The 14th NECLIME meeting

Saint Petersburg, October 1st - 4th, 2013

Palaeoclimate and vegetation of Northern Eurasia

Program and Abstracts

Organizing committee:
Dmitry Gromyko,Torsten Utescher, Svetlana Popova, Angela Bruch, Volker Mosbrugger

Edited by
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Komarov Botanical Institute
Russian Academy of Sciences

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2013

Conference Program

Tuesday October 1st

Registration: 16:00 – 18:00, Hall of the Scientific Council of the Komarov Botanical Institute
Ul.prof.Popova 2
Welcome dinner: 18:00, Banquet restaurant "Botanical garden" of Komarov Botanical Institute

Wednesday October 2nd

Hall of the Scientific Council (Herbarium)
Komarov Botanical Institute
Ul.prof.Popova 2

10.00	Deputy Director for Research of Komarov Botanical Institute Dmitri Geltman	Komarov Botanical Institute: episodes of 300-years history
10.30	Volker Mosbrugger	Introduction, NECLIME news
11.00	Zhekun Zhou, F. Jacques, T. Su	The onset and evolution of Asian monsoon brought some plants close to extinction
11.20	Torsten Utescher, O. Bondarenko, V. Mosbrugger	The Cenozoic Cooling - continental signals from the Atlantic and Pacific side of Eurasia
11.40	***Coffee break***	
12.00	Andrea Kern, M.W. Rasser, K. Stachura-Suchoples	Paleoenvironmental reconstruction of Maar lake in southern Germany and its implication towards paleoclimate of the Middle Miocene
12.20	Marianna Kováčová, N. Doláková	Palaeovegetation and palaeoclimate during the Middle Miocene in Central Paratethys (Czech and Slovak Republic)
12.40	Wei-Ming Wang, S. Q. Zhang	Recent progress in the study of late Miocene palynological flora in Badaogou, Northeast China

13.00	Vandana Prasad	Impact of global warming on early Paleogene vegetation of the Indian subcontinent
13-20	***Lunch***	
15.00	Mine Sezgül Kayseri-Özer, L. Karadenizli, F. Akgün, N. Oyal, G. Saraç, Ş. Şen	Palynological and Palaeoclimatic interpretation of the Late Miocene-Early Pliocene in the Çankırı-Çorum Basin (Kırıkkale- Central Anatolia)
15.20	Svetlana Popova, T. Utescher, D. Gromyko, E. Herzog, V. Mosbrugger	Cenozoic palaeoenvironmental reconstruction of the northeastern part of Russia based on palaeobotanical records
15.40*[cancelled]*	Christopher Traiser, A. Roth - Nebelsick, J. Kovar-Eder	MORPHYLL - a data base for the acquisition of ecophysiologically relevant data of morphometric data of fossil leaves
16.00	Wenyun Chen, T. Su, F. Jacques, Z. K. Zhou	The relationships between leaf margins and temperature: based on vegetation in humid region of China
16.20	***Coffee break***	
16.40	Felix T. Portmann, J. Liakka, T. Utescher	Climate response to variations of the Gulf Stream intensity - First model results for the Pliocene
17.00	Louis François, T. Utescher, N. Hamon, B. Erdei, M. Dury, A. Henrot, M. Krapp, E. Favre	Comparison of Middle Miocene palaeoclimate and palaeovegetation model reconstructions and their validation using the NECLIME database
17.20	Alexandra-Jane Henrot, L. François, A. Bertini, T. Utescher, E. Favre, M. Dury, G. Munhoven	Modelling the Middle Pliocene warm climate and vegetation: comparison of the CARAIB vegetation model results to NECLIME data
18.00	***Tour of the Komarov Botanical Institute Greenhouse***	

Thursday October 3rd

Hall of the Academic Council (Herbarium)
Komarov Botanical Institute
Ul.prof.Popova 2

10.20	Arata Momohara, T. Ueki, T. Saito	Late Early Pleistocene climatic evolution in central Japan reconstructed from plant macrofossil assemblages with reference to the winter monsoon development
10.40	Olesya V. Bondarenko, N. I. Blokhina, T. Utescher	Calabrian climate of southern Primory'e (Russian Far East) using multiple proxies
11.00	Adele Bertini, M. Ricci	Palynological approach in late Quaternary terrestrial carbonates of central Italy: anything but a "mission impossible"
11.20	***Coffee break***	
11.40	Shitao Zhang, D. Zhang, J. Zhang	The Sedimentation and Environment Change be Disturbed by Human in Lake Xingyun, Center Yunnan, China
12.00	Yaowu Xing, R. Onstein, Z.K. Zhou, H. P. Linder	Historical diversity dynamics of *Quercus* (Fagaceae) based on macrofossil record
12.20	Bainian Sun, S. Ding, Q. Wang, P. Jin, X. Li, L. Xiao	Cuticular characteristic of *Machilus* fossil from the Neogene in eastern Zhejiang, China and Geological Significance
12.40	Mircea Țicleanu, R. Niculescu, A. Ion	The impact of the Neogene's tectonic phases - closely associated with the key moments of the Valach climatic cycle - on the terrestrial biosphere
13.00	***Lunch***	
14.20*[cancelled]*	Christopher Traiser, M. P. Nobis, A. Roth-Nebelsick	How to disentangle environmental and phylogenetic signals in plant morphological traits - a study of the genus *Pinus*

14.40	Edoardo Martinetto, P.Jiménez-Mejías, E. Vassio	Characterization of modern and fossil Cyperaceae fruits as an essential tool to exploit their climatic indications;
15.00	***Poster session, discussions Coffee break***	
15.30	Volker Mosbrugger, T. Utescher	Final discussion and synthesis, outlook to future activities, closing of the conference
17.30	***Sightseeing Ship tour in St.Petersburg***	

Poster presentations

Hall of the Academic Council (Herbarium)

Komarov Botanical Institute

Ul.prof.Popova 2

Sergey Vikulin, E. Grundan, S. Engalychev, P. Tropina	Leaf, pollen and fruit-seed assemblages from the mid-Miocene of eastern Paratethys (Yashkul series, 13-16 Ma) of the southern Ergeni upland, European Russia: Kalmykia
Sergey Vikulin, A. Krylov, E. Yuferova	First evidence of arctic dwarf birch *Betula nana* – like mummified leaves from the Plio-Eopleistocene of Yugor peninsula (Russian European north)
Hang Sun, Z. Li, J. Yue, X. Wang	The Quaternary climatic oscillation might not play an important role on shaping the distribution pattern of some plants from Sino-Himalaya.—An example of phylogeographic study on *Eriophyton wallichii* (Labiatae)
Mine Sezgül Kayseri-Özer, Ş. Şen, K. Sözeri, G. Métais, T. Ayyıldız, B. Varol	A late Oligocene leaf flora from the Kağızman-Tuzluca Basin, Iğdır (northeastern Turkey), and its paleoenvironment
Vladimir Bozukov, D. Ivanov, T. Utescher	*Ficus palamarevii* sp. nov., a new subtropical element in the Bulgarian Paleogene flora.

Inna S. Zyuganova	Quantitative palaeoclimatic reconstructions from the Late Pleistocene of the north-central Russia (based on palaeobotanical data).

Friday October 4th

Historical and floristic bus tour; one day tour. Mon Repos (Vyborg) and the Nature of Karelian Isthmus.
09.00 a.m. Departure from the main entrance of the Botanical Graden (2 prof.Popova str.).

Saturday October 5th

Departure

Late Early Pleistocene climatic evolution in central Japan reconstructed from plant macrofossil assemblages with reference to the winter monsoon development

Arata Momohara[1], Takeyuki Ueki[2], and Takeshi Saito[3]

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In the late Early Pleistocene (Calabrian, 1.8 – 0.78Ma), climatic deterioration with the 41kyr glacial cycle became intense and changed distribution of terrestrial plants in the northern hemisphere. Quantitative reconstruction of terrestrial climate during this stage is important to understand evolution of Quaternary environment and modern plant biogeography. The Uonuma Group distributed along the Sea of Japan provides an excellent profile to reconstruct environmental and vegetation history during the whole Early Pleistocene (2.58 – 0.78 Ma) with the finest resolution. To reconstruct paleoclimate fluctuations correspondent with marine isotope stages, we studied 120 fruits and seeds assemblages from a fluvial profile of ca. 700m in thickness that was deposited between 1.77 Ma and 0.78 Ma. Fine age control between MIS63 and MIS19 was obtained based on paleomagnetic data including Cobb Mountain Event (MIS 35/36) and correlation of widespread tephra with calcareous nannoplankton datum planes (MIS 59, 55, 34). We reconstructed paleotemperature (Coldest Month Mean, Annual Mean, and Warmest Month Mean Temperature) of autochthonous assemblage from peat and massive silt by coexistence approach. Paleotemperature of allochthonous assemblage from sandy sediments were based on the coldest limit temperature of the component requiring warmest climate. Reconstructed paleotemperature curve exhibited 41kyr glacial-interglacial cycles before MIS 22 except for a duration between MIS 53 (1.56Ma) and MIS 45 (1.4 Ma) in that cold stages were not detected. The CMMT of interglacial stages were between -0.3 and -1.5 ºC and lower than present (1.3 ºC), while that in MIS 31 recorded a higher value (2.2 ºC). The CMMT of glacial stages MIS 62 and 60 was -4.8 ºC and that of MIS 58, 56, 54, 44, 42, 40 was -3.1 ºC. The CMMT decreased to -4.8 ºC in glacial stages since MIS 38 and the lowest value (-5.7 ºC) was recorded in MIS 22. The WMMT values were less fluctuated than CMMT values and it composed larger annual range of temperature in glacial stages. Interglacials cooler than recent

and glacials milder (4.4 – 7.0 ºC colder CMMT than recent) than last glacial maximum (12 ºC colder CMMT than recent, Nakagawa et al., 2002) in the late Early Pleistocene is consistent with trend of marine isotope curve with smaller amplitude than the Middle-Late Pleistocene. The CMMT temperature curve corresponded also with grain size curve of eolian deposit in the Loess Plateau, north China, that represents change of winter monsoon intensity. MIS 60, 38, and 22 were correspondent with L 24, 15, 9, respectively, that consists of larger grains than the other loess layers (Ding et al., 2002), indicating expansion of desert environment and increase of westerly wind promoted by prevailing Siberian High. These consistencies suggest that climate and plant distribution in central Japan were ruled by winter monsoon controlled by global ice volume changes.

