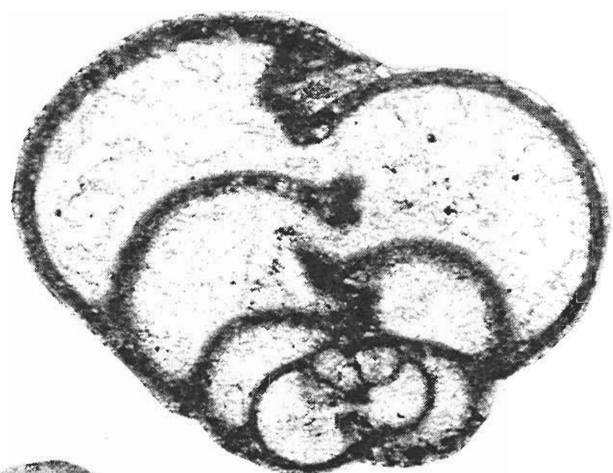
# Permophiles

No. 20 June, 92

A NEWSLETTER OF SCPS



SUBCOMMISSION ON PERMIAN STRATIGRAPHY

INTERNATIONAL COMMISSION ON STRATIGRAPHY

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

CONTENTS



Upper Left: *Cribrogenerina gigas* (Suleimanov, 1949) (34x), "Sakmarian", Belcher Channel Formation, Hamilton Peninsula, west-central Ellesmere Island, Canada.

Upper Right: *Globivalvulina* sp. nov. (86x), "Sakmarian" Nansen Formation, west side of Blind Fiord, southwest Ellesmere Island, Canada.

Center: *Bradyina lucida* Morozova, 1949 sensu Korolyuk and Rauzer-Chernousova, 1977 (34x), Nansen Formation, west side of Blind Fiord, southwest Ellesmere Island, Canada.

Photographs provided by S. Pinard

## 1. CHAIRMAN'S NOTE (ELECTION RESULTS)

Titular members were asked to vote for a new executive for the next four year term of duty. There were two candidates for the post of chairman, six for the two posts of vice-chairmen, and two for the post of secretary. Elections were held by mail and the results are as follows: Chairman: Jin Yugan; Vice-chairmen: B.I. Chuvashov and C. Spinosa; Secretary: J. Utting.

Jin Jugan

## 2. SECRETARY'S NOTE

I should like to thank all those who contributed to this issue of "Permophiles". The next issue will be in November 1992; please submit contributions by October 15.

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## 3. NUMERICAL TIME SCALE FOR THE PERMIAN

Time scales have some uncertainties, especially for the Permian period. The main problems are:

1. There is no agreement about the number and the names of Permian stages or subdivision into two or three Permian series.

2. Reliable radiometric data for the calibration of the Permian stratigraphic units are rare.

3. The time correlation between important Permian profiles is often doubtful, especially between marine and continental facies.

For the numerical calibration of Permian stages and other stratigraphic units a combination of relevant time-data derived by all available methods are needed, e.g. biostratigraphy, lithostratigraphy, magnetostratigaphy, chronostratigraphy, and last but not least, isotope-geochronometry. A first attempt was made by MENNING (1989, figure columns 1, 31; Tatarian stage re-drawn). An improved scale including comments is in preparation by the author for "The Permian of the Northern Continents" (SCHOLLE & PERYT eds.).

NUMERICAL TIME SCALE FOR THE PERMIAN

Figure 1

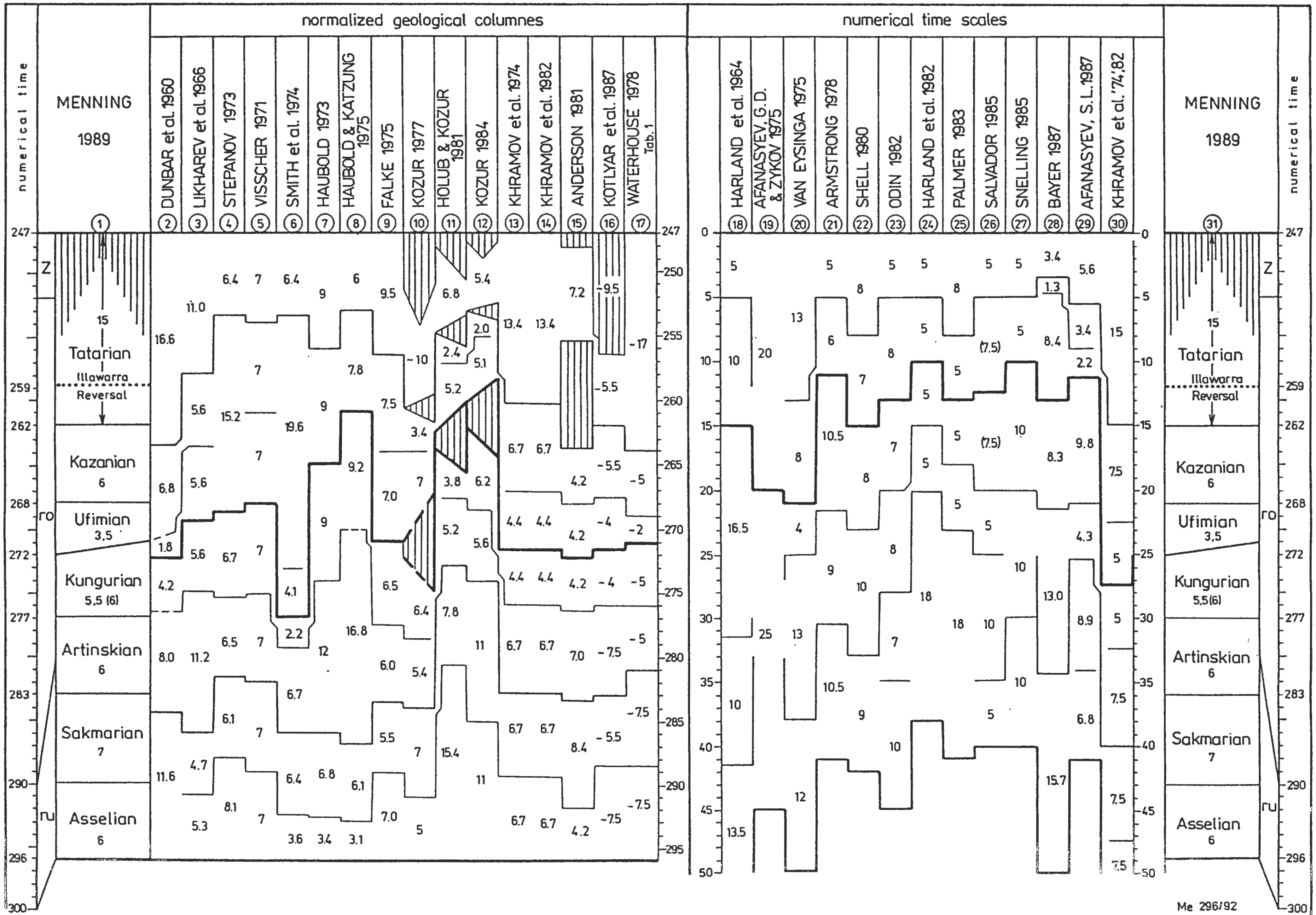

Figure 1 shown here is based on an unpublished compilation of time-relevant data available in 1988, and re-drawn in 1992. Although the improved age for the Permian/Triassic boundary is nowadays 251 ±3 Ma (CLAOUÉ-LONG et al. 1991) instead of 247 Ma the figure shows the present situation. The duration of Permian stages is seen to be quite different. It looks like chaos.

On the right side "normalized geological columns" are compared. That means, published stratigraphic columns show the stages of the traditional Permian standard section of Russia, are transformed on a Permian period with an estimated duration of 49 Ma. Of course, the authors of the 17 publications listed did not know the real time ratios between the stages, but they made the columns from geological data such as number of biozones, equal length of stages or substages, thicknesses, and so on. Most authors did not elaborate on the duration of stages.

Obviously the estimation of the duration of the stages depends on the working area. Specialists studying the marine sequences, subdivide the Russian Permian into two parts of comparable lengths (columns 2-5, 10, 13-17). On the other hand, scientists working only on Rotliegendes and Zechstein, attribute more time to the "Lower Permian" than to the "Upper" Permian (columns 7-8, 11-12) because of their belief that the Rotliegendes lasted longer than the Zechstein. However, the Zechstein is not equivalent to the Upper Permian (Ufimian + Kazanian + Tatarian = Guadalupian + Ochoan), but it is much shorter corresponding only to the upper Upper Tatarian (VISSCHER, 1973, MENNING 1986).

For instance KOZUR shows in his conodont paper (1977, column 10) a lower and an upper Permian of comparable length. In his 1981 paper (together with HOLUB) and 1984 paper (columns 11-12) his lower Permian is about three times longer than the upper Permian (middle and upper Permian in his sense). But in both papers he expressed correctly that the length of the stratigraphic units are not time-equivalent.

On the left side of the figure are shown 13 numerical time scales. Except the scales of KHRAMOV et al (1974, 1982, column 30) the lower Permian is much longer than the upper one. This can be explained by three suppositions:

- As the result of the introduction of new decay constants (STEIGER & JÄGER 1977), of improved radiometric data, and of the discovery that some older age determinations were incorrect, the upper and lower boundary of the Permian became distinctly older (20-15 Ma). But the age of the lower/upper Permian boundary was not lowered adequately because there is no single reliable radiometric datum for the late Early, "Middle" and early Late Permian time derived from a well defined biostratigraphic unit! Therefore the published numerical ages of that time span are speculative in many cases. And therefore up to now we can estimate numerical data only by geological means.

It is not clear why the Tatarian should have a duration of 3.4-8.0 Ma only (7-13% of the Permian time, columns 18, 21-29) although it contains about 40% of the thickness of the whole Permian sequences on the East European Plate and its marine equivalents include 10 ammonite zones! (correlation by magnetostratigraphy, KOTLYAR et al. 1984, 1987). This short Tatarian and this small upper Permian is based on unreliable dating (for instance potash salt of Solikamsk ±240 Ma - Middle Triassic now), on the uncritical adaption of (insecure) older time scales, and on the erroneous correlation of Zechstein and Upper Permian.

The proposed time scale (MENNING 1989, columns 1, 31, Z=Zechstein, ro=upper Rotliegendes, ru=lower Rotliegendes) is based on isotope-geochronometric deta for the lower and upper boundary of the Permian, on the indirect numerical dating (age estimation) of the Illawarra reversal in the Tatarian (MENNING 1986), on the knowledge that there is a distinct gap between the Tatarian and the base of the Triassic, on an estimation of the duration of stages by the number of ammonoid and conodont zones, and on typical thicknesses on the East European Plate. I believe that this geological based numerical time scale is more reliable than the older one made without sufficient radiometric data.

**References**

CLAOUÉ-LONG, J.C., ZHANG, Z., MA, G. & DU, S., (1991). The age of the Permian-Triassic boundary. Earth Planet. Sci. Lett., **105** 1/3, 182-190.

KOTLYAR, G.V. et al., 1987. The stages of Permian deposits of the tethyan region and its global correlation. Sovetskaya geologia 7, 53-62. (in Russian).

MENNING, M., (1989). A Synopsis of Numerical Time Scales 1917-1986. Episodes **12** 1, 3-5.

MENNING, M., (1986). Zur Dauer des Zechsteins aus magnetostratigraphischer Sicht. Z. geol. Wissl, Berlin, **14** 4, 395-404.

VISSCHER, H., (1973). The Upper Permian of western Europe - a palynological approach to chronostratigaphy. Canad. Soc. Petrol. Geol., Mem., Calgary, **2**, 200-219.

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# The Permocarboniferous of the Northern Black Forest (SW-Germany) — First results in stratigraphy

by

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During the last two years, the Karlsruhe group was working mainly on lithostratigraphic and facies related problems of the southwest Germany Permocarboniferous sedimentary rock pile. In this paper we present first results of this work and some research projects which are in progress yet.

