NECLIME Conference

Climate and vegetation evolution in the Paratethys, Eastern Mediterranean and Black Sea area

Program
&
Abstracts

Institute of Biodiversity and Ecosystem Research
Bulgarian Academy of Sciences

Sofia, 2012

NECLIME Conference

Climate and vegetation evolution in the Paratethys, Eastern Mediterranean and Black Sea area

Program and Abstracts

Edited by
Dimiter Ivanov and Viktoria Hristova

Institute of Biodiversity and Ecosystem Research
Bulgarian Academy of Sciences

Sofia, 2012

The NECLIME Conference

Sofia, October 1st - 4th, 2012

Climate and vegetation evolution in the Paratethys, Eastern Mediterranean and Black Sea area

Scientific Program

Monday October 1st

Registration: **16:00 – 19:00**	Conference Hall, Institute of Biodiversity and Ecosystem Research, 23, Acad. G. Bonchev Str.
Welcome dinner: **20:00**	Restorant "Pri Yafata", 40, Rayko Aleksiev Str., Sofia

Tuesday October 2nd

Conference Hall

Institute of Biodiversity and Ecosystem Research

23, Acad. G. Bonchev Str.

Opening ceremony: 9:30

9:30 – 9:50	**Welcome address**
9:50 – 10:10	Torsten Utescher and Angela A. Bruch: **Introduction and NECLIME news**
10:10 – 10:30	Mehmet Serkan Akkiraz, Nazire Özgen Erdem and Özgen Kanga: **Palynoflora and palaeoclimate of gypsiferous formations of the Oligo-Miocene Sivas Basin, Central Turkey**
10:30 – 10:50	Vladimir Bozukov, Dimiter Ivanov and Torsten Utescher: ***Ficus*** **sp. in Early Oligocene flora of Ustren (South Bulgaria)**

Coffee break: 10:50 – 11:30

11:30 – 11:50 Dimiter Ivanov, Elżbieta Worobiec and Nadezhda Djorgova: **Trends in Badenian (Middle Miocene) vegetation and climate dynamics in Poland and Bulgaria based on pollen data**

11:50 – 12:10 Ilaria Mazzini, Natália Hudáčková, Peter Joniak, Marianna Kováčová, Tamás Mikes, Andreas Mulch, Bora Rojay, Stella Lucifora, Daniela Esu and Ingeborg Soulié-Märsche **Palaeoenvironmental and Chronological Constraints on the Tuğlu Formation (Çankiri Basin, Central Anatolia, Turkey)**

12:10 – 12:30 Saida Nigmatova: **Evolution of climate, landscape and vegetation of the continental regions of Central Asia during the Neogene and Quaternary**

Lunch break: 12:30 – 14:00

14:00 – 14:20 Vladimir Bozukov: **A revision of species *Pleiomeris formosa* (Heer) Palamarev et Petkova in Bulgarian palaeoflora**

14:20 – 14:40 Andrea K. Kern, Jan-Peter Friedrich, Franziska Göhringer, Johanna Kovar-Eder, James H. Nebelsick, Michael W. Rasser, Anita Roth-Nebelsick and Reinhard Ziegler: **First small-scale insight from varved maar sediments in the environmental and climatic situation during the Middle Miocene Climatic Optimum**

14:40 – 15:00 Svetlana Popova, Torsten Utescher, Elena Herzog, Dmitry Gromyko and Volker Mosbrugger: **Cenozoic palaeovegetation patterns for Western Siberia and the Northeast of Russia reconstructed from plant functional type diversity**

15:00 – 15: 20 Mircea Ţicleanu, Radu Nicolescu, Adriana Ion, Viorel Ilinca: **The climate of the Carpathian Miocene reflected by the saliferous facieses**

Coffee break: 15:20 – 16:00

16:00 – 16:20 Dimiter Ivanov, Marianna Kováčová and Nela Doláková: **Early Late Miocene vegetation and climate dynamics in Slovakia and Bulgaria**

16:20 – 16:40 Nadja Ognjanova-Rumenova, Marlena Yaneva and Gabriel Nikolov: **Diatom-based correlation of Neogene lacustrine sediments from Gotse Delchev Basin, Southwestern Bulgaria**

16:40 – 17:00 Elżbieta Worobiec: **New palynological studies of the Pliocene freshwater deposits from the Mizerna locality, West Carpathians, Poland**

17:00 – 18:00 Poster Session* and Discussion

Poster No. 1. Andrea K. Kern, Mathias Harzhauser, Ali Soliman, Werner E. Piller: **The potential of non-laminated Miocene sedimentary records for multi-proxy-environmental analysis on a decadal- to centennial-scale**

**Posters will be exposed on October 2nd and 3rd at the Conference Room.*

Wednesday October 3rd

Conference Hall

9:30 – 9:50 Felix T. Portmann: **Modern gridded climate data - Effect of resolution on differences of CRU and WorldClim data sets**

9:50 – 10:10 Adele Bertini and Angela A. Bruch: **Plio-Pleistocene vegetation response on orbitally forced climatic cycles in Southern Europe**

10:10 – 10:30 Louis François, Torsten Utescher, Noémie Hamon, Boglárka Erdei, Marie Dury, Alexandra Henrot and Eric Favre: **Testing palaeoclimate and palaeovegetation model reconstructions with the NECLIME palaeovegetation database: application to the Paratethys and Eastern Mediterranean region in the Middle Miocene**

10:30 – 10:50 Boglárka Erdei, Torsten Utescher, Lilla Hably and Volker Mosbrugger: **Late Miocene Vegetation of the Pannonian Basin as reflected by plant functional types**

Coffee break: 10:50 – 11:30

11:30 – 11:50 Felix T. Portmann and Torsten Utescher: **Climate response to variations of the Gulf Stream intensity - Comparisons of model results with palaeovegetation records for the Late Miocene**

11:50 – 12:10 Torsten Utescher, Dimiter Ivanov, Andreas Dreist and Volker Mosbrugger: **Assessing aridity in palynomorph records – tests with a novel technique of signal enhancement and employment of aridity indices**

12:10 – 12:30 Angela A. Bruch: **Quantifying openness of palaeovegetation with modern LAI data – an attempt towards a new approach**

Lunch break: 12:30 – 14:00

14:00 – 14:20 Edoardo Martinetto, Elena Vassio and Giovanni Monegato: **East-European affinity of a fruit and seed flora from NE Italy**

14:20 – 14:40 Angela A. Bruch, Ivan Gabrielyan, Steffen Scharrer, Klaudia Kuiper and Uwe Kirscher: **Early Pleistocene Vegetation and Climate in Southern Caucasus**

14:40 – 15:00 Viktoria Hristova and Dimiter Ivanov: **Late Miocene vegetation change in Karlovo Basin, Central Bulgaria**

15:00 – 15: 20 Boris Tsenov and Dimiter Ivanov: **Comparative analysis of climate reconstructions results from Gotse Delchev Basin (SW Bulgaria)**

Coffee break: 15:20 – 16:00

16:00 – 16:20 Ivan Gabrielyan: **New species of the fossil macroflora from Early Pleistocene lake sediments of Sisian Formation, Southern Armenia**

16:20 – 16:40 Grzegorz Worobiec and Elżbieta Worobiec: **Preliminary results of investigations on fungal remains from Pliocene deposits of Mizerna (southern Poland)**

16:40 – 18:00 Final discussion and synthesis, outlook to future NECLIME research: Climate and vegetation evolution in the Paratethys, Eastern Mediterranean, and Black Sea area; NECLIME annual meeting 2013, St. Petersburg: presentation of the venue.

