(SS21) Paleofloristic and paleoenvironmental changes in Asia throughout the Mesozoic : palynological and megafossil evidence

Date: August 25
Place: Room 5334 (oral), Room 6309 (poster)
Organizers: Harufumi Nishida, Marc Philippe, Kazuo Terada & Julien Legrand
Contact email address: helecho@kc.chuo-u.ac.jp
Purpose: Paleobotany of the Mesozoic period is a rich and expanding field of research in Asia. Cross studies on macro- and microremains in various fields of research such as palynology, xylology or cuticular anatomy bring new advances in the understanding of past ecosystems and climates. Several models of paleofloristic provinces have been suggested for Asia, and a variety of point of views allows discussion concerning its biogeography and the relations between its components, as well as a global comparison.
Moreover, Mesozoic also includes the key period of Angiosperm diversification and worldwide expansion, and Asia has important clues to discover what happened at the beginning of the "vegetational revolution".

Oral Presentation

Aug. 25 [AM2] Room: 5334

Chairs: Harufumi Nishida, Marc Philippe, Kazuo Terada, Julien Legrand

10:50-11:10 **Outstanding diversity of conifer remains in the Late Permian marine Talung Formation, South China** SS21-O01 (596)

Jianxin Yu, Jean Broutin, Qianqian Song

11:10-11:30 **Plant microfossils from the Upper Triassic of the Central Iran Basin, east-central Iran** SS21-O02 (444)

Fereshteh Sajjadi

Chairs: Harufumi Nishida, Marc Philippe, Julien Legrand

11:30-11:50 **Late Triassic—Early Cretaceous coniferous woods in Japan: revisions of their geological horizons and associated nomenclatural problems** SS21-O03 (519)

Kazuo Terada

Chairs: Harufumi Nishida, Marc Philippe, Kazuo Terada, Julien Legrand

11:50-12:10 **Newly discovered Jurassic plants from Japan and their contribution to a better understanding of the paleoenvironment, from a morphological approach** SS21-O04 (512)

Hideo Takimoto, Tamiko Ohana

Aug. 25 [PM2] Room: 5334

Chairs: Harufumi Nishida, Marc Philippe, Kazuo Terada

14:30-14:50 **Palynostratigraphy and paleoenvironments of the Lower Cretaceous Choshi Group, Outer Zone of south-west Japan** SS21-O05 (268)

Julien Legrand, Denise Pons, Harufumi Nishida

Chairs: Harufumi Nishida, Marc Philippe, Kazuo Terada, Julien Legrand

14:50-15:10 **Late Cretaceous spores and pollen assemblages and palaeoclimate of the lower Nenjiang Formation in the Songliao Basin, NE China** SS21-O06 (608)

Jing Zhao, Xiao-Qiao Wan, Dang-Peng Xi, Xia Jing, Wei Li

15:10-15:30 ***Xenoxylon* synecology and its bearings on Mesozoic terrestrial climates** SS21-O07 (386)

Changhwan Oh, Marc Philippe, Kyungsik Kim

15:30-15:50 **Paleofloristic and paleoenvironmental changes in Amur (Heilongjiang) River region throughout the Late Cretaceous and Paleocene: palynological and paleobotanical evidence** SS21-O08 (311)

Valentina S. Markevich, Eugenia V. Bugdaeva, Ge Sun, Abdul Rahman Ashraf

Aug. 25 [PM3] Room: 5334

Chairs: Harufumi Nishida, Marc Philippe, Kazuo Terada, Julien Legrand

16:20-16:40 **Palynological implications of the Deccan Intertrappean sediments (Maastrichtian-Danian): A review** SS21-O09 (230)

Ratan Kar, Rama Shankar Singh

16:40-17:00 **Deccan continental flood basalt induced floral changes in Late Cretaceous-Early Paleocene: Evidences from palynomorph bearing interlava sediments of Indian subcontinent** SS21-O10 (447)

Bandana Samant, Dhananjay M. Mohabey

Poster Presentation

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13:30-14:30 **Late Permian Jiefangcun flora from Hunchun of Jilin, China** SS21-P01 (589)

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Record of a possible marattiaceous fern from the Upper Permian sediments of Indian Lower Gondwana SS21-P02 (29)

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Petrification and mineralization of ancient trees: Appreciation of arts of fossil woods SS21-P05 (604)

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SS21-O01 (596)

Outstanding diversity of conifer remains in the Late Permian marine Talung Formation, South China

Jianxin Yu[1], Jean Broutin[2], Qianqian Song[1]

[1] *State Key Laboratory of Biogeology and Environmental Geology (China University of Geosciences, Wuhan), P.R.China, yujx_cug@yahoo.com.cn*
[2] *Paleobotany and Paleoecology, Centre de Recherche en Paléoécologie et Paléoenvironments, Université Paris 6 (UPMC), France*