Ding, Z.L. et al., 2002. Earth and Planetary Science Letters, 200, 387-400.
Nakagawa, T. et al., 2002. Quaternary Science Reviews, 21, 2099-2113.

Palynological approach in late Quaternary terrestrial carbonates of central Italy: anything but a "mission impossible"

Adele Bertini[1,2], *Marianna Ricci*[1]

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2 CNR-Consiglio Nazionale delle Ricerche, IGG-Istituto di Geoscienze e Georisorse, Italy.

Fossil pollen grains are a powerful proxy for floristic-vegetational, environmental and climatic reconstructions both in marine and continental deposits. However, palynology has been rarely used for the study of terrestrial carbonates because they are considered not propitious for pollen preservation. This explains the lack of palynological studies in thermal carbonate deposit (travertine) and their rareness both in ambient-temperature deposits (calcareous tufa) and cave fills (speleothems). Anyhow, very recent finds of well preserved pollen grains in different terrestrial carbonates (Bertini et al., 2008; Ricci, 2011), demonstrate the possibility of face this approach in such deposits, with particular attention to improve the knowledge of factors that affect the accumulation of pollen grains during the time span between their dispersion and their recovery (Bertini et al., submitted). For this purpose, a palynological survey has been carried out on two late Quaternary travertine s.l. deposits of central Italy at Serre di Rapolano and Bagnoli (Tuscany region, Italy). 52526 pollen grains belonging to 118 pollen taxa, from local to extra-regional sources, have been counted by the analysis of 200 samples from different travertine and calcareous tufa lithofacies. 97 out of total 200 terrestrial carbonate samples, generally from thermal travertines, are barren in palynomorphs. On the contrary, in most of the remaining 103 samples, pollen grains are usually well preserved and do not show differential preservation features. This fact suggests that the pH of the solutions from which travertine or tufa precipitate is not a limiting factor in causing corrosion and/or destruction of pollen. Possibly, the barrenness recorded in many samples appears to be likely due to a lack in origin of pollen in the sediments, rather than to a subsequent destruction processes. In fact, the relative higher energy of the environment during the deposition of travertine plays an important role in controlling pollen concentration, as verified in both depressions (lower energy - higher pollen concentration) and slopes (higher energy - lower pollen concentration), respectively. Moreover, the pollen data analysis suggests that higher relative deposition temperatures and quicker rates of carbonate deposition are the main limiting factors for an efficient accumulation of pollen grains. According to the present pilot study, the understanding of pollen taphonomy processes

in travertine and calcareous tufa makes more effective and reliable the application of palynology to terrestrial carbonate in order to obtain correct palaeoenvironmental and palaeoclimatic reconstructions.

Bertini, A., Minissale, A., Ricci, M. 2008. Use of Quaternary travertines of central-southern Italy as archives of paleoclimate, paleohydrology and neotectonics. Il Quaternario, 21(B): 99-112.

Ricci, M. (2011). I depositi carbonatici terrestri come archivio climatico-ambientale per il tardo Quaternario: palinologia e geochimica isotopica. PhD Thesis, University of Florence, Italy, 219 pp.

Bertini, A., Minissale, A., Ricci, M. (submitted). Palynological approach in late Quaternary terrestrial carbonates of central Italy: anything but a “mission impossible”. Sedimentology.

Cuticular characteristic of Machilus fossil from the Neogene in eastern Zhejiang, China and Geological Significance

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2 School of Earth Sciences and Resources, Chang'an University, China

The global climates in the Cenozoic had alternated frequently between the "greenhouse climate" and "icehouse climate". The studies of Neogene climatic changes are very important for the prediction of the future climate trends. Plant fossils can record information of the climatic changes in the past, so the comparative analysis of morphological and anatomical characters between the fossil and extant relative species is the main research content in this study, which can provide us valuable fossil evidences to understand the climatic and environmental changes in the geologic time.

Leaf fossils were found in mudstone of the Shengxian Formation from the Upper Miocene in eastern Zhejiang Province, China. Based on the leaf architectural and cuticular characters of fossil leaves, the specimens were put to Machilus tiantaiensis sp. nov. which is represented by four complete leaves with finely venation and well-preserved cuticles. It shows an affinity within the family of Lauraceae, particularly with the modern genus Machilus, and the fossil is very similar to modern Machilus pingii. We think Machilus pingii as the Nearest Living Relative of the fossil species.

The Lauraceae is a large family of usually evergreen trees and shrubs, and it is a key part of tropical and subtropical evergreen broad-leaf forest. Machilus displays a subtropical evergreen broad–leaved forest with some temperate trees. Based on habitat of the modern Machilus, the palaeoenvironment and palaeoclimate of the Miocene in eastern Zhejiang are concluded. In addition, the CO2 concentration is estimated through the stomatal ratio method of the fossil species and the extant Machilus pingii. The result shows that the temperate and the level of atmospheric CO2 in the Late Miocene of eastern Zhejiang are higher than those of toady. Therefore, we speculate that it was a subtropical mountainous climate during the Miocene in eastern Zhejiang.

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Calabrian climate of southern Primory'e (Russian Far East) using multiple proxies

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Early Pleistocene climate dynamic in the southern Primory'e, Russian Far East (RFE) is studied using multiple quantitative techniques on various palaeobotanical organ types. Climate data of the time were obtained from a total of 8 macrofloras (fruits and seeds, woods, and leaves) and 18 microfloras collected from a 10 m thick, terrigenous succession exposed in the Pavlovskoe brown coal field. According to magnetostratigraphy, the studied section covers the last 200 kyr of the Calabrian and comprises the early/late Pleistocene transition, a crucial time-span involving the transition from obliquity-forced cyclicity to the strong, eccentricity triggered glacial events. In this first integrative study on palaeoclimate of the Russian Far East, Growth Ring Analysis, Multivariate Anatomical Analysis, Leaf Margin Analysis, Climate Leaf Analysis Multivariate Program, and Coexistence Approach were employed on the different organs, partly originating from the same layer.

In the results, the climate data obtained from the various methods are proven to be largely consistent. The late Calabrian of the southern Primory'e was characterized by overall cooling and drying. Our climate record displays 2 small scale cycles. Warm peaks (at 19.4–19.8 and 14.0–14.8 m) are tentatively correlated to the global isotope stages MIS 25 and MIS 21, respectively. In the warm phases, the Calabrian climate of southern Primory'e was significantly warmer and wetter when compared to present, especially regarding the cold season, while in cold phases, climate was similar to modern or event slightly cooler. As today, Early Pleistocene climate of southern Primory'e was warmer and wetter than neighbouring areas of the south RFE. The effect of the East Asian Monsoon Systems on the climate of the southern Primory'e was less pronounced compared to the present.

The study was supported by the Russian Foundation for Basic Research (project no. 11-04-01208), Presidium of the Russian Academy of Sciences (RAS) and Presidium of the Far Eastern Branch (FEB) of the RAS (project no. 12-I-P28-01, Program "The Problems of Life Origin and Biosphere Formation") to Nadezhda I. Blokhina and the German Science Foundation (project

no. MI 926/8-1) to Torsten Utescher. This work is a contribution to NECLIME (Neogene Climate Evolution in Eurasia).

Early Pleistocene environment of early humans in Southern Caucasus - High-resolution reconstruction of climate and vegetation in Armenia during MIS 31

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The Southern Caucasus is the area of earliest human occupation in Eurasia, proven by findings of Homo fossils in Georgia with an age of ca. 1.8 Ma. The pace and causes of the early human colonization, in one or several migratory waves from Africa in new environments of the Eurasian continent during the Early Pleistocene, are still a matter of debate. However, climate change is considered a major driving factor of hominin evolution and dispersal patterns. In fact directly or indirectly by its severe influence on vegetation, physiography of landscape, and animal distribution, climate modulates the availability of resources.

