleontology and paleogeography of the northern part of the Circum-Pacific belt, China. Science Press, Beijing, 219 p., 66 pls. (in Chinese).

Oleinikov, A.N. (ed.), 1994. Zonal subdivision and interregional correlation of the Palaeozoic and Mesozoic of Russia and adjacent territories. Izdatelstvo VSEGEI, St. Petersburg, Part 1 (Palaeozoic), 158 p., Part 2 (Mesozoic), 184 p. (in Russia).

Yin Hongfu, Yang Fengqing, Huang Qisheng, Yang Hengshu, Lai Xulong, 1993. The Triassic of Qinling Mountains and neighbouring areas. China University of Geosciences Press, Wuhan, 211 p. 20 pls. (in Chinese and English summary).

Informal Publications:

Kristan—Tollmann, E. (ed.), 1994. Abstract volume of the Fourth International Symposium on Shallow Tethys, 64 p.

Jin, Y.G. (ed.), 1994. Abstract volume of the International Symposium on Permian Stratigraphy, Environments and Resources, 53 p.

2.4. Activities involving other IGCP Projects, IUGC or major participation of scientists from developing countries

Cooperation has been carried out between this project and Permian and Triassic Subcommissions of IUGS, IGCP Projects 306 (Stratigraphic Correlation in S.E. Asia, leader Vu Khuc), 321 (Gondwana Dispersion and Asian Accretion, leader Ren Jishun), 335 (Biotic Recovery from Mass Extinctions, leader D. Erwin), GSGP Project (Pangea, Carboniferous to Jurassic, leader B. Beauchamp) and Shallow Tethys International (leaders G. Piccoli et al.). Meetings of 1993, 1994 and forthcoming years have been and will be largely realized through joint sponsorship with them (see 2.2 and 3.2).

Six developing countries (China, India, Iran, Jordan, Turkey and Vietnam) have participated in this project involving 39 scientists. India has hosted a workshop meeting (1994) and is now discussing the possibility of holding a project meeting in 1996. A Sino-Iranian team led by Jin and Golshani will begin Permian research in Iran next year. In 1995 Vietnam (Trau et al.) will host a project meeting and Turkey (Guvenc et al.) will conduct a Carboniferous—Triassic field excursion. A US—China cooperation led by Erwin (leader of Project 335) on Permian—Triassic extinction-recovery and snail evolution is underway. Besides, the project enjoys vigorous participation of Russia and Eastern European countries; workers in Russia and Hungary have been very active this year.

3. Proposed activities of the project for the year ahead

3.1. General goals

As stated in 2.1, our efforts will concentrate on the boundaries of the Permian and Triassic systems, series and stages and integrated regional stratigraphical charts. Most leaders of boundary working groups are members of this project and they have been conducting stimulating work within the scope of project. The boundary research of Triassic—Permian, Lopingian—Guadalupian and Ladinian—Anisian—Olenekian are very active and are approaching a consensus in near the future, especially during the 30th IGC (1996). Distinctive from the stratigraphic subcommissions, our boundary research will emphasize integrated stratigraphy in view of global or interregional geological episodes, not only dealing with biostratigraphy.

Team work on regional stratigraphical charts is underway and a few results have come out. The project has announced its policy to give support to those who will report their achievements at international meetings, and organize a final publication based on these achievements. More results are expected to be presented in the 1995 meetings.

On the basis of these two aspects, the project will try to organize research on the global changes during Permian—Triassic with the prospect that they have deeply rooted common causes, semi-synchronous interactions but different threshold values and timings of execution. This research will greatly add to our understanding of this important period of geological history and may shed light on the present and future of global change that mankind is now facing.

*3.2. Specific meetings and field trips (*indicates participation by developing countries)*

The following meetings, either independent or in association with other projects and meetings, have been scheduled for 1995 and 1996:

1. International Symposium on Geology of Southeast Asia and adjacent areas — a joint meeting of IGCP Projects 306, 321 and 359.
Date: November 1—3, 1995
Venue: Hanoi, Vietnam
Organizing Committee: Trau Van Tri (chairman), Phan Cu Tien (vice chairman, Research Institute of Geology and Mineral Resources, Thanh Xuan, Dong Da, Ha Noi, Vietnam), Dang Vu Khuc (vice chairman), J. Charvet, J.M. Dickins, H. Fontaine, S. Hada, I. Metcalfe, Ren Jishun, Tongdzuy Thanh, Yin Hongfu, Trinh Dzanh (secretary general).