The late Permian fossiliferous localities in the Western Guizhou-Eastern Yunnan of the upper Yangtze Platform in South China, deposited in: terresrial coal swamps, coastal marine and marine carbonates platforms. Conifer macro-remains are almost absent in the Late Permian terrestrial coal bearing deposits, their likely existence in surrounding areas being attested only by fossil pollen grains. Paradoxical, it is in the Late Permian marine Talung Formation that nicely preserved conifer leafy shoots showing surprisingly highly diverse types of foliage architectures occur, together with a typical Changhsingian marine fauna. This strange taphonomic distribution of conifer vegetative shoots, restricted to marine deposits is an interesting bias remaining to be understood**.** Our collecting includes now long and short leafy shoots, ovuliferous scales, male and female cones, charcoal woody stem, dispersed and in situ cuticles. Recently, among a formerly described assemblage of *Ullmannia*-like and *Szecladia* twigs, bearing small broad leaves densely spirally inserted, we discovered for the first time in a Late Permian Formation, ramified foliar branches and branchlets bearing appressed opposite-decussate, dorsal-ventral flattened, scale leaves. Many compressions of their fleshy leaves contain very informative preserved epidermis cuticles. This material is in accordance *Cupressinocladus* (Seward, 1919). This form-genus was made by Seward for "vegetative shoots agreeing in habit of branching and in predominance of a decussate arrangement of appressed leaves with recent Cupressinae including the genus *Chamaecyparis".* Such foliage architecture pattern was believed to appear only in the Late Early Triassic (still controversial) and to diversify from Middle Triassic to recent. In this respect, would the Late Permian South China be one of the Late Paleozoic "cradles" from where "Mesozoic forms" of conifers bearing "advanced cupressaceae-like" leafy shoots originated and spread out during the Mesozoic and Tertiary, diversifying into various lineages. Conversely to all the actual statements on the Late Permian conifers distribution in China, South China appears now to shelter a high diversified assemblage as in North China. It is assumed that the settlement of West European-like conifers in North China during the Late Permian, by migration, was linked to the establishment in this area of a similar hot dry climate. But in South China the climate remaining warm and humid until the latest Permian allowed the persistence of a dense coal-forming swampy vegetation, acting as a "biological barrier" for most conifer debris to reach the terrestrial vegetal burial environments. The real diversity of the conifers is then evidenced only in coeval marine deposits.

Keywords: new fossil conifers, morphology, marine Talung Formation, Late Permian, South China.

SS21-O02 (444)

Plant microfossils from the Upper Triassic of the Central Iran Basin, east-central Iran

Fereshteh Sajjadi

University of Tehran, Iran, sajjadi@khayam.ut.ac.ir

The Upper Triassic Nayband Formation of Kamar Macheh Kuh, southeastern Tabas, Central Iran Basin, contains quite diverse and moderately preserved palynomorph assemblages composed exclusively of terrestrial elements; fungal and algal spores also occur as minor constituents. No marine taxa was encountered. The palynofloras are dominated, respectively, by radially symmetrical and monolete spores and pollen grains. Among the pollen grains, bisaccate taxa such as *Ovalipollis* and *Falcisporites*, and the inaperturate *Araucariacites* dominate the assemblages. On the basis of the First Observed Occurrence (FOO) and Last Observed Occurrence (LOO) of selected taxa, vertical distribution of miospores allows the definition of four distinct successive biozones within the Nayband Formation: the *Araucariacites australis-Annulispora folliculosa*, the *Annulispora folliculosa-Quadraeculina anellaeformis*, the *Quadraeculina anellaeformis-Ricciisporites tuberculatus* and the *Ricciisporites tuberculatus-Alisporites similis* biozones. Considering the association of key species such as *Lunatisporites rhaeticus, Ovalipollis ovalis* (alias *pseudoalatus*), *Annulispora folliculosa, Polycingulatisporites mooniensis* and the taeniate bisaccate pollen grains within the assemblages, the strata can be dated as Late Triassic (Rhaetian), which is in accordance with previous faunal evidence. The absence of some Early Jurassic (Hettangian) key taxa such as *Pinuspollenites, Trachysporites* or *Cerebropollenites thiergartii*, as well as the paucity of *Classopollis* also appear to uphold this age determination. Inferred natural relationships of the Nayband *sporae dispersae* imply derivation from a quite diversified flora composed of Bryophytes, spore-producing seedless vascular plants comprising Pterophytes, Lycophytes, and Sphenophytes, and gymnosperms (Coniferophytes and Ginkgophytes). The abundance (up to 99%) of equidimensional and well sorted phytoclasts, the moderately preserved land-derived miospores and the absence of any marine palynomorph indicate an accumulation of the sediments in a turbulent, well oxygenated depositional setting.

Keywords: miospores, palynostratigraphy, palaeoecology, Nayband Formation, Central Iran Basin.