Lake sediments from Sisian Formation, Vorotan River Basin, southern Armenia, provide detailed information on environmental changes during late Early Pleistocene. Based on magnetostratigraphic and radiometric dating, the exposed part of the succession covers a stratigraphic age from ca. 1.3 to 0.9 Ma and includes the Jaramillo subchron.

Due to the precise age control high-resolution pollen analysis was conducted at the Matujama/Jaramillo reversal spanning from 1.12 to 1.035 Ma (MIS 33 - MIS 30) with a mean resolution of ca. 250 years per samples. Results document a clear vegetation response on orbitally forced climatic changes with open vegetation during the less pronounced cycles MIS 33/34, the expansion of broadleaved deciduous forests during the very warm and humid MIS 31, and the expansion of needleleaved forests during the long, cool and humid MIS 30. Furthermore, the age of the numerous macro floral assemblages could be constrained to warm and humid parts of the climatic phases, most of them connected to MIS 31 confirming the dominance of forests at that time.

Plant species compositions show strong relations to Euxinian and Hycanian forests occurring today at the coasts of the Black Sea and Caspian Sea, respectively, which must have been

expanded during warmer and more humid periods of the Early Pleistocene. Climate quantifications give at least 5 degrees warmer and 50-100% more humid conditions for most pronounced interglacials. Those results are a prerequisite for the extrapolation of the distribution of forests and mosaic landscapes in Southern Caucasus for different climatic phases during Early Pleistocene to reconstruct of early human environments in this region.

MORPHYLL - a data base for the acquisition of ecophysiologically relevant data of morphometric data of fossil leaves

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Foliage of modern plants provides a wealth of morphometric properties that are influenced by the environment. It therefore represents a valuable source of information for ecological and climatological research. Numerous important and famous fossil floras with high research potential are housed in various museum collections in Europe. Depending on the preservation state such traits are also preserved in fossil leaves but their potential has not yet been fully evaluated. In this DFG (German Research Foundation) project, it is intended to initiate access to morphometric data of fossil leaf collections by digitising fossil leaves from selected collections and to classify them according to their morphometry. The aim is the creation of a data base that allows for (1) morphotype-based queries in the data base, and (2) palaeoecological analysis of fossil leaves using morphometric traits.

Qualitative morphological classification of leaf traits will be based on recent standards such as Manual of Leaf Architecture (Ellis et al. 2009) whereas quantitative data are assessed by the analysis of various morphometric leaf traits. Both leaf shape as well as venation characters will be included in this investigation. It is planned to provide morphometric data via transnational network databases such as GeoCASe (Geosciences Collection Access Service). For this purpose morphometric standards, which are suitable for network databases have to be defined and established. In the current starting phase, the project will be focused on floras from Eocene to Oligocene time intervals that encountered substantial changes in climate and atmospheric CO2.

How to disentangle environmental and phylogenetic signals in plant morphological traits - a study of the genus Pinus

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Broad-scale analysis of interspecific trait variation is a fundamental approach in comparative ecology to investigate general species–environment relationships, but inferences from environmental and phylogenetic signals are still controversially discussed. Hence, a global study of variation of morphological traits within 103 species of the genus Pinus was performed in order to disentangle environmental and phylogenetic signals. The interspecific variation of morphological traits with latitude as a surrogate of broad-scale environmental changes was compared to biogeographic, environmental and phylogenetic signals. As a result strong latitudinal correlations were detected for traits, such as needle length:width ratio or needle longevity, with similar trends for different taxonomic species subsets and geographic regions. Strong latitudinal correlations were related to a decrease in the pure phylogenetic signal and to an increase in the phylogenetically structured environmental variation (PSEV), whereas the pure environmental signal was almost negligible. Besides a ranking of traits that differ in environmental and phylogenetic signals, the results showed a general relationship between increasing latitudinal trait correlation and an increase in PSEV, which indicates phylogenetic niche conservatism. Thus, for the investigated morphological traits of the genus Pinus both environmental and phylogenetic signals are directly linked by PSEV to broad-scale spatial patterns in trait variation.

Phytoecological reconstruction of association dominated by Platanus neptuni mf. fraxinifolia (Johnson & Gilmore) Kvaček & Manchester (Oligocene, Serbia)

Desa Djordjevic-Milutinovic[1], Branka Stevanovic[2], Vladimir Stevanovic[2]

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Composition of Oligocene paleoflora from the locality Janda (Mt Fruška Gora, N Serbia) is exceptionally dissimilar to all other Tertiary floras from territory of Serbia and the surrounding region. There is an almost equal representation of four clearly separate and completely different morphotypes of leaves. Each of them is characteristic for a particular taxon. The association is dominated by composite leaves of Platanus neptuni mf. fraxinifolia, twigs with microphyllous leaves of Cupressaceae, typical triplinerved leaves of Daphnogene and large megaphylls of at least two species of palms (Arecaceae). This composition of association, particularly due to high number of large palm leaves and many recorded tree trunks, indicates a possibility that fossilization was performed within a short period of time under the influence of weather catastrophe such as a flood, a landslide or a tsunami, which tore leaves and twigs and fell down trees. This paper presents several possible reconstruction models for this association, depending on representation of its dominant taxa. This association was also compared with modern associations dominated by taxa with similar leaf types. The reconstruction is greatly aided by the fact that fossil taxa are easily identified by leaf shape and then connected with recent taxa. The most abundant among the laurophyllous elements are typical triplinerved leaves of Daphnogene. Their shape matches the recent genus Cinnamomum. As eco-climatic demands of Cinnamomum are precisely determined and its range is very limited, it was chosen as a reference taxon for determining the possible ecological conditions in this Oligocene association. It was established that the association existed in conditions of pronounced humidity and without seasonal drought period. In contrast to Cinnamomum, Cupressaceae are cosmopolites inhabiting very diverse habitats from the eco-climatic standpoint. Like many other conifers they are not a reliable indicator of general ecological conditions within the fossil association (particularly when they are codominant with Angiospermae). In our study this taxon proved to be difficult to match within the phytoecological reconstructions of paleoflora. Distribution of Arecaceae (palms) is also cosmopolitan within the tropical and subtropical

climate. They may grow both in humid and arid habitats and are not precise indicators of habitat conditions, as they are very adaptable. However, Arecaceae are limited in altitudinal distribution as their seed dispersal type is suitable only for lower altitudes. Their presence was used to determine the possible altitudinal distribution of the studied association. The most abundant member of this paleoassociation is the extinct group of planes Platanus neptuni mf. fraxinifolia that might indicate presence of deciduous floristic element in this association. This extinct group of planes with composite leaves is not similar to the present-day species of the genus Platanus with simple indented leaves, so their ecological characteristics and demands are mostly unknown. According to most indicators, the paleophytocenosis from Janda belongs to vegetation of tropical or subtropical climatic belt without any pronounced arid season. It was probably able to grow in habitats from the sea coast to the altitude of about 1000 m above sea level. According to its composition and representation of each morphotype of leaves, this association shows most similarities with the recent associations in zonobiome of the warm-temperate humid climate.

Climate response to variations of the Gulf Stream intensity - First model results for the Pliocene

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From local geological records, it is known that the Central American Seaway (CAS) was open during parts of the Late Miocene, but finally closed during the following Pliocene. The character of CAS potentially has a strong impact on the poleward ocean heat transport as well as the meridional overturning circulation in the Atlantic Ocean. Using an Earth System Model of Intermediate Complexity (EMIC), we want to examine the effect of an open versus closed CAS on Pliocene climate. It is expected that the differences in the model results are also visible in palaeoclimate variables derived from palaeobotanical records.

We will present the experimental design and our first preliminary model results, which we compare to time-slice simulations of the Late Miocene and present-day.

Grant: German Research Foundation (DFG) MI 926/8-1 (Arne Micheels, Volker Mosbrugger, Madelaine Böhme)

The Quaternary climatic oscillation might not play an important role on shaping the distribution pattern of some plants from Sino-himalaya.—An example of phylogeographic study on Eriophyton wallichii (Labiatae)

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Abstract The Quaternary climate oscillation had dramatically shaped the geological patterns of the plants diversity in northern hemisphere, especially to Europe and N American. A lot of species became extinct or changed the range of distribution greatly. However, in Sino-Himalaya we found some species that abiotic dynamic of biogeographic evolution were by the uplift of the Himalaya uplift, the Quaternary glaciation seems to not play an important role. Here we checked the pattern of phylogeography of Enriophyton wallichii (Labiatae), which is a perennial endemic genus to the alpine subnival region of Sino-himalaya. We sequenced the nuclear ribosomal DNA internal transcribed spacer (ITS) of 187 individuals from 20 populations, and detected 19 haplotypes. By analyzing of molecular variance (AMOVA) for populations indicates that the genetic variation mainly resided among population (89.54%), the level of differentiation among populations is very rich (Gst=0.863, Nst=0.975) but do not show a significant phylogeographical structure. It is different from foregoing other species reported in other regions that the haplotypes of Eriophyton wallichii showed almost one population hold one unique halplotye, hardly share same haplotype among populations. We hypothesized the unique genetic structure of E. wallichii result from allopatric fragmentation in the islands of alpine due to the extremely isolated alpine scree and rough topography of the region since late Miocene or early Pliocene, the Quaternary climatic fluctuation do not cause the population shrinked or expanded, combining some other similar phylogeographic results in other groups of the region such as Chionocharis hookeri, Paraquilegia microphylla and Solms-laubachia eurycarpa, as well as so rich plant diversity in the region, we suggest that Quaternary climatic oscillation of globe might not be shaped the plant distribution greatly in Sino-Himalaya, which probably are mainly abiotic factors causing the region become biodiversity hotspot.