Moderators: A. Bruch and T. Utescher

Goodbye: 18:00

The NECLIME Workshop

Thursday October 4th

9:30 – 13:00 Joint Workshop of the NECLIME Working Groups on Taxonomy of the Macrobotanical and Palynomorph Record.
Moderators: T. Utescher, B. Erdei, E. Worobiec and D. Ivanov

Torsten Utescher: **Report on recent activities of the NECLIME working groups on Taxonomy of Neogene palaeobotannical record**

Dimiter Ivanov: **Objectives and progress of the NECLIME working group on taxonomy of Neogene palynomorphs**

Elżbieta Worobiec: **Some new ideas from the "Atlas of pollen and spores of the Polish Neogene – Angiosperms (2)"**

Adele Bertini and Edoardo Martinetto: **Palaeofloristic, vegetational and climatic reconstructions: a comparative analysis from micro- (pollen) and macropalaeobotanical (leaves, fruits and seeds) data**

Boglárka Erdei and Torsten Utescher: **Introduction to the single points to be discussed and opening of the discussion:**

- *integration of diverse plant records - the prospects of joint studies*
- *taxon complexes in the Cenozoic plant record and novelties in the taxonomy of Cenozoic plants*
- *NECLIME database - updating the taxonomy of fossil plant taxa and their NLRs, identification of synonyms; recent critique concerning CA methodology and Palaeoflora climate data*
- *potential exchange of palaeobotanical/botanical data from China*
- *possibilities to develop/improve available data (e.g revisions, reinvestigation of localities) - prospects of cooperation with Chinese colleagues*
- *Plant Functional Types - recent advances in pft classifications*
- *forthcoming NECLIME workshops*
- *additional suggestions, ideas on topics to be discussed in the scope of the workshop are highly welcome.*

Lunch break: 13:00 – 14:00

14:00 – 17:00 Optional:

- ***Work with reference and palaeobotanical collections***
  Organizers: V. Hristova and B. Tsenov
- ***Sightseeing tour of Sofia***
  Organizers: V. Bozukov and D. Ivanov

The NECLIME Field trip

Organizers: D. Ivanov, V. Bozukov, T. Utescher, D. Ivanova

Friday October 5th
08:00 – Departure from Sofia

Saturday October 6th
19:00 – Return to Sofia, Accommodation in the hotel

Sunday October 7th
Departure of participants

Abstracts

Climate and vegetation evolution in the Paratethys, Eastern Mediterranean and Black Sea area

Palynoflora and palaeoclimate of gypsiferous formations of the Oligo-Miocene Sivas Basin, Central Turkey

Mehmet Serkan Akkiraz[1]
Nazire Özgen Erdem[2]
Özgen Kangal[2]

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In central Turkey there are several important basins developed mainly after closure of the northern branch of Neotethys. The Sivas Basin is located in the eastern part of central Turkey, and includes gypsum-bearing sequences of three different ages, ranging from Eocene to Miocene. The first gypsum beds which are mainly laminated, deposited in the Eocene. After the marine transgression at end of the Eocene, thick gypsum beds, nodular gypsum and sandstone developed in the sabkha environments and river systems during Oligocene time. The third of gypsum occurs in the Miocene. The sequence also includes shallow-marine clastic and calcareous deposits in the Miocene. In this study, a number of outcrop sections were measured, and 64 samples of marine to terrestrial materials were palynologically studied, but 19 samples were productive.

The Oligo-Miocene palynoflora contained poor species diversification and consists of 47 palynomorphs covering angiosperms (32 types of palynomorphs), gymnosperms (8 types of palynomorphs), pteridophytes (3 types of palynomorphs) and undifferentiated dinoflagellate cysts (4 types of palynomorphs). During the Oligo-Miocene, although coniferous, broad leaved and mixed mesophytic forests were common, there is an increase in the proportion of herbaceous taxa in the Sivas basin compared to Miocene palynofloras in western Turkey. This may show the development of more opened vegetation. We also made palaeoclimate roconstructions based on the palynoflora from the Sivas Basin, using Coexistence Approach method. Preliminary data indicate a subtropical (MAT over 16.0°C) and drier climate.

Plio-Pleistocene vegetation response on orbitally forced climatic cycles in Southern Europe

Adele Bertini[1]
Angela A. Bruch[2]

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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.

Plant fossils usually are rare or even absent at hominin sites. Thus, direct evidence on local vegetation and environment is generally missing. Independent from such localities, pollen profiles from the Mediterranean realm show the response of regional vegetation on global climate changes and cyclicity, with distinct spatial and temporal differences. This provides an opportunity to attempt an

analysis, of successive cycles in different areas, of the range of natural climate variability and biotic response. Furthermore, plant fossils provide proxies for climate quantification that can be compared to the global signal, and add data to understanding the regional differentiation of Mediterranean environments. In this presentation we will discuss various palaeobotanical data from Southern Europe to assess Early Pleistocene climate and vegetation in time and space as part of the environment during the first expansions of early humans out of Africa.

Palaeofloristic, vegetational and climatic reconstructions: a comparative analysis from micro- (pollen) and macropalaeobotanical (leaves, fruits and seeds) data

Adele Bertini[1]
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Micro- and macrofloral evidence can contribute significantly to the reconstruction of the spatial and temporal modifications that affected terrestrial palaeoecosystems. Detailed pollen, leaf and carpological data collected from a large number of Italian localities of the Messinian–Piacenzian interval were analyzed to provide a model of ancient vegetation. The decision to integrate both micro- and macrofloristic records derived from the suggestion that reconstructions of ancient vegetation and plant communities are more effective when different plant parts can be seen as multiple records of the same ancient "whole plant". The chronological succession of four synthetic sketches (transects) of ancient vegetation reveals the main traits of ancient vegetation as reconstructed by means of integrated plant fossil records. They do not provide, however, detailed information on the vegetation structure or the spatial distribution of individual taxa and plant communities, and in principle they have to be considered artificial reconstructions of limited aspects of ancient vegetation. This contribution aims at summarizing, compare and discuss the information provided by different palaeobotanical records (micro- and macroflora), which are deemed useful for a revised and standardized reconstruction of vegetation and climate.

A revision of species *Pleiomeris formosa* (Heer) Palamarev et Petkova in Bulgarian palaeoflora

Vladimir Bozukov

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Palamarev and Petkova (1987) incorrectly modify the systematic affiliation of the leaf type described by Heer (1861) as *Myrsine formosa*. They are based on many in number, closely spaced secondary veins, which are at right angle to the primary vein of the leaf lamina. The last morphological feature,

however, is not characteristic for either genus *Myrsine*, nor the genus *Pleiomeris* and therefore the original combination *Myrsine formosa* should be preserved. The lef imprint found near the village Ruzhintsi (North Bulgaria, Middle Miocene), which served as the basis for the same authors wrong conclusion has identical morphological features with described by Palamarev & Petkova (1994) type *Plumeria* cf. *caucasica* (Padezh Graben, Upper Eocene - Lower Oligocene).

