NECLIME Online Conference 2021

April 19 - 22

Conference Volume

Conveners:

Angela A. Bruch, Torsten Utescher, Andrea K. Kern, Marianna Kováčová & Martina Stebich

General Schedule

Monday to Thursday, April 19 – 22, 2021

Time	Country	Difference to CEST	Time zone
00:00 – 03:00	California/USA	-9	Pacific Standard Time (PST)
03: 00 – 06:00	Connecticut/USA	-6	Eastern Standard Time (EST)
04: 00 – 07:00	Brazil	-5	Brazil Time (BRT)
08:00 – 11:00	UK	-1	British Summer Time (BST)
09:00 – 12:00	Czech Republic, Germany, Italy, Poland, Slovakia, Spain, Sweden	0	Central European Summer Time (CEST)
10:00 – 13:00	Bulgaria, Russia/Saint Petersburg, Turkey	1	Eastern European Summer Time (EEST), Moscow Time (MSK), Eastern European Time (EET)
11:00 – 14:00	Armenia	2	Armenia Time (AMT)
12:30 – 15:30	India	3.5	Indian Standard Time (IST)
13:00 – 16:00	Kazakhstan	4	Qyzylorda Time (QYZT)
14:00 – 17:00	Vietnam	5	Indochina Time (ICT)
15:00 – 18:00	China	6	China Standard Time (CST)
16:00 – 19:00	Japan	7	Japan Standard Time (JST)
16:30 – 19:30	Australia	7.5	Australian Central Standard Time (ACST)
17:00 – 20:00	Russia/Vladivostok	8	Vladivostok Time (VLAT)

Important Links

Zoom venue NECLIME online conference

Meeting-ID: 929 1466 3607

Password: **neclime21**

https://uni-frankfurt.zoom.us/j/92914663607?pwd=WUN6U2hydFRWWnh3ZFBFT1hkVGw1QT09

NECLIME wonder room for social gatherings

https://www.wonder.me/r?id=79b3a05f-5db1-434c-a253-bd92bef82804

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Scientific Program

Monday, April 19, 2021

09:00 CEST Angela A. Bruch
Welcome and technical instructions

09:15 CEST Torsten Utescher
Welcome and Introduction to NECLIME

09:45 CEST Volker Mosbrugger
Welcome address of the NECLIME advisory board

Chair Volker Mosbrugger & Andrea K. Kern

10:00 CEST **Robert A. Spicer** & Alex Farnsworth
Comparative Palaeoaltimetry of the Miocene-Pliocene Zanda Basin Southwestern Tibet

10:15 CEST **Gaurav Srivastava**, Harshita Bhatia, Torsten Utesher & R. C. Mehrotra
Monsoon and vegetation shift during the Neogene: evidence from the Siwalik flora of eastern Himalaya

10:30 CEST **Harshita Bhatia**, Gaurav Srivastava, Torsten Utescher & R. C. Mehrotra
Advent of monsoonal climate and evolution of evergreen forest in South Asia: evidence from Oligocene flora of India

15 min break

Chair Marianna Kováčová

11:00 CEST **Funda Akgün**, Mine Sezgül Kayseri-Özer, Erdoğan Tekin & Baki Varol
Palaeoenvironmental and Palaeoecological changes: Case Studies from Ereğli-Ulukışla in southern Central Anatolia

11:15 CEST **Dimiter Ivanov**, Torsten Utescher & Vladimir Bozukov
Palynological data for the late middle Miocene vegetation and climate change in the Eastern Paratethys (Northeast Bulgaria)

11:30 CEST **Adele Bertini**, Gabriele Niccolini, Benedetta Lanini, Elena Menichetti & Fabio Fusco
The latest Phases of the Messinian Salinity Crisis between 5.6 Ma and 5.33 Ma: The Italian Pollen Record

11:45 CEST *Social gathering in the **NECLIME wonder room***

Tuesday, April 20, 2021

Chair Adele Bertini

09:00 CEST **Martha E. Gibson**, Jessica McCoy, Jennifer M. K. O'Keefe, Noelia B. Nuñez Otaño, Sophie Warny & Matthew J. Pound
The Miocene Trwyn y Parc solution pipe complex on Angelsey, Wales, UK: new findings and a comparison of CREST with the Coexistence Approach

09:15 CEST **Thomas Kenji Akabane**, Andrea K. Kern & Carlos Eduardo M. Mazoca
Estimating tropical climate change in the South America during the last 30 ka using CRACLE

09:30 CEST **Anna Sommani**, Nils Weitzel, Martina Stebich & Kira Rehfeld
Temperature-precipitation relationship from pollen-based climate reconstructions and simulations during the Last Glacial

09:45 CEST **Gabriele Niccolini**, Adele Bertini, Niccolò Degl'Innocenti & Giuseppe Mastronuzzi
Palynological contribution to the study of morphoclimatic systems during the last 12 ka in Mar Piccolo (Taranto, Southern Italy)

10:00 CEST **Niccolò Degl'Innocenti**, Adele Bertini, Gabriele Niccolini & Giuseppe Mastronuzzi
Reconstruction of morphoclimatic systems in the Mar Piccolo (Southern Italy) during the last 12ka: the contribution of dinocysts and other NPP

15 min break

Chair Dimiter Ivanov

10:30 CEST **Olesya V. Bondarenko** & Torsten Utescher
Early Paleogene temperature gradients along the eastern Pacific coastal areas

10:45 CEST **Anna Averyanova**, Torsten Utescher, V. Tarasevich, Svetlana Popova & Volker Mosbrugger
Late Rupelian flora of the Zaissan depression (East Kazakhstan)

11:00 CEST **Svetlana Popova**, Torsten Utescher, V. Tarasevich, P. Tropina, Anna Averyanova, Dimitry Gromyko & G. Sitpaeva
Oligocene flora of Dyusembai (central Kazakhstan) on the basis of palynological and carpological data

11:15 CEST **Manuel Casas-Gallego** & Eduardo Barrón
The Oligocene climate in northern Iberia and present-day climate analogues

11:30 CEST *Social gathering in the **NECLIME wonder room***

Wednesday, April 21, 2021

Chair Olesya Bondarenko & Eduardo Barrón

09:00 CEST **Dieter Uhl** & André Jasper
Paleogene and Neogene palaeo-wildfires - Some burning questions

09:15 CEST **Bangjun Liu**, Rafael Spiekermann, Cunliang Zhao, Yuzhuang Sun, Wilhelm Püttmann, André Jasper & Dieter Uhl
Evidence for the repeated occurrence of wildfires in an upper Pliocene lignite deposit from Yunnan , SW China

09:30 CEST **Dimitra Mantzouka**, Vladimir Bozukov, Dimiter Ivanov, Torsten Utescher & Lubomir Metodiev
Preliminary Observations on Fossil Coniferous Wood Findings from the Cenozoic (Oligocene-Miocene) of Bulgaria

09:45 CEST **Kajal Chandra**, Anumeha Shukla & R.C. Mehrotra
A tale from the past: Paleogene plant megafossil records from the Indian subcontinent elucidating its biotic links

10:00 CEST **Vithoba M. Shendage**, Surendra R. Manik & B. A.Vagyani
Palaeofloristic Diversity of Upper Gondwana Beds from Andhra Pradesh, India

15 min break

Chair Martina Stebich

10:30 CEST **Andrea K. Kern**, Thomas Kenji Akabane, Allan Sandes de Oliveira, Fabricio Ferreira, Gary Dwyer, Cristiano M. Chiessi, Cleverson G. Silva, Debra A. Willard & Paul A. Baker
Amazonian biodiversity and biome stability during the last 1.8 Ma

10:45 CEST Andrea K. Kern & **Angela A. Bruch**
Model-Proxy-Comparison of Biome Reconstructions for MIS 6 and 5e – Preliminary Results

11:00 CEST **Yul Altolaguirre**, Meike Schulz, Luis Gibert & Angela A. Bruch
Mapping the vegetation of the Early Pleistocene environments of the Guadix-Baza Basin (Spain)

11:15 CEST **Torsten Utescher**, Martina Stebich & Sushma Prasad
Diversity patterns of plant functional types in the Holocene of India

11:30 CEST **Johan Jarl** & Angela A. Bruch
Modern Phytoliths as a Paleoenvironmental Proxy in the Southern Caucasus – Preliminary Results

11:45 CEST *Social gathering in the **NECLIME wonder room***

Thursday, April 22, 2021

Chairs Funda Akgün & Angela A. Bruch

09:00 CEST Vladimir Bozukov & **Marianna Kováčová**
Nearest living relatives of genus Carpinus *in Bulgarian Palaeogene and Neogene*

09:15 CEST **Grzegorz Worobiec**, Elżbieta Worobiec & Marek Widera
Wetland fungi as palaeoenvironmental proxies: Reconstruction of the middle Miocene wetlands from the Adamów Lignite Mine (central Poland) based on plant and fungal microremains

09:30 CEST **Barbara Słodkowska** & Marek Widera
Plant communities succession recorded in the pollen assemblages from the Jóźwin IIB lignite open pit (Konin area)

09:45 CEST Aye Thida Aung, **Cédric Del Rio**, Teng-Xiang Wang, Jia Liu & Tao Su
Fossil fruits and pollen grains of Trapa *from the Upper Pliocene of Sanying Formation (Yunnan, China)*

10:00 CEST **Arata Momohara**, Hisa Tsuji & Kiyohide Mizuno
A decrease in temperature during the late Middle Pleistocene interglacial stage (MIS 7.3) altered montane zone floral diversity in central Japan

15 min break

Chair Torsten Utescher

10:30 CEST NECLIME final discussion

Proposals for forthcoming events, conclusions, comments, and general discussion

Abstracts

Estimating tropical climate change in the South America during the last 30 ka using CRACLE

Thomas Kenji Akabane[1], Andrea K. Kern[1] & Carlos Eduardo M. Mazoca[1]

[1]Institute of Geosciences, University of São Paulo, São Paulo, Brazil

In face of a rapid global climate change, the need for accurately reconstructed past climates in key regions such as the tropical South America is of global importance. Pollen records provide direct information of past vegetation and represent valuable archives for reconstructing past environmental changes. Approaches of vegetation and climate estimations are widely applied in the northern hemisphere, but extensive gaps in particularly quantitative reconstructions are still present in regions such as Central and South America. Our ongoing study is a first attempt to model past climates based on pollen records using the Climate reconstruction analysis using coexistence likelihood estimation (CRACLE) method[1] conducted with the 'cRacle' R package[2]. CRACLE is based on the coexistence of present taxa and calculates the maximum likelihood for a climatic parameter for a given sample by using probability density functions and bioclimatic parameters. To evaluate the precision and error of CRACLE in the study area, we initially applied it on modern vegetation plot data resulting in well-represented regional and climate gradients. Uncertainties of the predictions are dependent on the number of taxa and may also relate to higher elevation areas. In our preliminary tests, we also reconstructed past climates from two cores spanning into the Last Glacial Maximum at distinct sites across tropical South America. These results support the applicability of pollen records from different climatic regions to result in distinct climatic estimations following modern trends. A cooling trend towards the Last Glacial Maximum could further be observed in our preliminary data sets. The non-parametric (kernel) approach provided the best estimations, while it showed higher fluctuations through time. CRACLE has a great potential to estimate bioclimatic parameters in the paleo-record of South and Central America, but still require further scrutiny before its application in tropical regions.