SS21-O03 (519)

Late Triassic—Early Cretaceous coniferous woods in Japan: revisions of their geological horizons and associated nomenclatural problems

Kazuo Terada

Fukui Prefectural Dinosaur Museum, 51-11 Terao, Muroko, Katsuyama, Fukui 911-8601, Japan, k-terada@dinosaur.pref.fukui.jp

Many strata from Late Triassic to Early Cretaceous are fragmentarily distributed over Japan. During the last century fossil woods, including more than 20 genera and 70 species, have been reported by some pioneer palaeoxylologists from certain strata for example the Nariwa Group and the Mine Group (Late Triassic), the Kuruma Group (Early Jurassic) and the Tetori Group (Middle Jurassic to Early Cretaceous) etc.. Some species reported have associated taxonomical problems. For example, six species considered as *Mesembrioxylon* Seward (an illegitimate generic name) are reported. It is therefore necessary to re-examine such specimens as it is a problem to simply assign them to correct morphotaxa. Furthermore, fossil material is often associated with the originally described geological ages without consideration for new geological ages of the strata that also bear fossil wood. For example, although the age of the Torinosu Group has been given a Middle-late Jurassic age, at least the Yatsuji Formation of the Torinosu Group is regarded as Early Cretaceous. The Tetori Group bearing many fossil woods of *Xenoxylon latiporosum* (Cramer) Gothan is stratigraphically divided into three subgroups, Kuzuryu, Itoshiro and Akaiwa, in ascending order. Although *X. latiporosum* had been frequently found throughout the three subgroups, no *X. latiporosum* has been reported from the distinct Kuzuryu Subgroup the age of which has now been corrected by recent geological stratigraphic revision. Furthermore, as some of the original holotype specimens proposed for

morphotaxa from the Nariwa, Mine, Kuruma Groups are now lost, it is necessary to designate neotypes.

Keywords: fossil wood, geological horizon, Japan, *Mesembrioxylon*, Mesozoic.

SS21-O04 (512)

Newly discovered Jurassic plants from Japan and their contribution to a better understanding of the paleoenvironment, from a morphological approach

Hideo Takimoto[1], Tamiko Ohana[2]

[1] *Ibaraki Nature Museum, Japan, takimoto@nat.pref.ibaraki.jp*
[2] *Institute of Natural History, Japan*

Well-preserved fossil plants were obtained from the Oxfordian Tochikubo Formation, Somanakamura Group (Northeast Honshu, Japan), on which can be observed the morphological features of leaves and venations, as well as the leaf arrangements. Reproductive organs are also present and allow understanding how they were attached to the stem. Unfortunately, these specimens do not show any preserved cuticle and they cannot be classified by cuticular anatomy. Despite of this absence of any cellar information, we can estimate most of plant shapes and real sizes and so consider a paleoenvironmental reconstruction from a morphological approach. In this flora, most of ferns have tri- or tetra-pinnate leaves with small pinnae. Pinnae of woody ferns tend to be smaller as they live closer to the equator, in the northern hemisphere. This feature suggests a warm to hot climate. Leaf scars and abscission layers can be confirmed in several species of Gymnosperms. This feature is related to the climate, as leaves are vulnerable to coldness and aridity. We can guess that the trees dropped their leaves under low temperature or arid season. However, considering the composition of the flora, there is no possibility for a cold climate and we can suggest that the leaf scars and abscission layers indicate an arid season. The Jurassic and Cretaceous floras of eastern Eurasia are classified into the Ryoseki-type, Tetori-type and Mixed-type floras on the basis of their taxonomic components (Kimura, 1988). The studied flora belongs to the Ryoseki-type, because of its composition and geographical location. From previous anatomical studies, it has been suggested that the Ryoseki-type flora flourished under tropical or subtropical conditions, with an annual long and arid season. As shown above, the present study confirms these conditions from a morphological approach. The most important contribution of our study, which has been made possible thanks to an intense effort of the local collectors, is the size reconstruction of some Jurassic plants. Original drawings are proposed for the reconstruction of *Nilssoniocladus tairae*, *Nilssoniocladus japonicus*, *Zamites nipponicus* and *Ptilophyllum* sp. nov., which make possible to obtain an accurate view of the landscape for the Mesozoic world. Plant reconstructions are significant elements for the comprehension of the past ecosystems, especially by their size and shape which are related to the ecology and function of the herbivorous dinosaurs.

Keywords: Jurassic, plant morphology, environmental reconstruction, outer zone of Japan.

