

(GS01) Paleozoic palynology and botany

Date: August 25, 30

Place: Rooms 5333, 5334 (oral), Room 6325 (poster)

Oral Presentation

Aug. 25 [PM3] Room: 5333

Chair: Michael T. Dunn

16:20-16:40 **A volcanic T⁰ assemblage permits the reconstruction of the most complete Early Permian forest ecosystem: new results from the Petrified Forest of Chemnitz, Germany** [GS01-O01 \(436\)](#)

Ronny Rößler, Zhuo Feng, Volker Annacker, Ralph Kretzschmar, Mathias Merbitz, Thorid Zierold

16:40-17:00 **Vegetation structure of the Early Permian Petrified Forest in Chemnitz, Germany** [GS01-O02 \(125\)](#)

Zhuo Feng, Volker Annacker, Ralph Kretzschmar, Mathias Merbitz, Thorid Zierold, Ronny Rößler

17:00-17:20 **Biocrhonostratigraphical and geochronological implications of a new U-Pb radiometric age dating from a Lower Permian palynological association of the Southern Paraná Basin, Brazil** [GS01-O03 \(392\)](#)

Ana Luisa Outa Mori, Paulo Alves de Souza, Juliana Charão Marques, Ricardo da Cunha Lopes

17:20-17:40 **A new approach on the taxonomy, biological affinity and stratigraphical distributions of *Portalites* Hemer & Nygreen 1967 and others Gondwana related species** [GS01-O04 \(123\)](#)

Cristina Moreira Félix, Paulo Alves de Souza, Marla Silva Saldanha

Aug. 30 [AM2] Room: 5334

Chair: Ronny Rößler

10:50-11:10 ***Aneurophyton germanicum* (Aneurophytales - Progymnosperms) from the Middle Devonian of Belgium and Germany** [GS01-O05 \(344\)](#)

Nicolas Momont, Philippe Gerrienne, Cyrille Prestianni

11:10-11:30 **The tetrastichian clade of hydrasperman seed ferns** [GS01-O06 \(111\)](#)

Michael T. Dunn

11:30-11:50 **A preliminary study on the Carboniferous medullosan pollen organs from the Upper Silesian Basin (Czech Republic)** [GS01-O07 \(479\)](#)

Zbyněk Šimůnek, Jana Drábková

Poster Presentation

Aug. 25 [PM1] Room: 6325

13:30-14:30 **Palynological analysis of Upper Ordovician-Lower Silurian sediments of the Murzuq Basin, southwest Libya** [GS01-P01 \(3\)](#)

Faisal H. Abuhmida

A *Sphenopteris* cf. *gothnii* flora from Early Permian Lower Shihhotse Formation, Fucheng, Shanxi [GS01-P02 \(181\)](#)

Xuezhi He, Mingli Wan, Mengxiao Yan, Jun Wang

A new peltaspermalean plant from the Upper Permian of Nanshan Section, Gansu, China [GS01-P03 \(553\)](#)

Mingli Wan, Jun Wang, Xuezhi He, Mengxiao Yan

GS01-O01 (436)

A volcanic T⁰ assemblage permits the reconstruction of the most complete Early Permian forest ecosystem: new results from the Petrified Forest of Chemnitz, Germany