Fossils of this type are known so far only from Paleogene deposits in South Bulgaria, while the species *Plumeria caucasica* Avakov is established in the Miocene flora of Georgia (Avakov 1979). The author considered *Plumeria fallax* J. Muell as a nearest living relative of the fossil species. The recent one growing in humid evergreen forests of South America. The new data on stratigraphic and geographic distribution of *Plumeria* cf. *caucasica* in Bulgaria brings forward the controversial issue concerning the relationship between the European Tertiary flora and the recent flora of Central and South America.

Ficus sp. in Early Oligocene flora of Ustren (South Bulgaria)

Vladimir Bozukov[1]
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First results from a palaeofloristic survey on a fossil site in the Momchilgrad Basin in the East Rhodopes Mts, S Bulgaria, are presented. The leaf imprints originate from Lower Oligocene volcano-sedimentary succession. A total of 78 well preserved specimens are analyzed and 22 different fossil taxa are identified. The objects of this study are five leaf-imprints identified as *Ficus* sp. The fossils are leave fragments and a completely preserved specimen with morphological features similar to those of two modern species: *Ficus grossularioides* Burm. f. and *F. exasperata* Vahl. The first species is distributed in Indo-China, and the second one is distributed in evergreen forests of southern parts of India and the Arabian Peninsula, and in central Africa. Tropical climate is characterized for both species areas.

Fossil materials from the Middle Eocene on Germany, determined as *Ficus* sp. by V. Wilde, and *F. daphnogenes* Ett. from Late Eocene sediments of the Czech Republik have the closest morphological affinities to our findings. But unlike our material, both fossil taxa have a higher number of secondary veins and no variability of the leaf margin.

Quantifying openness of palaeovegetation with modern LAI data – an attempt towards a new approach

Angela A. Bruch *ROCEEH Research Centre, Senckenberg Rresearch Iinstitute, Senckenbeganlage 25, 60325 Frankfurt am Main, Germany, abruch@senckenberg.de*

Although widely used in palaeontological literature to describe fossil habitats of animals and early humans, terms like "open woodland", “savannah”, or “open environment” are poorly defined in botanical and ecological sense. They tend to comprise all kinds of habitats that cannot be clearly assigned to closed forest (no open spaces) or open steppe (no trees).

In an attempt to better distinguish the different types of open habitats quantitatively, a new quantitative method based on the principles of the Coexistence Approach is developed to exploit remotely sensed data as independent proxies of vegetation density for correlation and will use such numerical data as leaf area index (LAI), vegetation cover and greenness. These parameters are so far widely used for vegetation modeling of open environments. However, their exploitation for palaeoenvironmental questions is not yet fully elaborated.

To test this approach we apply the GIS-based Coexistence Approach (CA_{GIS}) on fossil plant material from an archaeological site in South Africa. Obtained data show a distinct increase of winter temperatures, summer precipitation, and vegetation density from 60 to 50 ka. Although the example does not fit the temporal scope of NECLIME, I would like to discuss the methodological approach and its potential for applications in a wider stratigraphic range.

Early Pleistocene Vegetation and Climate in Southern Caucasus

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Ivan Gabrielyan[2]
Steffen Scharrer[1]
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For the reconstruction of Early Pleistocene landscape evolution in the Caucasus the Vorotan basin proved to be a rich area for palaeobotanical and palaeozoological studies. There, lake sediments form huge diatomitic sequences that are perfectly suitable for palaeoenvironmental studies. The highly precise age control of the sites studied so far is based on palaeomagnetic and Ar/Ar dating and enables us to reconstruct the environmental history of the Early Pleistocene between 1.15 and 0.95 Ma. The sedimentation rate for the diatomite is estimated to be about 20-30 cm per 1000 years, which allows for a resolution of about 250 years per sample.

The profiles show a rich and diverse flora and entomofauna. Some parts of the sequences studied in high resolution show clear cyclicity which can be correlated to global climate cycles. The prominent warm phase MIS 31 at 1.07 Ma is well pronounced in the pollen and macroflora record and linked

with a major expansion of the forest belt and a diverse mosaic landscape providing a high variety of habitats and resources to early humans. This time of wide spread forest cover lasted for less than 10 000 years. This rich leaf assemblage was the basis of a quantitative climatic analysis based on the Coexistence Approach yielding clearly warmer and more humid conditions than today. Before and afterwards vegetation was dominated by semi-arid steppes and montane meadows, very much similar to today.

Distinct differences between vegetation development during the two interglacial stages MIS 33 and MIS 31 can be used to define a climatic threshold for the development of habitats suitable to early humans in the Armenian highlands. Comparison with pollen data from Western Georgia will shed light on the spatial differentiation of vegetation in this topographically highly variable landscape.

Late Miocene Vegetation of the Pannonian Basin as reflected by plant functional types

Boglárka Erdei[1]
Torsten Utescher[2,3]
Lilla Hably[1]
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Terrestrial climate pattern and its change is reflected by vegetation. Palaeovegetation reconstruction using distribution of plant functional types (pfts) is a semi-quantitative methodological approach in palaeobotany providing quantitative results that enable direct comparisons with potential vegetation distributions simulated by dynamic vegetation models (e.g. CARAIB; cf. Francois et al., 2011). The present study focuses on a pft based vegetation reconstruction of the late Miocene Pannonian Basin in a climatic and palaeogeographic context. An extended pft scheme is applied which represent palaeo data in a form compatible with global model outputs. The new classification comprises a total of 40 pfts, including additional shrub types, mangrove, tuft plants and wetland elements. Having an extensive paleobotanical record with a number of well dated sites and a detailed palaeogeographic model the Pannonian Basin System provides an opportunity to study response of local and regional vegetation to paleoclimate in the context of changing paleogeography. Based on macrofloras we reconstruct vegetation layers for five time slices and put in a paleogeographic context. The paleogeographic background is set by a series of detailed maps published by Magyar et al. (1999). The maps represent configurations at 10.8, 9.5, 9.0, 8.0, and 6.5 Ma., respectively, and thus document the initial extension and subsequent shrinkage of Lake Pannon during the late Miocene (Tortonian-Messinian/Pannonian). In order to put the observed vegetation patterns in a regional context we include contemporaneous macrofloras from adjacent depositionl areas potentially not signalling a “lake effect”. The observed vegetation patterns are correlated and discussed in the context of relevant climate patterns and palaeogeography.

Testing palaeoclimate and palaeovegetation model reconstructions with the NECLIME palaeovegetation database: application to the Paratethys and Eastern Mediterranean region in the Middle Miocene

Louis François[1]
Torsten Utescher[2]
Noémie Hamon[3]
Boglárka Erdei[4]
Marie Dury[1]
Alexandra Henrot[1]
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In the last years, several model reconstructions of the Miocene climate have been performed by various research teams. It is important to test the quality of these reconstructions by confronting them to site data. The NECLIME database offers a unique opportunity for such an evaluation of palaeoclimate model reconstructions. This database provides data of the fossil flora observed at various palaeolocalities. Thus it does not provide direct information on climate, but on flora and vegetation. Hence, it is necessary to reconstruct palaeoclimate from the fossil flora before being able to compare these data with climate model results, using for instance the coexistence approach. François et al. (*Palaeogeography, Palaeoclimatology, Palaeoecology*, 304, 359–378, 2011) have presented an alternative method where palaeovegetation is simulated from the outputs of the climate model, using a dynamic vegetation model. Model vegetation reconstruction can then be compared to the vegetation cover indicated by the fossil flora record at the various localities, provided that a common classification of plant functional types is used for the data and the model. The advantage of the latter method is that, at least in theory, it allows taking into account non-climatic factors potentially influencing plant species distributions, such as atmospheric CO_2, soils or seed dispersal capacities.