SS21-O05 (268)

Palynostratigraphy and paleoenvironments of the Lower Cretaceous Choshi Group, Outer Zone of south-west Japan

Julien Legrand[1], Denise Pons[2], Harufumi Nishida[1]

[1] *Chuo University, Tokyo, Japan, legrand@kc.chuo-u.ac.jp*
[2] *Université Pierre et Marie Curie, UMR 7207 CNRS, Centre de Recherche en Paléobiodiversité et Paléoenvironnements MNHN, Paris, France*

The Choshi Group, which crops out along the eastern coast of the Choshi Peninsula, Outer Zone of south-west Japan, has been subdivided lithologically into five formations, in ascending order: Ashikajima, Kimigahama, Inubouzaki, Toriakeura and Nagasakihana Formations. Deposited in an offshore to shallow marine environment, it is dated as Barremian to early Albian based on the ammonite and other molluscan assemblages. The plant macrofossils assemblage have been described by Makoto Nishida, Harufumi Nishida and others, from the Ashikajima, Kimigahama and Toriakeura Formations, and contain typical components of the Ryoseki-type flora (Kimura, 1987), such as the cycad *Ptilophyllum cutchense* Morris, and the conifer *Brachyphyllum expansum* (Sternberg) Seward. New microfloras were discovered in the muddy, very fine-grained sandstones and mudstones of the Group, completing a previous study near its base and now providing an entire palynostratigraphical sequence. The studied assemblages yield spores, pollen grains, marine or freshwater algae and some epiphyllous fungi. The authors compare them with the paleofloristic associations of the South-Laurasian Province (Brenner, 1976) and Euro-Sinian Region (Vakhrameev, 1991). The spatio-temporal distributions of the genus *Manumia* Pocock, reported for the first time in Asia, and some species as *Cicatricosisporites sinuosus* Hunt, 1985 are plotted on paleogeographical maps. With this palynological study, we add new data to the present knowledge of the floras and climatic changes of the Outer Zone of Japan during its probable collision with the Eurasian continent, where first angiosperms are expanding.

Keywords: palynology, microfossils, Lower Cretaceous, Choshi Group, Japan.

SS21-O06 (608)

Late Cretaceous spores and pollen assemblages and palaeoclimate of the lower Nenjiang Formation in the Songliao Basin, NE China

Jing Zhao[1], Xiao-Qiao Wan[1], Dang-Peng Xi[1], Xia Jing[2], Wei Li[1]

[1] *School of Earth Science and Resources, China University of Geosciences, China, zjlc_2@163.com*
[2] *Guangzhou Marine Geological Survey, China*

The Cretaceous represents one of the warmest periods in the Mesozoic, but little information exists about the continental Cretaceous and its climate changes. The Songliao Basin located in northeastern China is one of the largest Cretaceous continental rift basins in the world. Well-preserved Cretaceous lacustrine deposits in this basin provide an excellent opportunity to study the palaeoenvironment and palaeoclimate of the non-marine Cretaceous. The Cretaceous Nenjiang Formation in the Songliao Basin were deposited during accelerated basin subsidence, and the members 1 and 2 of Nenjiang Formation represent the one of the main lake transgression events of evolutionary history of the basin. The spores, pollen, and other microfossils are abundant in this formation, which preserved valuable information of the palaeoclimate. This research is based on the material from borehole SK-1 and Jiang-79. The lithology of the member 1 to 2 of Nenjiang Formation is dominated by mudstone. Based on analysis of the spores and pollen fossils of this formation, the following two fossil assemblages have been recongnized (in ascending order): the *Proteacidites-Cyathidites-Dictyotriteles* and *Lythraites-Aquilapollenites-Schizaeoisporites* assemblages. In the member 1 of Nenjiang Formation, the dominate species of sporopollen fossils are *Cyathidites, Dictyotriteles, Schizaeoisporites, Laevigatosporites, Cedripites, Pinuspollenites, Piceaepollenites, Proteacidites, Songliaopollis,* which belong to the

Proteacidites-Cyathidites-Dictyotriteles assemblage. In the member 2 of Nenjiang Formation, there are many different kinds of spores and pollen fossils, such as *Lythraites, Beaupreaidites, Classopollis, Aquilapollenite, Schizaeoisporites, Cyathidites,* belonging to the *Lythraites-Aquilapollenites-Schizaeoisporites* assemblage. According to some of the typical species, it is suggested that the two fossil assemblages range from late Santonian to early Campanian in age. The quantitative analysis of spores and pollen fossils, such as vegetation type, climate type, and humidity type, diversity and dominance, indicate a sub-humid, mid-subtropical palaeoclimate, with slight climatic fluctuation. The specific evolutionary process of spores and pollen fossils shows a relatively warm and humid climate during the early-late Santonian, and a relatively dry and cool climate during late-late Santonian. The climate was more hot and humid during the early-early Campanian, where a group of black shale was deposited. During the late-early Campanian, the palaeoclimate was relatively dry and cold. And the palaeoclimate of this period became stable. The cycle of climatic fluctuation in this period was somewhat parallel to the global climate change.

Keywords: Late Cretaceous, Songliao Basin, spores and pollen assemblages, Nenjiang Formation, palaeoclimate.