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An Early Permian (290.6 ±1.8 Ma) fossil assemblage has been discovered from the Leukersdorf Formation in the Chemnitz Basin, Germany. The first systematic excavation of the Chemnitz Petrified Forest (2008-2011) provided more than 1,800 petrifications and cast fossils from different volcanoclastic units and their sedimentary basement. The autochthonous fossil deposit originated from volcanic eruptions and preserved the most complete Permian forest ecosystem known to date. 53 trunk bases, still standing upright in their place of growth and rooting in the underlying paleosol, characterise this fossil lagerstätte as a significant T⁰ – assemblage and gives insights into a spatially restricted lowland environment. The latter sheltered a dense hygrophilous vegetation of ferns, sphenophytes, and gymnosperms as well as a diverse fauna of vertebrates, arthropods and gastropods. The comprehensive data-set of 3D coordinates gathered for every fossil find resulted in a special database and a 3D model applied as research tool to attain fundamental information on the fossilisation processes, but also to permit the reconstruction of the ancient vegetation and shed light on their spatial heterogeneity, density, and canopy structure. The fossil record revealed previously unknown biological features, such as organ connections, ontogenetic variability or the branching architecture and root systems of the occurring arboreal plants. The geological section was documented in-depth, and thereby taphonomic phenomena were detected, such as fluid-escape structures, bleaching haloes, catchment areas rich in woody branches and patterns that reveal transport directions. The findings enhance our understanding of plant's response to environmental perturbations and enable us to visualize and reconstruct individual volcanic events and their effects on the ecosystem.

Keywords: fossil wood, taphonomy, plant-animal-interactions, palaeoecology, organ connections.

GS01-O02 (125)

Vegetation structure of the Early Permian Petrified Forest in Chemnitz, Germany

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The Chemnitz fossil forest represents an Early Permian subtropical vegetation that has been buried by volcanic eruption in its growth position. Based on the well-documented and systematic excavation in a site of 18×24×5 m, 53 upright standing tree trunks, numerous transported petrified stems and foliage remains, as well as diverse fossil animals have been unearthed, which offers unbiased quantitative spatial reconstruction of this ancient vegetation. Most of the *in situ* preserved upright standing trees are preserved with anatomical cell details and could be assigned to five plant groups, 5 calamitaleans (*Arthropitys bistrinata*, *A. ezonata*), 8 tree ferns (*Psaronius* sp. showing distichously arranged frond traces), 13 pteridosperms (*Medullosa stellata*, *M. spp.*), 9 cordaitaleans (*Cordaixylon/Mesoxylon/Dadoxylon* spp.) and 2 additional pyconxylic woods. Further 16 standing plants show small axes that are less well preserved; however, they could represent juvenile or small trees. The fossil foliage casts found in the lowermost tuff bed and in the underlying palaeosol mainly consist of *Annularia spicata*, *Sphenophyllum* sp., *Lobatopteris geinitzii*, *L. sp.*, *Noeggerathia zamitoides*, *Alethopteris schneideri*, *Neurocallipteris planchardii*, *Taeniopteris abnormis*, *Crossotheca* sp. *Cordaites* sp., *Walchia piniformis* and seeds of pteridosperms/cordaitaleans or fertile pinnae/shoots of ferns/pteridosperms and cordaitaleans. Combination of the data from both the petrified upright standing stems and the *in situ* preserved foliage indicates that, *Psaronius* and *Medullosa* were small trees and dominated in this vegetation. Cordaitaleans and calamitaleans were rather tall trees, grew over 15 m high, and formed the canopy. The lower storey of this habitat is characterized by herbaceous ferns or pteridosperms (*Lobatopteris* sp., *Sphenophyllum* sp., *Crossotheca* sp., climbing/scrambling/liana habit), and other forms (*Noeggerathia zamitoides*, *Taeniopteris abnormis*).

Keywords: T⁰ assemblage, *in situ* preservation, upright standing, tuff flora, spatial reconstruction.

GS01-O03 (392)

Biocronostratigraphical and geochronological implications of a new U-Pb radiometric age dating from a Lower Permian palynological association of the Southern Paraná Basin, Brazil