## 1. Introduction and geological setting

The Black Forest and the adjacent parts of southwest Germany and the Northern Vosges (eastern France) are part of the Variscan Permian Province su. FALKE (1972, 1976). In this region the Baden-Baden basin constitutes one of the largest and best known outcrop areas of Permocarboniferous sediments and volcanics and was thus considered as a striking example of the history of Permocarboniferous basin formation along the Moldanubian/Saxothuringian boundary (LÖFFLER, 1992). We now consider the Permocarboniferous basin formation as a result of crustal extension in the Black Forest region (Moldanubian) as currently shown by ECHTLER & MALAVIEILLE (1990) and ECHTLER & CHAUVET (1992). The area mentioned above thus forms part of a late Hercynian mid-european basin-and-range-province (MÉNARD & MOLNAR, 1988). The Baden-Baden basin comprises the southernmost part of a much larger trough covered by the triassic of the Kraichgau (Weiler-Oos-Main-Saale-Trough, FALKE, 1971, 1976). In the south, the basin is bounded by a synsedimentary active, listric master normal fault which controlled the facies development of the basin fill (Neuweier-Gernsbach-Loffenau Fault Zone, NGLSZ, LÖFFLER, 1992, Fig.2). Whereas the N and NW extension seems to be assured (SCHÄFER, 1989) there is some discussion about the relations with the Permocarboniferous basins of the Northern Vosges (Villé, St. Dié, Nideck, MIHARA, 1935, SAUCIER et al., 1959, LAUBACHER & ELLER, 1966, HOLLINGER, 1970, CARASCO, 1983/84, 1987, LÖFFLER, 1992).

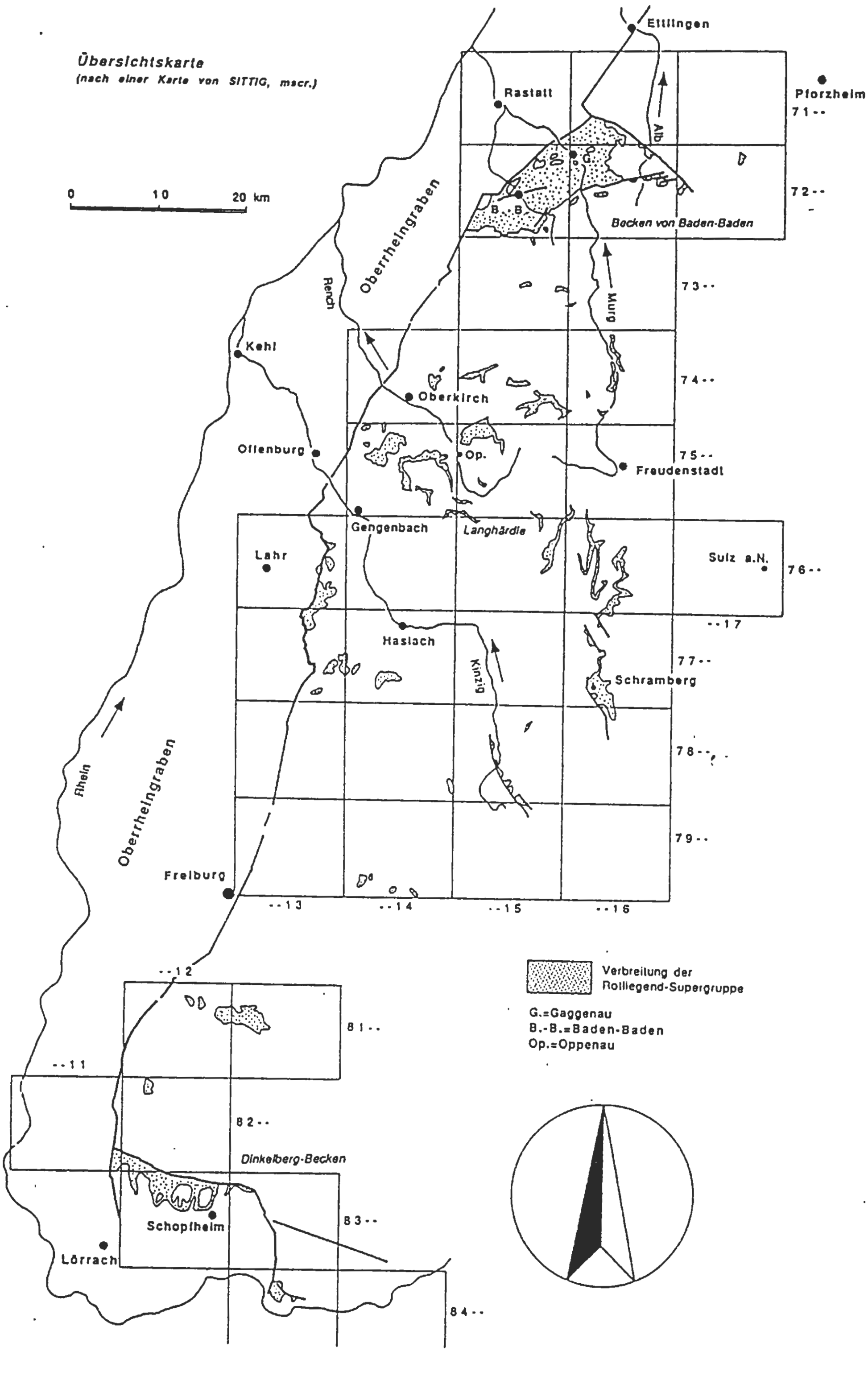


Fig.1.: Outcrop of Rotliegend rocks in the Black Forest (stippled), subsurface extension of individual basins not shown. Topographical maps are shown by rectangular grid.

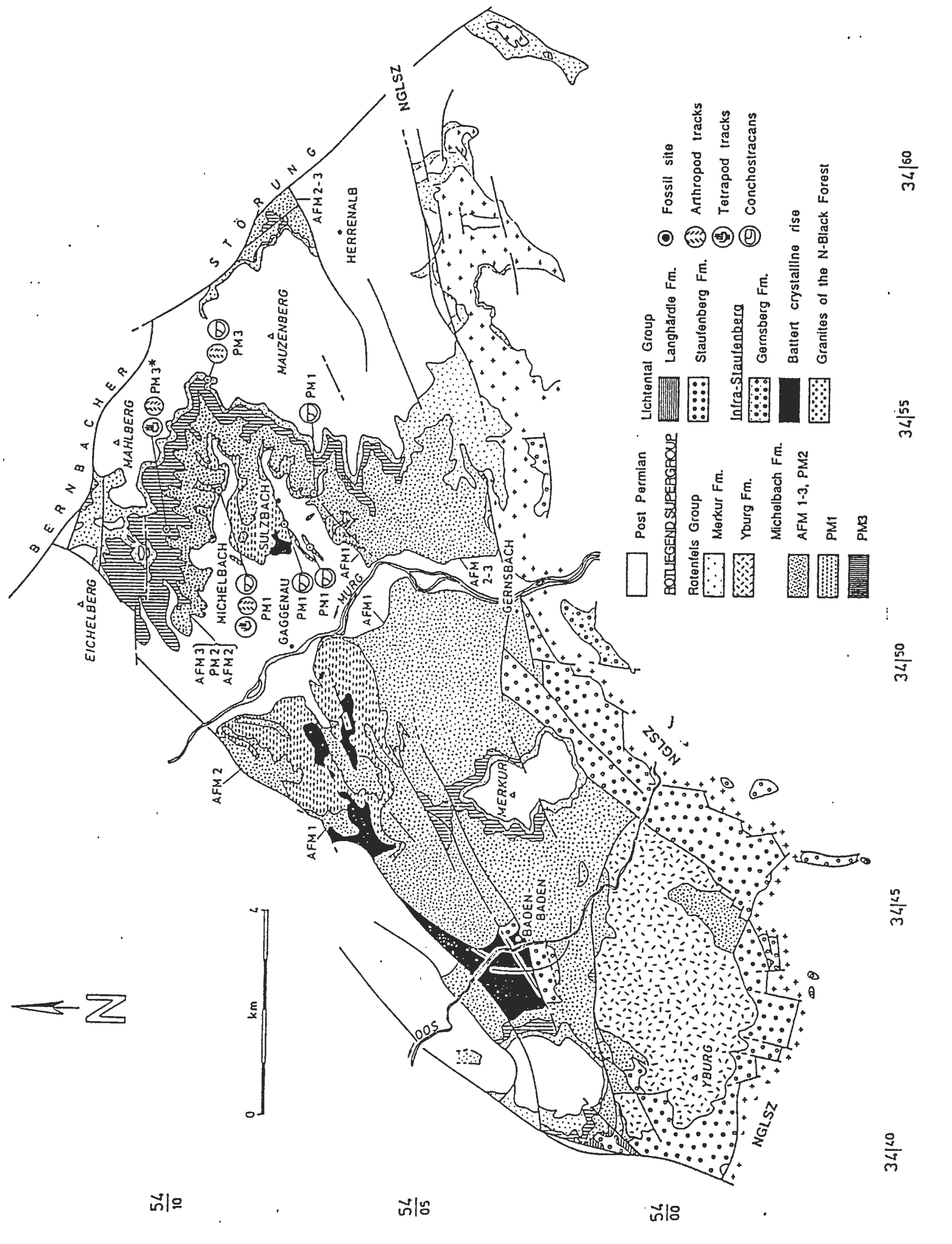


Fig.2.: Geological map of the Baden-Baden basin, asterisk marks fossil site of Fig.5.

## 2. Lithostratigraphy and basin development

Until recently, the lithostratigraphic subdivision of the Permocarboniferous rock pile was based on a very rough scheme established by ECK (1884, 1892, Fig.3). The volcano-sedimentary rock sequence of presumed Upper Carboniferous and Lower Permian age was divided into four or five quasi-lithostratigraphic units which were not clearly defined by stratotypes and also received some kind of erroneous chronostratigraphic significance (see discussion in KOZUR, 1977, 1978, 1980). There were also many attempts to correlate the scattered occurences of Permocarboniferous rocks in the Black Forest basing on crude lithostratigraphic comparisons and the supposed biostratigraphic significance of fossils such as *Uronectes fimbriatus*, *"Estheria" tenella* and *"Walchia" piniformis* (ECK, 1884, 1887, 1892, SAUER, 1892, 1894, SCHALCH, 1893, 1895, SCHNEIDER, 1966, BACKFISCH, 1984, JENKNER, 1986).

To establish a clearly defined lithostratigraphy we decided to choose the Baden-Baden basin (Fig.1, 2) because of its almost complete depositional record and its marginal position which gives us the chance to study the tectonic evolution and relationships between tectonics and facies development as well (LÖFFLER, 1992). During our field work we also found a surprisingly rich fossil record, comprising arthropod and tetrapod tracks as well as some new conchostracan occurences (LÖFFLER, 1992, LÖFFLER & WALTER, in prep.). This made it possible to draw some first comparisons between the Permian strata in the Northern Black Forest and other occurences (e.g. Thuringia). The following description of the new rock units should be considered as a first attempt to introduce a stratigraphic scheme defined strictly according to the lithostratigraphic procedure described by HEDBERG (1979, see also CODE-COMMITTEE, 1977, NACSN, 1983, WHITTAKER et al., 1991, Fig.3).

