

(GS07) Pollen morphology

Date: August 28

Place: Room 5336 (oral), Room 6326 (poster)

Oral Presentation

Aug. 28 [AM2] Room: 5336

Chairs: Abul Khayer Mohammad Golam Sarwar, Ming-Jou Wu

10:50-11:10 **On the exine ultrastructure of ginkgoaleans: dispersed pollen of presumed ginkgoalean affinity from the Early Cretaceous of Russia and pollen of extant *Ginkgo biloba* L.** [GS07-O01 \(602\)](#)

Natalia Zavialova, Valentina Markevich, Eugenia Bugdaeva, Svetlana Polevova

11:10-11:30 **Morphology and ultrastructure of *Wodehouseia* pollen** [GS07-O02 \(518\)](#)

Maria Tekleva, Valentina Markevich, Eugenia Bugdaeva, Ge Sun

11:30-11:50 **Pollen morphology and tribal classification of the subfamily Ericoideae (Ericaceae)** [GS07-O03 \(451\)](#)

Abul Khayer Mohammad Golam Sarwar, Hideki Takahashi

11:50-12:10 **On exine architecture of *Phyllanthus* pollen in Malesia and Taiwan** [GS07-O04 \(574\)](#)

Ming-Jou Wu, Tseng-Chieng Huang, Chia-Ching Liu, Yung-Sheng Chang, Chia-Lun Hsu

Poster Presentation

Aug. 28 [PM1] Room: 6326

13:30-14:30 **Pollen morphology of *Bomarea* (Alstroemeriaceae) and its systematic significance** [GS07-P01 \(450\)](#)

Abul Khayer Mohammad Golam Sarwar, Yoichiro Hoshino, Hajime Araki

Comparative pollen morphology of Sections *Doriae* and *Reniformes* of the Genus *Senecio* L. (Asteraceae) from Turkey [GS07-P02 \(406\)](#)

N. Münevver Pinar, Barış Aşçı, Nurhan Büyükkartal, Talip Çeter, Ergin Hamzaoglu, Ümit Budak, Hatice Çölgeçen, Aydan Acar

Pollen morphology of *Scilla* (Hyacinthaceae) [GS07-P03 \(8\)](#)

Saeed Amiri, Sayedmohammad Masoumi

Comparative pollen morphology of *Lilium* and *Calochortus* (Liliaceae) [GS07-P04 \(237\)](#)

Samira Kiani, Sayedmohammad Masoumi, Ahmad Majd

Comparative pollen morphology of some species of two Genus, *Crocus* and *Colchicum* at Western Iranian habitats [GS07-P05 \(174\)](#)

Seyedmeghdad Hashemi, Shamsollah Bagheri, Hamidreza Ghasempour, Sayedmohammad Masoumi

The significance of peripheral arrangement of pollen in the anther of Poaceae
[GS07-P06 \(531\)](#)

Chih-hua Tsou, Ping-chin Cheng, Chiung-Maan Tseng, Yu-lan Fu, Hsiao-Jung Yen

GS07-O01 (602)

On the exine ultrastructure of ginkgoaleans: dispersed pollen of presumed ginkgoalean affinity from the Early Cretaceous of Russia and pollen of extant *Ginkgo biloba* L.