Here, we apply this method to the Paratethys and Eastern Mediterranean region during the Middle Miocene. We test the results of a high-resolution climate simulation recently performed for this time period with the LMDZ4 climate model. Palaeovegetation is simulated with the CARAIB dynamic vegetation model in which an upgraded vegetation classification involving 26 plant functional types has been implemented.

New species of the fossil macroflora from Early Pleistocene lake sediments of Sisian Formation, Southern Armenia

Ivan Gabrielyan

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Macroremains of fossil plants from Early Pleistocene lake sediments of the Vorotan river basin have been studied since 1939 (A.K. Krishtofovich, 1939; A.L. Takhtajan, 1948; N.G. Gokhtuni, 1987-89; I.G. Gabrielyan, 1990-2011). About 150 higher plant taxa have been cited or determined from the above-

mentioned formations. These taxa might be divided as follows:

1. taxa (63), whose thorough description and pictures are provided;
2. taxa (7), whose names and pictures can be found in literature, but they have not been described yet;
3. taxa (44), whose names only have been published (without pictures and description);
4. taxa (31), whose scientific denomination is published here for the first time.

The new 31 species are: *Marchanthia* sp. cf. *polymorpha* L., *Tsuga* sp., *Pinus* sp., *Betula litwinowii* Dolukh., *Clematis* sp., *Cornusmas* L., *Diospyros lotus* L., *Groenlandia densa* (L.) Fourr., *Hippophaer hamnoides* L., *Juncus articulatus* L., *Malus orientalis* Uglitzk., *Mycelis* cf. *muralis* (L.) Dumort., *Pastinaca armena* Fisch. & C.A. Mey., *Periploca graeca* L., *Persicaria amphibia* (L.) S.F. Gray, *Potamogeton crispus* L., *Pyrus syriaca* Boiss., *Quercus* cf. *ilex* L., *Rhododendron* cf. *ponticum* L., *Salix armeno-rossica* A. Skvorts., *Sasa* sp., *Silene* sp., *Sorbus graeca* (Spach) Lodd. Ex Schauer, *Sorbus takhtajanii* Gabr., *Tilia cordata* Mill., *Viburnum* cf. *opulus* L., Apiaceae sp.1, Apiaceae sp.2, Apiaceae sp.3, Asteraceae sp.1, Asteraceae sp.2.

The higher plants listed above are rather interesting due to their taxonomic composition. All the 31 taxa: 20 species, 25 genera and 21 families have been cited for the first time for the fossil flora of the Vorotan river basin. Moreover, most of the species, e.g. Liverworts, Marchantiales, *Groenlandiadensa*, (*Sasa* sp.) and others have been cited for the first time for the whole fossil flora of Armenia. Of no less significance in the taxnomic sense are the families Asclepiadaceae, Ebenaceae, Ericaceae, Cornaceae, Ranunculaceae, Elaeagnaceae, Juncaceae, Caryophyllaceae, the subfamily Bambusoideae from Poaceae, as well as the genera *Pinus*, *Tsuga*, *Periploca*, *Diospyros*, *Rhododendron*, *Cornus*, *Clematis*, *Hippophae*, *Juncus*, *Silene*, *Sasa* that are new for the Pleistocene flora of Armenia.

A number of these species are rather interesting because of their ecological diversity. Thus, *Marchanthia polymorpha*, *Juncus articulatus*, *Groenlandia densa*, *Persicaria amphibia* and *Potamogeton crispus* indicate the prevalence of aquatic or littoral environments. *Periploca graeca*, *Salix armeno-rossica*, *Hippophae rhamnoides* are typical for riverside forests. The other species indicate forest, steppe or meadow vegetation.

Most of the above-mentioned species are adapted to the cool-temperate climatic zone, whereas the representatives of *Sasa* sp., *Quercus* cf. *ilex*, and *Rhododendron* cf. *ponticum* point to the presence of warm-temperate climate in the Vorotan river basin during Early Pleistocene.

Late Miocene vegetation change in Karlovo Basin, Central Bulgaria

Viktoria Hristova
Dimiter Ivanov

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Sediments of the neogene basins in Bulgaria contain important floristic information about the character and evolution of the local and regional flora. The Karlovo Late Miocene Basin (Central Bulgaria) occupies an important place in the system of lake-swampy sedimentary complexes on the Balkan Peninsula. Its specific location between the Balkan Range and Mt Sredna Gora determines its unique character. Irrespective of this, paleobotanical data about the basin are extremely scanty owing to the lack of natural outcrops of the Neogene basin. Recenrtly, new palynological study of sediments

from two boreholes drilled in the east part of the basin have been carried out. The investigated materials originated from the grey-bluish and grey-greenish clays, as well as from the diatomite clays above the main coal layer, and from the contact spots of the clays with the lignite coal.

Based on the characteristic changes in the percentage participation of the main pollen types in pollen spectras with help of the cluster analysis pollen zones are separated. The differentiated pollen zones have local character for each of the cores. They correspond to the vegetation dynamics, changes in the hydrological regime of the water basin and local climatic conditions, and could be regarded as regional character zones for the Karlovo Late Miocene Basin (Central Bulgaria). Thus the main trends in vegetation dynamics in the period are outlined. The new data obtained for palaeovegetation and floristic change are discussed and compared with previous palynological studies in the western part of the basin.

Early Late Miocene vegetation and climate dynamics in Slovakia and Bulgaria

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From the Cretaceous to modern time the earth's climate system has changed repeatedly from a greenhouse to an icehouse. The Miocene appeared as the last warm episode in earth history, prior to the establishment of large Northern Hemisphere ice sheets. In the present study we analyze and compare vegetational and climatic changes throughout the begging of Upper Miocene along the seacoast of Paratethys, taking into consideration the available and new palaeobotanical data from Slovakia and Bulgaria. These two countries have a key geographic position in central and southeastern Europe. Slovakia links the north to northwestern and central Paratethys (the Vienna, Danube, South Slovakian and East Slovakian basins and intramountain basins as well) during the Miocene. Bulgaria links central and eastern Paratethys during the Miocene. Its northwestern part belongs to the Central Paratethys domain during the middle Miocene and to the Eastern Paratethys during the late Miocene, while the NE Bulgaria belongs to the eastern Paratethys (Euxinian).

The available data indicate that significant vegetation changes occur in the early Late Miocene. This period is characterized by more diverse climatic conditions, which were directed by global climatic changes and probably complicated by regional palaeogeographic reorganizations and tectonic processes.