The Permocarboniferous rock suite of the Baden-Baden basin starts with coarse alluvial fan type conglomerates of mainly gray-red colour which basinwards interfinger with poorly exposed red pelitic sediments, representing a finer-grained distal facies. In general these sediments display a north- to northwestern dip, in places up to 70°. Along the marginal fault sandy coals and black shales accumulated between individual fans. These sediments, probably former swamps or bog-type areas, are considered to represent the oldest part of the basin fill. In their southernmost parts they show a strong orientation of illitic micas, possibly caused by the tectonic activity along the NGLSZ. We also found stretching lineations and hydroplastic slickensides gently dipping to the northwest, thus indicating normal detachement in this direction during the early stages of the basin formation. Similar features were described by ECHTLER & MALAVIEILLE (1990) from the Montagne Noire (Southern

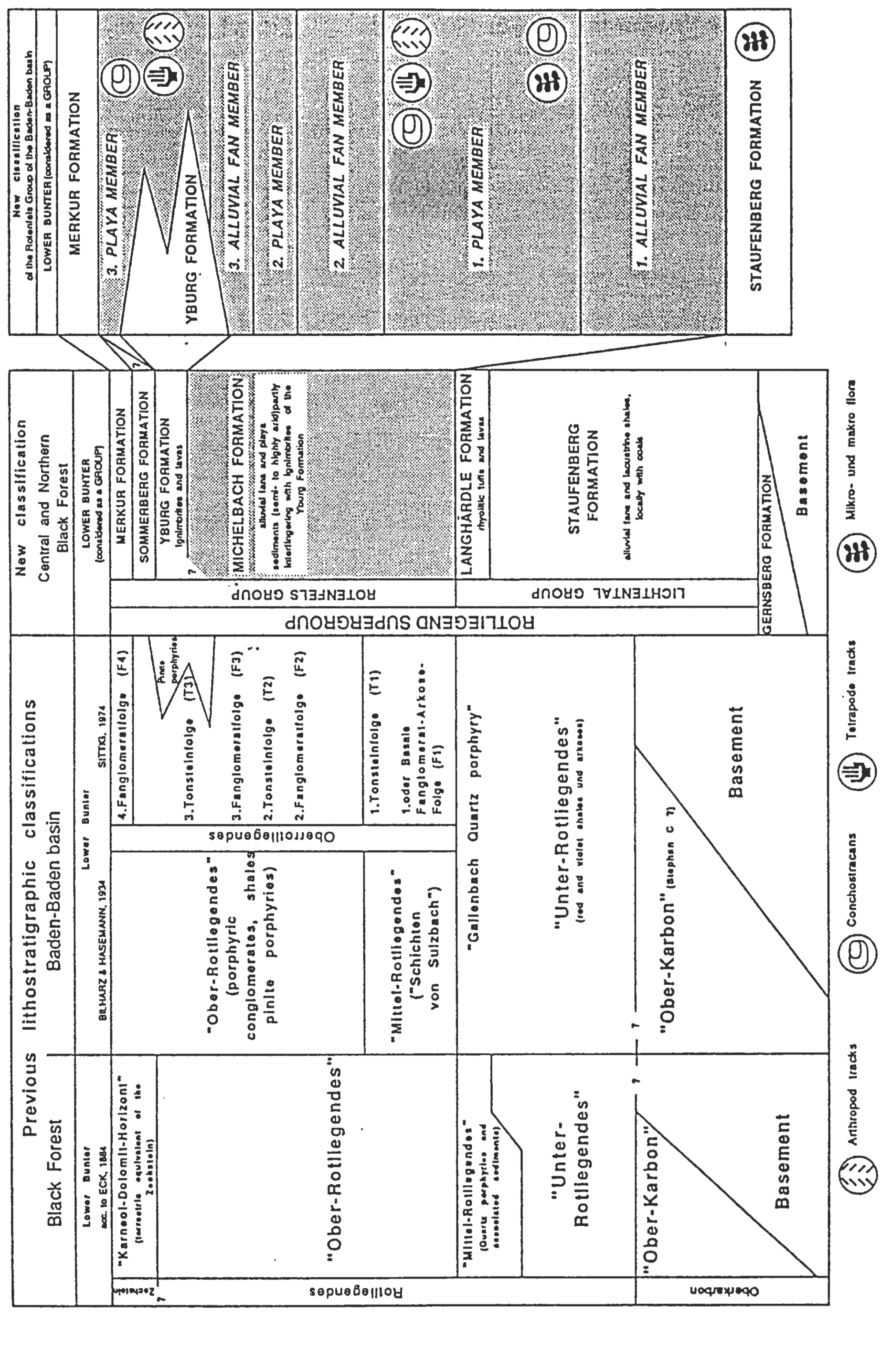


Fig.3.: Older lithostratigraphic classifications in the Black Forest and the Baden-Baden basin compared against the classification presented in this paper.

France). First investigations of illite crystallinity suggest a very low-grade metamorphism of this basal parts. We propose to group the sedimentary rocks described above into the *Staufenberg Formation* (after the village of Staufenberg near Baden-Baden). There may be some remains of older sediments unconformably overlain by the Staufenberg Formation and thus not belonging to the latter. So far sediments of this type are only known in a very few places in the northern and central Black Forest. They do not form part of the basin fills and define the *Gernsberg Formation* (after their stratotype Gernsberg south of the town of Gernsbach, Baden-Baden basin). The total thickness of the Staufenberg Formation is not known exactly due to bad exposure in their type area but must exceed 2-300 m in the Baden-Baden basin. In other parts of the Black Forest they only comprise a thin cover directly overlying crystalline basement (or rocks of the Gernsberg Formation) but display facies features similar to the Staufenberg rocks of the Baden-Baden basin.

Except for some tuffs or tuffitic layers intercalated with rocks of the Staufenberg Formation there is no evidence of volcanic activity during this time. The first extrusions of rhyolitic lavas in the Baden-Baden area are unconformably overlying conglomerates and arkoses of Staufenberg age ("Gallenbacher Quartz Porphyry", BILHARZ & HASEMANN, 1934). The same relationship applies to the occurences of rhyolites and rhyolitic tuffs of the central Black Forest. Since the exposures in the Baden-Baden basin are very restricted we prefered to choose a type section for this strata called Langhärdle in the middle Black Forest. Thus the rhyolites and rhyolitic pyroclastics overlying Staufenberg rocks were named *Langhärdle Formation.* In some places there is only indirect evidence of the lithostratigraphic position of lower permian volcanics because there exist no sediments underneath the rhyolites. Nonetheless we were able to demonstrate in almost every case that these volcanics were already under erosional conditions during the deposition of younger sedimentary strata. That means to us that they belong to the Langhärdle Formation as well. The thickness of Langhärdle volcanics varies greatly from place to place, it may reach several hundred meters of rhyolitic lavas as well as only a couple of meters of acidic tuffs.

In the whole area under investigation and especially in the Baden-Baden basin there is a major discontinuity between Langhärdle or Staufenberg rocks respectively and the overlying younger strata. Therefore we suggest to introduce as a higher lithostratigraphic unit the *Lichtental Group* which is composed of the Staufenberg and Langhärdle Formation and named after Lichtental near Baden-Baden. Since the Gernsberg Formation seems not to be related directly to the Permocarboniferous basin formation it should be excluded from these group and considered as a still older formation which seemed to be almost totally eroded before the sedimentation of the Rotliegend started.

The rocks overlying the discontinuity mentioned above and thus younger than the Lichtental Group are subsumed under the term *Rotenfels Group* (named after the town of Rotenfels near Gaggenau, Baden-Baden basin). The structural relationships in the Baden-Baden basin implie that there was a major tectonic event which marks a change in the extension from a more NW-direction during the deposition of the Lichtental Group to a northerly direction. These tectonic changes went along with the development of a newly activated normal fault system which results in an eastward expansion of the Baden-Baden basin. The sediments of this age comprise red alluvial fan conglomerates and fanglomerates which where derived from newly exhumed crystalline basement in the south as well as from older Permocarboniferous rocks mainly of volcanic origin (Langhärdle volcanics). In the more central parts of the basin a playa sequence developed, thus showing a climatic change towards more arid conditions. Periodically these playa sediments prograde towards the south, in some places almost reaching the margins of the basin. In our opinion these "transgressions" represent a predominance of tectonic subsidence over erosional processes in the hinterland therefore indicating stages of tectonic activity along the marginal fault system. During periods of relative tectonic quiescence the erosion rate exceeds tectonic subsidence giving the possibilitiy to coarse grained sediments to prograde towards the basin center. In the Baden-Baden basin this complex of three alluvial fan-type units (*Alluvial fan members 1-3*, AFM1-3) and intervening playa sequences (*Playa members 1-3*, PM1-3) defines the *Michelbach Formation* (after the village of Michelbach near Gaggenau, Baden-Baden basin).

The facies distribution during Michelbach times implies the assumption of an asymmetric basin structure controlled by a master listric normal fault in the south (the NGLSZ, see above) in accordance with a model developed by MACK & SEAGER (1990) for the Rio Grande rift. During the oldest phases of this stage of the basin history the hanging wall of the structure was exposed as the so-called "Battert crystalline rise". This complex comprises a line of outcrops of Saxothuringian metasediments, basic metavolcanics (SITTIG, 1965, 1966) and granitic mylonites of the Lalaye-Lubine—Baden-Baden fault zone (WICKERT et al., 1990) in some 3 km distance parallel to the southern border of the basin (Fig.2). During the deposition of the first alluvial fan cycle of the Michelbach Fm. these outcrops acted as topographical high and thus delivered metamorphic debris to be deposited in the vicinity of the Battert rise. Later it was drowned by sediments of the older parts of the first Playa member (SITTIG, 1974, 1988, LÖFFLER, 1992). The thickness of the whole Michelbach Fm. exceeds 4-500 m in the Baden-baden basin, individual playa sequences reaching up to 100 m. Along the southern border of the basin the Michelbach Fm. is represented solely by coarse fanglomerates of equal thickness at least, thinning out to only a few meters towards the center. In other parts of the Black Forest the sediments of the Michelbach Fm. comprise mainly red coloured coarse alluvial fan type volcanic and granitic debris of changing thickness unconformably overlying older strata of the Lichtental Group.

A second culmination of volcanic activity in the northern Black Forest resulted in the extrusion of rhyolitic ignimbrites in a caldera-like structure in the southwestern part of the Baden-Baden basin. We suggest to give these formerly so-called "Pinite porphyries" (BILHARZ & HASEMANN, 1934) the lithostratigraphic rank of a formation and name these extrusives *Yburg Formation* (after Yburg castle south of Baden-Baden). Undoubtedly the Yburg volcanics have the same age as the younger Michelbach Fm. as they are overlying fanglomerates of AFM2-3 age of the latter but there remains some uncertainity about the time-space relations between these two formations. Probably the extrusion of the ignimbrites took place during the deposition of the PM3 (LÖFFLER, 1992). First pebbles of these volcanics were found only in the youngest permian deposits in the Baden-Baden basin. (the Merkur Formation, see below). The rocks of the Yburg formation are restricted to the Baden-Baden basin, there is no volcanic equivalent of this age in the remaining parts of the Black Forest.

Permocarboniferous basin sedimentation in the Baden-Baden basin ceased with the deposition of fanglomerates of mainly granitic origin (SITTIG, 1983). In contrast to the older fanglomerates of Michelbach age, these younger coarse grained sediments show a very constant thickness of some 50 m which obviously is uninfluenced by the former basin structures. The fanglomerates of the (herewith) *Merkur Formation* (after Mount Merkur, east of Baden-Baden) prograde over the southern margin of the basin as well as over all basin-related faults and structures (LÖFFLER, 1992), thus defining another major discontinuity. By that time in other parts of the Black Forest, particularly in the Schramberg region, sedimentation was dominated by thick paleosoils ("Karneol Dolomit Horizon", BRÄUHÄUSER & SAUER, 1909, 1934[2], BRÄUHÄUSER, 1911, 1926, RÖPER, 1980). We now prefer to consider this facies type as an own formation: the *Sommerberg Formation* (after the Sommerberg, Schramberg basin). There remains some work to be done about the mutual relations between Merkur and Sommerberg Fm. respectively in southwest Germany. Nevertheless it seams clear that the deposition of this overlapping sediments throughout the whole Black Forest marks the change from basin-related sedimentation in Permian times to platform-type sediments of Triassic age. It remains a matter of debate wether these strata belong to the Lower or Upper Permian respectively or even to the Lower Triassic (Lower Bunter).

## 2.1 Lithostratigraphic rank of the "Rotliegend" s.s.

As was demonstrated above, the Permocarboniferous volcano-sedimentary succession of SW-Germany (mainly the Black Forest) was divided into 6 formations according to the procedure suggested by HEDBERG (1979, see also CODE-COMMITTEE, 1977, NACSN, 1983, WHITTAKER et al., 1991, Fig.3). A seventh formation (the Gernsberg Fm.) was excluded from this scheme because these rocks apparently were not part of the basin fills but seem to be restricted to a very few spot-like occurences in the northernmost and central Black Forest. The other six formations for their part were combined in two groups, named Lichtental and Rotenfels Group respectively. These two groups correspond roughly to the former "Unterrotliegend" and "Oberrotliegend", but in our opinion, these old terms should be avoided in stratigraphic nomenclature because they were neither defined properly by lithostratigraphic nor by biostratigraphic criteria. The former "Mittelrotliegend" (ECK, 1884) now has the rank of a formation (Langhärdle Fm.) and is thus a member of the Lichtental Grp. We also suggest to avoid the use of the terms "Autunien", "Saxonien" and "Thuringien" and above all not to equate the old terms "Unterrotliegend"/"Autunien" and "Oberrotliegend"/"Saxonien" respectively. It has been shown by BOUROZ &DOUBINGER (1974) that at its type locality Autun, the "Autunien" already starts with *Callipteris conferta* at the Stephanian C/D boundary. Therefore the boundary between Stephanian/Autunian (Stephanian/Rotliegend) is certainly not identical with the Carboniferous/Permian boundary !