This study was funded by FAPESP grant 2019/19948-0, CAPES grant 88887.370034/2019-00, and CNPq grant 426654/2018-8.

References:
1. Harbert RS, Nixon KC. *American Journal of Botany.* 2015;102:1277–89.
2. Harbert RS, Baryiames AA. *Applications in Plant Sciences*. 2020;8:1–8.

Palaeoenvironmental and Palaeoecological changes: Case Studies from Ereğli-Ulukışla Basin in southern Central Anatolia

Funda Akgün[1], Mine Sezgül Kayseri-Özer[2], Erdoğan Tekin[3] & Baki Varol[3]

[1]Department of Geological Engineering, Dokuz Eylül University, İzmir, Turkey
[2]Institute of Marine Science and Technology, Dokuz Eylül University, İzmir, Turkey
[3]Department of Geological Engineering, Ankara University, Ankara, Turkey

The Ereğli-Ulukışla Basin which is the focus of this study is situated at the south-eastern edge of the Central Anatolian Cenozoic basins (Tuzgölü, Haymana, Çankırı-Çorum and Sivas), and is divided into two sub-basins, the Aktoprak (AT) and Hacıbekirli-Tepeköy (HT). Sedimentary sequences of these sub-basins have been deposited during the late Eocene to late Miocene time interval. In this study, it was summarized that the changes in climate and vegetational characteristics of central Anatolia during this time interval based on Ereğli-Ulukışla Basin example.

In Anatolia during the late Eocene-early Oligocene, main palaeovegetation type is the mangrove and back-mangrove palaeocommunities in the deltaic palaeoenvironment, and represented by thermophilous plant species forests (e.g. *Engelhardia*, Schizaceae, Sapotaceae, Anacardiaceae, Cyrillaceae, Icacinaceae, *Platycarya*, Simarubaceae, *Reevesia*) in the terrestrial deposition system under the tropical and warm subtropical paleoclimate. However, the palaeoclimate in this time interval of the Ereğli-Ulukışla Basin is cooler and dryer than the main palaeoclimatic condition in Anatolia. Additionally, diversity of the herbaceous species were firstly observed in the basin during the late Eocene-early Oligocene.

During the Burdigalian and Langhian time interval in which Middle Miocene Climatic Optimum period was recorded, the palaeoclimate of Anatolia has been represented by the warm subtropical and humid climatic conditions in general. Additionally, the mangrove and back-mangrove palaeocommunities were also recorded in the deltaic palaeoenvironment. Besides, the palaeoclimatic conditions changed from humid-temperate/subtropical in the Serravallian to strongly dry and warm/cool-temperate in the Messinian. However in the Aktoprak sub-basin, palaeoclimate of the late Eocene-late Miocene is dryer and cooler than the other localities in Anatolia (except for the Hacıbekirli-Tepeköy sub-basin climate is resemble to these other localities). This result shows that the topographic and palaeogeographic changes due to regional tectonic activities (e.g. Central Anatolia Uplift) in Anatolia from the early Miocene to the present have significantly influenced the palaeoclimate.

Mapping the vegetation of the Early Pleistocene environments of the Guadix-Baza Basin (Spain)

Yul Altolaguirre[1,2], Meike Schulz[1], Luis Gibert[3] & Angela A. Bruch[1]

[1]The Role of Culture in Early Expansions of Humans (ROCEEH), Heidelberg Academy of Sciences and Humanities, Frankfurt am Main, Germany
[2]Institute of Geosciences, Goethe University, Frankfurt am Main, Germany
[3]Department of Mineralogy, Petrology and Applied Geology, Barcelona University, Barcelona, Spain

The Guadix-Baza Basin, in SE Spain, harbors hominin fossils and lithic artifacts dated to ca. 1.4–1.3 Ma, representing the first hominin habitat in the Iberian Peninsula and possibly in Western Europe. Recent palynological studies have described a high diversity of plant taxa and biomes existing in the basin at the time of hominin presence. However, the relationship between these hominins and their environment has not been fully explored yet. With this objective, the geographical extents of the various vegetation types of the hominin habitat have been reconstructed according to paleoclimate and paleogeographic data. The resulting vegetation maps reveal a great diversity of vegetation types. During dry (glacial) periods, the vegetation of the basin was represented mostly by steppes, with the appearance of forested vegetation only in the mountainous regions. During humid (interglacial) periods Mediterranean woodlands represented the dominant vegetation, accompanied by deciduous and conifer forests in the areas of higher altitude. The lake-system present in the basin also allowed for the presence of marshland vegetation both during dry and humid periods. By using modern analog and composite taxonomic lists, the number of edible plant parts found in each vegetation unit can be approximated. The assessment of the availability of edible plant parts reveals that early *Homo* could have found a high number of resources in marshland and riparian environments throughout the year. Mediterranean woodlands and deciduous forests also provided numerous edible plant parts. During dry periods, the availability of plant resources decreased heavily, but the prevalence of marshland and riparian vegetation and of the forested vegetation in the areas of higher altitude could have sustained hominin communities during harsher climatic periods. However, the disappearance of the lake system and an increase of aridity after the MPT and during the Middle Pleistocene probably led to an impoverishment of plant resources available to early Homo in the Guadix-Baza Basin.

Fossil fruits and pollen grains of *Trapa* from the Upper Pliocene of Sanying Formation (Yunnan, China)

Aye Thida Aung[1,2], Cédric Del Rio[1,3], Teng-Xiang Wang[1,2], Jia Liu[1,3] & Tao Su[1,3]

[1]CAS Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Xishuangbanna, China
[2]University of Chinese Academy of Sciences, Beijing, China
[3]Center of Plant Ecology, Core Botanical Gardens, Chinese Academy of Sciences, Mengla, China

Trapa (water chestnut or water caltrop) is a genus of annual free-floating plant mostly native from Africa and Eurasia and included in the family Lythraceae. The genus only contains 8 species today but has a huge number of fossil species in the Neogene, mainly based on fruits as well as pollen grains. In China, several fossil species have been previously recorded during the Miocene and Pliocene, but few with detailed description.

Here we describe a new species of fruits from the Pliocene of the Sanying Formation, Yangjie coalmine, western Yunnan based on the following characters: the medium size of the fruit, the relatively long upper horns, the well-developed and triangular lower horns, the well-developed tubercles between lower and upper horns, and a long and large neck bearing hairs without corona. In addition, pollen grains were uncovered from the same sediment and having typical Trapaceous characters such as medium size, tricolpate, obtuse triangular in shape in polar view, and in possession of 3 meridional crests covering the apertures.

The new species of *Trapa* shows a close morphological similarity with the Miocene species *Trapa chengsenii* from the Miocene of Yunnan and with the modern species *Trapa natans*. The pollen grains belonging to *Sporotrapoidites* cf. *weiheensis* also closely resemble those of *Trapa natans*. The occurrence of *Trapa* suggests that depositional environment corresponds to open and shallow water with a water temperature more than 20 °C in the growing period.

Late Rupelian flora of the Zaissan depression (East Kazakhstan)

Anna Averyanova[1], Torsten Utescher[2,3], V. Tarasevich[1], Svetlana Popova[1] & Volker Mosbrugger[3]

[1]Laboratory of the Palaeobotany, Komarov Botanical Institute of RAS, Saint Petersburg, Russia
[2]Steinmann Institute, University of Bonn, Bonn, Germany
[3]Senckenberg Research Institute, Frankfurt am Main, Germany

The Buran flora of the Ashutas mt. deposits was discovered by B.A. Borisov in 1960 from the Buran Formation of Oligocene age, which overlies the Lower Oligocene Kusto Formation (basal Rupelian); the latter is dated on the basis of biostratigraphic and magnetostratigraphic data. To date, opinions on the dating of the Buran Formation differ. According to palynological analysis, the deposits of the Buran Formation are allocated to the *Juglans sieboldianiformis-Betula gracilis* palynozone, which correlates with the Novomikhaylovsk Formation of Western Siberia and belongs to the Upper Rupelian. In this study, we assume a late Rupelian age for the Buran flora. This is confirmed by magnetostratigraphic studies of the Oligocene of the Zaisan depression by F.I. Suleimanova (1999), as well as by the absence of thermophilic taxa in the leaf flora, which were still preserved in the Lower Rupelian flora of the Kusto Zaisan depression.

Paleobotanical material of the Buran Formation is represented by two collections 981 and 981A, collected in 1960-62 by B.A. Borisov from the same layers, as well as the partially lost collection 3070 (collected by M.A. Akhmetyev) from another layer of the Buran Formation. Both floristic complexes existed close to each other in time, but at the same time it is impossible to speak of their age as being the identical. Based on the analysis of field data, we can conclude that the flora denoted “Buran-981, 981A”, is somewhat older (but within the Upper Rupelian), in comparison with the flora “Buran-3070”. The systematic composition of these two local floras is different, but there is one important similarity - a distinct predominance of leaves of the genus Carya among the fossil remains, as well as the presence of fruits of this genus. Another common feature is a noticeable presence of deciduous taxa – *Ulmus, Zelkova, Populus*. Thus, despite the change in the geological setting and, accordingly, the sedimentation, the general appearance of the vegetation of the Zaisan depression remained constant during the Late Rupelian. Comparison with the floras of neighboring regions shows some similarity at the generic level of the Zaisan Late Rupelian flora with coeval floras from Western Kazakhstan. At the same time, in the vegetation of Eastern Siberia, the advent of the Turgai flora occurred somewhat earlier than in Kazakhstan - even at the beginning of the Early Rupelian, which was apparently associated with a successively decreasing influence of the warm waters of the retreating Turgai Strait.
Quantitative climate reconstruction performed for the Buran floras using the Coexistence Approach (CA) reveal warm temperate conditions for the Buran microflora with MAT 13.8-18.5 °C and CMT 5.2-12.5 °C, comparable to values obtained for floras of western

(Toguzken) and eastern Kazakhstan (Kusto). For both less diverse macrofloras studied, the CA gives somewhat lower temperatures, especially for the cold season, that can possibly be related to local microclimate and/or Nearest Living Relative concept at species level used. Precipitation parameters largely overlap for the floras based on different organ type and indicate overall high MAP in the order of 800-1,100 mm and a distinct seasonality of rainfall. Moreover, the Plant Functional Type (PFT) technique was applied to compare vegetation dynamics throughout the Rupelian floras of Kazakhstan. Ecospectra reconstructed for the Buran leaf floras clearly indicate local presence of arboreal deciduous vegetation (85% diversity proportion of PFTs 5, 6, 23, 24). The ecospectrum of the Buran 981 microflora, better reflecting the regional vegetation has a more diverse composition and includes also various conifer PFTs (diversity proportion 36 %). The spectrum obtained for the Buran 981 microflora shows some similarity with pollen-based ecospectra reconstructed for eastern Kazakhstan (Toguzken).

The study was supported by grant RFFI 2020-2021 21-55-53054 GFEN_a.