Key Words Climatic oscillation, distribution pattern, Phylogeography, Eriophyton wallichii, Sino-Himalaya

Modelling the Middle Pliocene warm climate and vegetation: comparison of the CARAIB vegetation model results to NECLIME data

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In the Neogene long-term climatic cooling trend, the Middle Pliocene (3.29-2.97 Ma) represents the most recent warm period, similar in many aspects to the potential Earth climate of the late 21st century. Both terrestrial and marine palaeoclimate proxies suggest that high latitudes were significantly warmer, but that tropical sea surface temperatures and surface air temperatures were not very different from the present. The result was a substantial decrease in the latitudinal temperature gradient. Data-based vegetation reconstructions suggest that boreal forests shifted northward, whereas warm-temperate forests expanded at middle latitudes at the expense of deserts. The estimates of atmospheric CO2 levels for the Middle Pliocene, between 360 and 380 ppmv, are comparable to the CO2 levels that have already been reached today. Here, we simulate the Middle Pliocene climate using the PLAnet SIMulator (Fraedrich et al., 2005, Meteorol. Z. 14: 299-304 and 305-314), an Earth system Model of Intermediate Complexity. The PLAnet SIMulator is initialised with PRISM3D boundary conditions following the Pliocene Paleoclimate Modeling Intercomparison Project (PlioMIP) protocol (Haywood et al., 2010, Geosci. Model Dev., 3: 227-242). Middle Pliocene vegetation is simulated with the CARAIB dynamic vegetation model (Dury et al., 2011, iForest-Biogeosciences and Forestry 4: 82-89), forced with the climatic outputs of the PLAnet SIMulator experiment, and with an upgraded vegetation classification involving 26 PFTs. We compare the CARAIB model vegetation reconstruction to the vegetation cover indicated by the fossil flora records at various localities in Europe using the alternative method presented by François et al. (Palaeogeography, Palaeoclimatology, Palaeoecology, 304: 359-378, 2011).

New approaches for palaeoclimate reconstruction of cold sites

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Leaf physiognomy has long been used to reconstruct palaeoclimates. The methods using leaf physiognomy can be classified in two categories: univariate and multivariate approaches. All these approaches are based on linear mathematics. The most commonly used multivariate approach is CLAMP (Climate Leaf Analysis Multivariate Program). Siberian sites were included in the calibration dataset as representative of cold sites. The physiognomy of these sites is consistent with a worldwide dataset. However, the reconstructions of temperature parameters from these are commonly overestimated, even if cooler than those of other sites. Here we introduce a new mathematical approach that links leaf physiognomy with climate. This approach is non-linear. This approach increases the prediction power of leaf physiognomy for all parameters on a global perspective. However, the most important improvement is for the cold sites. The error we observe for cold sites is similar to the error we observe for sites from other parts of the world.

Our new approach allows better palaeoclimatic reconstruction for cold sites. This is very important for the study of the cooling at the end of the Cenozoic. Some particular aspects are the time of this cooling in Russia, and the palaeoclimate of Europe during the Quaternary glaciations.

Palynological and Palaeoclimatic interpretation of the Late Miocene-Early Pliocene in the Çankırı-Çorum Basin (Kırıkkale- Central Anatolia)

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The Akkaşdağı formation observed widespread in Kırıkkale (Central Anatolia) is composed of coal lavers, massive mudstone, gravelly sandstones, bedded limestones, laminated claystones and tuffs. This formation is aged by the Ar/Ar analysis, micro and macro mammalian records and sediments of the Akkaşdağı formation deposited during the Messinian-Zanclean time interval. Palynofloras of the Late Miocene (Messinian) and Early Pliocene (Zanclean) have been defined from coal bearing sediments in Kırıkkale. The late Messinian palynoflora is represented by less diversity and abundance of spores and pollen and it is characterized by the Sparganiaceae, Pinus, Cedrus, Ephedraceae, Cathaya, Alnus, Chenopodiaceae-Amaranthaceae and Poaceae. The Zanclean palynoflora has been indicated differences with the Messinian palynoflora because of the presence of rich and various palynomorphs. Spore and pollen distribution of the Early Pliocene is represented by the abundantly Poaceae, Apiaceae, Typhaceae, Salix, Castanea, Cyrillaceae, Sapotaceae, Chenopodiaceae-Amaranthaceae, Caryophyllaceae, HdV Type 128 of Van Geel, Poaceae, Asteraceae-Cichorioideae-Ligulifloreae and Asteraceae-Asteroideae-Tubuliflorea types.

In this study, continental climatic data of Anatolia for the late Middle Miocene (Serravallian)-Pliocene time interval calculated from palynofloras using the Coexistence Approach have been analyzed, so palaeoclimatic and vegetation interpretation of this time interval have been discussed. In total, 39 Miocene-Pleistocene floras were selected, including 24 early-middle Serravallian, 7 early-middle Tortonian, 2 Messinian and 6 Early-Middle Pliocene.

Late Middle Miocene climatic cooling is evidences in data of Anatolia with coexistences intervals of temperature and precipitation. According to the evidence of Anatolia, continentality is strong in the early-middle Serravallian time in western Anatolia different form the central Anatolia in which lowland and low altitude areas widespread. In the early-middle Tortonian time which is characterized the decreasing temperature and increasing humidity

were observed in the central Anatolia. Palaeoclimatic changing of Anatolia during the Plio-Pleistocene are firstly defined. The warming of the palaeoclimate in the early Pliocene and cooling during the middle Pliocene-late Pleistocene are recorded based on the numerical climatic values. Furthermore, climatic variables of central Europe which are obtained published study and Anatolia are compared.

A late Oligocene leaf flora from the Kağızman-Tuzluca Basin, Iğdır (north eastern Turkey), and its paleoenvironment

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In the study area, the Cretaceous ophiolites of the Kağızman-Tuzluca basin are the basement rocks. Kaan Formation of the Early Oligocene unconformably overlies these ophiolites, and it is made up of the sandy limestones with rich Nummulites. Güngörmez Formation conformably overlies the Kaan Formation; however contact relationship between these formations is locally unconformably in some areas. Sedimentary rocks of the Güngörmez Formation deposited in the deltaic and fluvial environments pass laterally and vertically with each other. Age of the Güngörmez Formation is determined the Late Oligocene, according to Paraceratherium sp. which is fossilized in sedimentary rocks of this formation. In the study area, Turabi Formation is composed of the clastic sediments with crocodile and fish fossils which are deposited in the lacustrine environment, and this formation is the Early Miocene age. Cincevat Formation deposited during the Early-Middle Miocene conformably overlies the Turabi Formation. Sequence of the Neogene age is ended Tuzluca Formation which is represented by evaporates, and contact between the Cincevat and Tuzluca Formations is conformable. Leaf fossils in Cenozoic sequence are defined from the North of the Iğdır-Güngörmez basin located within the Kağızman-Tuzluca basin. Based on the faunal evidences, age of this sequence is the late Oligocene. A macroflora from the late Oligocene of the Tuzluca region (Eastern Turkey) in the Kağızman-Tuzluca Basin is described. The leaf remains of Lauraceae species (Laurophyllum spp. and Daphnogene sp.) and Daphnogene cinnamomifolia (Brongnıart) Unger forma lanceolata Kvaček and Walther represent the dominant element. This flora also includes Daphnogene cinnamomifolia (Brongnıart) Unger forma cinnamomifolia sensu Kvaček and Walther, Eotrigonobalanus furcinervis (Rossmaessler) Walther and Kvaček, Quercus sp., Laurophyllum sp., Zelkova zelkovifolia (Unger) Bůžek et Kotlaba and some leaf remains of Arecaceae. According to the published palynological data and leaf fossils, we interpret the source vegetation as a mixed mesophytic forest as indicated by the occurrence of Fagaceae-Quercus, Fagaceae, Lauraceae and Ulmaceae-Zelkova and also by the presence of the Arecaceae.

Furthermore, back-mangrove element which indicates the presence of marine conditions near the deposition area in the Tuzluca region has been recorded, and also the occurrence of Arecaceae and Lauraceae indicates a warm and subtropical climatic condition in this region. Based on the mammalian fossil records represented by Paraceratherium sp., we conclude that this flora is of late Oligocene age. This is the first record in Turkey of a late Oligocene macroflora with back-mangrove elements. Additionally, evidences of mangrove and back-mangrove elements based on the palyno- and macro flora for the Oligocene age in Anatolia have been summarized.