Due to our newly developed scheme, the Rotliegend s.s. now gets the lithostratigraphic rank of a Supergroup. This is in accordance with the work done by STAPF (1990) in the Saar-Nahe basin and leaves other workers the possibility to group their basic lithostratigraphic units (and this must be the formation) prior to relate them to a higher stratigraphic unit. With this newly defined scheme we also avoid the use of terms such as "Oberkarbon"(Upper carboniferous") for rocks solely so-called because of their grey colour or "Unterrotliegend" or "Autunien" for rocks of supposedly Permian age. The Carboniferous/Permian boundary therefore has to be looked for somewhere in the basal parts of the Rotliegend Supergroup, probably the Staufenberg Formation.

## 2.2 Lithostratigraphic correlations with the Northern Vosges (Villé and St. Dié basins)

On the french side of the Upper Rhine Graben area several occurences of Permocarboniferous volcano-sedimentary rocks exist as well. Usually these regions were described as the Villé basin and the St. Dié basin respectively and there exists also a well established lithostratigraphic scheme for these successions (MIHARA, 1935, SAUCIER et al., 1959, LAUBACHER & ELLER, 1966, HOLLINGER, 1970, CARASCO, 1987, Fig.4). During our field work we observed that there exist two volcanic units in the Permocarboniferous rock pile close resembling the relations on the German side: an older *Assise de Meisenbuckel* and the younger *Ignimbrites rhyolitiques du Nideck*. The former looks very much like our Langhärdle Formation and consists mainly of rhyolitic tuffs and minor lavas (in the Langhärdle Fm. these relations are just vice versa), the latter is build up of thick rhyolitic ignimbrites which are restricted to the Nideck region (St. Dié basin). Due to this fact we suggest the following lithostratigraphic (!) correlation between the northern and central Black Forest and the northern Vosges (Fig.4). The older part of the Vosgian Permocarboniferous may be divided in up to three formation-like units: First the basal *"Stephanien" A de Lalaye* and the *Arkoses granitiques du Massif de Dambach* which were followed by the famous *Assise d'Albé* (showing a lacustrine calcareous facies development with algae and conchostracans described by CARASCO [1987]). In the higher parts tuffs and the so-called "cinérites" (ash-tuffs) were interbedded with the lacustrine sediments. These in turn were overlain by fanglomerates and conglomerates resembling our Staufenberg Fm. which were called *Assise de Triembach*. Due to its infravolcanic position we suggest to compare this part of the succession with the Staufenberg Fm. of the Black Forest. After the first volcanic event (Assise de Meisenbuckel) the facies development trended towards red alluvial fan-type conglomerates of the *Assise de Kohlbaechel* and the *Couches de Frapelle*. In the Villé basin Permocarboniferous sedimentation ceased with the Assise de Kohlbaechel whereas the Couches de Frapelle of the Nideck region were followed by the ignimbrites mentioned above. This leads us to the assumption that the Assise de Meisenbuckel may be an equivalent of the Langhärdle Fm. and the younger fanglomerates an equivalent of the Michelbach Fm. respectively. The Ignimbrites du Nideck themselves thus should be compared with the Yburg Fm. of the Baden-Baden basin. Only the youngest sediments of (supposed) Permian age show greater differences in their facies development: In the Vosges (Nideck) the ignimbrites were overlain by the fluvio-deltaic sandstones of the *Couches de Champenay*, only in places these were replaced by fanglomerates resembling the Merkur Fm. (*Couches de St. Dié*).

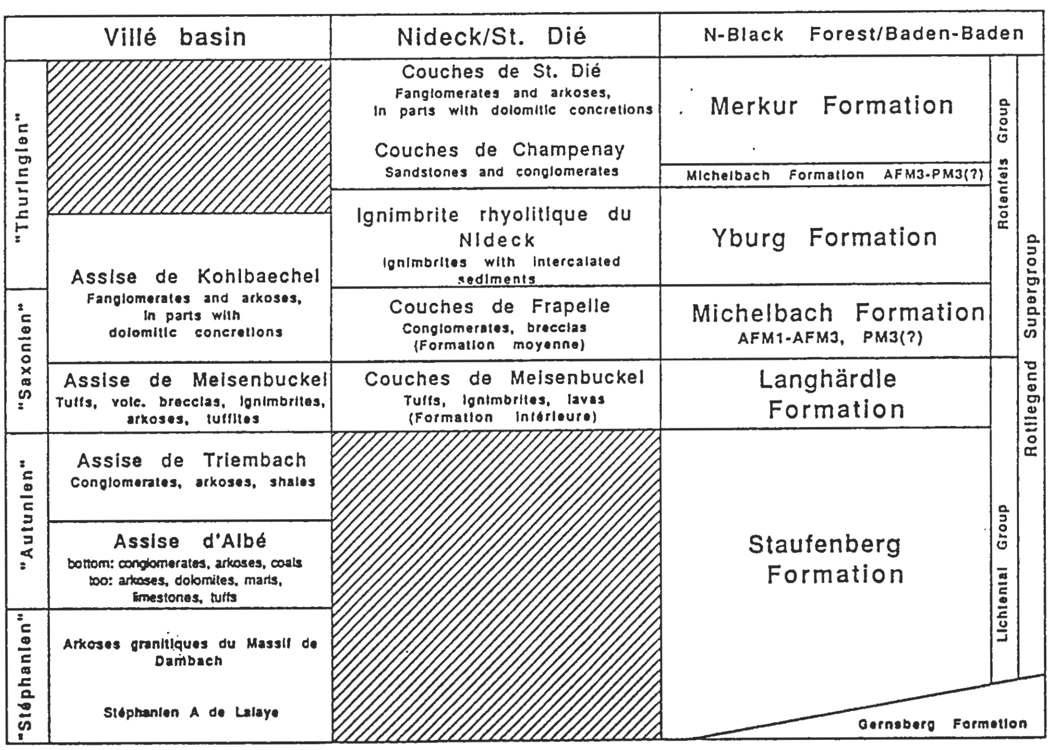


Fig.4.: Permocarboniferous lithostratigraphy in the Northern Vosges and a possible correlation with the SW-German succession.

This lithostratigraphic comparison should be understood as a first attempt to correlate the Permocarboniferous of these two regions. Further work must be done to find biostratigraphic markers in the northern Vosges: this should be considered as our very urgent task during the next times.

## 3. Fossil record of the Michelbach Formation (Baden-Baden basin, Northern Black Forest) and biostratigraphical results

In the year of 1990 we started a systematical search for fossils in the playa sequences of the Michelbach Fm (Fig.5). Conchostracans were known from the 1. Playa Member (ECK, 1884, SAUER, 1894, BILHARZ & HASEMANN, 1934, HASEMANN, 1934) and a few species of biostratigraphical significance were already described by KOZUR & SITTIG (1981). The same applies for *Uronectes fimbriatus* JORDAN (an Eumalacostracan, ECK, 1884, BILHARZ & HASEMANN, 1934, HASEMANN, 1934, KOZUR & SITTIG, 1981) and *Medusina limnica* MÜLLER (a tiny hydromedusa, HAGEMEISTER, 1985).

Thus it was to our great surprise that we found a very rich assemblage of arthropod and terapod trackways as well as some new conchostracan species, which inables us to draw some first cautious biostratigraphical comparisons between the Baden-Baden basin and some other european occurences esp. in eastern Germany (Thuringia).

The conchostracans were almost exclusively restricted to the 1. Playa Member but nonetheless showing a distinctive succession. So far the oldest known species is ?*Lioestheria oboraensis* HOLUB & KOZUR 1981a but it should be emphazised that we hitherto only found a few specimens which are currently under work. ?*L. oboraensis* is followed by (from older to younger strata and species respectively)

*Megasitum tenellum* (BRONN 1850) KOZUR & SITTIG 1981
*Pseudestheria fritschi* KOZUR & SITTIG 1981
*Protolimnadia ? sulzbachensis* KOZUR & SITTIG 1981
*Protolimnadia calcarea* (FRITSCH 1901) KOZUR & SITTIG 1981.

In our opinion, this zonation means that this part of the PM1 in the Baden-Baden basin ranges from C5 (*L. oboraensis*-Assemblage-Zone, HOLUB & KOZUR, 1981a) to C8 (*P. calcarea*-Zone, HOLUB & KOZUR, 1981a), that is from Middle to Upper Sakmarian to Lower Artinskian (Fig.6). There remains some discussion about the missing *Lioestheria andreevi* (ZASPELOVA 1968) KOZUR & SITTIG 1981 which is regarded as a predecessor of *Ps. fritschi* (HOLUB & KOZUR, 1981a). So far the only conchostracan which could be found in the younger PM3 was ?*Pseudestheria brevis* RAYMOND 1946 but according to HOLUB & KOZUR (1981a) this species has no value for Permian biostratigraphy.

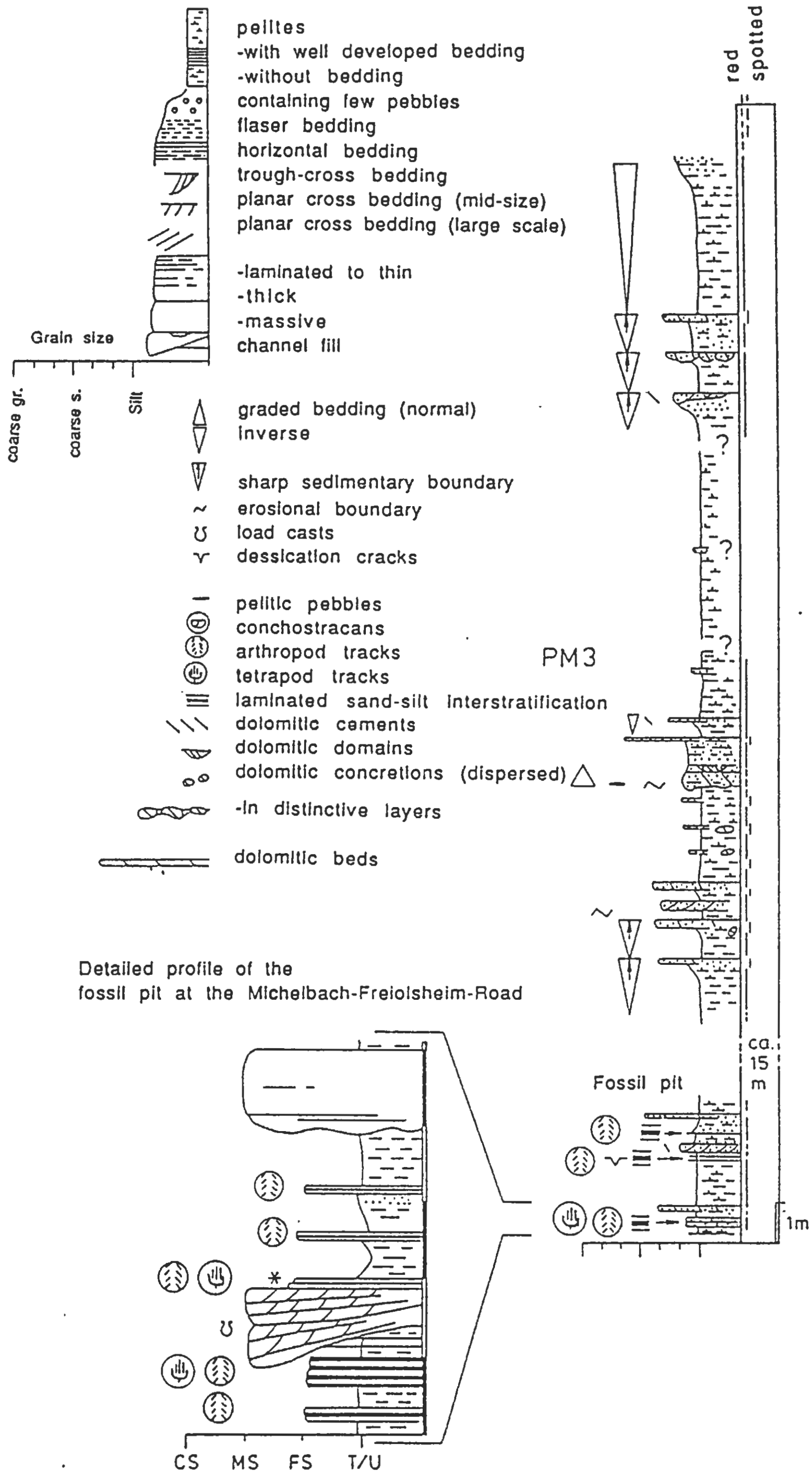


Fig.5.: Lithological profile at the *Paleohelcura* -fossil site. Sketch shows details of the fossil pit and facies in adjacent parts of the PM3. The layer with Paleohelcura is marked with an asterisk. Boundary to the Merkur Fm. is about 60 m over the top of this profile.