The latest Phases of the Messinian Salinity Crisis between 5.6 Ma and 5.33 Ma: The Italian Pollen Record

Adele Bertini[1], Gabriele Niccolini[1,2], Benedetta Lanini[1], Elena Menichetti[3] & Fabio Fusco[4]

[1]Dipartimento di Scienze della Terra, Università di Firenze, Firenze, Italy
[2]Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari "Aldo Moro", Italy
[3]Eni SpA, Natural Resources, San Donato Milanese, Italy
[4]Independent Palynologist

In the Mediterranean area, the latest phases of the Messinian salinity crisis (MSC), after the first massive evaporite precipitation, are expressed by two main sub-units (p-ev_1 and p-ev_2) bounded by the intra-Messinian unconformity (MES) at the base (~5.6 Ma) and the Messinian/Zanclean boundary at the top (5.33 Ma). Prevalent 'regressive' depositional trends characterized the p-ev_1 deposition in the deepest and/or strongly subsiding basins. On the other hand, p-ev_2 shows a basin-wide distribution and important modifications in the drainage areas and/or in the fluvial runoff; it also includes the most famous Lago-Mare event marked by the arrival of typical Paratethyan taxa in the Mediterranean realm.

Here we present the results of palynological analyses carried out in several Messinian "post-evaporitic" sedimentary successions located in Piedmont, Emilia Romagna, and Sicily (Italy). Such pollen assemblages together with those previously described (e.g. Maccarone and Trave sections) contribute to the definition of the flora composition as well as the main vegetational and climate changes linked to the effects of orbital forcings, especially precession but also eccentricity. They also provide evidence for the impact of glacial phases between TG14 to TG6.2.

The Messinian pollen record, between 5.6 Ma and 5.33 Ma, will be discussed with respect to a North-South transect and the main following points:

i. the overall predominance of arboreal plants which indicates a densely forested environment in Northern Italy (broad-leaved evergreen/warm mixed forest biome) vs a predominance of herbaceous plants in Southern Italy (warm grass/shrub biome);
ii. the sub-humid character of the forest vegetation expanding in the mesic lowlands of northern sites during the deposition of p-ev_1 and p-ev_2 which supports the idea of the main desiccation event in the deepest depocentres basin after the deposition of the Primary Lower Gypsum in the shallow sub-basins;
iii. the different palynological signature of p-ev_1 and p-ev_2 which needs to be evaluated with respect to both climate changes and taphonomic biases.

Advent of monsoonal climate and evolution of evergreen forest in South Asia: evidence from Oligocene flora of India

Harshita Bhatia[1,2], Gaurav Srivastava[1,2], Torsten Utescher[3,4] & R.C. Mehrotra[1]

[1]Birbal Sahni Institute of Palaeosciences, Lucknow, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, India
[3]Steinmann Institute, University of Bonn, Bonn, Germany
[4]Senckenberg Research Institute, Frankfurt am Main, Germany

The Makum Coalfield of northeast India has a rich assemblage of fossils which include leaves, wood, fruits, and seeds. The biostratigraphy and lithostratigraphy suggest a late Oligocene age for this coalfield. The modern analogs of the recovered fossil taxa are either growing in the evergreen forests of the Western Ghats or northeast India. The quantification of climate by using the Coexistence Approach (CA) provides the following result:Mean annual temperature (MAT) 24.55 ± 0.95 °C, cold month mean temperature (CMT) 19.6 ± 1.8°C, warm month mean temperature (WMT) 28.3 ± 0.2°C, mean annual precipitation (MAP) 2,681 ±470 mm, precipitation during the wettest months (MPwet) 367 ± 5 mm, precipitation during the driest months (MPdry) 22 ± 3 mm, and precipitation during the warmest months (MPwarm) 166.5 ± 39.5 mm. A recent reconstruction based on CLAMP (Climate Leaf Analysis Multivariate Program) indicates a MAT of 26 ±2.3 °C, CMT 21.3 ±3.5 °C, WMT 28.4 ±2.9 °C, MAP 2,166 ±643 mm, precipitation during the 3- wettest months (3-WET) 1135 ± 400 mm, precipitation during the 3-driest months (3-DRY) 99 ± 98 mm. Both the methodologies yield largely overlapping results, and indicate that the ratio of WET:DRY is greater than 6, which suggests a monsoonal type of climate. The leaf physiognomic trait reveals an Indonesian-Australian (I-Am) type of monsoon, which is due to the migration of the ITCZ (Intertropical convergence zone). This suggests that the characteristic South Asia Monsoon (SAM) might have emerged as a distinct monsoon system after the late Oligocene.

Early Paleogene temperature gradients along the eastern Pacific coastal areas

Olesya V. Bondarenko[1] & Torsten Utescher[2,3]

[1]Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch, Russian Academy of Sciences, Vladivostok, Russia
[2]Senckenberg Research Institute, Frankfurt am Main, Germany
[3]Institute for Geosciences, University of Bonn, Bonn, Germany

Early Paleogene latitudinal continental temperature gradients along the Pacific coast of Eurasia are studied in time and space using the Coexistence Approach (CA), for the first time applied on the large palaeobotanical record of this region. The palaeobotanical data used in this reconstruction are compiled from extensive literature resources on a total of 109 reasonably well-dated floras, including 78 palynofloras (PF), 30 leaf floras (LF) and one carpoflora (CF) covering the early Paleocene (Danian) to early Eocene (Ypresian), i.e. a time-span of ca. 25 Myr, in total. The palaeobotanical records originate from continental deposits of 73 localities situated along the Pacific coast of Eurasia, including the Far East of Russia, Eastern Siberia, China, and Japan. All palaeofloras considered were carefully re-evaluated regarding the validity of taxonomic identifications and the Nearest Living Relatives (NLRs) of the fossil taxa. According to our data, the latitudinal temperature gradient was very weak during the early Paleogene. Nevertheless, based on mean values of mean annual temperature (MAT) and cold month mean temperature (CMMT), two different regional climatic zones can be distinguished in the Paleocene representing in each case the cooler and warmer (subtropical) part of warm temperate climate of the Koeppen-Geiger system. In the early Eocene, the gradient became more clearly pronounced and in addition, a cool temperate zone can be distinguished. The presence of mangroves in our early Eocene records, already known from previous studies, is largely in line with our climate reconstruction and possible can be related to hyperthermal events such as the PETM and ETM.

Nearest living relatives of genus *Carpinus* species in Bulgarian Palaeogene and Neogene

Vladimir Bozukov[1] & Marianna Kováčová[2]

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria
[2]Department of Geology and Paleontology, Faculty of Natural Sciences, Comenius University in Bratislava, Bratislava, Slovak Republic

The genus *Carpinus* is widespread in the Bulgarian Paleogene and Neogene flora. There are more than 20 local paleofloras on the territory of Bulgaria where species of this genus are found. So far, they have been established as follows: by leaf imprints – 4 species (*C. betulus* foss., *C. grandis*, *C. orientalis* foss., *C. suborientalis*); by bract imprints – 3 species (*C. betulus* foss., *C. orientalis* foss., *C. mestensis*); by fossilized nutlets – 2 species (*C. europaea*, *C. pannonica*).

The new data presented here are based on a new find as a bract imprint that has morphological features similar to the recent SE Asian species *C. pubescens*. The previously known genus *Carpinus* fossil species from the territory of Bulgaria have one or more nearest living relatives (NLR). They are distributed over wide geographical boundaries. Some of them are of European distribution – *C. betulus* and *C. orientalis*. *C. caroliniana* is a N American species. The rest are of Asian origin: East and SE Asia – *C. pubescens*, *C. tschonoskii*, *C. turczaninovii*; Central and SE Asia – *C. viminea*; E Asia – *C. japonica* and *C. cordata*. In stratigraphic terms, the NLRs are distributed as follows according to their grouping by geographical distribution: those of Asian origin cover the Lower Oligocene - Upper Miocene range; those of American origin – Miocene-Pliocene boundary; the European NLRs remain in the Pliocene only.

A large number of genus *Carpinus* recent species have extremely close leaf morphology. It is also highly variable, with overlapping features of two or more species. These facts suggest the existence of more than two species of the genus found by leaf imprints (*C. grandis* and *C. suborientalis*) in Bulgaria during the Oligocene and Miocene. The findings of the genus by bract imprints and nutlets support this idea. They indicate the presence of different NLRs of those found by leaf imprints. A future revision of the leaf imprints material is needed to confirm this idea. As a basis of this study should be taken the data on NLRs of established species by bract imprints and nutlets, due to the reliable taxonomic information that can be derived from them.

The Oligocene climate in north-western Iberia and present-day analogues

Manuel Casas-Gallego[1] & Eduardo Barrón[2]

[1]Broadway Court, Mostyn Avenue, LL30 1YS Llandudno, UK
[2]Instituto Geológico y Minero de España (IGME), Madrid, Spain

In this study we examine the palynofloras yielded by 108 samples from the As Pontes Basin in north-western Spain, covering a time span of more than 7 Ma from the Early Oligocene (Rupelian) to the Early Miocene (Aquitanian). The palynological assemblages indicate the occurrence of forests dominated by broadleaved evergreen taxa with subordinate deciduous taxa, surrounding a small lacustrine system. The application of the Coexistence Approach method has resulted in paleoclimatic estimates that mirror the global Oligocene climate inferred from marine isotopic records. A period of relative high temperature is envisaged during the Rupelian (30–28.5 Ma) followed by a decrease in temperature throughout the late Rupelian and most of the Chattian (28.5–25 Ma). The Late Oligocene warming event is also reflected in the assemblages.

We make an attempt to identify modern climate analogues for the Chattian of As Pontes using the coexistence climatic intervals combined with high-resolution, present-day climate data available from the public domain. The occurrence of plant communities dominated by thermophilous evergreen taxa mixed with temperate deciduous taxa, which has no current analogue in modern vegetation, determines that the climatic requirements necessary to meet the tolerance of all taxa occur in very limited regions of the world. In that respect, the climate that predominated in As Pontes during the Oligocene can be regarded as relict, covering nowadays an area of less than 2,000 km^2. We found that current climates within the ranges of temperature and precipitation estimated for the Chattian of As Pontes are restricted to mountainous tropical regions where high precipitation associated with high altitude (1,500–3,500 m a.s.l.) compensate the occurrence of a dry season characteristic of the region, enabling the development of evergreen broadleaved-dominated forests. Most climate analogues occur in locations that host National Parks or reserves of ecological and biodiversity interest, such as the Elgon and Kadam mountains in Uganda, the Usambara mountains in Tanzania and the Comayagua National Park in Honduras.

A tale from the past: Paleogene plant megafossil records from the Indian subcontinent elucidating its biotic links

Kajal Chandra[1], Anumeha Shukla[1] & R.C. Mehrotra[1]

[1]Birbal Sahni Institute of Palaeosciences, Lucknow, India

After the break-up from the Gondwanaland continents the Indian subcontinent underwent significant biogeographic and climatic changes throughout its journey from the southern to the northern hemisphere. The equatorial position of the Indian subcontinent during the early Paleogene has provided an equable climatic condition that supported the growth of lush evergreen forests that deposited in form of thick lignites in the north-western margin of the Indian subcontinent. The rich megafloral diversity retrieved from the early Paleogene successions of the Indian subcontinent indicated the presence of ancestral lineages of many angiosperm families. The origin and dispersal of these plant families is always been a matter of concern for the paleobotanists. Based on the available fossil evidences, the role of the moving Indian plate portrays the clear picture of its possible land connections with the adjacent landmasses. The retrieval of many foreign elements from the early Paleogene successions of western India indicating its biotic links with Africa, Madagascar and Eurasia during the different geological time frame. These evidences are also in favour of various dispersal hypothesis viz., Out of India, Into India and boreotropical that involved in the distribution of basal plant lineages in deep time. The plant records from the early Paleogene of western India bear a strong relationship with the breakup of Gondwanaland and advocate for a large scale vicariance/dispersal wherein same phylogenetic groups and their distribution hint for a common history of isolation.