The fossil flora from Bulgaria shows a trend to decreasing abundance of palaeotropical elements at the end of the Middle Miocene and the beginning of the Late Miocene. Deciduous broadleaved species become dominant in the mesophytic forests, with reduced participation of thermophilous taxa. The swamp forests were reduced in distribution, but the herbaceous plants formed important plant communities as well. The maximum distribution of herbaceous vegetation is recorded in the beginning of the Late Miocene.

The Late Miocene paleogeographical changes, as well as climate variability in the northwestern Central Paratethys realm, resulted in decrease of the number of thermophilous taxa during this time

(change in latitudinal position of the vegetation cover). Variously high mountain relief of the uplifted mountain chains (altitudinal zonality) created ideal conditions on the territory of Slovakia for mixed mesophytic forests (to open woodland – open grassland type), still with presence of evergreen taxa.

The regression of the Paratethys and adjacent lakes at the beginning of the Late Miocene caused a greater seasonality of climate and significant drying, due to shrinking water basins and the appearance of open landscapes. Lower precipitation, lower annual and winter temperatures are observed in the early Late Miocene. As evident from vegetation data, the climate did not change equally in the northern and southern areas and to the North it was cooler and less dry.

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Trends in Badenian (Middle Miocene) vegetation and climate dynamics in Poland and Bulgaria based on pollen data

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The Miocene is a time in plant evolution in Eurasia when Palaeogene vegetation dominated by evergreen and thermophilous elements was replaced by vegetation dominated by deciduous and temperate plants. It appeared also as the last warm episode in earth history, prior to the transition from greenhouse to icehouse world. The processes of plant evolution and transformation of vegetation and coenotic structure was significantly forced both by changes in the earth climate system and palaeogeographic reorganizations. The Middle Miocene includes a time of remarkable climatic and environmental changes known as the climatic optimum (17 to 15 Ma) on global and regional scale, which was followed by drop of temperatures. To throw new light on the middle Miocene evolution of European ecosystems and climate dynamics, we compared plant assemblages from southern Poland and northern Bulgaria. Palaeogeographically this area belongs to the Polish Lowland and southern Paratethyan realms. Climatic changes after the Miocene climatic optimum caused changes in floristic composition and vegetation structure in both regions.

The fossil flora from northern Bulgaria (Paratethys Basin) includes more than 150 taxa from c. 100 genera, and the flora from southern Poland (Legnica Basin) consists of 195 taxa from 92 genera of pollen and spores. Based on palaeoecological analysis the main palaeocommunities have been distinguished: hygro-hydrophytic herbaceous palaeocoenoses (reed marshes), hygrophytic forest palaeocoenoses (swamp forest and bush swamp), riparian forests, and mixed mesophytic forests. Nevertheles some differences in taxonomic composition of the fossil floras and proportion of individual taxa the vegetation shows similar composition and trends in development. The main trend in the vegetation dynamics is general decreasing in the abundance of palaeotropic and thermophilous elements and some reduction of macrothermic elements of semi-evergreen forests. Together with these changes is a corresponding increase in the role of arctotertiary species in plant communities, and they became dominants in mesophytic forests. Changes in swamp vegetation reflect local environmental dynamics and changes in inundation of the basins.

This study is a contribution to the Project "Neogene palynomorphs from Bulgaria and Poland as palaeoenvironmental proxy" from the BAS-PAS Scientific Exchange Program.

First small-scale insight from varved maar sediments in the environmental and climatic situation during the Middle Miocene Climatic Optimum

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Maar lakes are commonly known for their good fossil preservation and their great potential to study short-termed variations due to their cyclic sedimentation such as varves. The Randecker Maar (17 – 15 Ma) from southern western Germany is no exception with its early discovery leading to a extensive collection of fossil specimens including among others plants, insects, diatoms, gastropods, ostracods, mammals, amphibians and reptiles. Although these provide a good outline for the whole paleoenvironmental situation, an analysis of a complete stratigraphic sequence and therefore the history of the lake itself are missing. Nevertheless, the Randecker Maar has been dated to MN5, which crosses the Early/Middle Miocene boundary and is time equivalent to the "Middle Miocene Climatic Optimum" (MMCO).

On this account a new multidisciplinary project was initiated in 2007, focusing on a re-investigation of previous findings as well as the high-resolution analysis of a new continuous 8-m-sequence with highly differentiated sedimentation. Initial counts and measurements of a section of the varved successions suggest a low sedimentation rate of app. 0.125 mm/yr (80yr/cm). In addition to these, metered values of natural gamma radiation are to be tested for possible cyclic pattern by statistical processes.

Next to other lacustrine indicators, the abundant plant fossils comprising pollen, leaves, fruits and seeds, are of high interest, especially in reference to their paleoclimatic interpretations.

Possible vegetation changes along the studied section may be directly linked to climatic variations because riverine inflow can be mainly excluded. Despite the presumption of Middle Miocene Climate Optimum conditions and likewise a subtropical climate, first analysis of the Integrated Plant Record revealed an indication of seasonality, which shall be discussed herein further by new palynological results. Thus high frequency multiproxy analysis will give detailed insights into the stability of the MMCO, the last warm phase of the Neogene.

The potential of non-laminated Miocene sedimentary records for multi-proxy-environmental analysis on a decadal- to centennial-scale

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A solid age model is the most difficult factor for high resolution analyses to achieve outside the ^{14}C-range. Exceptions such as annually preserved sediments are rare; however, comparable time resolutions can reconstructed by using a combination of various proxies to consider as many environmental aspects as possible. Simple geophysical measurements (magnetic susceptibility and natural gamma radiation) on one continuous section may provide a reliable frame for detecting astronomical or even solar forcing based on statistical calculation to maintain precise dating. On this account, smaller sequences can be studied in more detail, resulting in environmental successions of less than millennial scale.

This methodology was tested on three different depositional systems (estuarine, lagoonal lacustrine, offshore lacustrine) and climatic situations (Mid-Miocene Climatic Optimum, Early Tortonian warm phase, Tortonian transition), using a large set of different proxies. All records reflect short-termed environmental shifts within vegetation, surface water productivity, bottom water conditions, salinity and sediment input. Minor lake/sea level oscillations appeared as one major driving force next to variations within riverine inflow, leading to simultaneous and/or delayed response of different environments. Variations in the amount of wind derived input resulted in significant changes of the pollen compositions. Within the frame of this high-frequency analysis, no significant temperature changes are observed, but fluctuations within mean annual precipitation effected sensitive environments such as marshes on a decadal scale.
Therefore, the combination of proxies representing different environments definitely provides a much more detailed picture of small-scale changes, which may help to understand short termed natural variation even in the Miocene.
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East-European affinity of a fruit and seed flora from NE Italy

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The palaeobotanical study of a brown coal seam in NE Italy (San Pietro di Ragogna, Friulian foothills) pointed out the significant occurrence of several fossil fruit and seed taxa with East European affinity, recorded for the first time in Italy.

