(SS01) Palynological electronic resources and methods of palynological data processing and summarization

Date: August 24 (oral), 25 (poster)
Place: Room 5235 (oral), Room 6302 (poster)
Organizers: Dmitriy Britski & Olga Gavrilova
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Purpose: The great volumes of extremely valuable information concerning the pollen morphology of different taxa of modern and fossil plants as well as different applied and theoretical aspects of palynology was accumulated in laboratories of palynology around the world.
The digitization of available data and bringing them into a form available for a wide range of specialists makes it possible:
1) to avoid recurrent studying of the same material;
2) to prevent material loss due to natural aging of collections;
3) to present results of investigation in full mode, without constriction of ordinary journal publication and
4) make laboratory's archives accessible for scientific community.
In the nearest future the separated electron resources will be obviously united in the integrated information system that could bring applied and fundamental palynological studies up to the new standard by accumulation of information.
Methods, technologies, and approaches to development of informational systems and their integration are suggested to be discussed.

Oral Presentation

Aug. 24 [PM2] Room: 5235

Chair: Olga Gavrilova

14:30-14:50 **Online database as a tool for publication of pollen images and morphological data** SS01-O01 (50)

Dmitriy A. Britski

14:50-15:30 **[Keynote] PalDat - the bumpy road from microscope to database** SS01-O02 (57)

Ralf Buchner

15:30-15:50 **The digital conversion of palynological iconotheca** SS01-O03 (150)

Olga A. Gavrilova, Dmitriy A. Britski

Aug. 24 [PM3] Room: 5235

Chair: Dmitriy Britski

16:20-16:40 **Current status of the Neotoma Paleoecology Database** SS01-O04 (162)

Eric C. Grimm

16:40-17:00 **Confocal laser scanning microscope (CLSM) for identification of pollen grains: new possibilities** SS01-O05 (149)

Olga A. Gavrilova

Poster Presentation

Aug. 25 [PM1] Room: 6302

13:30-14:30 **Applying principal component analysis to the morphological data on tribe Tanacetinae (Asteraceae) pollen** SS01-P01 (51)

Dmitriy Britski, Lyudmila Mikhailova, Valentina Grigorieva

PalDat - milestones and plans for the future SS01-P02 (56)

Ralf Buchner

SS01-O01 (50)
Online database as a tool for publication of pollen images and morphological data

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In Komarov Botanical Institute we have developed the database "Recent plants pollen and spores morphology" (http://www.polba.ru) as a new form of our old pollen specimen collection and SEM micrographs archive. It was enthusiastic project based completely on the open source software set (Linux, Apache, PostgreSQL, PHP). Project objectives were: to prevent loss of collection materials resulting from their ageing; to make materials of pollen specimen collection and micrograph archive accessible for a wide range of specialists via Internet. During the work within the project and discussing the project features with colleagues from other organisations we come to conclusion that the problem of publishing of collections and archive materials are very common for all specialists in pollen morphology and it is necessary to develop a web-accessible tool for adding in the database pollen images and morphological descriptions by privileged users (http://www.polba.ru/admin). The template of palynological DB, developed as a result of the project, can function on a single computer, on the LAN database server, or on the server connected to Internet. In the case of functioning of a few independent similar databases it is possible to bind them into united pollen morphology informational system.

SS01-O02 (57)
PalDat - the bumpy road from microscope to database

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Taking photographs is in our digital world as easy as never been before. But what to do with our analogue treasures from the past? Digitizing is the magic word! Before starting the project a few important steps have to be defined: digitizing equipment, human and financial resources, development of a routine procedure, file format and storage. Handling modern pictures is much easier since digitizing is not necessary. Developing and running a database like PalDat involves always a team of specialists like palynologists, software programmers and ordinary staff. Needless to say that their point of views are often differing when a location for the server has to be found, the structure of the database has to be defined or new features have to be implemented. Decisions have to be taken on formal criteria like copyright regulations, selection of minimum dataset requirements, terminology in-use or the systematic concept(s). Design and usability of the website or concepts for the future are lively discussed since these features are often just a matter of taste and scientists have

their own agenda when using a database. Despite these criteria a solid financial funding for several years has to be developed and when a database should survive their initiators professional life then it is necessary to get scientists from different institutions on board. PalDat will serve here as an example for these considerations and as a model for successful database development.

Keywords: pollen, palynology, terminology, database, internet.