Unlike the conchostracans, the ichnofossils of the PM3 delivered some clues about the biostratigraphic position of this part of the succession. Typically the ichnofaunas were dominated by

*Permichnium* GUTHÖRL 1934, but we were lucky to find several specimen of at least two species of *Paleohelcura* GILMORE 1926 (LÖFFLER & WALTER, in prep.) together with tetrapod tracks of the *Laoporus* type and *Microsauropus* MOODIE 1926. A simliar association was described by HOLUB & KOZUR (1981c) from the lower Eisenach Fm. of the Thuringian Forest there defining the so-called provisory "Tetrapodenfährten-Fauna 5 (TF5)". This assemblage seems to bear some resemblance to the Coconino fauna (HOLUB & KOZUR, 1981c), a suggestion being supported by our new *Paleohelcura* findings (Fig.5).

If we compare the Baden-Baden basin with other Mid-european Permian occurences, it shows up that part of the PM1 should be correlated with the Hornburg and Tambach Fm. of eastern Germany (Thuringia, Halle region, Hartz Mountains, HAUBOLD & KATZUNG, 1975) and the Standenbühl Fm. of the Saar-Nahe basin respectively (HOLUB & KOZUR, 1981d). The uppermost playa sequence, the PM3, on the other hand is surely younger and should be compared with parts of the Eisenach Fm. (Thuringia, Fig.6). At the present time it remains uncertain if the PM3 reachs down to the Upper Hornburg Fm. of Thuringia.

In our opinion further work has to be done towards biostratigraphic correlations of the whole SW-German Permian succession. Radiometric datings of the volcanics mentioned above could be of great help in this context and our group intends to work on these topics in the nearest future.

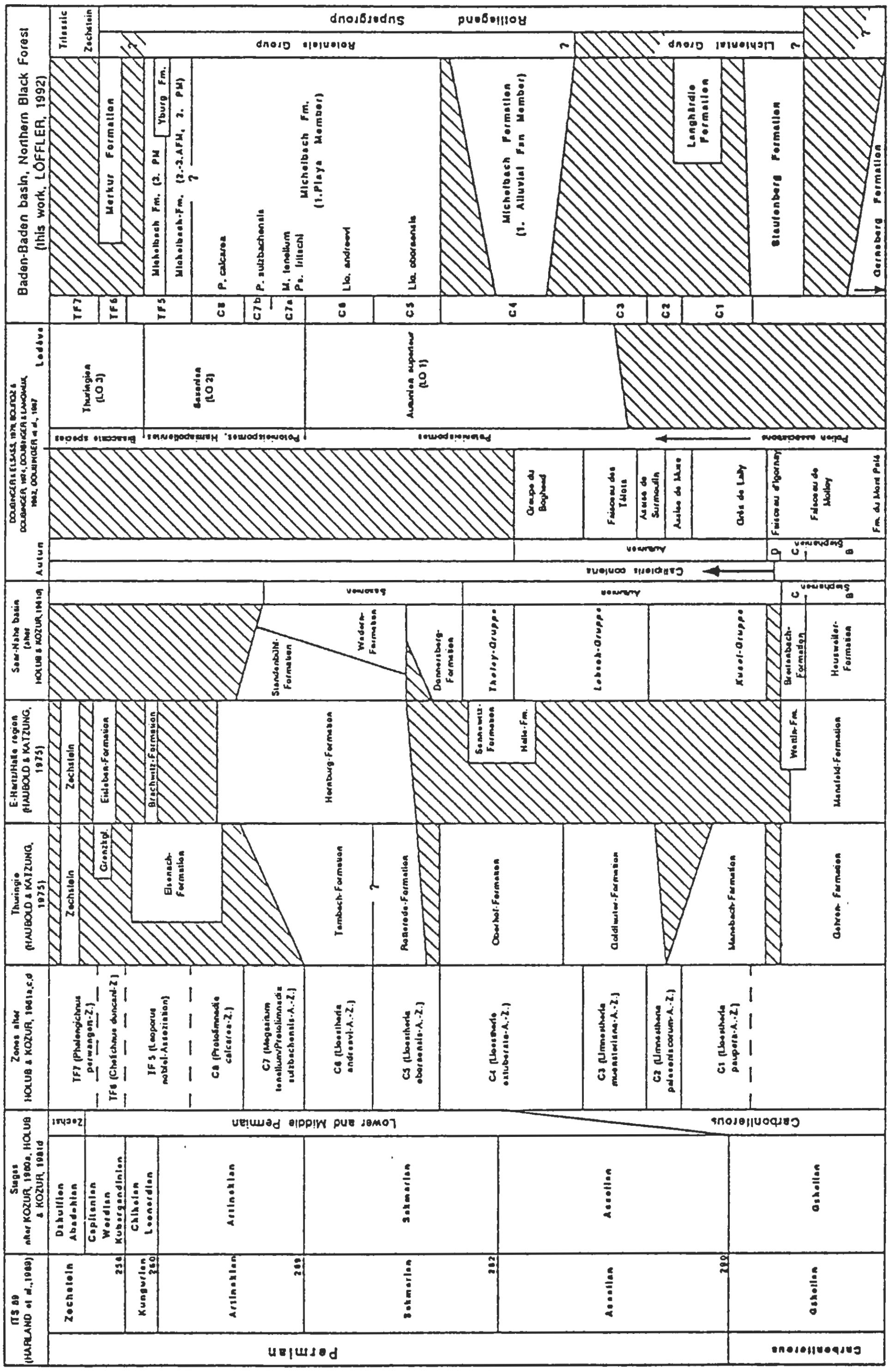


Fig.6.: Correlation chart of the Mid-european Permian mainly after HOLUB & KOZUR 1981d. Correlation with the SW-German occurences based on conchostracan zonation in the upper part. Correlation of the lower part ist still highly speculative.

## References cited


BACKFISCH, S. (1984): Die Petrographie der Rotliegendsandsteine Südwestdeutschlands: Ein Beitrag zur Diagenese vulkanoklastreicher Sandsteine.— 235 pp., Ph.D. thesis, unpublished, Heidelberg.

BILHARZ, A. & HASEMANN, W. (1934): Erläuterungen zu Blatt Nr. 67 Baden der Geologischen Spezialkarte von Baden (Blatt Nr. 7215 Baden-Baden der Geologischen Karte von Baden-Württemberg).— 144 S., Freiburg, Stuttgart.

BOUROZ, A. & DOUBINGER, J. (1974): Les rélations entre le Stéphanien supérieur et l'Autunien d'après le contenu de leur stratotype.— C.R. Acad. Sci. Paris, Série D, **279**: 1745-1748.

BRÄUHÄUSER, M. (1911): Geologische Spezialkarte von Württemberg (Blatt Nr. 117 Alpirsbach, Blatt Nr. 7616 Alpirsbach der Geologischen Karte von Baden-Württemberg).— Stuttgart.

BRÄUHÄUSER, M. (1926): Erläuterungen zu Blatt Nr. 117 Alpirsbach der Geologischen Spezialkarte von Württemberg (Blatt Nr. 7616 Alpirsbach der Geologischen Karte von Baden-Württemberg).— 125 S., Stuttgart.

BRÄUHÄUSER, M. & SAUER, A. (1909): Erläuterungen zu Blatt Nr. 129 Schramberg der Geologischen Spezialkarte des Königreichs Württemberg (Blatt Nr. 7716 Schramberg der Geologischen Karte von Baden-Württemberg).— Stuttgart.

BRÄUHÄUSER, M. & SAUER, A. ($1934^2$): Geologische Spezialkarte von Württemberg (Blatt Nr. 129 Schramberg, Blatt Nr. 7716 Schramberg der Geologischen Karte von Baden-Württemberg).— Stuttgart.

CARASCO, B. (1983/84): Facies petrographiques de l'Autunien inferieur du Bassin de Villé.— 40 S., Mém. de D.E.A., Univ. Strasbourg (unveröff.), Strasbourg.

CARASCO, B. (1987): Les Grabens Stéphano-Permiens de L'Est de la France: Évolution tectono-sédimentaire, dévelopement des facies lacustres carbonatés et sapropeliques.— Thése doct. Etat, Univ. Strasbourg, Vol.I+II, 147+47 S., Strasbourg.

CODE-COMMITTEE der Stratigraphischen Kommission der DUGW (1977): Stratigraphische Richtlinien.— Newsl. Stratigr., **6**: 131-151.

DOUBINGER, J. & ELSASS, P. (1979): Le bassin permocarbonifère d'Autun.— Bull. soc. Hist. nat. Autun, **91**: 9-25.

DOUBINGER, J. & LANGIAUX, J. (1982): Un faux problème: la limite Stéphanien/Autunien.— C.R. Acad. Sci. Paris, Série II, **294**: 395-398.

DOUBINGER, J., ODIN, B. & CONRAD, G. (1987): Les associations sporopolliniques du Permien continental du bassin de Lodève (Hérault, France): caractérisation de l'Autunien supérieur, du "Saxonien" et du Thuringien.— Ann. Soc. Géol. Nord, **CVI**: 103-109.

ECHTLER, H. & MALAVIELLE, J. (1990): Extensional tectonics, basement uplift and Stephano-permian collapse basin in a late variscan metamorphic core complex (Montagne Noire, Southern Massif Central).— in: Matte, P. (ed.): Terranes in the Variscan Belt of Europe and Circum-Atlantic Palaeozoic Orogens.— Tectonophysics, **177**: 125-138.

ECHTLER, H. & CHAUVET, A. (1992): Variscan shear zones in the southern Black forest, SW Germany; orogenic convergence and subsequent intracrustal extension.— Geodyn. Acta, in press.

ECK H.v. (1884): Geognostische Karte der Umgebung von Lahr mit Profilen und Erläuterungen.— 133 S, Lahr.

ECK H.v. (1887): Bemerkungen über die geognostischen Verhältnisse des Schwarzwalds im allgemeinen und über Bohrungen nach Steinkohlen in demselben.— Jh. Ver. vaterl. Naturk. Württ., **43**: 322-355.

ECK H.v. (1892): Geognostische Beschreibung der Gegend von Baden-Baden, Rothenfels, Gernsbach und Herrenalb.— Abh. k. preuß. geol. Landesanst., N.F.H., **6**: I-XLVI, 1-686, Berlin.

FALKE, H. (1971): Zur Paläogeographie des kontinentalen Perms in Süddeutschland.— Abh. hess. L.-Amt Bodenforsch., **60**, "Heinz-Tobien-Festschrift": 223-234.

FALKE, H. (1976, ed.): The continental Permian in Central, West, and South Europe.— Proceedings of the NATO Advanced Study Institute, **C22**: 352 pp., Dordrecht, Boston.

HAGEMEISTER, A. (1985): Ein weiteres Vorkommen von *Medusina limnica* MÜLLER im Oberrotliegenden von Baden-Baden/Nordschwarzwald.— Jh. geol. Landesamt Baden-Württemberg, **27**: 17-23.

HARLAND B.W., ARMSTRONG, R.L., COX, A.V., GRAIG, L.E., SMITH, A.G. & SMITH, D.G. (1989): A geologic time scale.— 263 S., Cambridge.

HASEMANN,W. (1934): Erläuterungen zu Blatt Nr. 62 Malsch der Geologischen Spezialkarte von Baden (Blatt Nr. 7116 Malsch der Geologischen Karte von Baden-Württemberg).— 69 S., Freiburg.

HAUBOLD, H. & KATZUNG, G. (1975): Die Position der Autun/Saxon-Grenze (Unteres Perm) in Europa und Nordamerika.— Schriftenr. geol. Wiss., **3**: 87-138.

HEDBERG, H.D. (1976, ed.): International Stratigraphic Guide.— 200 pp., New York, London, Sidney, Toronto.

HOLLINGER, J. (1970): Beitrag zur Gliederung des Deckgebirges der Nordvogesen.— Z. dtsch. geol. Ges., **121**: 79-91.