Paleoenvironmental reconstruction of maar lake in southern Germany and its implication towards paleoclimate of the Middle Miocene

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Although the Randeck maar lake (late Early/early Middle Miocene) offers only a short sequence of preserved sediments, it reveals a complex sediment structure of an enclosed lake and richness in plant and animal remains. Our current study, based on new excavations and re-evaluations of collection material of the Randeck maar, summarizes new information about the different environments in and around the lake as well as possible climatic variations during the Mid-Miocene Climatic Optimum. The combination of all palaeoecological indicators allows for the reconstruction of a palaeoenvironmental model with the distinction of open lake habitats, littoral to supralittoral habitats, crater slope with indications for more and less sun-exposed portions and platform habitats. Preliminary data of diatom analysis supports an abnormal water-chemistry and will allow discussing its stability.

Among all fossils, plant remains are the most diverse group (168 taxa from pollen, leaves, flowers, fruits and seeds), reconstructing a succession of various vegetation zones around the lake. The Integrated Plant Record (IPR) vegetation analysis suggests a subhumid sclerophyllous forests as most likely vegetation type, which characteristically develops under seasonally dry climate only. Similar results were indicated by the analysis of the fruiting ecology. Applying the Coexistence Approach on this rich flora, points towards a very warm climate (MAT 17.2-20.8°C; CMT 12.6-13.3°C; WMT 25-27.9°C), with an clear seasonality in rainfall (MAP 1217-1355 mm; MPwet 204-236 mm; MPdry 21-24; 24-43 mm; MPwarm 132-161 mm). This raises the question about seasonality patterns, particularly in rainfall, during the Miocene Climatic Optimum.

Palaeovegetation and palaeoclimate during the Middle Miocene in Central Paratethys (Czech and Slovak Republic)

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The adjacent areas of the Central Paratethys: Carpathian Foredeep, Vienna Basin, Danube Basins, South Slovakian Basin were studied from the palynological point of view. The landscape evolution during the Middle Miocene Climatic Optimum conditioned by uplift of the Carpathian mountain chain and subsidence of adjacent lowlands, led to commencement of the altitudinal zonation. This process is documented by palaeofloristic changes, presence and absence of proxy taxa. The presence of zonal vegetation with evergreen broadleaved forests (Engelhardia, Platycarya, Lygodium, Reevesia, Mastixia, Symplocos, Parthenocissus, Sapotaceae, Palmae, Pteridaceae, Rutaceae and Araliaceae) supplemented by azonal vegetation (riparian forests with Alnus, Sparganium, Potamogeton, Ulmaceae, Lythraceae, swamps with Nyssa, Taxodiaceae, Myricaceae) is common during the Early Badenian time span. Increased proportion of the arctotertiary taxa (Quercus, Ulmus, Carya) is visible in the Late Badenian palynospectra. The pollen data document subtropical climate during this time span, with a dominant representation of zonal vegetation with evergreen broadleaved forests. Higher differentiation of the oak type pollen, increasing numbers of Platanus pollen and different type of herbs were paralelly studied by using LM and SEM. Decreasing of some thermophilous elements and increasing of the warm to cold temperate zone taxa were registered first during the Late Badenian. These findings together with a higher portion of extrazonal (mountain) vegetation in the Late Badenian pollen spectra document changes due to the uplift of the Carpathian Mountain chain.

Comparison of Middle Miocene palaeoclimate and palaeovegetation model reconstructions and their validation using the NECLIME database

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The NECLIME palaeoflora database offers a unique opportunity for evaluating palaeoclimate model reconstructions. This database gathers data of the fossil flora recorded at many localities around the world at different times of the Miocene. François et al. (Palaeogeography, Palaeoclimatology, Palaeoecology, 304, 359–378, 2011) have presented a new method for evaluating palaeoclimate model simulations from such fossil floras. In this method, palaeovegetation is simulated from climate model outputs, using a dynamic vegetation model. Model vegetation reconstruction is then compared to the vegetation cover indicated by the fossil flora record at the various localities, using a common classification of plant functional types (PFTs) in the data and the model.

Here, we apply this method to the Middle Miocene. We test the results of several published model reconstructions of Middle Miocene climate. Corresponding palaeovegetation distributions are simulated with the CARAIB dynamic vegetation model, in which an upgraded vegetation classification involving 26 PFTs has been implemented. A comparison of model and data in terms of presence/absence of PFTs is then undertaken in different regions of the world, using all available NECLIME localities. The level of agreement varies among models, among PFTs and among regions. For instance, some models are able to produce tropical and subtropical PFTs in Europe consistently with the data, but the agreement for these PFTs may be much poorer in other parts of the world, such as in western Eurasia.

The impact of the Neogene's tectonic phases – closely associated with the key moments of the Valach climatic cycle – on the terrestrial biosphere

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The attempts which had as its objective the elaboration of an optimal cyclo-stratigraphical sketch for Neogene, based on the phases of the Valach climatic cycle (4.1 ma period), have not neglected the identification of the real causes of this very important climatic cycle. But for now, in the absence of other ideas, we maintain our view that the phases of this cycle reflect indirectly the internal dynamics of the Solar System, namely possible movements of radial, pulsator-type). The warm and could phases of the Valach climatic cycle could be determined by successive approaches and removals of all planets from the Sun. The 6 (six) coal-generating stages of the Neogene illustrate in this context the warm phases of this cycle. In this case the Quaternary Ice Age corresponds to the last cold phase of this climatic cycle (Ţicleanu M., Brisbane, 2012). But this perspective would imply the existence (in the past) of periodic planetary shocks which corresponds to the moments of change of meaning of the radial movements of the Solar System. These shocks, which can be treated as some of the tectonic Neogene phases, may be of two different types, but with identical dynamic effects. So, some phases may correspond to the sudden stop of the movement which closes the planets to the Sun, while another series of shocks (or tectonic phases) can be correlated with the sudden stop of the motion that removes the planets from the Sun. The dynamic effects of these moments are very different (folding, faulting, volcanic eruptions, planetary macro-earthquakes, diaper folding, sudden paleo-geographic changes, severe atmospheric disturbance, tsunamis, etc) and they often cause the emergence of new faunal associations, at least in certain parts of the terrestrial globe. In relation to the Valah climatic cycle the repetition of these changes of phase occurs at a time interval of approx. 2.05 million years. This periodicity is reflected for Neogene by the temporal position of the tectonic phases and also by the temporal position of the stratigraphical limits of the stages from the Paratethys and Mediterranean areas. From this perspective it is possible the separation of all tectonic phases associated with the Valah cycle having that temporal reference point the Rhodanian phase, that was manifested to the Miocene/Pliocene limit, about 5,33 million years ago. In this case can be listed, in chronological order, the following realities which may represent, in fact, tectonic phases (shocks) reflecting

the pulsation of the Solar System: the post-Oligocene diastrophism (Paleogen/Neogene or Chattian/Aquitanian limit), the Early Savian orogeny (phase) with the temporal position of the lacune of sedimentation between Eggerrian and Eggenburgian, the Savian phase (Aquitanian/Burdigalian), the Old Styrian phase (or pre-Karpathian, placed between Ottnaginan and Karpathian), the New Styrian phase (intra-Badenian), the Moldavian phase (Badenian/Sarmatian), the Attican phase (Sarmatian – Suess/Pannonian s.s.), Late Attican phase (intra-Meotian), the intra-Pontian discordance (in Portaferrian), the Rhodanian phase (Miocene/Pliocene or Pontian/Dacian limit), an intra-Pliocene discordance and, finally, the Pasadenian phase (Lower Pleistocene/Middle Pleistocene). The next term of this dynamic series will be noted over about 0.82 million years. But it should not be forgotten the doubtless negative effects on the biosphere due to the emergences of some stages of excessive aridity (with the achievement sometime complete of the evaporitic series in lagoonal environments), especially in Lower and Middle Miocene, or of an excessive cold moments, especially in Upper Miocene, in Pliocene and in Quaternary. But these moments, connected with the warm and could phases of the Valach climatic cycle, have manifested only in relation to the phases of some cycles with smaller periods (especially the short cycle of orbital eccentricity). In addition to all it is possible, in this context, to distinguish several tectonic phases linked to other radial movements, with longer periods, involving Earth. It is first of all the case of the potential pulsations of our Galaxy, probably reflected by Raup-Sepkoski cycles, with about 26 million years period. They would lead to dynamic shocks more powerful repeated at intervals of approx. 13 million years. In this sense may be admitted as a reference tectonic phase the Wallachian orogeny, manifested about 2,58 million years ago (at the boundary between Pliocene and Quaternary). In relation to this tectonic phase may be suspected such phase in Badenian, basically superimposed on the temporal position of the New Styrian tectonic Phase and also another phase, before the Oligocene/Miocene limit, the Helvetian tectonic phase.