Reconstruction of morphoclimatic systems in the Mar Piccolo (Southern Italy) during the last 12 ka: the contribution of dinocysts and other NPP

Niccolò Degl'Innocenti[1], Adele Bertini[2], Gabriele Niccolini[1] & Giuseppe Mastronuzzi[1]

[1]Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari "Aldo Moro", Italy
[2]Dipartimento di Scienze della Terra, Università di Firenze, Firenze, Italy

The Mar Piccolo basin (Gulf of Taranto, northern Ionian Sea) formed during the Last Glacial as an incised valley partially filled by sediments related to the sea ingression connected to the Holocene transgressive phase. Holocene deposits have already been object of numerous geophysical, sedimentological, mineralogical, and geochemical studies whereas high resolution palynological research have not yet been performed. The present project aims to reconstruct the first dataset on dinocysts and other Non Pollen Palynomorphs (NPP) from the Mar Piccolo in order to identify the climate changes and the anthropic impact during the Holocene. The analysis of palynomorphs assemblages, now in progress, on core S05B, will provide information on salinity, temperature, productivity, and nutrients, as well to describe the main paleoenvironmental changes in marine/transitional environments (distality vs proximity, sea level fluctuations, changes in runoff regime). Such evidence together with the paleoclimatic reconstructions, will permit to reconstruct the history of the morphoclimatic systems evolution in the Mar Piccolo area during the Holocene.

The Miocene Trwyn y Parc solution pipe complex on Angelsey, Wales, UK: new findings and a comparison of CREST with the Coexistence Approach

Martha E. Gibson[1], Jessica McCoy[1], Jennifer M. K. O'Keefe[2], Noelia B. Nuñez Otaño[3], Sophie Warny[4] & Matthew J. Pound[1]

[1]Department of Geography and Environmental Sciences, Northumbria University, Newcastle upon Tyne, UK
[2]Department of Physics, Earth Science, and Space Systems Engineering, Morehead State University, USA
[3]Laboratorio de Geología de Llanuras, Facultad de Ciencia y Tecnología, Universidad Autónoma de Entre Ríos, Sede Diamante. CONICET (National Scientific and Technical Research Council), Argentina
[4]Center for Excellence in Palynology, Department of Geology & Geophysics, and Museum of Natural Science, Louisiana State University, USA

The British Isles are not blessed with extensive onshore Neogene sediments. The Trwyn y Parc solution pipes on the Isle of Anglesey, Wales, UK, are of national importance as they are the only confirmed Miocene sediments in Wales and one of only four fossiliferous Miocene deposits in the UK. The solution pipes are a Regionally Important Geoscience Site and part of the GeoMôn UNESCO Global Geopark. A re-analysis of the original palynological analysis has substantially refined their age from Miocene to Middle Miocene (possibly Langhian). This would make them the oldest Neogene sediments from the onshore strata of the UK. Here we present an overview of this important Middle Miocene site in the context of other UK Neogene deposits, revised palynostratigraphy, palaeoenvironmental interpretation and new palaeoclimate reconstructions.

To quantify the palaeoclimate we have applied the Co-existence Approach and the Bayesian method CREST (Climate Reconstruction SofTware). We compare preliminary results of a CREST palaeoclimate reconstruction with the Co-existence Approach reconstruction of the Trwyn y Parc flora. Both techniques provide overlapping climate reconstructions, but CREST provides a probability of uncertainty. For example, the Co-existence Approach reconstructs a mean annual temperature (MAT) of 17.2 – 18.1°C while CREST reconstructs a MAT of 16.9 °C with uncertainties ranging from 15.8 – 20.7 °C (2-sigma). Whilst this further confirms that the Co-existence Approach is a simple and effective means to reconstruct terrestrial palaeoclimates. The ability to provide uncertainty with a probability of the uncertainty is critical for making meaningful data – climate model comparisons.

The Trwyn y Parc data reveals a window into a warmer and wetter interval during the Middle Miocene of the UK. Post-COVID resampling of the original material will further contribute to an understanding of the long-term Neogene climate-biota interactions in the western most peninsula of Neogene Eurasia.

Palynological data for the late middle Miocene vegetation and climate change in the Eastern Paratethys (Northeast Bulgaria)

Dimiter Ivanov[1], Torsten Utescher[2,3] & Vladimir Bozukov[1]

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria
[2]Senckenberg Research Institute, Frankfurt am Main, Germany
[3]Institute for Geosciences, University of Bonn, Germany

The results of palynological studies of the late middle Miocene sediments in the western part of the Euxinian Basin (Eastern Paratethys) are based on the analysis of 97 samples from outcrop Balgarevo (Zelenka beach) near the town of Kavarna, Dobrich district. Mixed deciduous forests were widespread during the time period studied. Swamp forests are also recorded, with distribution maxima observed in the Oligocene and in the Bessarabian. The herbaceous vegetation is recorded in the whole profile showing some cyclicity.

The climatic data reconstructed by the Coexistence Approach indicate mean annual temperatures (MATs) of ca. 14–17 °C and MAPs from 800–1500 mm per year. The climate record shows a warming trend in the bottom part of the section culminating at ca. 5 m. A distinctly cooler phase is observed at ca. 17 m. In the lower half of the record, there seems to be longer term cyclicity in the order of 15 m, possibly reflecting long excentricity. With its three distinctly wet phases, the precipitation evolution looks as well quite intriguing.

The analysis of Plant Functional Types (PFT's) reveals a chart with ecospectra that can be interpreted in terms of vegetation allowing to trace changes in diversity of vegetational components at the time of the middle Miocene climatic transition. Various indices calculated as ratios of functional types with high climatic and ecological significance show distinct cyclicity at various scales and long-term trends along the profile. Arboreal diversity is composed of ca. one third conifer functional types and two third broadleaved PFTs, at a mean. Among the broadleaved arboreal fraction, evergreens constantly has a very moderate diversity, while the deciduous component shows a long-term increasing trend, at the expense of conifers.

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Modern Phytoliths as a Paleoenvironmental Proxy in the Southern Caucasus – Preliminary Results

Johan Jarl[1] & Angela A. Bruch[2]

[1]Department of Anthropology, University of Connecticut, USA
[2]The Role of Culture in Early Expansions of Humans (ROCEEH), Heidelberg Academy of Sciences and Humanities, Frankfurt am Main, Germany

The Southern Caucasus straddles the border between Europe and Asia, constituting a biodiversity hotspot which covers a large range of environments – from the high elevation landscapes of the Armenian Highland to the lush forests on the eastern shore of the Black Sea, and the arid steppes of Eastern Georgia. Having the earliest evidence of hominin occupation outside of Africa at 1.8 Ma, the region is of great importance for our understanding of the migrations and cultural behaviors of the genus Homo. Archaeobotanical research is uniquely positioned to shed light on past environments, and the utilization of natural resources by past peoples. Here, the first results of a larger pilot study are revealed, to show how phytolith analysis might aid as a proxy in paleoenvironmental reconstruction in Georgia and Armenia. In total, the phytolith assemblages of 51 soil samples taken from modern known vegetation units are presented, representing the first data of the project. These preliminary results will show how phytoliths can aid in discerning between open and closed environments in the region, as well as providing insight into the nature and overall composition of these modern phytolith assemblages.

Model-Proxy-Comparison of Biome Reconstructions for MIS 6 and 5e – Preliminary Results

Andrea K. Kern[1] & Angela A. Bruch[2]

[1]University of São Paulo, Institute of Geoscience, São Paulo, Brazil
[2]The Role of Culture in Early Expansions of Humans (ROCEEH), Heidelberg Academy of Sciences and Humanities, Frankfurt am Main, Germany

Early Neanderthals lived in Europe since roughly 200 ka and remained for many thousands of years in very variable environments driven by severe global climatic changes. In particular, the long and harsh glacial period of MIS 6 (190-130 ka) as well as the relatively short but warm and humid interglacial of MIS5e, the Eemian (130-115 ka), provided profoundly different landscapes for Neanderthal communities. Biome simulations driven by global climate simulations contribute to an understanding of vegetation changes and express the regional extent and variety of biomes available at different times. In addition, plant fossils allow for direct evidence of past vegetation.

In this study, we aim to compare recently published global vegetation maps with pollen-based proxy data. Preliminary analyses arebased on a subset of so far 51 compiled published pollen data sets, which were used to quantitatively reconstruct paleo-biomes by the well- established biomization technique. Further, consideration of 72 qualitative vegetation studies will allow increasing the resolution of data points. The highest concentration of data points is available for Europe so far, while global regional cover is still low in the current analysis.

First results for central and eastern Europe reveal shifts from a temperate grassland and temperate xerophytic shrublands during glacial MIS6 to forest biomes such as cool mixed forests, cool evergreen needleleaf forests and temperate deciduous forests during MIS5e. In contrast, Southern European sites shift from grass and shrub-dominated biomes toward warm-temperate evergreen broad-leaved forests at the warmest peaks of the Eemian interglacial.

The proxy-model comparison revealed a general agreement of the data sets for central and southern Europe. Main obstacles for data comparison appear to be the different concepts of biome classification of the two approaches and different degrees of temporal resolution of the inhomogeneous data sets. Further analysis will provide a comprehensive picture on the glacial/interglacial variability of vegetation cover of Europe and beyond and will contribute to the understanding of Neanderthals-enviromnet-interactions.

Amazonian biodiversity and biome stability during the last 1.8 Ma

Andrea K. Kern[1], Thomas Kenji Akabane[1], Allan Sandes de Oliveira[2], Fabricio Ferreira[2], Gary Dwyer[3], Cristiano M. Chiessi[4,5], Cleverson G. Silva[2], Debra A. Willard[6] & Paul A. Baker[3]

[1]Institute of Geoscience, University of São Paulo, São Paulo-SP, Brazil
[2]Department of Geology, Federal Fluminense University, Niterói-RJ, Brazil
[3]Division of Earth and Ocean Sciences, Duke University, Durham, USA
[4]School of Arts, Sciences and Humanities, University of São Paulo, São Paulo- SP, Brazil
[5]Interdisciplinary Climate Investigation Center (INCLINE), University of São Paulo, São Paulo-SP, Brazil
[6]U.S. Geological Survey, Reston, USA

To understand the history of biodiversity in the Amazon, long-term paleoenvironmental studies provide unique contributions to the discussion on past climate change and its impact on vegetation. Accordingly, marine sediment archives retrieved from the vicinity of big rivers potentially register these environmental changes to a regional extent. Herein, we discuss the pollen data of an excellent and continuous marine core representing a terrestrial material deposition entirely of Amazon River origin and spanning the last 1.8 Ma. Due to its large catchment area, the Amazon River carries a mixture of pollen grains from the lowland evergreen rainforest, various higher elevation forests and grasslands as well as savannas towards the Atlantic Ocean. Although pollen concentration was low and strongly varied along the core, certain trends could be detected by comparing biome affinity scores. The most likely reconstructed biomes are the tropical evergreen rainforest exceeded by the warm-temperate rain forest, which grows in low elevation and therefore share common plant taxa. A long-term expansion trend of both dominating biomes in the Amazonian drainage basin is supported by an increase in biodiversity. Highest values of both proxies were detected in the last 400 ka with distinct alternations between glacial and interglacial stages, where complex shifts of in- and decreasing values of wetter and drier biomes were recorded. Strong variations also occurred during the Mid-Pleistocene Transition, when a decrease of tropical and warm-temperate rainforest affinity scores coincided with relative expanding higher-altitudinal cool grass- and scrublands as well as semi-arid vegetation.
This data gives for the first time a long-term perspective towards the entire Amazonian region by showing complex interactions of the diverse biomes across the large Amazonian catchment area. Although the lowland and low elevation rainforests remained present during the last 1.8 Ma, significant variations outlined vegetation shifts and/or river input of the Amazon River and its tributaries.