The recovered freshwater macrophyte assemblage also has relevant similarity to the ones of modern north Italian lakes. The living species *Menyanthes trifoliata* and *Potamogeton natans* are firmly documented by the carpological record. Nevertheless, the detailed morphological analysis of fossils fruits and seeds of the SPR site allowed to recognize precise morphospecies (*Eleocharis microstylosa, Hypericum tertiaerum, Myriophyllum praespicatum, Najas major-pliocenica, Nymphaea borysthenica*), mostly reported only in Pliocene and early Pleistocene localities of Eastern Europe (Velichkevich & Zastawniak 2003, 2006).Their presence in the SPR assemblage points to a singular east-European affinity. For this reason, this assemblage, even if relatively species-poor, assumes a peculiar character in the framework of the several carpological assemblages known in northern and central Italy (Martinetto 1999; Martinetto & Vassio 2010). Also the geographic position of the site is crucial, because the Venetian-Friulian plain was confined in the northeastern margin of the Adriatic Gulf, isolated from the Po Plain (Massari et al. 2004), but close to the low elevated relieves at the Alps-Dinarides junction. This location was very favourable for the record of palaeovegetational changes during the Plio-Pleistocene transition, when the migration of plant taxa from the central-eastern Europe may have reached only the easternmost part of northern Italy.

Palaeoenvironmental and Chronological Constraints on the Tuğlu Formation (Çankiri Basin, Central Anatolia, Turkey)

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The Çankiri Basin, located in the Northern Part of the Central Anatolian Plateau, is a large Tertiary basin where thick Miocene to Quaternary continental sediments overlain the Cretaceous-Tertiary units. The current investigation focuses on the Tuğlu formation, an Upper Miocene succession mainly composed of dark grey silty and organic rich clays. The type section of Tuğlu has been sampled for an array of multidisciplinary analyses. The palaeontological proxies included ostracod, foraminifers, nannoplancton, pollen, molluscs, charophytes, small mammals assemblages, fish and crab remains. The abiotic parameters studied were: palaeomagnetism and environmental magnetism, stable carbon and oxygen isotopes (on ostracods and bulk sediment samples), strontium isotope (on ostracods and foraminifera) and major elements composition of the sediments. All analysed proxies point to a continental setting characterised by permanent water bodies affected by strong salinity oscillations. A shallow saline lagoon developed in a permanent freshwater lake. Barren layers maybe linked to a short sub-aerial exposure mark the end of the lagoon and the passage to a fluvial environment.

Geochemical analysis data confirmed climate aridity–humidity oscillations as recorded by the micropalaeontological proxies. The analysis of the small mammal assemblages refined the dating of the Tuğlu formation, with the onset of the deposition at the base of the MN9 zone (around 11 Ma) and continuous deposition until the MN11 zone (around 8 Ma). The stable oxygen isotope records from the Tuğlu section point to reconstructed $\delta^{18}O$ values consistent with a flat topography where no prominent mountain belts were yet developed at the plateau margins. To conclude, we can assume that at least until the end of the deposition of the Tuğlu Formation, the Çankiri basin was not yet uplifted. Consequently we could date the surface uplift of the area to post-8 Ma.

Evolution of climate, landscape and vegetation of the continental regions of Central Asia during the Neogene and Quaternary

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The formation of arid areas of Central Asia took place in the Neogene and Quaternary. Arid areas located east of the Caspian Sea had a difficult path of development from the flat land and lake transgressions in the Neogene to the complicated terrain of mountain systems and the surrounding deserts in the Quaternary. These transformations are associated with the latest tectonic phase during which the formation took place, and the modern appearance of the arid zone, climate, vegetation and fauna of the region.

In the Neogene the landscape and biota of this area were greatly influenced by the transgressions and regressions of Paratethys basins and the monsoon climate. On the basis of research of macro- and microflora remains it can be concluded that moderate deciduous flora of Turgai ecological type prevailed along the shores of the vast and numerous lakes in early stage of the stage (Aquitanian). Xerophytic deciduous flora described from localities Kushuk (Kornilova 1960) and Jungar Aktau (Rayushkina 1993), was developed in Burdigalian time due to the increasing arid climate.

Pliocene and Quaternary sediments were studied according to palynology data. The flora of the late Neogene represents the final stage of the existence of sub-tropical and savanna vegetation, with its inherent faunal complex of Late Hipparion. Palynological studies show the development of savannah and steppe dominated by sagebrush-haze-grass associations with tree species (poplar, elm, Caracas), the remains of coniferous-deciduous forest with *Betula* sp., *Alnus* sp., *Ulmus* sp., in river valleys. *Ulmus* sp. and Salix sp. have been identified in the floodplain plants (Nigmatova, 2010).

In the Eopleistocene towering mountain ranges blocked the path of the southern monsoon, and helped formation of the modern arid zone and differentiation of landscape areas (steppes and deserts of different types, mountain belts) (Aubekerov 1990). The first traces of glaciations recorded with the rise in the mountains above the snow line. Quaternary climate became more continental, changing parameters of the era of glaciations and interglacials.

Further desertification of open spaces and the formation of vertical zones in the mountains occurred during the Quaternary. Landscape-climatic zones had the border shape close to current one. Changing the boundaries of the zones, the expansion of lowland forests and displacement of the vertical boundaries of mountain belts occur in the glacial phase.

The northern part of the arid zones of had more pronounced response on global climate change. At the same time, the regions located to the south, had a smoother and less expressive features of the arid zone due to its stable climate and landscape conditions. This feature was characteristic for most part of the Quaternary period.

Palynological data supported by the data of the surface sediments study revealed several stages of changes in climate and vegetation: three stages of the Eo-pleistocene climate of the Kazakhstan (they had not been allocated early), four stages of the Lower Pleistocene, four stages and three substages in the Middle Pleistocene, four stages in the Upper Pleistocene. First developed stratigraphic (palinozonal) scheme of the Holocene of the Kazakhstan arid zone has 13 climate-stratigraphic horizons, reflecting changes in vegetation, climate (temperature and humidity) in Preboreal, Boreal, Subboreal, Atlantic and Subatlantic (Nigmatova 2008, 2010).

Thus, the vertebrate fauna and vegetation of arid zones of the deeply continental areas are more inert and very late response to any event, in contrast to the fauna and vegetation of marine regions. Further studies will more accurately answer on the question of milestone Neogene and Quaternary of continental regions.

Kazakhstan is the link between the offshore regions of the Caspian Sea, Black Sea and the continental regions of western Siberia, China and Mongolia. So far, there are many problems with the correlation of geological events of the Neogene and Quaternary periods in the vast continental region. Materials on the climate, landscape and vegetation of Kazakhstan can be used for international projects to address these problematic issues.

Diatom-based correlation of Neogene lacustrine sediments from Gotse Delchev Basin, Southwestern Bulgaria

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Gotse Delchev graben is situated in the southwestern part of Bulgaria, surrounded with some of the highest mountains on the Balkan Peninsula. The graben is formed as a result of regional exstensional environments, typical for back-arc zone of the Aegean island arc. The flanked structures are normal faults and strike-slip faults dipping 60-90^{o}. Part of them are old structures, activated during the Neogene- Quaternary stage, others are formed during it.

Four lithostratigraphic units are detached in the basin: Valevitsa Formation, Baldevo Formation, Nevrokop Formation and Sredna Formation.