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Index species useful for correlations with the International Stratigraphical Column are rare or absent in the Pennsylvanian-Permian strata of the Paraná Basin in Brazil, preventing accuracy in geochronologic assignments. Besides, absolute datings are very scarce in comparison with other Gondwana basins. This contribution aims to present palynological data from an outcrop on the surroundings of the Candiota Coalmine, southernmost Brazil, retrieved from several levels of the Rio Bonito and Palermo formations. The presence of certain index spore-pollen species allowed the recognition of two Permian palynozones: the *Vittatina costabilis* and the *Lueckisporites virkkiae* zones. Furthermore, U-Pb in zircons from a volcanoclastic level interbedded in the coal strata of the former unit was analyzed through LAM-MC-ICP-MS method, providing a radiometric dating of 281.4 ± 3.4 Ma (Cisuralian, Early Permian). This dating is assumed as the oldest occurrence of the *L. virkkiae* Zone in Paraná Basin, which contains guide species with a widespread distribution along

other Gondwana basins. A well distributed surface boundary occurs in this section also, allowing local and regional correlations. These new biostratigraphical and geochronological data are integrated, in order to offer a deep analysis on the stratigraphical significance for correlations across the Occidental Gondwana.

Keywords: palynology, biostratigraphy, radiometrical dating, Gondwanan correlations, Occidental Gondwana.

GS01-O04 (123)

A new approach on the taxonomy, biological affinity and stratigraphical distributions of *Portalites* Hemer & Nygreen 1967 and others Gondwana related species

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Rounded vesicles, without process or ornamentation and with a thick wall (between 2 and 8 μm) occur with relative abundance in coals and associated levels of the Gondwana, being assigned to *Portalites* Hemer & Nygreen 1967 and/or *Spongocystia* Segroves 1967. The former includes organic-walled microfossils with circular to oval amb, thick-walled and a thickened portion containing a circular pore from which a channel is extended, as an exclusive characteristic of this genus. *Spongocystia* is attributed for microfossils apparently without any kind of dehiscence mechanism, being spheroidal to subspheroidal, constituted by an organic wall very thin in the inner portion, surrounded by a thicker outer portion, darker in colour and presenting a spongy appearance. Among these, the genus *Portalites* has the largest number of citations and described species. Since their biological nature is still unknown, species assigned to these genera possess an uncertain systematic position, and have been tentatively assigned to Acritarcha Group, *Incertae sedis* or attributed to fungal spores. We present the results of a detailed morphological analysis of the genera above mentioned, including new taxonomic proposals. The stratigraphic and paleogeographic significance of the species are revalued based on occurrences recorded in the literature and from direct examination of slides containing well-preserved specimens, especially from those units pertaining to the Permo-Carboniferous of Western Gondwana. To the morphological and taxonomic analysis, the diagnostic characters considered for comparison of the species comprise: the stratification, surface appearance and thickness of the wall, the presence and amount of pores, as well as its overall size. Sharing the same diagnostic features, the genera *Portalites* and *Spongocystia* are taxonomically adjusted, with priority given to the former. The analysis of the surface of the wall features three patterns: smooth in *P. confertus*, ornate in *P. gondwanensis* and baculate in *P. baculus*. The assumption for *Portalites* as belonging to the Fungi Kingdom is accepted in this work, since specimens containing germination processes that resemble those of actual fungal spores are first observed in the coals of southern Brazil. The three species of the *Portalites* genus are validated herein and have different stratigraphic distribution on deposits between Mississippian and Cisuralian ages, mostly occurring in Pennsylvanian strata in Argentina and Cisuralian in Brazil. Species of the genus are confined to Gondwana regions, being *P. gondwanensis* the widespread species and more abundant in the majority of the analysed areas.

Keywords: palynology, Paleozoic, Western Gondwana, paleogeography, fungal spores.