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The general morphology, surface sculpturing and exine ultrastructure have been studied in dispersed monosulcate pollen of *Ginkgocycadophytus* sp. from the Early Cretaceous of Transbaikalia, Russia. The pollen grains dominate the palynological assemblage extracted from coal seam of the Khilok Formation in the Buryat Republic, which also contains ginkgoalean leaves *Baierella averianovii* as the only constituent of the assemblage of plant megafossils. The relationship between the pollen grains and ginkgoalean leaves from this autochthonous burial is hypothesized on the basis of taphonomical analysis and palaeobiogeographical data. All specimens under study show a distinct aperture, quite acute extremities and an almost smooth, indistinct surface and they vary significantly in size. However, their exine ultrastructure provides enough information to conclude that they have a common affinity, since the sections show identical ultrastructure. The ectexine of the pollen grains includes a thick solid tectum with a distinct lower boundary, and an infratectum of considerably big rare granules sandwiched between the tectum and a thin, but continuous foot layer. The endexine is fine-grained, slightly more electron-dense than the ectexine, and is preserved only in places. The distal aperture is formed by a thinning of the exine. No analogous ultrastructure has been described so far in fossil pollen grains of this morphotype studied ultrastructurally from *in situ* material. For comparison, we also studied the exine ultrastructure of pollen grains of extant *Ginkgo biloba*, focusing on the nature of infratectal elements. The infratectal elements of *G. biloba* are pillars. The majority of the pillars hang from the inner surface of the tectum into the infratectal cavity, which may or may not reach the foot layer. On the other hand, some pillars arise from the foot layer, not reaching the tectum. Pollen grains of *Ginkgocycadophytus* sp. and *Ginkgo biloba* have the same ratio between sub-layers of the ectexine, all three sub-layers become much thinner towards the apertural area, the infratectum is the first sub-layer to disappear towards the apertural area and the tectum transforms into separated remnants. The most important difference is the presence of an unequivocal granular infratectum in the fossil pollen contrasting to the peculiar infratectum of the extant pollen. Thus, the fossil pollen is not identical to pollen of extant *G. biloba*, but shows several significant similarities in the exine ultrastructure, which does not contradict the presumable ginkgoalean affinity of the fossil pollen.

Keywords: monosulcate pollen, exine ultrastructure, ginkgoaleans.

GS07-O02 (518)

Morphology and ultrastructure of *Wodehouseia* pollen

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The characteristic genus of the Aquilapollenites Province such as *Wodehouseia* represents an extinct group of plants of uncertain botanical affinity (most having become extinct at the K–T boundary). This distinctive pollen is sometimes referred to as ‘oculate’ pollen. Dispersed pollen grains *Wodehouseia spinata* Stanley were studied from the palynological assemblage from the sediments of Furo Formation widely-distributed on right bank of Heilongjiang (Amur) River. The deposits were drilled by borehole XHY2008 near the Xiaoheyuan area. The palynomorphs belong to assemblage *Aquilapollenites stelkii* - *Pseudointegricorpus clarireticulatus* having the Late Maastrichtian age with dominating of angiosperm pollen (48%) and are represented by the taxa of 21 angiosperms, 7 gymnosperms, and 4 pteridophytes (Markevich et al., 2011). Pollen grains were picked up from the residue and individual specimens were subsequently studied in LM, SEM and (for a number of specimens) in TEM. The combined analysis has shown that among studied material pollen is 16.26x29.7 µm on average, ellipsoidal, flanged, with four slit-like pores on each side in pairs. The sculpture is spinulate with spines of three different size ranges, the surface between the spines is smooth and perforated. Large spines are few and disposed in the central part of the compressed pollen, such a type of the spine is present at the pore margin, though sometimes they are broken and cannot be observed. Next to the periphery middle-sized spines are disposed and the smallest spines are on the flange, these two types are more numerous. Spine dimensions vary, but on average, the large ones are from 1.7 to 3 (sometimes more) µm high and 0.6-0.8 µm in diameter, middle-sized – from 1.0 to 1.8 µm high and 0.25-0.3 µm in diameter and the small ones – less than 1 µm high and less than 0.2 µm in diameter. The ectexine is columellate with a thin tectum. The endexine is thick, looks homogeneous, being about two times thinner at the flange region. A combination of pollen characters observed by LM, SEM and TEM confirms an angiosperm affinity of the species with highly specialized morphology and ultrastructure, unknown for extant plants. Further EM study of other *Wodehouseia* species will help to reveal the diversity of this kind of pollen.

GS07-O03 (451)

Pollen morphology and tribal classification of the subfamily Ericoideae (Ericaceae)

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Pollen morphology of 90 species of subfamily Ericoideae was investigated with light, scanning and 9 species with transmission electron microscopy. Pollen-unit, viscin-threads, and exine sculpture were mapped onto a phylogenetic tree within the subfamily Ericoideae. Ericoideae are characterized by the tetrad pollen, but monad pollen has reversely evolved in some species of *Erica* in the tribe Ericaceae. Viscin-threads which were absent in the common ancestor of the Ericoideae, have evolved parallel in different tribes. But possible reversal to the lacking of viscin threads has also occurred in some members. Presence or absence of viscin threads in two *Phyllodoce* species possibly indicates the different pollination efficiency. The absence of viscin-threads of Empetreae and Ericaceae is