SS21-O07 (386)

Xenoxylon synecology and its bearings on Mesozoic terrestrial climates

Changhwan Oh[1,2], Marc Philippe[1], Kyungsik Kim[2]

[1] *Paléobotanique, Université Claude Bernard-Lyon 1 and UMR5276 of the CNRS, France, bluegaia@jbnu.ac.kr*
[2] *Division of Biological Sciences, Chonbuk National University, Republic of Korea*

Fossil wood is of interest to palaeoecological synthesis, as it is not too mobile and more resistant than other plant mega fossils. The distribution of fossil wood genera was demonstrated to be an efficient proxy of Mesozoic terrestrial climates. In particular, *Xenoxylon* Gothan was recently confirmed as a potential marker of cool and/or wet climate in boreal Hemisphere. In this study, we investigated the fossil wood phytocoenoses which are associated with *Xenoxylon* (i.e. *Xenoxylon* phytocoenoses) during the Mesozoic. It is confirmed that *Xenoxylon* more often co-occurs with some genera than with others. *Protocedroxylon* Gothan was the most often associated genus in *Xenoxylon* phytocoenoses. Although *Taxodioxylon* Hartig was also a part of *Xenoxylon* phytocoenoses, it was not as constant as *Protocedroxylon*. The distribution and diversity of *Xenoxylon* phytocoenoses changed all through the Mesozoic. During the Late Triassic and Late Cretaceous *Xenoxylon* phytocoenoses were very restricted, while they widely expanded during the Early to Middle Jurassic, while their diversity sharply increased. During the Late Jurassic to Early Cretaceous *Xenoxylon* phytocoenoses get more restricted northward in Europe than in East Asia. The distribution of *Xenoxylon* phytocoenoses was in agreement with the global or regional climate changes. Our results confirm the value of *Xenoxylon* as an indicator of relatively wet and/or cool boreal climates. They also demonstrate that within *Xenoxylon* range corresponding phytocoenoses were differentiated on a latitudinal gradient.

Keywords: *Xenoxylon* phytocoenoses, *Protocedroxylon*, *Taxodioxylon*, palaeoecology, palaeoclimate.

SS21-O08 (311)

Paleofloristic and paleoenvironmental changes in Amur (Heilongjiang) River region

throughout the Late Cretaceous and Paleocene: palynological and paleobotanical evidence

Valentina S. Markevich[1], Eugenia V. Bugdaeva[1], Ge Sun[2], Abdul Rahman Ashraf[3]

[1] *IBSS FEBRAS, Russia, markevich@ibss.dvo.ru*
[2] *Shenyang Normal University, China*
[3] *University of Tuebingen, Germany*

Sedimentary cover of the Zeya-Bureya Basin (Russian Far East) developed since the Santonian. During this age, the climate was warm and wet, and lakes were widely distributed, with abundant limnophilous fauna and aquatic angiosperms. Vegetation was dominated by cyatheaceous and dicksoniaceous ferns, and taxodialeans. In the palynoflora, gymnosperms pollen grains are dominated by *Ginkgocycadophytus* and pollen close to the Pinaceae and Taxodiaceae; pollen of angiosperms is mainly represented by *Kuprianipollis*. A deterioration of the climate began during the Campanian, and lakes became shallow. Terrestrial vegetation was dominated by conifers, while aquatic angiosperms were abundant in the lakes. Palynoflora is dominated by ferns close to the Cyatheaceae and Polypodiaceae; among gymnosperms bisaccate conifer pollen having affinity with the Pinaceae prevails; angiosperms are represented by pollen close to the Platanaceae, Fagaceae, and Juglandaceae; "unica"-type pollen is rare. During the Maastrichtian, quick and drastic changes took place in the climate and paleoenvironments, especially between the middle and late Maastrichtian, when the thermophilous plants and giant dinosaurs disappeared. During this age, the vegetation abruptly changed. The early Maastrichtian palynoflora is dominated by angiosperms; they are represented by tricolpate pollen grains. The diversity of "unica"-type pollen increases. Among gymnosperms, pollen having affinity with the Pinaceae and Taxodiaceae dominates. The middle Maastrichtian palynoflora is dominated by gymnosperms (Pinaceae, Taxodiaceae and *Ginkgocycadophytus*); among angiosperms, pollen from plants close to the extant families Betulaceae, Juglandaceae, Fagaceae, Ulmaceae and Myricaceae prevail. Margins of the basin began to rise during the Maastrichtian, when tectonics revives. Palynoflora is dominated by pollen close to the Taxodiaceae and Ulmaceae; among spores, *Laevigatosporites* predominates; the angiosperms are rather diversified and represented by pollen having affinity with the Betulaceae, Salicaceae, Juglandaceae, Myricaceae and Myrtaceae; the diversity of "unica"-type pollen increases (up to 33%). Floral changes were gradual across the K-T boundary. Only some Cretaceous palynotaxa disappear; the structure of dominance changes, but composition of the palynoflora mostly remains invariable. The early Danian palynoflora is dominated by *Laevigatosporites* and gymnosperms (Taxodiaceae, Cupressaceae and Pinaceae); among angiosperms, the Juglandaceae and Fagaceae predominate; the "unica"- and "oculate"-type pollen is rare, and its taxonomical diversity decreases. Vast swamps appeared during the Danian. The late Danian palynoflora is dominated by gymnosperms (Taxodiaceae and Pinaceae) and angiosperms close to the Ulmaceae, Betulaceae, Fagaceae, Juglandaceae, Salicaceae and Myricaceae. This research was supported by the Russian Academy of Sciences (grant № 12-I-P28-01), Russian Foundation for Basic Research (grant 12-04-01335), Far East Branch of RAS (grant 12-III-A-06-075, 12-III-A-06-070).