GS01-O05 (344)

***Aneurophyton germanicum* (Aneurophytales - Progymnosperms) from the Middle Devonian of Belgium and Germany**

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Progymnosperms are basal members of the Lignophytes (plants that possess a bifacial vascular cambium, producing secondary phloem -inner bark- outwards, and secondary xylem -wood - inwards). Progymnosperms are a paraphyletic grade including three orders: Aneurophytales, Archaeopteridales and Protopytales. These plants combine a gymnosperm-type anatomy and a free-sporing reproduction. This unique combination of characters is generally indicating that the progymnosperms are closely related to the early evolution of seed plants (spermatophytes). Despite the importance of the group, both gross morphology and architecture of most progymnosperms are still poorly understood. The present study focuses on specimens of *Aneurophyton germanicum* Kraüsel & Weyland (Aneurophytales). Specimens studied here are mostly compression fossils from the late Eifelian (AD pre-Lem spore zone; Berry and Fairon-Demaret, 2001) locality of Goé (Massif de la Vesdre, Belgium) and from late Eifelian and Lower Givetian (Schweitzer and Matten, 1982) localities near Elberfeld (Germany). Most of large *Aneurophyton germanicum* specimens studied are vegetative. They are comprised of a main axis (stem) bearing large lateral branching systems (LBS). Vegetative LBS are inserted in a spiral arrangement. They are composed of N-order axis bearing N+1-order axes. N+1-order axes are spirally emitted in pairs along the N-order axis. These N+1-order axes bear ultimate appendages, which seem to be inserted alternately. Ultimate appendages are dichotomous unwebbed structures; divisions occur in the same plane. Ultimate appendages show a bilateral symmetry. Fertile LBS are generally poorly preserved. Their architecture is similar to that of vegetative LBS. Fertile ultimate appendages are composed of a stalk which divides once to form a lyre-shaped structure. Each arm of this structure bears two rows of stalked sporangia on its inner face. Sporangia are elliptical; they show a rounded tip and a longitudinal dehiscence line. The complexity of LBS varies according to their position in the plant. Proximal LBS are larger than distal LBS. Within the same LBS, there is also a variation of the complexity of N+1-order axes. Proximal N+1-order axes are larger than distal ones. Ultimate appendages also exhibit a morphological variation related with their position on the plant: proximal ultimate appendages are more complex than distal ones. Vegetative ultimate appendages can be divided up to five times; fertile ultimate appendages include a stalk that divides once or twice below the lyre-shaped structures. LBS of *Aneurophyton germanicum* have been compared with those of the others Aneurophytales and early spermatophytes. The phylogenetic position of *Aneurophyton* and of the Aneurophytales is discussed.

GS01-O06 (111)

The tetrastichian clade of hydrasperman seed ferns

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The analysis of 59 previously undescribed stems, plus roots and numerous frond segments of *Tetrastichia bupatides* suggest that many characters originally used to describe this taxon exhibit a wider range of variation than has been reported. For example, these data suggest that arms of the protostele most commonly are four in number, but range from three to five. Arm number has also

been observed changing from three to four, four to three, and four to five in some specimens. Phyllotaxy ranges from opposite decussate to 1/3 to 2/5, and rachis forking can be equal or unequal. Secondary xylem could be produced by all stems regardless of size, and rachis trace morphology ranges from “butterfly” shaped, to U, to broadly U, to T-shaped. Pinnules are vascularized by a single trace that diverges from the outermost protoxylem strand of a pinna trace. However, stems can be identified by a consistent mode of rachis trace production. Cauline protoxylem strands are located approximately midway between the center of the stele and the apex of each arm, and rachis trace formation is initiated by the division of a protoxylem strand, producing two radially oriented strands. The distal strand then divides producing two tangentially oriented strands. The distal protoxylem strands divide a number of times and the trace then diverges from the stele. This variability for many characters complicates identification of isolated Devonian and Mississippian aged stems as these new data reveal that the range of variation for *Tetrastichia bupatides* overlaps with characters used to describe *Laceyia hibernica* and *Tristichia ovensi*. All three of these taxa have been placed in the Lyginopteridaceae, however these new data suggest that based on published descriptions, they should all be segregated into a single clade due to the consistent mode of rachis trace production. Subsequently 23 previously undescribed specimens attributed to *Laceyia* from the Famennian type locality in Ireland have been analyzed. These additional data support the published data, suggesting that all known characters of *Laceyia* fall within the range of variation exhibited by *Tetrastichia*.