regarded as a symplesiomorphic character state, which does not necessarily support the sister relationship between them. Seven apocolpial exine sculpture types were recognized. It is difficult to determine the character transformation series of sculpture types within Ericoideae because of often homoplasious evolution. Even so exine sculpture is a useful palynological character especially in generic or infrageneric level. Pollen-unit and exine architecture are possibly useful characters for future infrageneric taxonomic studies of *Erica*. Sexine of monad pollen of *Erica barbigeroides* and *E. recurvifolia* show granular-fibrillar structure distinct in the Ericaceae. Most *Menziesia* species are easily distinguishable from *Rhododendron* in the very rare finely narrow, straight-edged striate exine sculpture. The combined analyses of morphological, palynological and molecular data might be useful to understand the relationships among genera and/or tribes, and also to construct the infrageneric taxonomic system in the subfamily Ericoideae.

Keywords: pollen-unit, viscin-threads, exine sculpture, infra-generic classification.

GS07-O04 (574)

On exine architecture of *Phyllanthus* pollen in Malesia and Taiwan

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The diversity of pollen morphology in *Phyllanthus* has been noticed and applied to plant systematic studies. Pollen aperture system and exine ornamentation based on light microscopy and scanning electron microscopy have been proved to be highly related to sectional classification. In this study, we focus on the variation of pollen wall stratification among infra-genus taxa of *Phyllanthus*. Species from from six subgenera *Embllica*, *Eriococcus*, *Gomphidium*, *Isocladus*, *Kirganelia*, and *Phyllanthus* of Malesian and Taiwanese *Phyllanthus*, and some representative taxa of genera *Breynia*, *Glochidion*, and *Sauropus* were sampled for this study. The sampling species contain 14 different pollen types of exine ornamentation based on previous studies using light microscopy and scanning electron microscopy. No significant differences on the pollen wall stratification were found within species between pollen grain stage and free microspore pollen stage. Pollen wall structure in sampled *Phyllanthus* can be grouped into three types, perforate tectate, semi-ectate, and pre-intectate pollen walls. The perforate tectate pollen wall, a primitive pattern, is represented by subgenus *Phyllanthus*. The pre-intectate pollen wall, an advance pattern, is represented by subgenus *Eriococcus*. The semi-ectate pollen wall is related to all the remained subgenera, genera *Breynia*, *Glochidion*, and *Sauropus*. Though no intectate pollen wall has been examined, pollen grains with the pilar exine of *Phyllanthus triphlebius* of subgenus *Eriococcus* could be intectate. Though the difference of the electronic dense of pollen wall stratification caused of chemical stains are not clear, five different stratification patterns based on electronic dense were recognized. Different electron dense patterns are found within same sections and even in closely related species. Therefore, these patterns might be evolved very recently. The evolutionary trend of *Phyllanthus* pollen compared with recent molecular phylogeny is discussed.

Keywords: exine stratification, exine structure, perforate tectate, pre-intectate, semi-ectate.

GS07-P01 (450)

Pollen morphology of *Bomarea* (Alstroemeriaceae) and its systematic significance

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Bomarea Mirbel with 110–120 species represents the most diverse genus of Alstroemeriaceae Dumort., distributed through neotropics, found mainly in highland areas. This taxon has traditionally been divided into three or four subgenera, which were not recovered in a recently published molecular phylogenetic analysis. In order to explore and characterized possible palynological differences between taxa, pollen morphology of 87 species, representing all the subgenera, of *Bomarea* was examined in detail using light and scanning electron microscopy (LM and SEM, respectively) or only with SEM. The *Bomarea* species are stenopalynous. Pollen grains are characterized by monosulcate and large monads with the reticulate exine sculpture. Differences in pollen grain size, exine thickness and sculpture, were observed. *Bomarea ampayesana* produces largest pollen among the taxa studied. Based on exine sculpture, the studied species were divided into two major groups; species having reticulate exine (Type I) and the other having coarsely rugulate-psilate to psilate exine (Type II). The exine sculpture Type I can be divided into two sub-types based on width of brochi (or lumen). In principal component analysis of quantitative data, *Bomarea* species make only two distinct groups; on contrary, the agglomerative hierarchical clustering produces three major clades. Therefore, the combined analyses of morphological, palynological and molecular data from larger number of both species and specimens would be useful to clarify the relationship among the species and the infra-generic classification of *Bomarea* as well.