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Evidence for the repeated occurrence of wildfires in an upper Pliocene lignite deposit from Yunnan, SW China

Bangjun Liu[1,2], Rafael Spiekermann[3], Cunliang Zhao[1], Yuzhuang Sun[1], Wilhelm Püttmann[2], André Jasper[4] & Dieter Uhl[2,3]

[1]School of Earth Science and Engineering, Hebei University of Engineering, Handan, China
[2]Department of Environmental Analytical Chemistry, Institute of Atmospheric and EnvironmentalSciences, Goethe-University Frankfurt am Main, Frankfurt am Main, Germany
[3]Senckenberg Research Institute, Frankfurt am Main, Germany
[4]Programa de Pós -Graduação em Ambiente e Desenvolvimento, Universidade do Vale do Taquari – Univates, Lajeado, Rio Grande do Sul, Brazil

Charcoal remains collected from the late Pliocene Jinsuo lignite basin, Yunnan, China, have been studied to reveal changes of wildfire regime related to the palaeoenvironment, palaeoclimate and palaeobotany during the transition from a global coolhouse into a global icehouse climate which happened in the late Pliocene. Different types of wildfire occurred in the late Pliocene palaeomire with a predominance of low temperature surface fires and ground fires. The distribution of low temperature fires is indicated by the mean inertinite reflectance (Ro) values, which mostly range from 1% to 2%. Considering the lithotype, high-temperature fires occurred more frequently in dark layers compared to pale layers and charcoal layers, as deduced from the high proportion of high Ro values (>3%) produced by crown fire or high temperature surface fire. Wildfire distributions in pale and dark layers were probably influenced by both plant community and depositional environment during their formation. Charcoal layers represent in-situ surface and ground fires, whereas pale and dark layers record both, in-situ and remote fire events in/around the basin. The pre-charring evidence observed associated with charcoal or pyrogenic inertinite shows that decayed wood materials from dead and abscised plant parts lying on the ground could be sources of fuels for the combustion, which preserved these pre-charring evidence in charcoals by ground or surface fires. Conifers, which are the main source of charcoal remains observed in this basin, play an important role in the fire system, and angiosperm charcoal also has been identified, suggesting a combined combustion of fuels for the spread of fires in the profile. Higher macro-charcoal and inertinite contents observed in the lower than the upper part of the profile is probably related to the decreased temperature and oxygen level during the climatic transition in the late Pliocene.

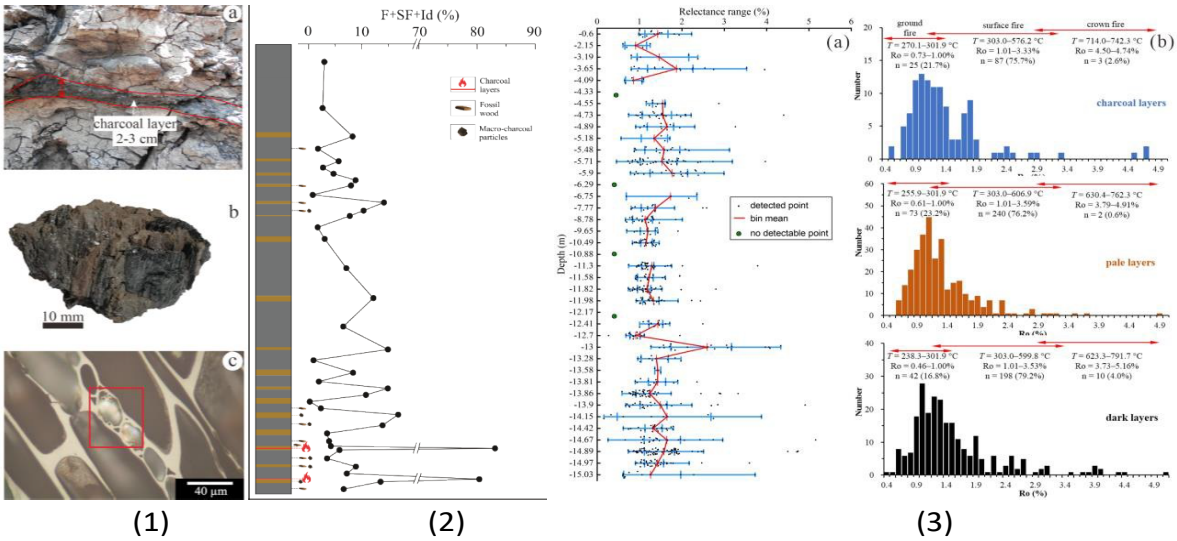

Fig. 1. (a) Charcoal layers, (b) charcoal particles, and (c) inertinite preserved in the Jinsuo lignite seam.
Fig. 2. Distribution of pyrogenic inertinites in the different layers of the Jinsuo lignite seam.
Fig. 3. (a) The variation of inertinite reflectance values throughout the No. 3 lignite seam, and (b) Inertinite reflectance histograms and calculated burning temperature (T = 184.10 + 117.76 ×Ro) of charcoal, pale, and dark layers, along with the possible fire types.

Preliminary Observations on Fossil Coniferous Wood Findings from the Cenozoic (Oligocene-Miocene) of Bulgaria

Dimitra Mantzouka[1], Vladimir Bozukov[2], Dimiter Ivanov[2], Torsten Utescher[3,4] & Lubomir Metodiev[5]

[1]Senckenberg Natural History Collections Dresden, Dresden, Germany
[2]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria
[3]Senckenberg Research Institute, Frankfurt am Main, Germany
[4]Institute for Geosciences, University of Bonn, Germany
[5]Geological Institute, Laboratory for Geocollections, Bulgarian Academy of Sciences, Sofia, Bulgaria

The discovery of new fossil wood findings from two relatively new fossiliferous localities (Ustren and Staroseltsi) and one already known (Bobov Dol), from the South and North part of Bulgaria reveal new evidence on the palaeofloristic map of Bulgaria which counts over 120 localities of Cenozoic age. The study of the material has revealed three conifers of the Paleogene and Neogene from the areas of a. Ustren, b. Bobov Dol and c. Staroseltsi, respectively. The fossils have different preservation states and wood anatomical details. The anatomical features of the studied specimens are discussed in terms of identification, botanical affinities, palaeoecological and ontogenetic aspects.

From the oldest to the youngest our preliminary observations include:

a. A well-bedded sedimentary-pyroclastic succession close to Ustren includes tuffs dated to 32 Ma (early Oligocene) with well-preserved leaf imprints. The study of the macrofloristic findings of the area has already revealed the occurrence of a subtropical element: *Ficus palamarevii* Bozukov, Ivanov & Utescher. Our new research includes a petrified-semi-charcoalified piece of a branch belonging to a fossil conifer. Microscopic slides were prepared and the xylem and pith anatomical structure have been microscopically studied.

b. The late Oligocene coal-bearing formation exposed in open-pit of the coal mine Bobov Dol includes palaeofloristic macroremains belonging to conifers and angiosperms. Leaves imprints of *Glyptostrobus europaea* (Brong.) Ung., *Taxodium dubium* (Sternberg) Heer, *Sequoia abietina* (Brong.) Knobloch and *Libocedrites salicornioides* (Ung.) Endl. represent the fossil conifers already reported from this area. The wood finding from Bobov Dol is permineralized. In spite of the moderate preservation of the specimen, the wood anatomical characteristics of our wood were analyzed both qualitatively and quantitatively, resulting to a compressed *Taxodioxylon* sp. which is most similar to the extant *Sequoia sempervirens* (D. Don) Endl. A further reappraisal of the material from this locality could allow the application of the Whole Plant Concept, with a synthesis of all organs of the fossil *Sequoia* tree. In some parts the material seems to represent 'callus' wood which could be related to a tumor as a result of damage due to fungi or environmental factors.

c. The middle Miocene locality Staroseltsi: The localities of fossilized stumps and other plant remains of Miocene age, in the area between the rivers of Iskar and Vit (Central North Bulgaria), have long been known in the literature. The results of the palaeoxylotomical studies applied by Evlogiev (2009) have provided Taxaceae, Taxodiaceae and Pinaceae woods. The preservation of the material that we studied was not sufficient for a more accurate identification. However, the fossilization process at this locality, including both partly silicified, opalised and semicarbonised plant remains, offers the potential of further research based on the different fossilization pathways.

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A decrease in temperature during the late Middle Pleistocene interglacial stage (MIS 7.3) altered montane zone floral diversity in central Japan

Arata Momohara[1], Hisa Tsuji[1] & Kiyohide Mizuno[2]

[1]Graduate School of Horticulture, Chiba University, Matsudo, Chiba, Japan
[2]Geological Survey of Japan, AIST, Japan

Plant fossils from the Early and Middle Pleistocene have mainly been obtained from lowland sediments and information on changes in montane zone vegetation prior to the last glacial stage is currently limited. However, fossil plant assemblages occurring at high altitudes can be used to assess the influence of climate change on the vertical distribution of plants and vegetation. In this study, we analyzed plant macrofossil assemblages from fluvial deposits in the upper Middle Pleistocene strata outcropping in a riverbed at ca. 1170 m a.s.l. in the southeastern foothills of Mt. Yatsugatake, central Japan. Ages of the assemblages were constrained by two widespread tephras that were deposited above the interglacial peak of marine isotope stage (MIS) 7.3 (ca. 212 ka). The annual mean temperature in the lower and middle sections of the profile was estimated to be warmer than that at present, based on the coldest temperatures limiting the distribution of *Phytolacca japonica* and *Selaginella remotifolia*, and the temperature decreased in the upper section. Species diversity, estimated by rarefaction analysis of plant macrofossil assemblage composition, declined as temperatures decreased after the peak of MIS 7.3. Decreasing floral diversity during the subsequent cooling phase possibly coincided with a downward migration of the vegetation zone and extirpation of plants from the inland basin in central Japan.