HOLUB, V. & KOZUR, H. (1981a): Revision einiger Conchostracen-Faunen des Rotliegenden und biostratigraphische Auswertung der Conchostracen des Rotliegenden.— Geol. Paläont. Mitt. Innsbruck, **11**: 39-94.

HOLUB, V. & KOZUR, H. (1981b): Arthropodenfährten aus dem Rotliegenden der CSSR.— Geol. Paläont. Mitt. Innsbruck, **11**: 95-148.

HOLUB, V. & KOZUR, H. (1981c): Revision einiger Tetrapodenfährten des Rotliegenden und biostratigraphische Auswertung der Tetrapodenfährten des obersten Karbon und Perm.— Geol. Paläont. Mitt. Innsbruck, **11**: 149-193.

HOLUB, V. & KOZUR, H. (1981d): Die Korrelation des Rotliegenden Europas.— Geol. Paläont. Mitt. Innsbruck, **11**: 195-242.

JENKNER, B. (1986): Ein Vorschlag zur Neugliederung des sedimentären Oberrotliegenden in der Baden-Badener Senke und ihrer nordöstlichen Fortsetzung (Nordschwarzwald).— Jh. geol. Landesamt Baden-Württemberg, **28**: 49-159.

KOZUR, H. (1977): Beiträge zur Stratigraphie des Perms: Teil I. Probleme der Abgrenzung und Gliederung des Perms.— Freiberger Forsch.-H., **C 319**: 79-121.

KOZUR, H. (1978): Beiträge zur Stratigraphie des Perms. Teil III: Zur Korrelation der überwiegend kontinentalen Ablagerungen des obersten Karbons und Perms von Mittel- und Westeuropa.— Freiberger Forsch.-H., **C 342**: 117-142.

KOZUR, H. (1980): Beiträge zur Stratigraphie des Perms. Teil III: Zur Korrelation der überwiegend kontinentalen Ablagerungen des obersten Karbons und Perms von Mitteleuropa (2).— Freiberger Forsch.-H., **C 348**: 69-172.

KOZUR, H. & SITTIG, E. (1981): Das "Estheria" tenella-Problem und zwei neue Conchostracen-Arten aus dem Rotliegenden von Sulzbach (Senke von Baden-Baden, Nordschwarzwald).— Geol. Paläont. Mitt. Innsbruck, **11**: 1-38.

LAUBACHER, G. & ELLER, J.P. von (1966): Contribution à l'étude géologique des dépots permiens du Bassin de Villé.— Bull. Serv. Carte géol. Als. Lorr., **19**: 163-186.

LÖFFLER, M. (1992): Das Permokarbon des Nordschwarzwaldes — Eine Fallstudie am Beispiel des Beckens von Baden-Baden.— 284 pp., Ph.D. thesis, unpublished, Karlsruhe.

LÖFFLER, M. & Walter, H. : Arthropodenfährten aus dem 3. Playa Member (Michelbach-Fm., Rotenfels-Gruppe) des Beckens von Baden-Baden (Nordschwarzwald, SW-Deutschland) — fazielle und biostratigraphische Konsequenzen.— in prep.

MACK, G.H. & SEAGER, W.R. (1990): Tectonic control on facies distribution of the Camp Rice and Palomas Formations (Pliocene-Pleistocene) in the southern Rio Grande Rift.—Bull. geol. Soc. Amer., **102**: 45-53.

MÉNARD, G. & MOLNAR, P. (1988): Collapse of a Hercynian Tibetan Plateau into a late Paleozoic European Basin and Range province.— Nature, **334**: 235-237.

MIHARA, S. (1935): Étude géologique et pétrographie de la région du Nideck.— Mém. serv. Carte géol. Als. Lorr., **4**:1-134.

NORTH AMERICAN COMMISSION ON STRATIGRAPHIC NOMENCLATURE (1983): North American Stratigraphic Code.— Bull. amer. Assoc. Petroleum Geol., **67**: 841-875.

RÖPER, H.-P. (1980): Zur Petrographie und Genese des Karneol-Dolomit-Horizontes (Grenze Rotliegendes-Buntsandstein) im Gebiet des Mittleren Schwarzwaldes.— 289 pp, Ph.D. thesis, unpblished, Heidelberg.

SAUCIER, H., MILLOT, G. & JOST, R. (1959): Les ignimbrites permiennes de la région du Nideck.— Bull. Serv. Carte géol. Als. Lorr., **12**: 33-48.

SAUER A. (1892): Geologische Specialkarte des Großherzogthums Baden (Blatt Nr. 82 Gengenbach, Blatt Nr. 7514 Gengenbach der Geologischen Karte von Baden-Württemberg).— Leipzig, Berlin.
SAUER A. (1894): Erläuterungen zu Blatt Nr. 82 Gengenbach der Geologischen Specialkarte des Großherzogthums Baden (Blatt Nr. 7514 Gengenbach der Geologischen Karte von Baden-Württemberg).— 87 S., Heidelberg.
SCHÄFER, A. (1989): Variscan molasse in the Saar-Nahe Basin (W-Germany), Upper Carboniferous and Lower Permian.— Geol. Rdsch., **78**: 499-524.
SCHALCH, F. (1893): Geologische Specialkarte des Großherzogthums Baden (Blatt Nr. 83 Petersthal-Reichenbach, Blatt Nr. 7515 Oppenau der Geologischen Karte von Baden-Württemberg).— Leipzig, Berlin.
SCHALCH, F. (1895): Erläuterungen zu Blatt 83 Petersthal-Reichenbach der Geologischen Specialkarte des Großherzogthums Baden (Blatt Nr. 7515 Oppenau der Geologischen Karte von Baden-Württemberg).— 81 S., Heidelberg.
SCHNEIDER, H. (1966): Sedimentation und Tektonik im Jungpaläozoikum der Baden-Badener Senke (Stefan, Rotliegendes, Zechstein).— 112 pp, Ph.D. thesis, unpblished, Heidelberg.
SITTIG, E. (1965): Der geologische Bau des variszischen Sockels nordöstlich von Baden-Baden (Nordschwarzwald).— Oberrhein. geol. Abh., **14**: 167-207.
SITTIG, E. (1966): Das metamorphe Altpaläozoikum des Nordschwarzwaldes.— Jber. Mitt. oberrhein. geol. Ver., N.F., **48**: 121-131.
SITTIG, E. (1974): Die Schichtenfolge des Rotliegenden von Baden-Baden (Nordschwarzwald).— Oberrhein. geol. Abh., **23**: 31-41.
SITTIG, E. (1983): Eine Geröllbestandsaufnahme im grobklastischen Oberrotliegenden der Senke von Baden-Baden.— Oberrhein. geol. Abh., **32**: 45-68.
SITTIG, E. (1988): Rotliegendes of the Schwarzwald Mountains. A reappraisal.— Z. geol. Wiss., **16**: 1003-1012.
STAPF, K.R.G. (1990): Einführung lithostratigraphischer Formationsnamen im Rotliegend des Saar-Nahe-Beckens (SW-Deutschland).— Mitt. Pollichia, **77**: 111-124.
WICKERT, F. , ALTHERR, R. & DEUTSCH, M. (1990): Polyphase Variscan tectonics and metamorphism along a segment of the Saxothuringian-Moldanubian boundary: The Baden-Baden-Zone, northern Schwarzwald (F.R.G.).— Geol. Rdsch., **79**: 627-647.
WHITTAKER, A., COPE, J.C.W., COWIE, J.C., GIBBONS, W., HAILWOOD, E.A., HOUSE M.R., JENKINS, D.G., RAWSON, P.F., RUSHTON, A.W.A., SMITH, D.G., THOMAS, A.T. & WIMBLEDON, W.A. (1991): A guide to stratigraphic procedure.— J. geol. Soc., London, **148**: 813-824.

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## 5. MAIN EVENTS OF TETHYAN PERMIAN HISTORY AND FUSULINIDS

Refined dating of Permian subdivisions in different Tethyan regions and refinement of the existing correlation schemes enable one to establish the general sequence of the Tethys evolution controlled by large transgressions and regressions. Two first order transgressive-regressive cycles (Gzhelian-Sakmarian and Yahtashian-Dorashamian) have been recognized, each comprising cycles of lower order (fig. 1). These correlate well with basic stages of fusulinid evolution.

The most significant crises in the Permian history of fusulinids are related to post-Sakmarian and post-Midian regressions. The former witnesses the extinction of genera *Sphaeroschwagerina*, *Pseudoschwagerina*, *Paraschwagerina*, *Zellia*, *Occidentoschwagerina* and *Dutkevitchia* most typical of Asselian and Sakmarian stages. The *Rugosofusulina* genus drastically decreases in abundance while the specific compositions of other genera are completely renewed. Disappearance of the orders Neoschwagerinida and Schwagerinida which form the main components of the fusulinid assemblage indicates the second, post Midian crisis.

A new Yahtashian-Dorashamian transgressive-regressive cycle following the first crisis brought essential renewal of the fusulinid complex. Most major taxa which characterize the fusulinid assemblage of younger Permian deposits were rooted in the Yahtashian-Bolorian sequences. These taxa were rapidly differentiating and their genera and species grew in number due to the transgressions drastic extension in the Kubergandinian age. This primarily refers to the order Neoschwagerinida, as well as to such families as Yangchienidae, Eopolydiexodinidae, Parafusulinidae. The above taxa had evolved up to the Midian age when they reached their acme and maximum specialization.

The widespread Midian transgression triggered the development of small fusulinids of the Schubertellida order. Several new genera originated among them, including the aberrant ones with a straightened last volution of the spiral. The *Reichelina* and *Parareichelina* genera of the Ozawainellida order which appeared synchronously displayed similar characteristics.

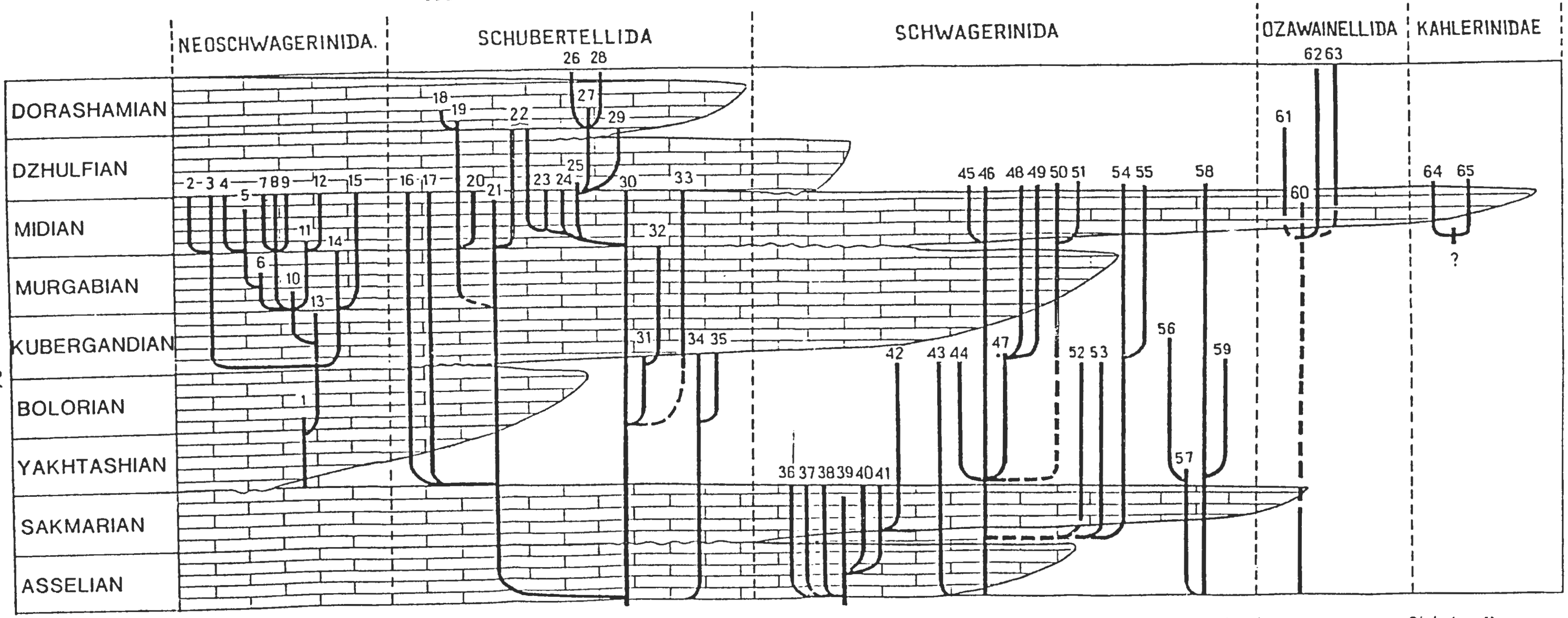
These were the only fusulinids that survived during the post-Midian crisis except several species of the Staffelida order. A short term Dorashamian transgression contributed to a relative revival of fusulinid assemblage. The subsequent regression resulted in its total extinction.