Keywords: Devonian, hydrasperman seed ferns, Mississippian, rachis trace formation.

GS01-O07 (479)

A preliminary study on the Carboniferous medullosan pollen organs from the Upper Silesian Basin (Czech Republic)

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At least seven species of medullosan pollen organs have been distinguished following a revision of the collections in the Ostrava Museum. All the specimens come from the Carboniferous (Yeadonian and Langsettian) Karviná Formation, Saddle, Suchá and Doubrava members. Prepollen synangia were classified into the following species: *Boulayatheca hallei* (Gothan) Šimůnek et Drábková nov. nom., *Givesia media* (Stockmans) Stockmans et Willièrè, *Kotasothea annadamii* Pacyna et Zdebska, *Whittleseya brevifolia* White, *W. delphinae* Stockmans et Willièrè, *W. desiderata* White and *W. silesiaca* Pacyna et Zdebska. Prepollen grains are elliptical in outline. On the proximal surface a single suture is present and two longitudinal grooves ornament the distal surface. These prepollen grains are assigned to *Monoletes* (formerly *Schopfipollenites*) *ovatus* Schopf and were isolated from specimens belonging to the species *Boulayatheca hallei*, *Givesia media* and *Whittleseya desiderata* for the first time. The smallest prepollen grains were found in *Boulaya hallei*, 170–190 µm long. *Givesia media* has prepollen grains approximately 200–230 µm long. The largest prepollen grains occur at the smallest synangia *Whittleseya desiderata*. Their length is 220–280 µm and therefore a small overlap in prepollen grain length exists between *Givesia media* and *Whittleseya desiderata*. No fructifications were found in attachment, therefore their parent plants remain tentative. However, according to co-occurrence of fronds and fructifications, it seems that *Boulayatheca hallei* belongs to *Alethopteris urophylla* and *Whittleseya desiderata* belongs to *Neuropteris obliqua*. The remaining fructifications were not accompanied by pteridosperm fronds. *Whittleseya delphinae* and *W. elegans* are considered as synonyms by some authors (Pacyna and Zdebska). Maybe, the cuticular study could solve this problem. This research was undertaken with support of the GACR 2010/10/0232.

Keywords: Carboniferous, “in situ” prepollen, medullosan pollen organs, *Whittleseya*, Upper

Silesian Basin.

GS01-P01 (3)

Palynological analysis of Upper Ordovician-Lower Silurian sediments of the Murzuq Basin, southwest Libya

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Ninety core and cuttings borehole samples from the Upper Ordovician (Melez Shugran, Memouniat, Bir Tlakshin Formations) and Lower Silurian (Tanezzuft Formation) of the Murzuq Basin of southwest Libya were palynologically analyzed and investigated to determine the age and depositional environment of these deposits. The majority of these samples proved palyniferous, yielding abundant and well preserved marine palynomorphs (acritarchs, chitinozoans, scolecodonts) and non-marine palynomorphs (spores). A total of 118 species belongs to 45 genera of acritarch, 94 species belongs to 21 genera of chitinozoan and 20 species belongs to 15 genera of cryptospore/spore have been identified and taxonomically described. Scolecodonts as well as a graptolite remains were also observed (counted but not taxonomically identified). Based on the presence of age diagnostic chitinozoan and acritarch taxa, late Katian-early Hirnantian age has been assigned to the Melez Shugran Formation and it is considered to correspond to the *Armoricochitina nigerica*, *Ancyrochitina merga* and lower *Tanuchitina elongate* Biozones. The Memouniat Formation is assigned to the middle Hirnantian and is considered to be within the *Tanuchitina elongata* Biozone. The Bir Tlakshin Formation is attributed to late Hirnantian age and is assigned to the *Spinachitina oulebsiri* Biozone. Chitinozoan assemblages Biozones recorded in this study reflect a clear palaeobiogeographic affinity with those previously defined in the North Gondwana domain. The composition of acritarch assemblages also appears to be consistent with Late Ordovician North Gondwana phytoplanktonic palaeobiogeographic affinities. It is noteworthy that the acritarch assemblages from the Bir Tlakshin and Lower Tanezzuft (Hot shale) formations co-exist with some reworked acritarch species of late Katian age. Chitinozoan and acritarch assemblage Biozones recognized from the Lower Silurian Tanezzuft Formation allow correlation with both chitinozoan and acritarch biozonations from North Gondwana and elsewhere, and indicates that the Tanezzuft Formation ranges from Rhuddanian to Telychian in age. The presence of cryptospores, together with taxonomically diverse chitinozoans and acritarchs, suggests an inner shelf marine depositional environment for the Melez Shugran Formation and the shale intercalations in the lower Memouniat and overlying Bir Tlakshin Formations. A marine environment is also indicated for the hot shale of the Tanezzuft Formation, which was deposited during a maximum flooding event in the Rhuddanian, before passing up into marginal marine environments.