The Cenozoic Cooling - continental signals from the Atlantic and Pacific side of Eurasia

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Continental deposits in two mid-latitude regions of the Atlantic and Pacific side of Eurasia, containing a rich palaeobotanical record, provide the opportunity to compare the climate evolution of both areas along the Cenozoic, representing the characteristic west and east coast climate situation. For the Atlantic side of Eurasia, a relatively strong imprint of North Atlantic circulation and Gulf Stream intensity on the continental climate can be expected, also for the past, while the eastern coastal regions at that latitude presumably were under the varying influence of the warm Kuroshio and cold, subarctic currents. Moreover, the climatic evolution in the latter region is tied to the history of the East Asian Monsoon System and is complicated by young tectonic processes such as uplift of the Tibetian Plateau, and the Japan Sea back-arc opening. On the Atlantic side, macrofloras from two continental to marginal marine Cenozoic basins, Lower Rhine Basin and Weisselster Basin (both in N Germany), allowed for reconstructing detailed climate records based on a total of 40 stratigraphic levels (Mosbrugger et al., 2005; Utescher et al., 2009). These records document the Cenozoic Cooling since ca. 45 Ma and reflect global climatic trends and events, thus testifying the close correlation of continental and marine temperature evolution as derived from oxygen isotopes. In order to obtain a climate record for the mid-latitude Pacific side of Eurasia, we have compiled lists for leaf and pollen floras reported from the continental strata of Cenozoic basins of Primorye (Russia). The palaeobotanical record originates from a well-defined region, and allows for the analysis of ca. 20 different floristic levels, covering the time-span from the late Eocene to the early Pleistocene. First results indicate very warm, almost tropical conditions for the late Eocene, followed by a declining trend towards the Oligocene. The Miocene phytocoenoses of Primorye have a temperate aspect and estimated palaeotemperatures stayed behind the values reconstructed for the West. Also the Mid-Miocene Climatic Optimum, well expressed in the record for N Germany is not distinctly reflected. The generally less diverse Pliocene floristic record of Primorye reveals still warm temperate conditions, with MAT > 10 °C, while cooler

phases of the early Pleistocene were close to the present-day, cool temperate conditions (MAT ca. 6 °C) (Bondarenko et al., in press). Our future work will focus on precipitation reconstruction in context of the monsoon history, and on comparison of the Primorye climate record with marine isotope data for the North Pacific.

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Ficus palamarevii sp. nov., a new subtropical element in the Bulgarian Paleogene flora.

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A new species, Ficus palamarevii sp. nov. (Moraceae), have been described from the Lower Oligocene sediments from Bulgaria. The description of the species is based on leaf imprints disclosed in volcanogenic rocks in East Rhodope Mts. The age of fossil finding is ca. 32 Ma as proved by isotope dating. Modern analogues of the fossil species are growing in subtropical-tropical climate. Based on transfer function we consider the fossil species as a member of hygro-mesophytic forests widely distributed in the lowland surroundings the palaeobassin. The analysis of the environmental conditions that exist Nearest Living Relatives of the fossil species form the basis of discussion on the role of this thermophilic element in the Bulgarian Paleogene flora

Recent progress in the study of late Miocene palynological flora in Badaogou, Northeast China

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A systematic palynological analysis was carried out for the Neogene diatomite deposit interbedded with basalts in Linjiang area, southeast Jilin Province. Abundant fossil pollen grains and spores were found, including a majority of woody angiosperm (accounted for 52.50-59.75% in pollen assemblage), a small number of herbaceous angiosperm pollen (0.63-2.50%), rich gymnosperm pollen (39.25-44.83%), and some individual fern spores (0.17%). Woody angiosperm pollen grains are mainly represented by Ulmus and Quercus, together with some other stably occurrence of Carpinus, Ulmoideipites Tilia, Betula, etc. The content for herbaceous angiosperm pollen is relatively low, but includes many types such as Artemisia, Cyperaceae, Poaceae, Asteraceae, Ranunculaceae, Chenopodiaceae, etc. Gymnosperm pollen grains are well represented by Picea and Tsuga, along with other ingredients such as Pinus, Abies, Podocarpus, etc. Fern spores are sporadically indicated by Osmunda.

It is deduced that age of this palynological assemblages would be later than the famous Late Early Miocene – Early Middle Miocene Shanwang flora in North China, based on its more or less diversiform herbaceous angiosperm pollen, as well as the higher occurrence of cool resistance plants. However, the overall lower content of herbaceous angiosperms restricts it to be further for Pliocene. Consequently, this fossiliferous stratum is most probably of Late Middle Miocene - Late Miocene in age. In East China, only limited sites contain rich Middle-Late Miocene fossil pollen grains and spores. Our study turns out to be significant not only in revealing the floral variation during the Neogene global cooling, but also for better understanding of various volcanic activities in eastern China.

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The relationships between leaf margins and temperature: Based on vegetation in humid region of China.

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Leaf margin analysis has been an important method of estimating paleotemperatures from fossil leaf floras. In most regions of the world, the relationships between the proportion of woody dicotyledonous species with untoothed leaves and mean annual temperature (MAT) have been investigated, but some potential factors has not been investigated with large data sets based on Chinese vegetation. We used species range maps of native China dicotyledonous trees to derive synthetic local floras for each county in the humid region of China, and compared the percentage of entire-margined species with the MAT, WMT, CMT and MAP in each county. As a source of data on tree floras, we used the Seed Plants of China, the specimen of the KUN (herbarium, Kunming institute of botany) and published floral of China. At the same, leaf margin type for each species was obtained using the specimen of KUN.

This study we present the results of the systematic spatially-distributed patterns of leaf margin in humid region of China. Transfer functions for several climatic parameters have been established, based on the observed relationships.

The results demonstrate the existence of strong relationships between untoothed leaf margins and climatic parameter on a continental scale. In contrast to the results of previous authors, however, we observe slightly different correlation between the proportion leaves with an entire margin and MAT, which from those recognized from other regions and other study result from China. Leaf habit (deciduous vs. evergreen) affects this correlation.

The study provides evidence that synthetically generated floras represent a useful tool for analyzing spatial patterns of relationships leaf margin and climate of China. This work also demonstrates the need for better understanding of the leaf habit effect on the relationships between leaf margin percentages and MAT

Historical diversity dynamics of Quercus (Fagaceae) based on macrofossil record

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Knowledge of past diversity is crucial to understand the mechanism of diversification processes and to predict the future diversity change. However, diversity dynamics of angiosperms have poorly been studied based on fossil record. In this study, we reconstructed the historical diversity patterns of Quercus based on its global fossil record. Furthermore, we tested whether the diversity fluctuation was affected by climatic change by analyzing the correlations between the diversity and the Cenozoic temperature. Raw richness, the estimated mean standing diversity (EMSD), and the mean standing diversity (MSD) show that Quercus slightly accumulated diversity from the Paleocene to the Oligocene after which followed by a dramatic increase until the Middle Miocene. After the Middle Miocene, raw richness reached a diversity peak during the Late Miocene and decreased dramatically from the Late Miocene to the Pleistocene while EMSD and MSD decreased until the Pliocene and increased during the Pleistocene. However, the reconstructions of these three methods were greatly biased from the sampling density that the Middle-Late Miocene peak was resulted from larger sampling sizes. The rarified richness showed that the diversity of Quercus increased from the Paleocene to the Early Eocene and dropped in the Middle Eocene after which increased gradually until the Pliocene and decreased during the Pleistocene. We tested the correlation between the Cenozoic temperature and proportions of different phenological types. The results showed that the proportion of evergreen Quercus species was significant positively correlated with the Cenozoic temperature while the deciduous and sclerophyllous Quercus species didn't significantly correlate with the Cenozoic temperature.

The Sedimentation and Environment Change be Disturbed by Human in Lake Xingyun, Center Yunnan,China

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Lake Xingyun is a half-close plateau lake, lies in the center of Yunnan Province, China. Since decades, the environment of lake have degenerated sharply. This paper tries to find the reason from the recent sediments in Xingyun Lake.

According to the study of continuous 210Pb isotope chronology, The surface sediments (0-90cm thick) are formed since 1817 and the average sedimentation rate is 0.765cm/y. The sedimentation rate from 1990 to 2010 is the fastest and reaches 1cm/y.The rates from 1979 to 1990, from 1968 to 1979, from 1968 to 1923, and before 1923 are 0.566cm/y, 0.84cm/y, 0.67cm/y and 0.33cm/y, respectively.

The sludge at the bottom of Xingyun Lake is consisted of clay, carbonate, felsic and iron minerals. Besides, anatase mineral is a little. From bottom to top, felsic, clay and iron minerals decrease and carbonate minerals and organic increase. The characteristics of granularity also respond the environment changes of lake. From distribution pattern, we know that particles size increase from bottom to top, Shows that the development of the lake before 1923 is affected by natural factors and after 1923 human activities affects more and more even more than nature. From bottom to top, the content of phosphor and nitrogen increases sharply. It reveals that positive correlation exists between the content of organic and the content of phosphor and nitrogen. The distribution of nutrients has close relation with man-made discharge. The characteristics of changed of Sr/Ba coincide with other analysis. The higher Sr/Ba shows depauperization and increasing salinity. Human activities result in that under 56cm（1923 AD）the ratio is relatively stable, after 56cm drastically fluctuated. Thus coincide with history records. Characteristic values of CaO, CaO/MgO, CaO/(MgO*Al2O3), (CaO+K2O+Na2O)/Al2O3 stabilized before 1923 and changed a little from 1923 to 1956 and increased slowly from 1956 to 1982 and increased rapidly from 1982 to 1993 and then stabilized on high levels from 1993 to now. Analysis of pollen from sediments can show the history of vegetation evolution in valley. From bottom to top, pollen in the sediments can be divided to seven sporopollen assemblage. Each reveals different ratio of plant species in different periods and also clearly record human activities. Macrophanerophytes such as pine

and cedar are more and always have greater percentage, this phenomena maybe reflect disturb from human activity. Because people pay more attention to Macrophanerophytes and less to shrub and herb plants when they forestation, ecology of the forest is unbalance.