Keywords: palynology, paleoenvironments, Late Cretaceous, Paleocene, Zeya-Bureya Basin.

SS21-O09 (230)
Palynological implications of the Deccan Intertrappean sediments (Maastrichtian-Danian): A review

Ratan Kar, Rama Shankar Singh

Birbal Sahni Institute of Palaeobotany, India, ratankar@yahoo.com

The Deccan Traps, one of the largest continental basalt provinces in the world, cover an area of ~ 500,000 km^2, occupying western, central and southern parts of the Indian peninsula. In the recent past, extensive radiometric dating of the traps have provided an age constraint of 67-64 Ma for the duration of trap activity, with a broad consensus that the major volcanic episode was for a short duration (~ 1 Ma) centered around 29R. Rapid eruption (~ $2km^2yr^{-1}$) and wide distribution (~ 2km thick pile covering an area of ~ 500,000 km^2) of lava flows reflect the magnitude of the catastrophic volcanism. The Deccan volcanism is a major Cretaceous-Tertiary Boundary (KTB) event and has also been linked with the mass extinction at the K/T transition. Thin sedimentary beds (=intertrappeans) sandwiched within the volcanic flows were deposited during the quiescence phases of volcanic activity, in the shallow lakes and water bodies formed due to the obstruction of drainage system by the lava flows. The intertrappean beds are exposed in isolated patches mostly on the peripheral areas of the Deccan volcanic province and preserve the signatures of the then biotic communities. The flora and fauna of the intertrappean deposits have evoked considerable interest since long. Angiosperms, gymnosperms, pteridophytes, charophytes, blue-green algae, aquatic ferns, ostracodes, molluscs, fishes, dinosaurs and other vertebrates thrived during the volcanic episode and provide an opportunity to study the organisms in terms of extinction, survival and evolution, manifested in response to the stressful environment. Since the last two decades, considerable new palynological data have been generated from these volcano-sedimentary deposits. The pollen-spores, fossil paraphyses, fungal remains, diatoms etc are discussed with reference to biostratigraphy, palaeoecology, palaeogeography, provincialism and K/T transition.

Keywords: flood basalt eruption, Indian peninsula, age constraints, Cretaceous-Tertiary transition, plant microfossils.

SS21-O10 (447)

Deccan continental flood basalt induced floral changes in Late Cretaceous-Early Paleocene: Evidences from palynomorph bearing interlava sediments of Indian subcontinent

Bandana Samant[1], Dhananjay M. Mohabey[2]

[1] *PG Department of Geology, RTM Nagpur University, Nagpur-440001, India, bandanabhu@gmail.com*
[2] *Geological Survey of India, Northern Region, Lucknow-226007, India*

Palynological study of sediments associated with Deccan Continental Flood Basalt (DCFB) sequence was carried out for understanding the affect of Deccan volcanism on flora close to the Cretaceous-Paleogene (K-Pg) boundary. The study shows that prior to the initiation of Deccan volcanism in the Late Cretaceous (Maastrichtian), the terrestrial vegetation was having mixed assemblage comprising of gymnosperms (*Araucariacites*, *Classopollis*, *Cycadopite*s), angiosperms (*Graminidites, Palmaepollenites*, *Retimonocolpites* etc) and pteridophytes (*Isoetes* etc). The onset of volcanic activity affected the contemporary depositional environments, both directly and indirectly. Lakes and ponds having new ecological niches developed over fresh lava fields. In the changed scenario, over fringe areas of water bodies a new palynofloral assemblage is observed which is dominated by angiosperms and pteridophytes. During the earliest phase of volcanism in Maastrichtian, prevalence of humid to subhumid climatic conditions is noted. At higher stratigraphic levels close to the K-Pg boundary a sharp decline in recovery of palynomorphs and noticeable increase in recovery of *Glomus* like mycorrhizal fungi is observed. The lithology at these levels is dominated by limestones, marlites and calcareous shales possibly suggesting a period of aridity induced by volcanism. A marked increase in the presence of both centric and pinnate type diatoms is observed at this level indicating volcanogenic effusive induced eutrophic lakes. Further higher up, in

the waning phase of volcanic activity in late Paleocene a good palynofloral assemblage is recorded suggesting return of favourable environmental conditions for the growth of plants. However, this later palynofloral assemblage distinctly differs from that of Maastrichtian assemblage and is indicated to be closer to the post DCFB palynoflora of Paleocene-Eocene. The emerging palynological data from the Indian subcontinent provide a strong evidence of three major events of floral change during the Deccan environmental transition. The first floral change is associated with the initiation of Deccan volcanism and arrival of first lava flows during early Maastrichtian, the second is related to peak volcanism that outpoured voluminous lava flows in quick successions close to the K-Pg boundary and the third change is linked to the waning phase of volcanism when flora reestablished itself. Thus, a strong link between the floral changes and DCFB eruptions, close to the Maastrichtian-Paleocene is evident.