The reasons for transgressions and regressions, and the relative role of tectonic processes and eustacy in their origin, are yet unclear. The problem could possibly be solved after a detailed correlation of Permian Tethys sections and those from other world regions has been accomplished.

TRANSGRESSIONS AND THE DISTRIBUTION OF THE MOST WIDE-SPREAD FUSULINID GENERA THROUGH THE TETHYAN PERMIAN SECTIONS

Figure 1

## ТРАНСГРЕССИИ И РАСПРЕДЕЛЕНИЕ НАИБОЛЕЕ РАСПРОСТРАНЕННЫХ РОДОВ ФУЗУЛИНИД ПО РАЗРЕЗУ ПЕРМСКИХ ОТЛОЖЕНИЙ ТЕТИСА




1. *Pamirina*
2. *Metadoliolina*
3. *Pseudodoliolina*
4. *Sumatrina*
5. *Afghanella*
6. *Presumatrina*
7. *Yabeina*
8. *Neoschwagerina*
9. *Colania*
10. *Cancellina*
11. *Gifuella*
12. *Lepidolina*
13. *Misellina*
14. *Armenina*
15. *Verbeekina*
16. *Minojapanella*
17. *Wutuella*
18. *Gallowaiinella*
19. *Russiella*
20. *Lantschichites*
21. *Boultonia*
22. *Codonofusiella*
23. *Paradoxiella*
24. *Pseudodunbarula*
25. *Dunbarula*
26. *Palaefusulina*
27. *Nanlingella*
28. *Parananlingella*
29. *Paradunbarula*
30. *Schubertella*
31. *Mesoschubertella*
32. *Neofusulinella*
33. *Yangchienia*
34. *Biwaella*
35. *Toriyamaia*
36. *Sphaeroschwagerina*
37. *Paraschwagerina*
38. *Occidentoschwagerina*
39. *Triticites*
40. *Pseudoschwagerina*
41. *Zellia*
42. *Robustoschwagerina*
43. *Rugosochusenella*
44. *Chalaroschwagerina*
45. *Rugoschwagerina*
46. *Pseudofusulina*
47. *Praeskinnerella*
48. *Skinnerella*
49. *Parafusulina*
50. *Chusenella*
51. *Orientoschwagerina*
52. *Darvasites*
53. *Eoparafusulina*
54. *Monodiexodina*
55. *Eopolydiexodina*
56. *Laxifusulina*
57. *Dutkevitchia*
58. *Rugosofusulina*
59. *Darvasella*
60. *Ozawainella*
61. *Sichotenella*
62. *Reichelina*
63. *Parareichelina*
64. *Pseudokahlerina*
65. *Kahlerina*

The above information indicates the possibility of resolving the problems of subdividing the Permian into series (as discussed at the Congress on the Permian system in the summer of 1991). A three-member scheme for subdividing the system suggested by the American delegation is not quite in accord with natural evolution of biotic and abiotic events occurring in the Tethys. For example, it does not mention the crisis associated with the post-Sakmarian regression.

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## 6. STATUS OF PERMIAN/LOWERMOST TRIASSIC (GRIESBACHIAN) PALYNOSTRATIGRAPHY, BARENTS SEA AREA

Active oil and gas exploration in Upper Paleozoic targets of the Barents Sea, has led to a great amount of palynostratigraphic work being carried out on Carboniferous, Permian and Triassic rocks in recent years. Much of this work has been done on material from onshore equivalents on Svalbard and Bjørnøya, and since 1986 several exploration wells in the southern part of the Barents Sea have penetrated the Upper Paleozoic succession. Additional information on the Paleozoic from the Barents Sea include 8 shallow cores drilled in 1987-1988 by IKU Petroleum Research into the Lower Carboniferous to Upper Permian succession (a total of 800 m of core). The provisional palynostratigraphic framework for the Permian succession presented below is based on both onshore and offshore shallow drilling data. Assemblages are comparable with those of the Sverdrup Basin, as well as those of Greenland and Arctic Russia.

The Asselian is dominated by polyplicate pollen, but commonly present are striate, bisaccate pollen. Due to the dominantly carbonate facies palynomorphs are poorly preserved, and it is not easy to distinguish the Carboniferous/Permian boundary from palynological criteria. The overlying Sakmarian to Artinskian assemblage is dominated by polyplicate pollen, but with a higher diversity than in older rocks. It is characterised by the first appearance of, for example, *Nuskoisporites dulhuntyi*, *Striomonosaccites*, and *Hamiapollenites tractiferinus*, which has a limited range within the Sakmarian to Artinskian. Striate bisaccate pollen are common to abundant throughout. The time-span of the hiatus at the pronounced mid-Permian unconformity separating typical Early Permian floras from the overlying late Early Permian to Late Permian floras has not been precisely dated. The Kungurian/Ufimian assemblages are very similar to the Roadian assemblages in the Sverdrup Basin with the appearance of several different spore genera not seen in the underlying succession. Another characteristic feature is the marine acritarchs dominating many of the assemblages including *Micrhystridium*, *Veryhachium* and *Unellium*. The microflora includes *Neoraistrickia*, *Cyclogranisporites*, *Granulatisporites*, *Gordonispora*, *Apiculatisporis*, *Kraeuselisporites*, *Convolutispora*, various polyplicate pollen and striate bisaccate pollen including rare *Hamiapollenites bullaeformis*. The diversity of non-taeniate bisaccate pollen is higher than the underlying assemblages. *Florinites luberae*, *Falcisporites* spp., *Lueckisporites* sp., *Vesicaspora schemeli*, *Platysaccus papilionis*, *Piceapollenites* sp. and *Alisporites* spp. are common.

The Kazanian resembles the Kungurian - Ufimian assemblages, but can be distiguished on basis of the appearance of *Taeniaesporites* and *Scutasporites* cf. *unicus*. It closely resembles the assemblages from the Wordian of the Sverdrup basin (Utting, 1991), which is dated on the basis of the marine fauna. A hiatus probably spanning the uppermost Permian (Tatarian?) is present in all investigated localities. The overlying Griesbachian assemblages are characterized by the first appearance of, for example, *Densoisporites nejburgii*, *D. playfordii*, *Uvaesporites* morphon, *Proprisporites pococki*, *Maculatasporites indicus*, *Striatoabieites richteri* and *Chordecystia chalasta*. Occasional *Lueckisporites virkkiae* and *Vittatina* occur in the Lower Griesbachian.

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## 7. SMALL FORAMINIFERS BIOSTRATIGRAPHY AND CORRELATIONS OF THE MIDDLE PERMIAN FORMATIONS OF THE SVERDRUP BASIN, CANADIAN ARCTIC

Middle Permian formations in the Sverdrup Basin are from the margin to the centre: Sabine Bay/Assistance and van Hauen (Roadian), and Trold Fiord and Degerböls (Wordian). The Sabine Bay Formation is composed of non-marine quartzose sandstone and conglomerate, and the Assistance is dominated by sandstone with minor concretionary siltstone bands (Harker and Thorsteinsson, 1960; Nassichuk, 1970). The van Hauen is characterized by chert and shale. The Trold Fiord is dominated by green glauconitic sandstone, the Degerböls by limestones and chert. The descriptions of these formations and their ages are given in Thorsteinsson (1974). The fauna associated with the deposits characterized a sea in the boreal realm (Nassichuk, Furnish and Glenister, 1965; Nassichuk, *in press*).

In Nassichuk's 1970 publication, the ammonoids from the Sabine Bay Formation on Melville Island were considered to be Artinskian. Now Nassichuk (*in press*) thinks they are of slightly younger Roadian age. In this recent publication, Nassichuk gives a Roadian age to both the Assistance and van Hauen formations; the van Hauen Formation being the basinal equivalent of the Assistance Formation.

An ammonoid specimen collected from the Trold Fiord Formation indicates, according to Nassichuk, Furnish and Glenister (*ibid.*), an early Guadalupian (Wordian) age; this age was confirmed by the brachiopods identified by Grant (Thorsteinsson, 1974, p. 70). The Degerböls Formation is considered to be equivalent to the Wordian Trold Fiord Formation. The controversy about the age of the fossils from the Degerböls Formation was resumed in Thorsteinsson (1974, p. 71-72) and an early Guadalupian age was adopted in that publication.

No paleontological evidence has been published to suggest the presence of latest middle Permian-Capitanian or latest Permian - Dzhulfian and Dorashamian stages - in the Sverdrup Basin. Early Guadalupian (Wordian) is generally considered to be the youngest Permian in the basin. Nevertheless, paleontologists continue to search for post-Guadalupian marine faunas in Arctic regions. This search should involve as many fossil groups as possible, including palynomorphs. It is interesting to mention that the only known upper Permian Dzhulfian in the circum-Arctic regions are outcrops in central east Greenland (Nassichuk, *in press*).

Under the auspices of GSC, I have begun preliminary examination of small foraminifers from the youngest formations in the Sverdrup Basin. Small foraminifers belonging mainly to the families Geinitzinidae *sensu lato* (considered by most authors to be Nodosariidae), Pachyphloiidae, "Frondicularids" and Hemigordiopsidae are present. Many stratigraphic sections measured along a centre-margin profile of the basin will provide the material for systematic study of small foraminifers. Their identification will permit the establishment of faunal sequences (taking into account the facies control of the organisms) for correlating the formations in more detail. At the same time, the biostratigraphic framework will help to identify the youngest Permian strata in the Canadian Arctic and will also provide new data on the Permian-Triassic boundary in this region.

I would like to correspond with other colleagues who have been dealing with boreal small foraminiferal faunas of middle and upper Permian deposits. If any of you are actively involved in comparative studies elsewhere or if you are aware of publications on the subject, please let me know.

REFERENCES CITED:

HARKER, P. and THORSTEINSSON, R., 1960. Permian rocks and faunas of Grinnell Peninsula, Arctic Archipelago. Geological Survey of Canada, Memoir 309, 89 p., pls. 1-25.

NASSICHUK, W.W., *in press*. Permian ammonoids in the Arctic regions of the world, *in* Permian of northern hemisphere.

NASSICHUK, W.W., 1970. Permian ammonoids from Devon and Melville Islands, Canadian Arctic Archipelago. Journal of Paleontology, v. 44, no 1, p. 77-97, pls. 19-22.

NASSICHUK, W.W., FURNISH, W.M., and GLENISTER, B.F., 1965. The Permian Ammonoids of Arctic Canada. Geological Survey of Canada, Bulletin 131, 56 p., pls. 1-5.

THORSTEINSSON, R., 1974. Carboniferous and Permian stratigraphy of Axel Heiberg Island and western Ellesmere Island, Canadian Arctic Archipelago. Geological Survey of Canada, Bulletin 224, 133 p.

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## 8. IGCP PROJECT 272 - LATE PALAEOZOIC AND EARLY MESOZOIC CIRCUM-PACIFIC EVENTS - 1991 AND 1992

Project 272 is a successor to 203: Permo-Triassic events of East Tethys and their intercontinental correlation. It aims to correlate, integrate and publish information on faunal-floral, climatic, sedimentary, volcanic-magmatic, tectonic, sea-level, palaeomagnetic and geochemical and metallogenic events especially around the Pacific.

In addition to the events well-known to be associated with the Permian-Triassic boundary, other important changes are known to be associated with the Carboniferous to Permian (base of Asselian), mid-Permian (Kungurian to Ufimian of twofold Permian subdivision), Lower to Middle Triassic, Middle to Upper Triassic and Triassic to Jurassic. Study of events associated with these boundaries are part of the project as well as consideration of other events of the Upper Palaeozoic and Lower Mesozoic.