This study integrates our work on diatom biostratigraphy. The diatom thanatocenoses from the sediments of Baldevo Formation are monotaxonic and comprised of variable roughly silicified *Aulacoseira/Melosira* species. During recent decades they have been determined according to Jousé (1952) as *Melosira praegranulata* Jousé, *M. praeislandica* Jousé and *M. praedistans* Jousé. Pertinent taxonomic and morphological data of *Aulacoseira* taxa, the dominant group of diatoms, are reviewed and discussed. Our observations suggest that there may be several fossil *Aulacoseira* species but their taxonomy is far from being clear. The nomenclatural confusion of the *Aulacoseira* taxa within Gotse Delchev Basin led us to reinvestigate the type materials, housed in the Pantocsek Collection, Natural History Museum Budapest, and the Ehrenberg Collection, Natural History Museum Berlin, of

Melosira/Aulacoseira and their relationships with our fossil *Aulacoseira* morphodemes.

Diatom analysis, complemented by sedimentological investigation could demonstrate the impact of different paleoenvironmental proxies on the development of the diatom flora. The primary goal of this study was to determine which of the paleoenvironmental variables explained best the variation in the fossil diatom assemblages of the sediments studied. We found that the process of eutrophication, the salt content, temperature and the changes in the depth of the lake correlated significantly with patterns in the diatom assemblages. The results of these different analyses presented here indicated different stages in the paleoenvironmental development of the basin, at the end of the Miocene and the beginning of the Pliocene. A large alluvial system with local swamping in two sites within the basin occurred during that time.

Jousé A. 1952. On the history of the diatom flora of Lake Khanka. Trudy Instituta Geografii, Akademia Nauk SSSR 51: 226-252 (in Russian).

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Cenozoic palaeovegetation patterns for Western Siberia and the Northeast of Russia reconstructed from plant functional type diversity

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There exist numerous quantitative descriptions of Cenozoic vegetation evolution in Western Siberia (WS) and the Northeast of Russia (NER) based on carpoflora and fossil leaves (e.g., Krishtofovich 1955; Budantsev 1983; Nikitin 2005; 2006; Akhmetiev 2007). However, no quantitative survey of vegetational data is available so far that allows for a detailed analysis of regional vegetation gradients and their changes along the Cenozoic cooling. Here we use diversity of 27 herbaceous to woody plant functional types (PFTs) to classify 148 carpofloras from WS and NER covering the time-span from the middle Eocene to the late Pliocene. The analysis of PFT diversity spectra allows for quantitative assessment of spatial patterns and temporal trends of vegetation evolution. Based on the application of multivariate statistics on the PFT spectra of the single sites considered, 8 different biome types are identified and shown in vegetation maps for a total of 9 time slices. The biomes comprise open woodland, shrub, conifer forest and various types of mixed forests with a varying fraction of broadleaved evergreen taxa. Hence, a first comprehensive, quantitative data set is presented for the study area that can be used to test previous, qualitative reconstructions and recently published palaeoclimate data (Popova et al. 2012). For WS the maps illustrate the change in composition of the arboreal flora from the Palaeogene to middle Miocene, then the transition to open woodland existing from the late Miocene related to increasing aridity (in the southern part of WS only). Contrasting results are obtained for NER where forest biomes persisted until the late Pliocene, even in the High Arctic. The observed patterns are largely consistent with the climate data provided in an earlier study.

Modern gridded climate data - Effect of resolution on differences of CRU and WorldClim data sets

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For continental palaeoclimatic proxy data from palaeovegetation (such as the Coexistence Approach / Nearest Living Relative), but also from palaeofauna, modern data sets on present-day climatic variables are used. With classical station data (such as FAOCLIM2), information of climatic variables has to be transferred to the points of interest by the user himself. The spatial resolution and transfer method can be freely defined, but is often limited by the access to station data, auxiliary data, and methodological and computing skills. To the contrary, gridded data sets have the advantage of already providing continuous spatial coverage. However, the resolution is predefined, while information also stems from station data that are processed in a specific manner given by the providers. The selection of one specific gridded data set, assumed to be the standard case for many users, will certainly have an effect on the results of the palaeoproxy climate estimation, but is a major effort if taken seriously. To assist this selection, differences between two of the most popular gridded data sets in climate research, the Climate Research Unit (CRU) CL (versions 1.0 and 2.0), and the WorldClim (version 1.3) are investigated, especially considering the effect of grid cell size and the selection of climate variables.

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Climate response to variations of the Gulf Stream intensity - Comparisons of model results with palaeovegetation records for the Late Miocene

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The meridional overturning circulation in the Atlantic Ocean and, hence, the northward ocean heat transport intensified in the Neogene, not the least because of an open Central American Isthmus. However, the effect of a weaker-than-present ocean circulation on climate on either side of the North Atlantic is still an open issue, especially with regard to the Neogene climate cooling. We present results of climate modelling sensitivity experiments, which focus on the climate response to different heat transports in the North Atlantic Ocean using an earth system model of intermediate complexity. The sensitivity experiments are designed for Late Miocene and for present-day conditions. The modelled climate data are compared to continental palaeovegetation proxy data for temperature and precipitation.

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The climate of the Carpathian Miocene reflected by the saliferous facieses

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The profound studies of this subject in the last period of time allowed us to enforce some important points of view. The Miocene evaporites of the Carpathian area can be included in a Lower and Middle Miocene stratigraphic intervals, in the stages Aquitanian, Burdigalian and Badenian. These evaporites reflect any distinct salt-generating phases due the warm phases of a climatic cycle with ~ 4.1 ma period, clearly distinguished by the lithology of the Mio-Pliocene deposits in the Carpathians area. The salt-generating phases are manifest in Aquitanian, in Middle Burdigalian and in Badenian, and are synchronous with the Miocene coal-generating phases. The salt-generating phases start with the precipitation of the gypsum member, continue with sedimentation of the halite and eventually of the deliquescent salts; in the end it is another (final) gypsum member. These salts precipitation represent a classic evaporites series reflecting a typical marine-lagoonal facies. During the Lower Miocene (Aquitanian) salt-generating phase the evaporites series was complete, in the external area of the Carpathians. During the Burdigalian salt-generating phase it was not possible (climatically) the precipitation of the halite member. This phase produced the gypsum members only. In return, during the next salt-generating phase (the Badenian one), the halite member is present above the gypsum member. During this phase, the area with salts sedimentation was much more extensive, including the Transylvanian Basin and the Maramureş Depression. To the final part of this phase, even in the Moldavian Platform, gypsum could be precipitated. The first gypsum member of the Aquitanian salt-generating phase was named in the past the “lower gypsums”. At the stratigraphic level of this gypsum it were distinguished the “Feschi Gypsum” (Moldavian Subcarpathians) and the “Sărata Gypsum”(Wallachian Subcarpathians). The halite member of the lower salt-generating phase is represented by salt massifs with the associated gypsum member and makes up the so-called “lower salt formation” (the lower saliferous formation). This is associated with a “potassium complex” with deliquescent salts found in a restricted zone within the “lower salt formation” (between Putna and Ozana valleys). The final gypsum member of the Aquitanian salt-generating, Varniţa Gypsum”, was weaker than the lower one (Moldavian Subcarpathians). The lower gypsum member of the Burdigalian salt-generating phase is well developed and was called the “Perchiu Gypsums” in the Moldavian Subcarpathians. In their Wallachian part, the correspondent could be the “Vispeşti Gypsum” of the Istriţa Hills zone. The final Burdigalian gypsum member is weak and it was named “Stufu Gypsum” in the Moldavian Subcarpathians. At the upper part of the Burdigalian deposits pile there is another gypsum level, associated with dolomite schists, which was called the “Gîrbova Gypsum”. This gypsum level could be an outer-sequence episode in respect with the previous salt-generating phases or could be an initial gypsum member of the new Badenian phase, starting in Uppermost Burdigalian. The Badenian salt-generating phase is illustrated in the outer Carpathians area by the “Evaporites Formation” (upper saliferous formation) containing an initial gypsum member followed by salt massifs. In the Istriţa Hills zone the gypsum member was called “the selenite of Valea Rea”. The final gypsum member of the Badenian salt-generating phase is contained in the classic Badenian.