Palynological contribution to the study of morphoclimatic systems during the last 12 ka in Mar Piccolo (Taranto, Southern Italy)

Gabriele Niccolini[1], Adele Bertini[2], Niccolò Degli Innocenti[1] & Giuseppe Mastronuzzi[1]

[1]Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari "Aldo Moro", Italy
[2]Dipartimento di Scienze della Terra, Università di Firenze, Firenze, Italy

The Mar Piccolo basin is characterized by a continuous sedimentary succession which includes the transition from the last glacial phase to the current interglacial (MIS 1), marked by rapid climatic changes, at a sub-millennial scale (e.g. 11.7 ka, 8.2 ka, 4.2 ka). The latter had a notable impact on the different environments as well as on the development of ancient societies too. A palynological study (pollen and palynofacies), at very high resolution (about 50 years), is in progress with the aims: i. to describe the main climatic changes and their effects on floristic and vegetal communities; ii. to quantify the main climatic parameters (temperature, precipitation, humidity, evapotranspiration) particularly critics for the characterization of sub-millennial events; iii. to reconstruct the changes of terrestrial landscapes surrounding the Mar Piccolo during the Holocene; iv. to develop a technique for measuring ^{14}C in pollen grains to obtain an additional and comparative chronological indication with respect to those already available (^{14}C on peat and tephra layer).

Oligocene flora of Dyusembai (central Kazakhstan) on the basis of palynological and carpological data

Svetlana Popova[1], Torsten Utescher[2,3], V. Tarasevich[1], P. Tropina[1], Anna Averyanova[1], D. Gromyko[1] & G. Sitpaeva[4]

[1]Komarov Botanical Institute of RAS, Laboratory of the Palaeobotany, Saint Petersburg, Russia
[2]Steinmann Institute, University of Bonn, Bonn, Germany
[3]Senckenberg Research Institute, Frankfurt am Main, Germany
[4]Institute of Botany and Phytointroduction of the Committee for Science of the Ministry of Education and Science Republic of Kazakhstan, Almaty, Kazakhstan

The investigation of the Oligocene flora of Dyusembai (central Kazakhstan) in context of palaeofloras of Turgai Plateau contributes to a better understanding of the origin of the warm temperate Turgai flora type as well as to the transitional stages of vegetation development at the Eocene-Oligocene boundary. We present the results of a carpological and palynological study on the Dyusembai flora collected from a flora-bearing horizon of the regional coal-bearing Zhilanchik suite, dated to the late Oligocene. Pollen analysis identified 30 taxa, dominated by arboreal plants (about 93%) and reflecting zonal vegetation. Pollen of herbaceous plants and fern spores occur in a small amount. Among the arboreal species, gymnosperms and angiosperms are recorded in almost equal amounts. Juglandaceae dominate, with Pterocarya attaining 16 to 34 % while *Juglans*, *Carya* and *Cyclocarya* are represented by single grains. *Fagus*, *Quercus*, *Ulmus*, and *Zelkova* pollen account for up to 2 %. In addition to these taxa, *Ilex*, *Liquidambar*, *Tilia*, *Nyssa*, *Liriodendron*, and *Magnolia* are occasionally recorded, all common in Cenozoic floras. *Taxodium* dominates among gymnosperms, making up a total of 16.5 to 43 %. Pinaceae pollen attain about 23 %. *Picea*, *Abies*, *Tsuga*, *Cathaya*, and *Cedrus* are represented by single grains, with the exception of *Pinus*, which constitutes 5% to 23 %. The proportion of herbaceous plants in the spectra is 5 to 18 %. They mainly represent coastal-aquatic elements such as *Potamogeton*, *Sparganium*, *Brasenia*, and *Nelumbo*. Among terrestrial herbs, Onagraceae pollen have been regularly found, and single grains of Chenopodiaceae. Spores of Polypodiaceae, *Osmunda*, *Equisetum*, and *Salvinia* are recorded in minor proportions. Carpological analysis revealed 27 taxa, 14 of them were already described from this locality by Dorofeev (1963). The macrofossil record more reflects mesophytic herbaceous plants. The macroflora includes *Stratiotes*, *Nuphar*, *Aldrovanda*, water ferns, and wetland grasses such as *Carex*, *Scirpus*, and *Decodon*. Arboreal plants, distributed in the coastal zone, include *Leithneria*, and *Sambucus*. Extinct genera, possibly creepers (*Epipremnites*, *Dorofeevia*), are less diverse.

To quantify palaeoclimatic and ecological conditions of the Dyusembai floras Coexistence Approach and PFT diversity technique were applied. Coexistence intervals obtained for the different climate variables (MAT, CMT, WMT, MAP, MPWet, MPDry) show 100 % overlapping of the macro and microfossil data, except for MPdry. The carpoflora that, for taphonomical reasons, more closely reflects the local climate

indicates slightly warmer and more humid conditions and is characterized by high diversity of mesophytic herbaceous components (PFTs 1, 27 around 45 %). The pollen record suggests a general arboreal vegetation consisting of broadleaved deciduous elements (about 38%) and conifers (about 26%, PFT 12-18). According to our results the study area may have received rainfall up to ten times higher or even more in the wet season when compared to the dry season. Our data point to dry summers. Precipitation data based on the Dyusembai microflora indicate a lower level of rainfall when compared to earlier studied Aquitanian and Rupelian pollen floras of Kasakhstan. This is supported by the PFT approach, revealing diversities of drought-tolerant needleleaved evergreens of up to 7% and presence of xeric shrubs (1 %). In the context of the general climate evolution in Kasakhstan throughout the Rupelian to Aquitanian our new data for the Chattian Dyusembai pollen record point to an ongoing warming trend (MAT) and increase in temperature seasonality. Pollen-based precipitation data representing a regional signal point to somewhat drier conditions during the late Oligocene when compared to the results earlier obtained from Rupelian and Aquitanian palynofloras of the same region.

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Palaeofloristic Diversity of Upper Gondwana Beds from Andhra Pradesh, India

Vithoba M. Shendage[1], Surendra R. Manik[2] & B. A. Vagyani[3]

[1]Department of Botany, Arts, Commerce and Science College, Palus
Affiliated to Shivaji University, Kolhapur, Maharashtra, India
[2]Department of Botany, Sant Gadge Baba Amravati University, Amravati, India
[3]Department of Botany, Shivaji University, Kolhapur, Maharashtra, India

The Mesozoic assemblage of plant fossils signifies the luxuriant growth of Gymnosperms that have an impart on origin of Angiospermic vegetation. The diversification of gymnosperms along with emergence of angiospermic floral plant remains also helps in deciphering the palaeoecological conditions prevelent in the area. The Upper Gondwana deposits are exposed in Krishna-Godavari, Cauvery and Mahanadi basins. They are specially found in East Godavari, West Godavari, Prakasam and Mahanadi basins. They are specially found in East Godavari and West Godavari, Prakasam and Vishakhapattanam districts. The plant remains were collected from Vemavarum, Ommevarum, Uppugunduru, Prakasam, Errayagudem and other adjoining localities from Andhra Pradesh, India.

The detailed investigation revealed the occurrence of Cycadophytes, Coniferophytes, Ginkgoales with predominance of Bennettitales and Coniferous assemblage. All the megafossils are preserved in the form of impressions on yellow and reddish white coloured sandstones and shales. The floristic composition of the various geological formations can be assessed with respect to their dominance similarities and diversity pattern. Thus it is also important to know about the ecological conditions as evidenced by preservation of plant assemblages in various localities.

The plant fossils recovered from the new locality viz. Errayagudem preserved in white-grey coloured sandstones revealed the dominance of Ptilophyllum flora along with well preserved coniferous remains. Similarly, plant assemblage from Raghudevapuram and Kurukuru represented dominance of gymnosperms along with few members of pteridophytes. The palaeofloristic composition of Godavari districts in Andhra Pradesh represents an occurrence of distinct floral elements with impact on determining the age and palaeoclimate during upper Jurassic-early Cretaceous period. Particularly, the locality Raghudevapuram in east Godavari district can be regarded as unique due to presence of angiospermic remains in intertrappean beds around Rajahmundry. The plant assemblages suggest the warm and humid climate on account of cycadophytes along with small patches of high altitude harbouring conifers. The pteridophytes though rare are indicative of moderate climate with good rainfall in East and West Godavari districts of Andhra Pradesh during upper Jurassic-early Cretaceous period.

Plant communities succession recorded in the pollen assemblages from the Jóźwin IIB lignite open pit (Konin area)

Barbara Słodkowska[1] & Marek Widera[2]

[1]Polish Geological Institute-National Research Institute, Warsaw, Poland
[2]Institute of Geology, University of A. Mickiewicza, Poznań, Poland

Very rich pollen assemblages obtained from the first Mid-Polish lignite (MPLS-1) seam at the Jóźwin IIB open-cast mine made it possible to evidence the development of phytogenic sedimentation and succession of plant communities. The first Mid-Polish lignite (MPLS-1) seam is the most widely spread level of lignite in the Polish Lowlands (Piwocki, 1998). In the Konin region, it is fully developed and has a thickness of up to 20 m. It was formed in terrestrial conditions on alluvial plains. (Kasiński, Słodkowska, 2016). In the more than six-meter long profile at the Jóźwin IIB open-cast mine, all analyzed samples represented the same palynostratigraphic pollen VIII Celtipollenites verus Zone according to the palynostratigraphic division of the Polish Lowland Neogene (Piwocki and Ziembińska-Tworzydło 1997).

The vegetation from the area of peat accumulation and adjacent areas was reconstructed in this lignite complex. During the entire sedimentation period, the temperature and humidity were favorable for the development of lush peat bog vegetation, as evidenced by the fairly uniform nature of the seam. The pollen preserved in the sediment came from both peat-forming habitats and forests covering the area outside the bog. The peat-forming significance is mainly played by the communities of water and marsh vegetation (moss, rush and swamp forest), and to a lesser extent of shrub bog. It is generally azonal vegetation, not sensitive to thermal changes. Due to the similar conditions of peat sedimentation, the peat-forming communities recorded in the entire studied profile had a similar floristic composition. On the other hand, in the mixed mesophilous forests growing on the periphery of the mire, changes in the share of climate-related elements were visible.

Significant differences in the composition of taxa in individual intervals of the Jóźwin IIB open pit profile indicated different stages of sedimentation basin development, related mainly to the changing dynamics of water and other hydrological factors as well as changes in ambient temperature. The described succession of the plant communities were grouped into five cycles. Climatic changes (mainly temperature and humidity fluctuations) were recorded in the mixed forest community, and they were registered in three cycles I, III, V. In subsequent cycles, the number of highly thermophilic taxa was reduced. Plant succession, recording the development of rich multi-species forests, is divided twice by sections in which phytogenic sedimentation is significantly reduced and its record is fragmentary.

Flood rises caused the formation of clastic sediments, which was documented during the pollen-poor spectrum cycle (II). The stage of fen decline was recorded in lignite (cycle IV).

In the section analyzed, the beginning of the cooling trend of the Middle Miocene Climatic Transition (MMCT) approx. 13.7 million years ago - late Langian was observed after the last MMCO peak (Middle Miocene Climatic Optimum 15.97–13.65 million years ago), as indicated by floristic record, cycle V. This is also a declining stage in the development of mid-Miocene mires.