Keywords: pollen grain size, exine thickness, exine sculpture, infra-generic classification, *Bomarea*.

GS07-P02 (406)

Comparative pollen morphology of Sections *Doriae* and *Reniformes* of the Genus *Senecio* L. (Asteraceae) from Turkey

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Morphological features of pollen of sections *Doriae* and *Reniformes* taxa of the complex genus *Senecio* were examined using light (LM) and scanning electron (SEM) microscopies. The pollen is radially symmetrical, isopolar, tricolporate and operculate. Section *Doriae* is prolate- spheroidal with the polar axes 22- 30 µm and the equatorial axes 19-29 µm. Section *Reniformes* is oblate- spheroidal with the polar axes 20- 33 µm and the equatorial axes 20-30 µm. Echinete-granulate sculpturing is observed in the section *Doriae*, echinate-perforate sculpturing in section *Reniformes*. The

delimitation of two sections on the basis of pollen characteristics found to be more significant pollen characters. The study revealed that palynological characters are of taxonomic significance in these sections.

Keywords: *Senecio*, *Doriae*, *Reniformes*, pollen morphology, Asteraceae.

GS07-P03 (8)

Pollen morphology of *Scilla* (Hyacinthaceae)

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Scilla is a large genus in the Hyacinthaceae. We have studied pollen grains of two species of *Scilla* under LM, SEM, TEM (transmission electron microscope). Pollen grains of studied species are monosulcate, heteropolar, single, medium in *Scilla persica* Hausskn. (39/0-47/48 -66/0 μm), and large in *Scilla autumnalis* L. (57/0-64/0-71/0 μm). Sulcus is rather long reaching the end of the grain or extending to the proximal side (almost equal to equatorial diameter). The shape of pollen is oblate-spherical, and their outlines are flatten in equatorial position. Exine surface of pollen grains of *S. persica* Hausskn. is microreticulate, but in *S. autumnalis* L. is reticulate. In addition two species differ from each other by the surface of membrane sulcus and sulcus margin, by structure and width of muri, size of lumina. With the help of TEM it was revealed, that two species by thickness of ectexine (thickness of tectum and foot-layer and, height and width of columns), shape of the heads of columns and microrelief of sculptural elements are almost similar each other, but differ from each other by different layers of intine (ectintine, mesintine, endintine), by the of presence endexine. Entine thickness in the sulcus region of *S. autumnalis* L. is two times higher than *S. persica* Hausskn.. Endexine in *S. persica* Hausskn. is very thin and discontinuous, but in *S. autumnalis* L. is thin and lamellar layer. Thus, the material investigated by us has shown the big variety of a pollen grains structure in studied species of *Scilla*.

Keywords: ectexine, endexine, exine ornamentation, intine, ultrastructure.

GS07-P04 (237)

Comparative pollen morphology of *Lilium* and *Calochortus* (Liliaceae)

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The Liliaceae, or the lily family, is a family of monocotyledons in the order Liliales. In this study, pollen grains of 8 species of *Calochortus* from subfamily Calochortoideae and 11 species of *Lilium* from subfamily Lilioideae from this family, was examined with LM, SEM and TEM. Comparative palynomorphological characteristics of the studied species with the help of LM and SEM showed significant differences between species. They differ in size of pollen grains, the shape and size of Lumina, thickness of muri. Size of pollen grain in *Calochortus* is medium, but in *Lilium* is large and very large. Exine ornamentation in *Calochortus* is striate or tuberculate or microreticulate, but in *Lilium* is reticulate or macroreticulate. Our results showed that pollen grains of all the studied