Keywords: Volcanism, intertrappean, palynoassemblage, Cretaceous-Paleogene boundary.

SS21-P01 (589)
Late Permian Jiefangcun flora from Hunchun of Jilin, China

Tao Yang[1], Ge Sun[1,2], Serge V. Naugolnykh[3]

[1] *College of Paleontology, Shenyang Normal University, Shenyang 110034, China, Monster.yang@yahoo.com.cn*
[2] *Key-Lab for Evolution of Past Life & Environment in NE Asia, MOE, Jilin University, Changchun 130026, China*
[3] *Geological Institute, Russian Academy of Sciences, Moscow 109017, Russia*

In Late Permian, the Angara floras in China are mainly distributed in the northern and northeastern region, including Heilongjiang, northern Jilin, Inner Mongolia, and the Ningxia- Tianshan Mt of Xinjiang. Tectonically, the region bearing the Angaran floras is situated in the southern and southeastern edges of the Siberian Plate. This study is the first systematic report of the Jiefangcun flora from the Jiefangcun of Hunchun, NE China, in which 30 species of 22 genera are described, including 2 new species. Based on the characters of the floristic assemblages, the authors consider that the Jiefangcun flora is dominated by the Angaran taxa such as *Paracalamites*, *Prynadaeopteris*, *Comia*, *Iniopteris*, *Zamiopteris*, *Noeggerathiopsis*, but mixed with some Cathaysian elements e. g. *Lobatannulaira*, *Schizoneura*, *Taeniopteris*. This flora is assigned to the Late Permian according to the stratigraphic ranges of the known taxa it includes and the comparisons with its coeval floras in China and abroad. Based on the floristic characters, the authors discuss on the reconstruction of the paleoclimate implied by the flora, and consider that the Hunchun area was probably in temperate climatic area during the Late Permian, and that the climate was more mild and humid than in the inland areas of Angaran Land, as the Hunchun area was closer to the sea. Phytogeographically, the division line between the Angaran- and Cathaysian floristic regions in the eastern Jilin, is along Yanji-Tumen-Hunchun, and extends to Vladivostok in Russia. This phytogeographical line is probably corresponding to the suture line between Siberian Plate and Sino-Korean Plate.

Keywords: Angara flora, Late Permian, Jiefangcun, Huchun, China.

SS21-P02 (29)
Record of a possible marattiaceous fern from the Upper Permian sediments of Indian Lower Gondwana

Subir Bera[1], Ashalata D'Rozario[2], Ruby Ghosh[3], Radhanath Mukhopadhyay[4]

[1] *Centre of Advanced Study, Department of Botany, University of Calcutta, 35, Ballygunge Circular Road, Kolkata-700019, berasubir@yahoo.co.in*
[2] *Narasinha Dutt College, 129, Bellilious Road, Howrah-711 101*
[3] *Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow-226007*
[4] *Centre of Advanced Study, Department of Botany, University of Burdwan, Burdwan*

Fertile frond recovered from the Upper Permain sediments of Indian Lower Gondwana of Kalipahari area, Burdwan, West Bengal, India has revealed well preserved soral features. The coalified fertile frond is bipinnately compound, pinnules pinnatifid, emerging alternately at an acute angle from the rachis and bearing oval synangiate structures near the margins. The specimen has been compared with the known fern taxa recorded from the Indian Gondwana. However, the fertile pinnules of the fern resemble closely with that of Marattiaceae in the presence of 1-3 times pinnatifid leaves and fused sporangium or synangium. At this moment, it is difficult to comment on the affinity of this possible marattialean fern. However, its close resemblance in having synangiate sporangial structures suggests the members of modern Marratiaceae as its nearest living relative. So far, no record of Marattiaceous fern is available from Indian Lower Gondwana sediments. Hence, present study suggests a possible pre-Mesozoic occurrence of Marattiaceae in the Indian Gondwana sequence.

Keywords: fertile frond, pinnatifid, synangiate, pre-Mesozoic, Marattiaceae.