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Temperature-precipitation relationship from pollen-based climate reconstructions and simulations during the Last Glacial

Anna Sommani[1], Nils Weitzel[1], Martina Stebich[2] & Kira Rehfeld[1]

[1]Institute of Environmental Physics, Ruprecht-Karls-University Heidelberg, Heidelberg, Germany
[2]Senckenberg Research Station for Quaternary Palaeontology, Weimar, Germany

The hydrological response to radiative forcing is not as well understood as the thermal one: many climate models have di_culty simulating seasonal rainfall and its variability. Indeed, future precipitation projections are more uncertain than those of temperature. Proxy reconstructions in monsoonal Asia covering the Holocene show positive centennial-timescale correlations between temperature and precipitation. Conversely, climate model simulations feature negative correlations. Here, we investigate the timescale-dependent relationship between temperature and precipitation from pollen-based climate reconstructions and simulations. To extend previous estimates to longer timescales, we focus on the Last Glacial Period, characterized by colder temperature than the Holocene as well as pronounced millennial-scale climate uctuations in the Northern Hemisphere. Temperature, precipitation and moisture index are reconstructed from _ve high-resolution pollen records at midlatitudes in the Northern Hemisphere: Sihailongwan Lake, Lago Grande di Monticchio, Lake Tulane, Little Lake and Fargher Lake. The estimates are compared with climate model simulations. We employ three di_erent multivariate reconstruction methods and perform a correction to the moisture index to account for lower CO_2 concentrations than present. The results suggest that at mid-latitudes the local temperature-precipitation relationship cannot be explained by models based on purely thermodynamic-energetic constraints for all timescales from centennial to orbital. In addition, we found limitations when reconstructing multiple variables from a given proxy, which should be taken into account in future studies. Furthermore, the analysis of timescale-dependent hydrological sensitivity performed in this work may be a promising method to investigate temperature-precipitation variability patterns.

Comparative Palaeoaltimetry of the Miocene-Pliocene Zanda Basin Southwestern Tibet

Robert A. Spicer[1,2] & Alex Farnsworth[3]

[1]CAS Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Xishuangbanna, China
[2]School of Environmental, Earth and Ecosystem Sciences, The Open University, Milton Keynes, U.K.
[3]School of Geographical Sciences and Cabot Institute, University of Bristol, Bristol, U.K.

Accurate measurement of past land surface height (palaeoaltimetry) is essential for meaningful interpretations of spatial variations in palaeotemperatures and palaeovegetation, prescribing boundary conditions for numerical palaeoclimate models, and understanding geological processes. There have been very few instances where different palaeoaltimeters (e.g. stable isotopes and plant fossils) using different methodologies (isotopic and thermal lapse rates, energy conservation) have been tested for the same location. The late Miocene-Pliocene Zanda (Zada) Basin in southwestern Tibet is an ideal palaeoaltimetric test bed because 1) its age is well constrained and is relatively young so we would expect past surface heights to be similar to those of the present,2) it is located close to the Himalayan front which favours the use of simple Rayleigh distillation/isotopic fractionation models without the need for complex corrections for 'continental effects', 3) the sediments have never been deeply buried, so diagenetic resetting of isotope ratios is minimal to non-existent, 4) it has a well-studied pollen and leaf flora for which palaeoaltimetric interpretations already exist, 5) the plant taxa are similar to those of today, simplifying the use of nearest living relative techniques to extract climate data, 6) contemporaneous near sea level data are available nearby in the Siwaliks along the southern flank of the Himalaya, 7) secular climate and palaeogeography is similar to that of the present, eliminating other causes of uncertainties when using numerical climate modelling mediation. We find that stable isotope and moist enthalpy palaeoaltimetry give similar results, as has been found for the mid MIocene Namling-Oiyug Basin in a similar south-central Tibetan setting. Thermal lapse rate data produce varying outcomes, highlighting 1) spatial and temporal variability, 2) what aspects of the environment the proxies are 'capturing' (growth periods in plants and when mineral formation occurs) and 4) are moderated in various ways by moisture pathways. Overall thermal lapse rates as currently applied make unreliable palaeoaltimeters and those based on mean global thermal lapse rates, either using modern values or estimates of past lapse rates, should be discarded. Those based on wet bulb temperatures may, however, offer more promise.

Monsoon and vegetation shift during the Neogene: evidence from the Siwalik flora of eastern Himalaya

Gaurav Srivastava[1], Harshita Bhatia[1], Torsten Utesher[2,3] & R. C. Mehrotra[1]

[1]Birbal Sahni Institute of Palaeosciences, Lucknow, India
[2]Steinmann Institute, University of Bonn, Bonn, Germany
[3]Senckenberg Research Institute, Frankfurt am Main, Germany

The orogeny of the Himalaya had a direct impact in changing the regional as well as global climate. Isotopic and palaeofloristic data from the central and western Himalayan Siwalik indicate an intensification of the Indian Summer Monsoon and an increase in the winter season temperature during the Middle Siwalik which supported the expansion of C4 vegetation in that region, however, this is in contrast to the data retrieved from the eastern Himalayan Siwalik. We have quantified the climate of Lower and Middle Siwalik of Darjeeling by using the Coexistence Approach (CA). The reconstruction indicates a decrease in temperature and rainfall during winter and summer seasons in the Middle Siwalik. The ratio of wettest (summer) and driest (winter) months also decreases from 11.83 to 6.85 from the Lower to Middle Siwalik, respectively. A previous reconstruction based on CLAMP (climate leaf analysis multivariate program) from the Lower and Middle Siwalik of Arunachal Pradesh also suggests a decrease in temperature during the winter months in the Middle Siwalik. It also reveals a coeval decrease in the ratio of wettest and driest seasons from 13.09 to 7.21. Both the results by CA and CLAMP from the eastern Himalayan Siwalik indicate an overall decrease in temperature in the cooler part of the year and also a decrease in the rainfall ratio of wettest and driest seasons. The present reconstruction has important implications in understanding why the expansion of C4 vegetation did not occur in the eastern Himalayan foreland basin during the Neogene.

Paleogene and Neogene palaeo-wildfires – Some burning questions

Dieter Uhl[1, 2] & André Jasper[2]

[1]Senckenberg Research Institute, Frankfurt am Main, Germany
[2]Programa de Pós-Graduação em Ambiente e Desenvolvimento da UNIVATES (PPGAD/UNIVATES), Universidade do Vale do Taquari – Univates, Rua Avelino Tallini, Lajeado, Rio Grande do Sul

Fire is an important source of disturbance in many modern ecosystems and also was important in many paleoenvironments. During the last decades an increasing number of studies have dealt with fires in deep time ecosystems. Evidence for the occurrence of wildfires (i.e. in the form of pyrogenic inertinites in lignite deposits, pyrogenic polyaromatic hydrocarbons, as well as macro-charcoal) is geographically and stratigraphically widespread. Such evidence, is known since the Silurian and various authors have recognized 'high' fire phases like the Late Palaeozoic and Cretaceous, as well as 'low' fire phases such as the early Triassic and parts of the Cenozoic. In recent decades there has been increased interest in Quaternary and pre-Cenozoic palaeowildfires. Additionally, a number of studies have dealt with evidence for Paleogene and Neogene wildfires, and their fire ecology. However, as compared to earlier periods (i.e. the Permian and Cretaceous), fewer studies have utilized a botanical approach to identify the plants or vegetation types, which experienced wildfires, even though these periods are of considerable interest for our understanding of the evolution of modern ecosystems.

So far many studies merely mention the occurrence of fossil charcoal in clastic deposits or inertinites in lignites, without providing detailed information or even considering the ecological role of wildfires in such ecosystems. In this contribution we present some examples about macro-charcoal from different Paleogene and Neogene clastic deposits, as well as inertinites from lignites, to demonstrate that there is great potential for further in-depth studies on the fire ecology of such deposits.

Diversity patterns of plant functional types in the Holocene of India

Torsten Utescher[1,2], Martina Stebich[3] & Sushma Prasad[4]

[1]Senckenberg Research Institute, Frankfurt am Main, Germany
[2]Institute for Geosciences, University of Bonn, Bonn, Germany
[3]Senckenberg Research Station of Quaternary Palaeontology, Weimar, Germany
[4]ERA Scientific Editing, Potsdam, Germany

Recent advances in the study of Holocene palynological records of the Indian subcontinent allow for the analysis of spatio-temporal patterns and their changes throughout the past 10 kyr. At present, the vegetation in the study area is characterized by steep vegetational gradients referable to largely differing hydrology caused by atmospheric circulation and orography. Thus, the ecosystems of the subcontinent are at high risk to be severely impacted by the ongoing anthropogenic climate change, in addition to the threat cause by increasing land use. This underlines the importance of studying vegetation dynamics and interactions with climate in the most recent past.

Here we study diversity patterns of Plant Functional Types (PFTs) based on a total of 145 palynomorph records from 44 sites published in literature, selected to represent five time slices (present-day, 2. weak monsoon phase (0.5-2 k BP), 1. weak monsoon phase (4-4.7 k BP), max. Holocene warmth and humidity (6-7 k BP), early Holocene (~10 k BP)) in order to unravel ecosystem changes. The studied sites are distributed over the Indian subcontinent, including the Himalayan range and adjacent parts of the Tibetan Plateau. We use a PFT approach with a classification system including a total of 41 herbaceous to arboreal PFTs, defined in each case by plant traits and climatic thresholds. The approach uses presence and absence of palynomorph components. Resulting PFTs diversities and ecospectra, interpretable in terms of vegetation, are shown on map series for the single time slices.

As is shown in our analysis, the obtained ecospectra can be referred to basic present-day biome types such as montane grassland and temperate broadleaved and mixed forest of the high and mid-altitudes in the northern part of the study area, various subtypes of subtropical mixed broadleaved vegetation in Northeast India and the central part, tropical forest to the south, as well as intrazonal types such as mangroves, thus enabling us to analyse past changes in the presence and extension of these biomes. It is shown that high diversity of deciduous-raingreen PFTs in the vegetation cover was a characteristic feature of the central part of India, also in the generally more humid earlier Holocene, though attaining somewhat lower proportions. The generally lower percentages of arboreal diversity in the present-day ecological spectra obtained for most of the sites reflect the human impact. Moreover, diversity data of single key PFTs such as the drought-tolerant components provide important clues to past hydrological patterns. For Northeast India, persistent dominance of drought-intolerant PFTs since the onset of the Holocene points to permanently wet conditions, culminating in the interval from 6-7 k BP. In the more arid area of the Deccan Plateau,

diversity proportions of woody PFTs indicate E-W humidity gradient persisting throughout the Holocene, with drier conditions to the west. Work is in progress for a more comprehensive statistical analysis of our PFT dataset.