species of *Lilium* is single (only the pollen grains from *Lilium candidum* L. collected in the dyad), heteropolar, bilaterally symmetrical, distal-monosulcate, flattened-spheroidal, usually boat-shaped form, in outline with a pole rounded-elliptical, with the equator - flattened. Sulcus is long (almost equal to the equatorial diameter). With the help of TEM it was revealed, that these species differ from each other by the shape and thickness of Tectum, shape and diameter of Caput, height and width of Columella, thickness of Foot Layer, the presence or absence of Endexine, the thickness of Intine in the Sulcus zone and below the Exine in a zone without the Sulcus, and the position of various layers of Intine and their thickness. Microrelief of sculptural elements in *Lilium kesselringianum* Mishchenko and *Lilium davidi* Duch. is rough and tuberculate, while microrelief in other investigated species of *Lilium* is smooth or almost smooth. In addition, exine ornamentation in *Calochortus eurycarpus* Wats. is similar to *Amana latifolia* (Makino) and *Erythronium denscanis* L. from Tulipeae tribe from subfamily Lilioideae, and also size and form of pollen grain in subfamily Calochortoideae almost is similar to Lloydieae tribe, and different from in Lilieae tribe from subfamily Lilioideae in Liliaceae family. Thus, our research shows that much difference between these two genera.

Keywords: Calochortaceae, Calochortoideae, exine, exine ornamentation, intine, Lilioideae.

GS07-P05 (174)

Comparative pollen morphology of some species of two Genus, *Crocus* and *Colchicum* at Western Iranian habitats

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Many species of genus *Colchicum* and *Crocus* share the same period of blossoms, while occur in Two different genus. 13 samples were collected and examined by Light Microscope from each of species of the mention genera. Pollen grains of *Crocus* were spheroidal, large size, monoporate with spinal exine, but *Colchicum* pollens were suboblate or oblate, medium to large size, biporate and microreticulate exine. Among studied colchicum species, the size of *Co. steveni* Kunth pollen were smaller ($40.5 \pm 2.5 \mu$) and *Co. speciosum* Steven were with larger size ($62.5 \pm 1 \mu$). Furthermore the ratio of P/E (the polar axis (P) to the equatorial diameter (E)) for *Co. kotschyi* Boiss. were the same in two different habitats, but the ratio for *Co. haussknechtii* Boiss. was 0.6. The study revealed that size of pollens were different due to habitats. The size of pollen grains of *Crocus haussknechtii* Boiss. & Reut. ex Boiss. from Songhor province habitat was $81.5 \pm 11.5 \mu$ and in Kangavar habitat was $63.5 \pm 8.5 \mu$. In conclusion, beside of their diverse morphology among the studied genera, the blossom periods were the same which indicate their habitat environmental adaptations.

Keywords: blossom period, habitat, exine, P/E, porate.

GS07-P06 (531)

The significance of peripheral arrangement of pollen in the anther of Poaceae

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Poaceae and Cyperaceae are the only two families in the angiosperms having peripheral arrangement of pollen in the anther locule. How the pollen grains are arranged in such a pattern which generates significant biological interests. Previous studies have shown that polarity exists in the two meiotic divisions and in the callose deposition, which positions the tetrads in a peripheral arrangement which ensures all the microspores in direct contact with the tapetum. In this project, cryo-SEM, TEM and LM were used in the study of anther development in a number of poaceous species; our data revealed that microspores remained in their original positions during the phase of callose decomposition suggesting that callose acts as a structural member holding the microspores in position during meiotic stage. Our study also revealed that in addition to the peripherally positioned microspores (PPM), centrally positioned microspores (CPM) are commonly found in rice and maize. These centrally located grains are in contact with the peripherally positioned grains but have no direct contact with the tapetum and are distinctively different from the peripheral grains; the CPM is always smaller in size and more spherical in shape than the PPM throughout the development and has significantly lower number of starch granules whereas the PPM is heavily loaded with starch granules at maturity. The presence of the CPM varies among the species and among different cultivars of maize. In a number of wild rice species and cultivars of maize, the CPM may account for as high as 20% of the total pollen grains. Central grains are mostly viable based on FDA staining; but due to the lack of starch granules, their pollen tubes are short and probably not competitively enough with the starch-rich pollen in the fertilization process. It is highly possible that the tightly packed peripheral arrangement with direct contact with tapetum is crucial for nutrient transportation during pollen maturation. CPM are in direct contact only with the PPM, which limits its development and nutrient acumination. Our study, for the first time, characterizes the two distinct types of pollen grains in Poaceae and interprets that the significance of peripheral arrangement of pollen grains is crucial for normal pollen development.

Keywords: Poaceae, pollen position, peripheral arrangement, central arrangement.