SS01-O03 (150)
The digital conversion of palynological iconotheca

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Our palynological iconotheca is a systematic collection of pollen and spore images of modern plants with the links of bibliographical references. It is kept in the palynological laboratory of Komarov Botanical Institute RAS. The researcher and previous chief of the laboratory D. B. Archangelsky started to collect it in the middle of 60th of the 20th century and its enrichment is still going on. The pollen images are mainly of flowering plants and they were collected from the very earliest publications as well as from the quite rare ones. The images were rephotograph and recomposed in accordance with the species they represented. So, each paper sheet demonstrates the pollen images of one species, which have been published. Species and genera sheets within the families disposed in alphabetica order. There is a separate directory with index cards for each species for finding references to the papers where the images were published. The material is placed on the basis of A. L. Takhtajan flowering plants system and for user convenience and quick finding of any taxon arranged in alphabetical order too. The collection includes pollen pictures of about 500 families and 32,000 species of plants. The palynological images represent both micrographs of mature pollen made by light, scanning, more rarely transmission electron microscopes and botanical drawings. Iconotheca makes possible to obtain quickly full data of the state of knoweledge about pollen of any taxon and is useful for spore-pollen analysis. The lab launched the iconotheca conversion into electronic form. The sheets with images and catalog cards with references are scanned simultaneously. This database is used within the lab. In the future we are planing each taxon to provide with a brief description (morphological type) of pollen grains and a list of references, and make it available online. There we use developed template of palynomorphological database with the next search characteristics: pollen type, taxonomic unit (item) and author or reference.

Keywords: pollen analysis, pollen morphology, taxonomy, electronic resources.

SS01-O04 (162)
Current status of the Neotoma Paleoecology Database

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The Neotoma Paleoecology Database (www.neotomadb.org) is a multiproxy relational database that includes fossil data for the past 5 million years (the Pliocene and Quaternary) and modern surface-sample data for calibration datasets. The Neotoma project is an international collaborative

effort among individuals from more than 20 institutions worldwide, including domain scientists representing a spectrum of Pliocene-Quaternary fossil data types, as well as experts in information technology. Neotoma is an open-access community database that provides the underlying cyberinfrastructure for a variety of disciplinary database projects. A key design concept of Neotoma is that "stewards" for various data types will be able to remotely upload data to Neotoma and manage data already in Neotoma. Cooperatives for different kinds of paleo data or from different regions can appoint their own stewards. Over the past year, much progress has been made on development of the steward software-interface that will enable this capability. The steward interface uses web services that provide access to the database. More generally, these web services enable remote programmatic access to the database, which both desktop and web applications can use and which provide real-time access to the most current data. Use of these services can alleviate the need to download the entire database, which can be out-of-date as soon as new data are entered. In general, the Neotoma web services deliver either data from an entire table or the results of a view or stored procedure —the same queries that would be made to a local copy of the database. Upon request, new web services can be quickly generated. A major challenge to organismal databases is changing taxonomic concepts, which may enlarge or limit the circumscriptions of individual taxonomic names. This challenge has become particularly acute with many recent taxonomic revisions due to phylogenetic studies. The challenge is not simply heterotypic taxonomic synonymy within the database but that taxonomic circumscription varies among investigators who have followed different heterotypic taxonomies. The phylogenetic basis of taxonomy is of special interest to palynology, as pollen morphology is often a critical phylogenetic indicator. Plant taxonomy in Neotoma has been revised to be in accordance with the Angiosperm Phylogeny Group, but special effort has been made to preserve taxonomic circumscription in legacy data.

Keywords: Angiosperm Phylogeny Group, palynology, taxonomy, web services.

SS01-O05 (149)

Confocal laser scanning microscope (CLSM) for identification of pollen grains: new possibilities