SS21-P03 (219)
Occurrence of *Sciadopitys*-like fossil wood (Coniferales) in China

ZiKun Jiang[1,3], YongDong Wang[1], ShaoLin Zheng[2,4], Wu Zhang[2], Ning Tian[4]

[1] *Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China, zikunjiang@hotmail.com*
[2] *Shenyang Center of China Geological Survey, Shenyang Institute of Geology and Mineral Resources, Shenyang 110034, China*
[3] *Graduate University of Chinese Academy of Sciences, Beijing 100049, China*
[4] *Institute of Palaeontology, Shenyang Normal University, Shenyang 110034, China*

The genus *Sciadopitys*, containing a single species (*S. verticillata*), is the only extant representative of the Family Sciadopityaceae (Coniferales), and is a remarkable living fossil. Although some leafy fossils have been ascribed to Sciadopityaceae, fossil xylem material with a close affinity to this family is very rare, and there have been no fossils found showing both pith and primary xylem structures, which are of great importance for wood identification. We briefly report on *Sciadopitys*-like fossil wood found in the Middle Jurassic of western Liaoning, which bears well-preserved *Protosciadopityoxylon*-type secondary xylem, endarch primary xylem and heterogeneous pith. This is the first report of fossil specimens of the Sciadopityaceae with such detailed preservation of wood structures. The discovery provides precise anatomical evidence for reconstructing the evolutionary history and geographical distribution of Sciadopityaceae, as well as contributing to understanding of the fossil diversity of the Jurassic Yanliao Flora in northern China.

Keywords: conifer, Sciadopityaceae, anatomical structure, Tiaojishan Formation.

SS21-P04 (537)

First record of fossil pollen and spores from the Upper Cretaceous, Mongolia and its paleoclimatic and palynofloristic implications

Keita Umetsu[1], Khishigjav Tsogtbaatar[2], Mototaka Saneyoshi[3], Shigeru Suzuki[3], Mahito Watabe[3]

[1] *Center for Deep Earth Exploration, Japan Agency for Marine-Earth Science and Technology, keitaum@auone.jp*
[2] *Mongolian Paleontological Center, Mongolian Academy of Science, Mongolia*
[3] *Hayashibara Museum of Natural Sciences, Japan*

Plant fossils from Upper Cretaceous dinosaur sites of the Gobi Desert are rare, although the Upper Cretaceous terrestrial sediments in the Gobi Desert in Mongolia are well known for their abundant dinosaur remains. The present study reports a Late Cretaceous fossil pollen and spores assemblage found from the Nemegt Suite ("Suite" is a Russian stratigraphic code, and includes lithostratigraphy and biostratigraphy; Gladenkov, 2007) in Tsagaan Khushuu, located in the southwestern region of the Gobi Desert, Mongolia at the first time. The palynological sample was collected during the 2006 field campaign of the Hayashibara Museum of Natural Sciences–Mongolian Paleontological Center Joint Paleontological Expedition and yielded numerous well-preserved terrestrial palynomorphs. The relative abundances of angiosperm pollen grains, gymnosperm pollen grains and fern spores are 65.0%, 26.1% and 8.9%, respectively in the assemblage. The most abundant genus identified in this assemblage is the non-saccate gymnosperm pollen *Ephedripites*, showing a relative abundance of 15.8%. The assemblage is characterized by a low diversity and low relative abundance of fern spores (5 genera) and bisaccate gymnosperm pollen grains (5 genera). Ten genera of angiosperm pollen grains are found. In the angiosperm, a high proportion of porate-type pollen grains (spherical or equatorially triangular grains with three or more pores on their surface), such as *Subtriporopollenites* and *Triporopollenites*, is recognized. The high abundance of *Ephedripites* and low diversity and relative abundance of fern spores suggest that the climate of the study area may have been drier during the Late Cretaceous than previously interpreted. This gives new insights on the paleovegetation and paleoclimate of central Asia during the Late Cretaceous.

Keywords: fossil pollen and spores, Gobi Desert, Mongolia, terrestrial palynomorph, Upper Cretaceous.

SS21-P05 (604)

Petrification and mineralization of ancient trees: Appreciation of arts of fossil woods

Haiwang Zhang, Xiulan Hao

Bureau of Coal Mining Security Supervision of Inner Mongolia Autonomous Region, China, wangjun040208@hotmail.com

The petrification and mineralization of fossil woods are not unfamiliar to palaeobotanists, palaeontologists and geologists, since research on fossil woods represents a subject of palaeobotany. Fossil woods not only facilitate excellent taxonomical study on plant taxa, but also supply significant information on palaeo-climate. However, few people know that the petrification and mineralization of fossil woods could be as attractive as an artwork from an artist point view. The present authors would like to exhibit some artwork of fossil woods collected from various localities all over China during the past several decades. These woods are mostly Palaeozoic and Mesozoic in age. They

represent a large number of taxa, of gymnosperms and tree ferns. Because of numerous chemical components and the verification of petrification and mineralization, the shapes exposed from a polished section of a fossil wood can differ in numerous ways, absolutely showing the daedal hand of nature. The different parts of a tree trunk such as the pith, phloem, protoxylem, metaxylem of a vascular bundle, secondary woods and cortex, root zone, etc. may appear in various colors and shapes. This, together with the deformation during the fossilization process, may suggest various beings such as a bird, snake, dragon, pig, monkey, and so on. With an appreciation of the present collection, it is surprising to found that fossil woods could be so highly valuable in an artistic way.

Keywords: Fossil wood, artwork, fossilization, chemical components.