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Wetland fungi as palaeoenvironmental proxies: Reconstruction of the middle Miocene wetlands from the Adamów Lignite Mine (central Poland) based on plant and fungal microremains

Grzegorz Worobiec[1], Elżbieta Worobiec[1] & Marek Widera[2]

[1]W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, Poland
[2]Institute of Geology, Adam Mickiewicz University, Poznań, Poland

The lignite seam exploited in the Adamów mine, correlated with the 1st mid-Polish lignite seam, the youngest among the main Neogene lignite seams in Poland, was investigated. Lignites of this group developed in the middle Miocene over almost the whole territory of Poland. The seam was three meters thick at the sampling site. The accumulation of peat, from which the examined lignite seam comes from, took place during the middle Miocene optimum, on peat bogs located on the floodplain of the Miocene river (Widera et al. 2021, Worobiec et al. 2021). Palynological analysis of 30 palynological samples revealed the presence of well-preserved pollen grains, spores and non-pollen palynomorphs including fungal remains (spores, sporocarps). The results point to the presence of wetland and mesophytic vegetation during the time of sedimentation. The study area was overgrown by wetland communities similar in their composition to modern shrub bogs called Pocosins from the south-eastern USA (Worobiec et al. 2021). The fungi of the wetland communities from Adamów are represented by remains of ascomycetes and hyphomycetes saprophytic on decaying wood and on fallen leaves during the formation of peat deposits from which this seam was formed, in a very humid, periodically flooded environment (Worobiec et al. submitted). Fungal remains of *Neomycoleptodiscus pertusus* (Dilcher) G.Worobiec, *Potamomyces* sp., and *Trichothyrites* spp. indicate a warm (subtropical) and humid climate. The *Potamomyces* genus is of particular importance for the assessment of the Adamów paleoclimate. Modern representatives of this genus are found in areas with a predominantly tropical or subtropical climate, in a very humid (e.g. riverine) environment and prefers moist organic substrates, such as, for example, decaying wood (Schlütz & Shumilovskikh 2013). Adamów is the first site in Poland where ascospore of *Potamomyces* was found in the fossil state. The warm and humid character of the Adamów Miocene climate, inferred from the analysis of fungal palynomorphs, is in agreement with the results of palynological studies. The mean annual temperature for this period, estimated by the Coexistence Approach method based on pollen analysis results, ranges from 15.7 to 18.0 °C (Worobiec et al. 2021).

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List of Participants

Adroit, Benjamin **benjamin.adroit@gmail.com**
Naturhistoriska Riksmuseet
Stockholm, Sweden

Akabane, Thomas Kenji **thomas.akabane@usp.br**
Institute of Geosciences
University of São Paulo
São Paulo, Brazil

Akgün, Funda **funda.akgun@deu.edu.tr**
Department of Geological Engineering
Dokuz Eylül University
İzmir, Turkey

Altolaguirre, Yul **yul.altolaguirre@senckenberg.de**
The Role of Culture in Early Expansions of Humans (ROCEEH)
Heidelberg Academy of Sciences and Humanities
Frankfurt am Main, Germany

Arcangeli, Pierluca **pierluca.arcangeli@stud.unifi.it**
University of Florence
Florence, Italy

Averyanova, Anna **AAveryanova@binran.ru**
Komarov Botanical Institute of RAS
Laboratory of the Palaeobotany
Saint Petersburg, Russia

Barrón, Eduardo **e.barron@igme.es**
Museo Geominero
Instituto Geológico y Minero de España – IGME
Madrid, Spain

Bertini, Adele **adele.bertini@unifi.it**
Dipartimento di Scienze della Terra
Università di Firenze
Firenze, Italy

Bhatia, Harshita **bhatiaharshita2013@gmail.com**
Birbal Sahni Institute of Palaeosciences
Lucknow, India

Bondarenko, Olesya V. **laricioxylon@gmail.com**
Federal Scientific Center of the East Asia Terrestrial Biodiversity
Russian Academy of Sciences
Vladivostok, Russia

Bozukov, Vladimir **vladimir_bozukov@yahoo.com**
Institute of Biodiversity and Ecosystem Research
Bulgarian Academy of Sciences
Sofia, Bulgaria

Bruch, Angela A. **angela.bruch@senckenberg.de**
The Role of Culture in Early Expansions of Humans (ROCEEH)
Heidelberg Academy of Sciences and Humanities
Frankfurt am Main, Germany

Casas Gallego, Manuel **m.casas.gallego@gmail.com**
Llandudno, United Kingdom

Chandra, Kajal **kajal.chandra@bsip.res.in**
Birbal Sahni Institute of Palaeosciences
Lucknow, India

Degl'Innocenti, Niccolò **niccolo.deglinnocenti@uniba.it**
Dipartimento di Scienze della Terra e Geoambientali
Università degli Studi di Bari "Aldo Moro", Italy
Bari, Italy

Del Rio, Cédric **cedric.del-rio@edu.mnhn.fr**
CAS Key Laboratory of Tropical Forest Ecology **cedric-delrio@xtbg.ac.cn**
Xishuangbanna Tropical Botanical Garden
Chinese Academy of Sciences
Mengla, China

Doláková, Nela **nela@sci.muni.cz**
Department of Geology and Palaeontology
Masaryk University
Brno, Czech Republic

Dolezych, Martina **martina.dolezych@senckenberg.de**
Museum of Mineralogy and Geology
Senckenberg Natural History Collections Dresden
Dresden, Germany

Evans, Tara **tara.evans@adelaide.edu.au**
School of Biological Sciences
The University of Adelaide
Adelaide, Australia

Gabrielyan, Ivan **ivangabrielyan100@gmail.com**
Institute of Botany after A.L. Takhtajyan
Armenian Academy of Sciences
Yerevan, Armenia

Gibson, Martha E. **martha.gibson@northumbria.ac.uk**
Department of Geography and Environmental Sciences
Northumbria University
Newcastle upon Tyne, United Kingdom

Hakobyan, Elen **elenhakobyan939@gmail.com**
Department of Earth Sciences
Turin University
Turin, Italy

Hayrapetyan, Narine **narine.hayrapetyan1993@gmail.com**
Institute of Botany after A.L. Takhtajyan
Armenian Academy of Sciences
Yerevan, Armenia

Hertler, Christine **christine.hertler@senckenberg.de**
The Role of Culture in Early Expansions of Humans (ROCEEH)
Heidelberg Academy of Sciences and Humanities
Frankfurt am Main, Germany

Höfer, Dana **dana.hoefer@senckenberg.de**
Quatenary Microflora Section
Senckenberg Research Station of Quaternary Palaeontology
Weimar, Germany

Hung, Nguyen Ba **nbhung@vnmn.vast.vn**
Vietnam National Museum of Nature
Vietnam Academy of Science and Technology
Hanoi, Vietnam

Ivanov, Dimiter **dimiter@gbg.bg**
Institute of Biodiversity and Ecosystem Research
Bulgarian Academy of Sciences
Sofia, Bulgaria

Jarl, Johan **johan.jarl@uconn.edu**
Department of Anthropology
University of Connecticut
Connecticut, USA

Kayseri Özer, Mine Sezgül **mskayseri@gmail.com**
Marine Sciences and Technology Insitute **sezgul.kayseri@deu.edu.tr**
Dokuz Eylül University
İzmir, Turkey

Kern, Andrea K. **annkkern@gmail.com**
Institute of Geoscience
University of São Paulo
São Paulo, Brazil

Khachatryan, Sirush **sirush_xachatryan@mail.ru**
Institute of Botany after A.L. Takhtajyan
Armenian Academy of Sciences
Yerevan, Armenia

Konrad, Wilfried **wilfried.konrad@uni-tuebingen.de**
Department of Geosciences
University of Tuebingen
Tübingen, Germany

Kováčová, Marianna **marianna.kovacova@uniba.sk**
Department of Geology and Paleontology
Comenius University
Bratislava, Slovakia

Lanini, Benedetta **benedettalanini@tiscali.it**
Dipartimento di Scienze della Terra
Università di Firenze
Firenze, Italy

Li, Qijia **qjli@chd.edu.cn**
School of Earth Science and Resources
Chang'an University
Xi'an, China

Liu, Bangjun **liubangjun@hebeu.edu.cn**
School of Earth Science and Engineering **bangjunliu@126.com**
Hebei University of Engineering
Handan, China

Manik, Surendra R. **manik_bot@rediffmail.com**
Department of Botany **manik.surendra@gmail.com**
Sant Gadgebaba Amravati University
Amravati, Maharashtra, India

Mantzouka, Dimitra **dimitra.mantzouka@senckenberg.de**
Section of Palaeobotany
Museum of Mineralogy and Geology
Senckenberg Natural History Collections Dresden
Dresden, Germany

Martinetto, Edoardo **edoardo.martinetto@unito.it**
Università degli Studi di Torino
Torino, Italy

Menichetti, Elena **elena.menichetti25@gmail.com**
Eni SpA
Natural Resources
San Donato Milanese, Italy

Momohara, Arata **arata@faculty.chiba-u.jp**
Graduate School of Horticulture
Chiba University
Matsudo, Chiba, Japan

Mosbrugger, Volker **vj.mosbrugger@senckenberg.de**
Senckenberg Research Institute
Frankfurt am Main, Germany

Niccolini, Gabriele
gabriele.niccolini@uniba.it
Dipartimento di Scienze della Terra e Geoambientali
Università degli Studi di Bari “Aldo Moro”, Italy
Bari, Italy

Papikyan, Astghik **papikyanastghik@gmail.com**
Institute of Botany after A.L. Takhtajyan
Armenian Academy of Sciences
Yerevan, Armenia

Pili, Matteo **matteo.pili@edu.unito.it**
University of Turin
Turin, Italy

Popova, Svetlana **celenkova@gmail.com**
Komarov Botanical Institute of RAS
Laboratory of the Palaeobotany
Saint Petersburg, Russia

Pound, Mathew **matthew.pound@northumbria.ac.uk**
Department Geography and Environmental Sciences
Northumbria University
Newcastle upon Tyne, United Kingdom

Quan, Cheng **quan@chd.edu.cn**
School of Earth Science and Resources
Chang'an University
Xi'an, China

Salzmann, Ulrich **ulrich.salzmann@northumbria.ac.uk**
Department Geography and Environmental Sciences
Northumbria University
Newcastle upon Tyne, United Kingdom

Shendage, Vithoba M. **shendagevmp01@gmail.com**
Arts, Commerce and Science College,
Palus, India

Shivaji University
Kolhapur, India

Słodkowska, Barbara **barbara.slodkowska@pgi.gov.pl**
Polish Geological Institute
National Research Institute
Warsaw, Poland

Sommani, Anna **asommani@iup.uni-heidelberg.de**
Institute of Environmental Physics
Ruprecht-Karls-University Heidelberg
Heidelberg, Germany

Spicer, Robert A. **r.a.spicer@open.ac.uk**
School of Environment, Earth, and Ecosystem Sciences
The Open University
Milton Keynes, United Kingdom

Xishuangbanna Tropical Botanical Garden
Chinese Academy of Sciences
Xishuangbanna, China

Srivastava, Gaurav **gaurav_jan10@yahoo.co.in**
Birbal Sahni Institute of Palaeosciences
Lucknow, India

Stebich, Martina **martina.stebich@senckenberg.de**
Quatenary Microflora Section
Senckenberg Research Station of Quaternary Palaeontology
Weimar, Germany

Tiffney, Bruce **Bruce.Tiffney@ccs.ucsb.edu**
Department of Earth Science
University of California
Santa Barbara, USA

Uhl, Dieter **dieter.uhl@senckenberg.de**
Palaeontology & Historical Geology
Senckenberg Research Institute
Frankfurt am Main, Germany

Utescher, Torsten **utescher@geo.uni-bonn.de**
Senckenberg Research Institute
Frankfurt am Main, Germany

Institute for Geoscience
Bonn University
Bonn, Germany

Wang, Tengxiang **wangtengxiang@xtbg.ac.cn**
Xishuangbanna Tropical Botanical Garden
Chinese Academy of Sciences
Xishuangbanna China

Weitzel, Nils **nweitzel@iup.uni-heidelberg.de**
Institute of Environmental Physics
Ruprecht-Karls-University Heidelberg
Heidelberg, Germany

Worobiec, Grzegorz **g.worobiec@botany.pl**
W. Szafer Institute of Botany
Polish Academy of Sciences
Kraków, Poland