Meetings and field visits have now taken place in three of the four sectors of the Pacific: Australia (New South Wales and Tasmania), New Zealand, Japan, and South America (Argentina and Brazil). Working Group meetings and field studies in 1991 were held in association with the 10th Gondwana Symposium, Hobart, in June, the Permian Congress in Perm, Russia in August and the 12th International Congress on Carboniferous and Stratigraphy, Buenos Aires, Argentina in September, 1991. The fourth sector will be covered in 1992 with a meeting in North America in association with the North American Paleontological Convention in Chicago, 28 June to 1 July followed by a field visit to north-western U.S.A. 2-12 July. In addition a meeting and symposium will be held during the International Geological Congress, Kyoto, Japan, 24 August-3 September, 1992, followed by a meeting in Vladivostok and subsequent field visit in the Primorye Region, 6-12 September.

Important scientific results during 1991 include data leading towards better understanding of the Carboniferous-Permian boundary. There is increased support for placing the boundary at the base of the Asselian of the Ural stratotype, corresponding apparently to a distinct biological change, a strong sea-level change, and a marked change in world climate.

These conclusions suggest the top of the Pennsylvanian (top of the Virgilian) in the U.S.A. is older than the base of the Asselian and that, accordingly, the lower part of the Wolfcampian generally taken to be basal Permian, should be regarded as Carboniferous.

Western Argentinian faunal relationships are of particular interest. The Middle Carboniferous has close relationships with eastern Australia and shows evidence of glacial action, the Upper Carboniferous is warm without glaciation and has faunal relationships apparently with the northern hemisphere. Lower Permian has close faunal relationships on the other hand with Western Australia and the northern hemisphere and there is little evidence of the glaciation indicated in eastern South America (Parana and Sauce Grande Basins) and in other parts of the world in the Early Permian. In the Parana Basin it has been suggested that rather than a single icesheet, a number of areally discrete icefields were present, which may have implications for other Gondwana areas.

Study has progressed on the mid-Permian which is marked by the beginning of a major orogenic folding and magmatic event in many parts of the world, called in eastern Australia the Hunter-Bowen Orogeny and generally in South East Asia the Indosinian (it has other names in other parts of the world). Its beginning at the mid-Permian can now be identified in Australia, New Zealand, South and North America, Greenland, Europe and various parts of Asia including Himalayas, Thailand, Malaysia, China and Japan. It corresponds to important sea-level and biological changes.

An important outcome of the project has been recognition of the significance of the Midian-Dhulfian boundary dividing the traditional Upper Permian into two parts. This corresponds to an important tectonic and magmatic event of the Hunter-Bowen (Indosinian) Orogeny and is characterized by distinctive biological and sea-level change. In Japan it corresponds to the traditional Japanese boundary between the Middle and Upper Permian and in China to the traditional Chinese boundary between the Lower and Upper Permian.

Publications containing material concerned with the project are "Paleozoic and Early Mesozoic Paleogeographic Relations: Sierra Nevada, Klamath Mountains and Adjacent Terranes" edited by D.S. Harewood and M.M. Miller, Geological Society of America Special Publication 255, 1990; "Shallow Tethys 3" edited by T. Kotaka, J.M. Dickins, K.G. McKenzie, K. Morei, K. Ogasawara and G.D. Stanley Jr., Saito Ho-on Kai, Museum of Natural History, Sendai, Japan, Special Publication No. 3, 1991; and "Permo-Triassic Events in the Eastern Tethys" edited by W.C. Sweet, Yang Zunyi, J.M. Dickins and Yin Hongfu, Cambridge University Press, World and Regional Geology 2, 1992.

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## 9. 272 IGCP PROJECT SOVIET UNION WORKING GROUP REPORT (VLADIVOSTOK, 1991)

DESCRIPTION

During 1991, the Permian-Triassic terrigenous, carbonate and chert sediments of Far East, Siberia and Pamirs were investigated by Soviet Union Working Group represented by paleontologists of the Far Eastern Geological Institute VSEGEI, (Leningrad) and IGG (Novosibirsk).

SUMMARY OF ACHIEVEMENT

1. New data on Middle Permian flora of South Primorye were received. *Prymocyrpus* n. gen. was described (Zimina, 1989).

2. As a result of a comprehensive study of the Midian-Dorashamian deposits in the South USSR zonal schemes for various groups have been elaborated. Their use extends the facies and spatial possibilities of correlation and increases its precision (Kotlyar, Kropatcheva and Pronina, 1990).

3. The find of the Permian ammonoids *Timorites* and *Neocrimites* in Verkhnetogotuiskaya subformation of Borzia river (Trans-Baikal) testifies that this region was populated by Tethyan cephalopods during Midian time (Zakharov, 1990; Zakharov and Okuneva, 1990).

4. The probleum of the Permian-Triassic paleomagnetism of Eurasia (Zakharov and Sokarev, 1990, 1991) has been investigated.

5. The peculiarities of distribution of different groups (foraminifers, corals, brachiopods, ammonoids and conodonts) within Permian-Triassic boundary beds were investigated (Burij and Zharnikova, 1989; Kotlyar, 1990; Zakharov, 1991). The following arguments are in favour of the traditional point of view:

    1. In many regions of the world the *Otoceras* beds and their equivalents lie with erosion on Palaeozoic rocks that may be connected with a large eustatic fluctuation of sea level and, in particular, with a regression.

    2. Dzhulfian and Dorashamian cephalopod faunas have not been discovered in the Boreal realm. For a long time in the Late Permian this basin was, probably, isolated and cephalopod faunas were absent here. It appears to be more reasonable to connect both the large invasion of *Otoceras* fauna to the Boreal realm and the global ingression of this time with the very beginning of the Triassic rather than with the very end of the Permian.

3. In the Boreal realm, *Otoceras* is associated sometimes with *Ophiceras* (*Lytophiceras*) sp. (Zakharov, 1971) *Glyptophiceras* (*Tompophiceras*) *nielsoni* Spath (Kortchinskaya, Vavilov, in press), being usual elements of the overlying sediments of the Induan.

4. Good evidence of global events marking the Palaeozoic-Mesozoic boundary seems to be the abrupt shift of carbon isotope composition (decrease of 13°C) and iridium anomaly somewhat below the *Isarcicella isarcica* zone in the Central Tethys that may correspond to the base of *Otoceras* beds in the Boreal realm and Himalayan province.

6. The Lower Triassic conodonts of South-Eastern Pamirs were described. Some conodont beds are recognized:

   1. *Neospathodus dieneri - N. cristagalli*,
   2. *Platyvillosus costatus*,
   3. *Neospathodus*? *conservativus*,
   4. beds with no conodonts,
   5. *Neospathodus homeri - N. triangularis* (Dagys, 1990)

7. In the oceanic basin of Sikhote-Alin, underwater erosion of bottom sediments, apparently, took place in Triassic time. Evidence of this may be the appearance of mixing different-age condont complex on the Anisian-Ladinian boundary within the Middle-Upper Triassic cherty stratum in the Matai River rightbank (Khor-Anjui subzone of the Central Sikhote-Alia), which indicates the intraformation break in sedimentation (Buryi and Philippov, 1991).

   In this complex, together with Late-Carnian *Metapolygnathus nodosus* there are conodonts occurring as a rule in more ancient deposits: *Neogondolella constricta*, *N. excentrica* (Low Ladian), *Carinella japonica* (Upper Ladinian), *Metapolygnathus permicus* (Low-Carnian). Late Carnian patterns have been better preserved, but they are less diverse. Grading of redeposited conodonts and microwashouts suggest, that the latent stratigraphic break in lithologically homogenous cherty rock mass was formed by the underwater erosion of poorly lithified sediments by powerful currents.

8. Dimirskian horizon (Carnian) has been based in the Olga region with stratotype in Novonikolaevka village environs characterized by *Halobia* remains (Burij and Zharnikova, 1989).

9. Original data on evolution of Ladinian-Norian Scleractinia complex of Sikhote-Alin (Punina, 1989) and paleotemperature characteristic of Triassic reefogenic limestones in this region have been received (Cherbadzi, 1990).

10. New data on morphogenesis of Triassic molluscs in Siberia and ammonoid evolution during Triassic-Jurassic boundary beds have been received (Dagys and Dubatolov, 1990).

INTERNATIONAL MEETINGS

The basic materials of National Group were read in International Symposium on Shallow Tethys 3 (Sendai, September, 1990) - G.V. Kotlyar and Yu.D. Zakharov.

PLAN FOR FUTURE WORK

1. Further investigation of the Permian-Triassic organisms (plants, radiolarians, Sphinctozoa, ammonoids, conodonts) of Far East and south USSR.

2. Solution of the problem on phosphatogenesis during Late Paleozoic and Mesozoic time.

3. Organization of the Field Conference "Late Paleozoic and Early Mesozoic Biotic and Geological Events in Circum-Pacific" (272 IGCP Project, September 6-12, 1992, Vladivosktok).

SELECTED REFERENCES


a) Collection of scientific papers

1. Buryi, G.I., Tochilina, S.V. (eds.), 1989: Paleontological and Stratigraphic Investigations of the Phanerozoic in Far East. 132 p. Dalnev. Nautchn. Otd. Akadem. Nauk SSSR, Vladivostok (in Russian).

2. Dagys, A.S., Dubatolov, D.N. (eds.), 1990: The Triassic of Siberia. 104 p. Nauka, Moscow (in Russian).

b) Papers and abstracts

1. Buryi, G.I. and Philippov, A.N., 1991: Latent stratigraphical hiatuses in Triassic chert series of Sikhote-Alin. Izv. Akad. Nauk SSSR, Ser. Geol. (in press) (In Russian).

2. Burij, I.V. and Zharnikova, N.K., 1989: Paleogeographical and stratigraphical peculiarities of mutual relation of the Permian and Triassic in Primorye. In Buryi, G.I. and Tochilina, S.V. (eds.) Paleontological and Stratigraphical Investigations of the Phanerozoic in Far East. p. 11-12. Dalnev. Nautchn. Otd. Akadem. Nauk SSSR, Vladivostok (in Russian).

3. Burij, I.V. and Zharnikova, N.K. The problem of marine Carnian in South Primorye. Ibid. p. 48-52.

4. Cherbadzhi, A.K. To the paleotemperature characteristic of reefogenic limestones of Dalnegorsk region. Ibid. p. 34-38.

5. Kotlyar, G., 1991: Permo-Triassic boundary in Tethys and the Pacific Belt and its correlation. In: Kotaka, T., Dickins, J.M., McKenzie, K.G., Mori, K., Ogasaware, K. and Stanley, G.D. Jr. (eds.) Shallow Tethys 3. p. 387-391. Sendai.

6. Kotlyar, G.V., Kropatcheva, G.S. and Pronina, G.P., 1991: Upper Permian zonal scales of the South USSR and possibilities of their correlation.

7. Punina, T.A. Corals in organogenic constructions of Dalnegorsk region. In: Buryi, G.I. and Tochilina, S.V. (eds.). Paleontological and Stratigraphical Investigations of the Fanerozoic in Far East. p. 31-34. Dalnev. Nautchn. Otd. Akad. Nauk SSSR. Vladivostok (in Russian).

8. Zakharov, Yu.D., 1990: The minute-hands of the geological clock. Vestnik Dalnev. Otd. Akad. Nauk SSSR, N 2. p. 156-158.

9. Zakharov, Yu.D., 1991: On the problem of the Permian-Triassic boundary. The Permian system of the earth. Abstracts. Ural. Otd. Akad. Nauk SSSR. Perm.

10. Zakharov, Yu.D., 1990: The problem of the Permian-Triassic boundary in the Tethys. Geotectonica et Metallogenia, vol. 14, N 4. p. 365-367.

11. Zakharov, Yu.D., 1991: The Permo-Triassic boundary in the southern and eastern USSR and its international correlation. Sweet, W. (ed.). Permo-Triassic events of East Tethys region and their intercontinental correlations, p. 46-55. Servis Filmsetting Limited, Richmond House, Manchester.

12. Zakharov, Yu.D. and Okuneva, T.M., 1990: Stratigraphical significant of the Permian ammonoids of Borzja river basin (Trans-Baikal). p. 116. Stratigr. dokembrija i phanerozoja Zabaikalja i juga Dalnego Vostoka. Abstracts of 1V Dalnevost. region. stratigr. sovestch. Khabarovsk (in Russian).

13. Zimina, V.G., 1989: Permian flora of South Primorye and their role in the determination of the connection between Western and Eastern Angarida. In: Buryi, G.I. and Tochilina, S.V. (eds.). Paleontological and Stratigraphical Investigation of the Fanerozoic in Far East. p. 3-10. Dalnev. Nautchn. Otd. Akadem. Nauk SSSR, Vladivostok (in Russian).

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