Assessing aridity in palynomorph records – tests with a novel technique of signal enhancement and employment of aridity indices

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Palynofloras in general are capable to reflect arid or seasonally dry palaeoclimate because they reflect as well regional vegetation, apart from the local phytocoenosis in the deposition area where lakes and rivers may account for additional water supply. There exist various classical techniques in pollen analysis to estimate aridity in a record, such as the relation of arboreal / non-arboreal pollen or the percentage proportion of certain herbaceous components in a synthesised pollen diagram, respectively. Although these procedures allow for detecting major changes of biomes they do not allow for quantifying drying events. To obtain quantitative estimates from palynomorph records the Coexistence Approach (CA) is frequently used. However, in practical experience it is shown that the method has weaknesses in resolving dry climates. This is in parts due to the low diversity of palynomorph components in the spectra that are indicative for dry climates (e.g., *Nitraria, Ephedra*), in parts related to the fact that potentially relevant floristic components cannot be identified as morphotypes (e.g. identification of a genus in the Chenopodiaceae and Asteraceae families). Here we apply the CA together with a recently developed procedure of signal enhancement based on probability considerations on various records from the Eastern Paratethys. The approach employs palynomorph frequency as an additional dimension in CA analysis. We take into account that the climatic ranges of NLR taxa together with commonness of a component define the standard deviation: if we have a high palynomorph frequency we have a small standard deviation and the other way round. It can be demonstrated that in many cases the procedure provides a probable solution thus improving the resolution of the CA when reconstructing drier climates. Furthermore, the potential of various aridity indices is tested on the same records.
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Comparative analysis of climate reconstructions results from Gotse-Delchev Basin (SW Bulgaria)

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The present investigation has for an object to compare the results from palaeoclimate reconstructions based on pollen and plant macrofossil data from the Late Miocene of Bulgaria. Pollen materials originated from a 63 m thick profile in the Kanina opencast mine (Gotse-Delchev Basin, SW Bulgaria). The exposed sequence comprises a basal unit with brown coal-clay cycles and clayey/siliclastic cover

layers partly representing a lacustric facies. Samples were analyzed and quantitative data were obtained for 30 poleniferous samples.

The macrofossil materials originated from the same location but the flora bearing sediments are located above the pollen sampled profile. They are preserved basically in diatom rocks with different amounts of clay and consist of 1416 spesimens representing different plant parts remains but mostly leave blades.

Results from the palynological and palaeobotanical analysis of these materials were used as a base of palaeoclimate reconstructions. The climatic data reconstructed by the Coexistence Approach showed very close results but nevertheless there are some differences that should be analyzed and discussed.

Mean annual precipitation intervals derived from both types of material are almost fully concurrent. But analyses of the macroflora provide little lower temperature intervals which could be due to two reasons. The macrofossil bearing sediments are located above the pollen profile i.e. they are closer to the end of the Late Miocene, which as we all know is marked by a significant cooling of the climate.

On the other hand collected macrofossil remains originated from a very wide profile presenting a long period of time. During this period most likely fluctuations in temperature occurred but the averaging of materials and results has led to lowering of temperature intervals.

New palynological studies of the Pliocene freshwater deposits from the Mizerna locality, West Carpathians, Poland

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The Mizerna freshwater sediments, rich in well preserved plant remains have been known for over sixty years, and are listed among the most important late Cenozoic palaeobotanic sites of Poland and Middle Europe as well. According to Szafer (1949, 1952, 1954), their macrofloral remains document development, succession and changes of vegetation cover in the West Carpathians during the Pliocene and early Pleistocene.

The newly-obtained data come from 39-m long sedimentary core of the Mizerna-Nowa borehole. During the palynological studies a total of 145 morpho-taxa of sporomorphs and 24 morpho-taxa of freshwater organic-walled algal micro-remains have been identified.

Results of pollen analysis, e.g. occurrence of aquatics pollen (e.g. Nymphaeaceae) and abundant freshwater algae (mainly *Pediastrum*, *Botryococcus*, *Sigmopollis*, and zygospores of Zygnemataceae) point to sedimentation in a freshwater body, surrounded by herbaceous vegetation. Higher situated habitats were forested with conifers, among which *Picea* as well as *Pinus*, *Abies*, *Tsuga*, and *Sciadopitys* were particularly important. Along riversides and streams favourable conditions for riparian forests dominated by *Alnus*, *Ulmus*, *Salix*, *Betula*, and accompanied by *Pterocarya*, *Carya*, *Juglans*, *Acer*, and others, existed. In places with high ground-water level, also *Taxodium* and single trees of *Nyssa* probably occurred. More dry, higher terrains were presumably covered by mixed forests with *Fagus*, *Quercus*, *Carpinus*, *Castanea*, *Betula*, accompanied by *Tilia*, *Aesculus*, *Corylus*, and conifers.

Changes in the palynoflora reveal, in turn, decrease of mixed forests relatively rich in warm-temperate taxa, development of more photophylous and open-country plant communities and,

finally, increase of coniferous forests with *Picea*, *Pinus*, *Tsuga*, *Abies*, very poor in warm-temperate taxa. The main change in the composition of the spore-pollen spectra is the decreasing of both palaeotropical and warm-temperate taxa. Although, the composition of the spore-pollen spectra is also connected with facies conditions, they point to gradual changes of vegetation and palaeoclimate during sedimentation. Moreover, the new results point to a Pliocene age of the whole Mizerna-Nowa palynoflora.

Preliminary results of investigations on fungal remains from Pliocene deposits of Mizerna (southern Poland)

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In course of palynological investigations on Pliocene deposits from Mizerna (southern Poland) in pollen slides fungal remains were found. There were conidia of *Tetraploa* and dispersed fructifications of epiphyllous fungi, mainly affinities of Microthyriales. Presence of the members of Microthyriales (*Trihothyrites* and, probably *Lichenopeltella*), especially in lower part of the studied profile, points to rather high total annual rainfall (probably above 1000 mm; Elsik 1978) and/or high air humidity. Besides that, climate was mild as representatives of genus *Tetraploa* occur today in areas with warm, especially subtropical and tropical climate (Worobiec et al. 2009, Karpińska-Kołaczek et al. 2010). It is confirmed by the results of palynological analysis. In the whole profile genera of temperate climate plants dominate, however, there are admixture of warm temperate plants, and even single subtropical taxa. All these observations point to warm temperate climate during sedimentation of the studied deposits. Climate was distinctly cooler than that of the Miocene, but still warmer comparing with the present-day climate of the studied area.

The NECLIME Conference

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