GS01-P02 (181)

A *Sphenopteris* cf. *gothnii* flora from Early Permian Lower Shihhotse Formation, Fucheng, Shanxi

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Ferns are abundant and diverse in the Early Permian Cathysian flora of Shanxi, North China. In traditional research, the stratigraphic division and comparison of coal-bearing strata have been investigated much extensively, whereas paleoecology, especially of the ferns are rarely concerned. Recently, reinvestigation of *Sphenopteris (Oligocarpia) gothanii* indicates the growth habit and cloning reproduction strategy. However, the detail of sedimentologic and taphonomic information is unknown. In this study, new materials of *Sphenopteris (Oligocarpia) cf. gothanii* have been collected from the Lower Shihhotse Formation of southeast Shanxi. This plant was found in a lenticular mudstone, associated with rooting structure. It is characterized by aplebia at the base of the penultimate rachis. Sedimentologic, taphonomic and morphologic analyses are conducted to understand the growth habit and ecology of the fern. The result indicates that the fern has prostrate, ground cover growth habit, and lived surround (or in) a pool on floodplain.

Keywords: paleoecology, plant taphonomy, Early Permian, *Sphenopteris (Oligocarpia) cf. gothanii*.

GS01-P03 (553)

A new peltaspermalean plant from the Upper Permian of Nanshan Section, Gansu, China

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Some well preserved compression specimens of once-pinnate plant fronds were collected from Late Permian Sunan Formation in the well known Nanshan Section, Gansu Province, China. Both morphological and epidermal characteristics are very distinct. Frond morphology suggests that the plant probably a member of seed plant order Peltaspermales. Venation of pinnae is fan-shaped without a midvein. The venation pattern is quite invisible based on impression-compressions due to the coverings of thick cuticles. Pinnae vary from oval to lanceolated and stripe in shape. The apical and basal pinnae gradually decrease in size relative to those located in the middle part of the frond, where the pinnae are biggest. Angles between pinnae and rachis are less than 45° at the apical of the frond, increasing gradually to roughly a right-angle on the basal portion. Pinnae are amphistomatic. Epidermal cells on both lower and upper epidermis are polygonal and stomata are located randomly on both sides of pinnae surfaces. In the lower leaf surface cuticle, stomata are much more common. Palillae occur on the perclinal walls of subsidiary cells and overarch the stomata pore. No papillae occur on the upper surface. By these features this plant is distinct from any other known members of Peltaspermales and represents a new species, which is markedly different from those peltaspermales taxa in the Euramerican and Angaran floras. It might be an endemic species in the Cathysian-Angaran mixed flora of Northern China. Judging from the significant thickness of the cuticles, the strong papilosity and deep cutinizations of stomata, together with other associated plants such as *Pursongia* sp., we may deduce that the general climatic conditions of the time of the mixed flora existence might be semiarid climate with rare seasonal rains.

Keywords: Peltaspermales, Nanshan Section, Late Permian, Cathysian-Angaran mixed flora, paleoecology.