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Pollen analysis is based on identification of pollen of different plant taxons using detailed characteristics of grains and exine structures. Usually we use light microscope (LM) to describe the general structure, scanning electron microscope (SEM) to describe pelicularities of pollen surface and transmissional electron microscope (TEM) to study exine layers. For each microscopic method we use different way of sample treatment. Pollen light microscopic specimens are employed for confocal microscoping investigations, but this method have more opthions to examine pollen, to obtain exine slice and to look inside grain. So, confocal microscope reveals more characteristics by providing a more detailed feachures of the pollen structure at once, and 3 D reconstruction allows us to see the object from all sides, as well as to obtain the cut of envelope and to introspect a pollen grain. Pollen grains from different genera of angiosperms (*Viola* (Violaceae), *Ribes* (Grossulariaceae), *Salsola* (Chenopodiaceae), *Euonymus* (Celastraceae), *Cucumis* (Cucurbitaceae) and some others) have been studied by confocal laser scanning microscope LSM 780 using 561 nm laser. We have found details of apertural structures slightly marked colpa and pores in pollen with thick ornamentated exine, wherein apertures are disappeared or are covered by composed ornamentation, we can describe and measure endoapertures and cryptoaperture and so, specify morphological apertural type for investigated species and illustrate the terms colpate – colporoideate – colporate. We have be able to study and to make measurements of pollen detail of small grains

(7-13 mkm in diameter). Exine slice have been illustrated. And we can visualize anomalous or irregular apertural disposition in separate pollen grains and apertural location in tetrads. In the most cases we had the opportunity to compare the results obtained with confocal with those ones made with traditional microscopy (LM, SEM, TEM). Mathematical tools technique (imaging software Zen 2011) allows to measure different parts of the pollen structure without changing of pollen size what occur due to pollen treatment needed for the study with SEM and TEM. Consequently, we have described pollen structure details of studied species, which are applied for better identification. It will be suitable also for plant taxonomy and systematics and applied palynology.

Keywords: pollen analysis, exine, pollen apertures, pollen morphology.

SS01-P01 (51)

Applying principal component analysis to the morphological data on tribe Tanacetinae (Asteraceae) pollen

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Pollen of 8 species of *Hippolytia*, 5 species of *Lepidolopha*, 16 species of *Tanacetopsis*, 25 species of *Tanacetum*, 2 species of *Xylanthemum*, 9 species of *Pyrethrum* and 5 species of *Sphaeromeria* were studied by LM and SEM. Data obtained from the study were processed by principal component analysis method. Eight characteristics were used for analysis including qualitative (sculpture, spines shape, exine microrelief pattern) and quantitative ones (polar axis length and equatorial diameter, their ratio, mesocolpium width, thickness of exina without spines). Analysis revealed 2 factors. Lengths of polar axis, equatorial diameter and mesocolpium width strongly correlated and contributed to the 1st component that compounded about 40% of total variability. Exine thick, not so strongly correlated to other characters, also belongs to the 1st component. The 2nd component amounted about 20% of total variability. The major part of 2nd component are the pollen shape and exine pattern characters, including characters of spine. Analysis of species distribution using specified factors (characteristics) showed that in most cases species delimited distinctly. Specimens of the same species were represented at diagram as dense groups with few divergent variants. Thereby, selected characters are suitable for species delimiting. Species of different genera form integrative dense group excluding *Tanacetum glabriusculum.* There were no species in *Xylantemum, Hippolitia* and *Lepidolopha* that differed from *Tanacetum* reliably. Some species in *Tanacetopsis* и *Pyrethrum* differed from *Tanacetum* but they were few (*P. partenicum, T. kraschenninnikovii, T. pamiroalaica, T. pjataeviae*). *Tanacetum glabriusculum* stands apart from other species studied, forming well-isolated compact group. Used characters are acceptable for distinguishing of studied species, but they are not acceptable for dividing of studied genera. The work was performed with financial support of Russian Foundation for Basic Research (project № 10-04 00779).

SS01-P02 (56)

PalDat - milestones and plans for the future

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The PalDat team started in 1995 with the development of a database to organize the huge amount of SEM and TEM pictures. At this moment nobody thought of the amazing potential of the internet. So PalDat was initially developed as a single user MSAccess database. Soon it was apparent that we want to share our data with other scientists. Consequently an internet version at http://www.paldat.org was launched in 2000. Keeping PalDat online required a more solid and stable funding as in the past so in 2005 the Society for the Promotion of Palynological Research in Austria was founded. One major aim of the Society is to develop PalDat in the future. After several years with minor changes the PalDat team launched a completely new developed website in 2011 with new design, online submission and forum integration. The future plans for PalDat are to open the online submission for external authors and to develop http://www.paldat.org as a "one stop resource" for palynologists. Finally in 2015 PalDat is celebrating its 20th birthday and 15 years "PalDat goes internet".

Keywords: pollen, database, PalDat, palynology.