From above environment multi-indicative study coupling history records, we can divide the development of Xingyun Lake into four periods as follows. (1) natural evolution period from 1817 to 1923, (2) human molest disturbance period from 1923 to 1956, (3)human transform period from 1956 to 1982 and (4)Eutrophication period from 1982 to 2010. The lake development is mainly controlled by nature before 1923 and more affected by human after 1923 with increasing human activities.

The onset and evolution of Asian monsoon brought some plants close to extinction

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One of the most distinguished characteristics of the Asian monsoon is its seasonal precipitation. More than half of the annual precipitation is concentrated in the rain season, from May to October in general. Asia monsoon regions have wet summer and dry winter and spring. In Asia, this climate system starts from late Miocene and is associated with the Himalayas uplift. Under a monsoon climate system, some plants would suffer from the winter and spring drought that this will cause their distribution areas to narrow , and some time even cause their extinction. We analyze the fossil history, modern distribution, seed biology of Cedrus, Metasequoia and Quercus sichourensis and the evolution of monsoon paleoclimate in order to reveal how the onset and evolution of Asian monsoon brought some plants close to extinction. Their seeds are ripe in late autumn or early winter at the end of the rainy and seeds germinate immediately when they are ripe. They may not have enough water for seed germination. Even some seeds can germinate and seeding will suffer from more serious dry spring. The long dry season in winter and spring cause Cedrus and Metasequoia to disappear from most of Asian monsoon climate region and Quercus sichourensis is endangered with only 9 individuals left in the world.

Quantitative palaeoclimatic reconstructions from the Late Pleistocene of the north-central Russia (based on palaeobotanical data)

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Mean temperatures of the warmest and coldest months for the time slices during the last (Mikulino-Eemian) interglacial and the beginning of the subsequent Valdai-Weischelian glaciation were determined on the basis of palaeocarpological and palynological data from the number of sites in the south of the Valdai Hills and in the Upper Volga region. Original paleocarpological records and data from published sources (Gorlova, 1968; Borisova et al., 2007; Novenko et al., 2009) were selected for the present study. The method of climagrams was used for the quantitative reconstruction of the mean temperatures of July (TVII) and January (TI). This method was developed in the Laboratory of Evolutionary Geography Institute of Geography RAS (Grichuk 1985). Climagrams are special graphs showing the present temperature limits of different plants. Combination of graphs for all species presented in the fossil assemblage gives the temperature conditions when these plants could grow simultaneously.

In the warmest phases of the interglacial TVII was 18 – 20°C both in the south of the Valdai Hills and in the Upper Volga basin. It is 2–4 °C higher than the present values. The mean temperature of January ranged from -4 to 1°C (south of the Valdai Hills) and from -4 to 3°C (Upper Volga basin). The present values of TI in the studied areas are -8.6°C and -11°C respectively. The obtained curves of mean temperatures of the coldest and warmest months show that the warming was gradually increased from the beginning of the interglacial to its middle part, when they reached the maximum values. After that the temperature went down which indicates the onset of the cold epoch. Temperature values calculated for the same time slices in the studied sites vary within the limits of statistical error of the climagrams method.

The deposits of the beginning of the cold stage are characterized by poor carpological remains in the studied sites. However mean temperatures of the coldest and warmest months for two warmings of interstadial type within the cold stage were calculated using palaeobotanical data from the site Ples-2002 in the Upper Volga basin. During the first short warming TVII was about 15 - 16°C what is only 2 - 3 °C lower than the modern values. TI ranged from -19 to -14 °C which

was 3 – 8°C below the present conditions. In the second warming (s.c. Verhnevoljsky Interstade) TVII was about 15 - 16°C, TI ranged from -20 to -16 °C what demonstrates significantly much colder conditions than the modern values.

Characterisation of modern and fossil Cyperaceae fruits as an essential tool to exploit their climatic indications

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Several modern taxa of the Cyperaceae, in particular at species level, have very precise climatic requirements, with consistent differences species by species. A good example, within the genus Carex, is provided by the contrasting requirements of C. hispida, strictly linked to the Mediterranean climate type, and C. maritima, with a comparably strict link to the cold temperate climates of the Arctic and the highest European relieves. The abundant fossil record of the Cyperaceae in the late Cenozoic, mainly provided by fruits, suggests us to evaluate its potential in palaeoclimatic studies. This requires being able to characterize the fossil fruits and assign them to subgeneric-sectional categories, or to certain species. One of the main problems for assessing taxonomy of the hyperdiverse genus Carex using fruits is that carpological characters are often neglected in favour of more evident features, even if previous authors have reported meaningful taxonomic characters in the achenes.

Due to the broad distribution and the hyperdiversity of the Cyperaceae in general, and Carex in particular, we had to concentrate our first analyses on a restricted region, Europe, and a relatively small taxonomic group: Carex sect. Phacocystis. The analysis of carpological features of all the modern European species of this section was revealed as useful for the distinction of groups, even up to species level, so that carpology was confirmed as an accurate tool in Carex palaeotaxonomy. From the climatic point of view our analysis permitted to characterise and differentiate the fruits of several similar species with a very distinct climatic requirement. For example, the fruits of C. aquatilis, restricted to the cool- and cold-temperate climates of northern Europe, have been differentiated with respect to those of C. buekii, C. panormitana and C. reuteuriana, growing in definitely warmer climate conditions in southern Europe. Even the very similar and variable fruits of C. elata and C. nigra appeared to be suitable for a morphological distinction, as to permit the identification of these species in the fossil record. In North West Italy we observed that the distribution of these two widespread wetland species appears to be controlled by the temperature parameter, so that in the warmer sites of the

lowland only C. elata is present, whereas in an intermediate belt (ca. 1000-1700 m a.s.l.) the two species co-occur, and in the cooler belt above 1700 m a.s.l. only C. nigra grows.

This kind of analysis needs to be extended to other Cyperaceae groups and also implies a better morphological characterization of each species' modern fruits. Accordingly, we propose a standard approach for collecting modern carpological material, as performed in the MCC collection (Turin University). Our methodological proposal would ease the identification of fossil materials, a work that requires the simultaneous analysis of large quantities of fruits.

First evidence of Arctic dwarf birch Betula nana – like mummiefied leaves from the Plio-Eopleistocene of Yugor Peninsula (Russian European North)

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Arctic is a floristic region, which was and continues to induce an interest of botanists and paleobotanists due to the peculiarities of its flora and vegetation. One of the regions seeking further detailed neo- and paleo- floristic investigation is the area of the mountain range of Yugor peninsula at the northern end of the Ural Mountains - the Pay-Khoy ridge (Russian: хребет Пай-Хой). An interest for that area was influenced already since F.I. Ruprecht (1850, 1856) and A.N. Kryshtofovich (1935, 1939), who have paid attention to neo- and paleo- floristic connections of Polar Ural flora with the Siberian Flora. Despite the fact that the presence of the Neogene-Pleistocene sediments in the Russian European Arctic has been found in the middle of the XX century, it is still considered controversial. One reason for this is the lack of geological knowledge of these deposits and the fossil remains of organisms they contain. Locality information and background: sedimentary rocks containing plant macrofissils from the Plio-EoPleistocene were still rarely found in Russian European North. In 2012, in the course of geological surveys in the north of the Yugorski peninsula, geologists Krylov A.V. and Yuferova E.A. of ZAO "Polyargeo" in the Pliocene-Pleistocene sediments had found two locations of mummified foliage of the dwarf birch. They are located near the mouth of the river ‘Vtoraya Peschanaya’ (‘2nd sandy river’, aka 9550) and the upper reaches of another river - ‘Pervaya Peschanaya’ (‘1st sandy river’, aka 9568). These fossil remains were further preliminarily investigated by the paleobotanist S.V. Vikulin of Botanical Institute of the Russian Academy of Sciences, BIN RAS. Earlier, in 1970-ties, findings of plant detritus in the upper reaches of the river ‘Pervaya Peschanaya’ river also were noted by geologist academician N.P. Yushkin (Komi branch of the RAS). Amber bearing lignite layers are located on the left bank of the ‘Pervaya Peschanaya’ river, which flows into the Kara Sea 17.5 km upstream from its mouth, and 25 km to the southeast from the village Anderma. Amber bearing layer is 0.8 m, and lies at a depth of 1.20 m. It exposes the sand and pebble stratum, which is the alternation of sandy and pebble lenses, in which the sand is finely and medium-grained, laminated gray

sand inter-bedded with frequent thin (5-10 mm) lenses of lignite-like plant material presented by mummified brown leaves, stems, roots of herbs, plant seeds, shields of beetles, small fragments of wood, with abundant grains and chunks of amber-like resin in which they take up about half of the volume. The length of the amber horizon with plant detritus varies within of 10 to 100 m.