Scientific topics:

- Stratigraphic correlation of South and East Asia
- Paleobiogeography of South and East Asia in Permo-Triassic
- All aspects of Gondwana dispersion and Asian accretion
- Economic geology in South and East Asia

Field excursion (post-symposium)

- Song La section of Permian—Triassic boundary, 3 days
- Song Ma suture zone, 4 days
- Quang Ninh coal basin, 3 days

2. Field excursion on outcrops of the Permian—Triassic and Carboniferous—Permian sequences at the Anatolian Platform (Hadim Nappe) in the Western Taurus Mountain Belt. This is in affiliation with the 6th International Symposium on Fossil Algae and Carbonate Platforms (September 18—22, 1995).
Date: September 24—27, 1995
Venue: Ankara, Turkey
Organizing Committee: T. Guvenc (H. U. Faculty of Engineering, Department of Geology, Beytepe, 06532, Ankara, Turkey), V. Toker, V.S. Ediger, G. Eseller, I.H. Demirel, M. Dogan, K. Erodogan.

3. The International Congress on Triassic Biostratigraphy, co-sponsored by Queensland University of Technology, IGCP 359 and the Gondwana Subcommission.
Date: April 9—12, 1996
Venue: Brisbane, Australia
Organizers: J.M. Dickins (chairman, co-leader of IGCP 359), John Rigby, S.C. Shah, Yin Hongfu

Scientific topics:
- Triassic—Jurassic boundary
- Triassic stratigraphy
- Triassic climate
- Permian—Triassic boundary sequence

4. Symposium on the Permian—Triassic Boundary and Global Triassic Correlations in Marine and Nonmarine Environments — 30th IGC, 1) Stratigraphy, Symposium 1.7. — together with an excursion to Permian—Triassic sections in Changxing and Hushan.
Date: August 4—14, 1996
Venue: Beijing, China
Convenors: Yin Hongfu, S. Lucas

Three of the four meetings will be hosted by developing countries. Possibility of a fifth meeting hosted by the Indian group is now under discussion.

3.3. Proposed major publications

At least 7 monographs and special issues in connection with this project have been scheduled with names of both books and their authors tentative.

Baud, A., Zakharov, Y., Dickins, J.M. (eds.). Late Paleozoic and Early Mesozoic Circum-Pacific bio-, geological events, a symposium of the International Field Conference on Permian—Triassic Biostratigraphy and Tectonics in Vladivostok. Papers have been collected and are now being edited.

Dickins, J.M. Yang, Z.Y., Yin, H.F. Late Palaeozoic and Early Mesozoic Circum-Pacific events and their global correlation. Manuscripts of 25 papers have been submitted to Cambridge University Press for publication.

Beauchamp, B. and Embry, A. Symposium of Pangea, Carboniferous to Jurassic. It includes a number of presentations by IGCP 359 members.

Jin, Y.G. et al. Publication of the International Permian Symposium. Papers being collected.

Kristan-Tollmann, E. Shallow Tethys 4. Papers being collected.

Yin, H.F. et al. Upper Permian to Middle Triassic ecostratigraphy and sequence stratigraphy of Yangtze Platform and its margins (in Chinese with English summary) has been submitted to the Science Press, Beijing and will be published in 1995.

Yin, H.F. Triassic of East Asia (in Chinese). First proofs of this book is now being read by the author. It will be published in 1995.

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19. AVAILABILITY OF PERM CONFERENCE PAPERS

Some members have asked as to how they can obtain Perm conference papers that were published by the Earth Sciences and Resources Institute (ESRI) University of South Carolina. These include:

Occasional Publication ESRI 8A-B (1992) Gas resources E. Europe/Contributions to Eurasian Geology

Occasional Publication ESRI 9A-B (1993) Bibliography of South American Geology/Contributions to Eurasian Geology

Occasional Publication ESRI 10 Permian System. Guides to geological excursions in the Uralian type localities (1993)

Occasional Publication ESRI 11 A-B (title not finalised)/ Contributions to Eurasian Geology (in prep.)

All the Occasional Publications are printed as single volumes. Price for individual use $25 US plus postage (regular or airmail). They may be ordered through the ESRI-Librarian at the address and fax given below:
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(phone 803-777-2932;
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OCCASIONAL PUBLICATION ESRI NO. 8B

Table of Contents

OCCASIONAL PUBLICATION ESRI NO. 9B

Table of Contents

ANNOUNCING
THE GUADALUPIAN SYMPOSIUM II
APRIL 4—6, 1996
ALPINE, TEXAS

SPONSORED BY THE GEOLOGY DEPARTMENT OF SUL ROSS STATE UNIVERSITY, THE UNITED STATES GEOLOGICAL SURVEY, AND THE PERMIAN SUBCOMMISSION (ICS-IUGS)

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INCLUDING:

1. A FIELD TRIP TO THE PROPOSED BOUNDARY STRATOTYPES OF THE BASE OF THE GUADALUPIAN SERIES AND ROADIAN STAGE, THE WORDIAN STAGE, AND THE CAPITANIAN STAGE, ALL WITHIN THE GUADALUPE MOUNTAINS NATIONAL PARK.

2. DETAILED DISCUSSION OF THE UPPERMOST BEDS OF THE GUADALUPIAN AND SUCCEEDING SERIES.

THIS IS THE FIRST ANNOUNCEMENT.

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