Macromorphology: fossil mummified leaves are dark brown in colour, obovate to orbicular in shape and small in size (width 5-7 mm across). Margins slightly crenulate to denticulate, often entire, leaf tip rounded and leaf base acute-obtuse. Reticulate venation with midrib, veins rather thick. Fossil leaves might represent late Pliocene-Eopleistocene fossil subspecies predecessor of the modern species of *Betula nana.* The fossils have shorter leaf blades in comparison with modern European subspecies of *Betula nana.* Though fossil leaves resemble North American subspecies –*B*. *exilis,* they also differ from the latter by their mostly entire leaf margin. The taxonomy of modern birches is further complicated because in many regions of Europe there is no clear morphological borderline between true species and intermediate forms, which is an expected consequence of gene flow via introgressive hybridization or introgression. Modern *Betula nana* (dwarf birch) - a diploid that is the keystone woody species of subarctic scrub communities. Contrary to mostly entire-margined fossil dwarf birch leaves from Pay-Khoy of Russian European North, leaf-margins of both modern subspecies from Northern Europe and North America are distinctly crenulated or denticulate. Two distinct modern subspecies are recognised: *Betula nana* ssp. *nana*, which grows in western coastal Greenland, Iceland, Scotland, Scandinavia, the Alps and across northern Asia to western Siberia; and *Betula nana* ssp. *exilis*, which is found in Siberia, Alaska, northern Canada and Greenland. The principal difference between these two subspecies is that *exilis* has shorter leaf blades than ssp. *nana*. Our fossil mummified leaves being smaller and shorter in comparison with European subspecies, also differs from both of them by its smaller size and more entire margin of lamina.

Pollen, fruit-seed and leaf assemblages from the mid-miocene of eastern paratethys (Yashkul series, 13-16 Ma) of the southern Ergeni upland, European Russia: Kalmykia

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The combined study of pollen, fruit-seeds and leaves from the Miocene sediments of paleo-valley of the paleo-Don river gives the opportunity to establish vegetation correlations, trying to link climate and vegetation changes to changes of paleogeography in Eastern Paratethys. Here we present the joint results of the first paleobotanical study of preliminary-dated Neogene continental-marine sediments in the area of Elista (*Kalmykia)*. Wells were drilled by the state geological enterprise "Koltsovgeologiya", which revealed a strong sand-shale sequence of middle Miocene up to Pliocene age. The sediments (280 – 80 m thickness), embedding the pollen, fruit-seed and leaf records for an interval between ~13 and 16 Ma are derived from Balkovskoe № 210 drill core, were deposited both with marine/brackish and freshwater environments. Besides the core of well, on multiple stratigraphic levels located occasional fossil shells, seeds-fruits and plants impressions, their age was not determined quite confidently still. Nevertheless, diverse pollen assemblages occur throughout the succession and the four stages/intervals were established according to their palynological characteristics.

The palynological analysis reveals that coastal deltaic areas of the study area during the Miocene were dominated by *Taxodium* swamp forests that also hosted terrestrial angiosperms such as *Myrica*, *Betula*, *Alnus* and ferns related to *Polypodiaceae*, *Osmunda*.

Herbaceous hygrophytic vegetation (carpology: *Alismataceae* gen., *Scirpus, Potamogeton, Persicaria*) were well developed around the deltaic plain margins of the paleo-Don. Their distribution was forced by the vast flooded areas and a well-developed river system. Macrofossil (*Salix*) and palynological data also support this assumption and provide information about wide distribution of swamp (*Taxodium, Myrica, Osmunda*) and marsh vegetation (*Polypodiaceae и Sphagnum*).

Further inland, a mixed deciduous-evergreen forest prevailed. In areas with better drained soils, or on elevations, gymnospermous conifer forests prevailed including *Pinus, Sciadopitys*

and cf. *Podocarpus*. In higher mountains *Picea* dominated in coniferous forests. Additionally, some herb species were also present, but herbaceous assemblages became more diverse and dominant after the Tshokrakian. The source areas of pollen at this location are swamp forests in flooded areas, ecologically related riparian forests, where *Salix* (leaf remains) and *Alnus* dominated riparian forest in river valleys and around lakes; mixed mesophytic forests occupied more elevated areas around the water basin, and herbaceous vegetation dominate in saline soils and steppes.

Mixed mesophytic forests occupied more elevated areas around the water basins and were composed of different taxa (*Carpinus, Ulmus, Juglans, Carya, Pterocarya, Acer, Tilia*, Vitaceae gen. - carpology), mainly deciduous species. Thus the vegetation points to a temperate-warm and humid climate up to the end of the mid-Miocene. Afterwards the vegetation went through significant change. A high number of thermophilous elements disappeared, while the genera of deciduous temperate forests became dominant (*Fagus, Quercus, Betula, Carpinus, Ostrya* and *Tilia*). These changes correspond probably to a cooling and arid trends. The swamp forests were reduced in distribution, but the herbs, especially Chenopodiaceae, become more abundant. Other herbaceous plants (*Poaceae, Asteroideae, Artemisia*, and Chenopodiaceae) formed important plant communities as well. The maximum distribution of herbaceous vegetation is recorded in the beginning of the Late Miocene. These higher proportions are combined with subxerophytic/xerophytic plants, which became increasingly important — such as species of *Ephedra.* Overall, the climate in the study area was warm temperate during major parts of the Miocene with mean annual temperatures between 15.5 and 20 degrees C.

Impact of global warming on early Paleogene vegetation of the Indian subcontinent

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Understanding of tropical sensitivity to global warm climate is one of the most challenging issue in climate change research. Early Paleogene (55-45 Ma) time interval provides good analogue for long term effect of CO_2 on bio-geosphere. Global warm events i.e. Paleocene-Eocene Thermal Maxima (PETM) at 55.5 Ma followed by several small scale hyperthermals till 50 Ma, had far reaching and significant impact on both marine and terrestrial ecosystems. Understanding the impact of such 'greenhouse' conditions on already warm global climate is vital to identify and assess the present and future climate change related to rising atmospheric carbon concentrations. The geological records of hyperthermal events represent extinction of certain biotic communities but evolution, proliferation and dispersal of others. Amongst the terrestrial plants, replacement of high and mid-latitudinal temperate floras with diversified subtropical and tropical vegetation is a significant phenomenon and is indicative of geographic extension of moist tropics during early Paleogene warming.

During its northward journey till its eventual collision with Eurasia, the Indian subcontinent lay within the equatorial zone at the time of late Paleocene-early Eocene. Carbonaceous shale, coal and lignite deposits from the western and north-eastern margins of the Indian subcontinent are important repositories that hold information regarding the floral turnover during hyperthermal events from low latitude. The rich fossil flora from these shows that highly diversified tropical rain forest community was widespread in many parts of the Indian subcontinent during early Paleogene. Equatorial positioning, coupled with global warm climate resulted in high precipitation and low seasonality, a key factor in the evolution and diversification of tropical rain forest on the Indian subcontinent. Many common Late Paleocene-early Eocene palynomorphs of India show generic similarity with the palynofossils of mid-high latitudinal belt of similar age indicating extension of low seasonality tropical rain forest vegetation in the subtropics and high latitudes during periods of global warming. An attempt has been made to trace the nearest living relatives (NLR) of early Paleogene fossil palynomorphs of India. The study shows a striking similarity of the fossil palynomorphs with the extant pollen of tropical rain forest of South East Asia, Sri Lanka, Africa, Madagascar and Western Ghats of India. These studies, besides providing paleogeographic clues, offer an understanding of the early Paleogene

climatic conditions, and evolutionary history of tropical rain forest vegetation on the Indian subcontinent.

Cenozoic palaeoenvironmental reconstruction of the northeastern part of Russia based on palaeobotanical records

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The high latitudes are a target region, where proxy data should be acquired (Lunt et al., 2008). This region is most relevant because anything what happens with climate seems to affect the higher latitudes. Here we present a quantitative reconstruction of the early Cenozoic palaeoenvironmental dynamics in Siberia and the northeastern part of Russia.

Palaeoclimate data reconstructed for the above regions testify that the warmest and wettest conditions existed in Western Siberia during the Oligocene, with mean annual temperature around 14 °C, and mean annual precipitation at 1,000 mm, while early Miocene data suggest slight cooling and drier conditions. In the middle Miocene, temperatures increased again. In Eastern Siberia and the Russian Far East, a further cooling period started in the late Miocene. In the late Pliocene, mean annual temperature was about 6 °C at a mean. The reconstructed mean annual precipitation data show a drying trend from the early Miocene on. Driest conditions are observed in the late Pliocene (Popova at al., 2012).

Biomes reconstructed for the study area based on the interpretation of diversities of plant functional types reflect the main climatic signals described above. The vegetation dynamics of the northeastern part of Russia presents a contrasting pattern in comparison with the continental Siberian region. The obtained semi-quantitative data set can be used to complete and verify previous qualitative reconstructions.

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