INSTITUTE OF
GEOLOGICAL SCIENCES
NAMED AFTER K.I. SATPAYEV

THE MAIN
BOTANICAL
GARDEN

NECLIME

NECLIME Annual Conference 2024

Almaty, Kazakhstan

September 8-15

Program and Abstracts

General Schedule

Sunday, September 8th

Arrival, hotel accommodation

For those who already arrived we meet at the hotel lobby at 18:00 (local time) to walk in the city center and have dinner together

Monday, September 9th

9.00 – 10.00 Registration

10:00 – 17:30 Scientific Sessions:

Welcome and Introduction to NECLIME

Oral and poster presentations

13:30 – 14:30 Lunch

Oral and poster presentations

18:45 Welcome dinner

Tuesday, September 10th

10:00 – 17:30 Scientific Sessions:

Oral and poster presentations

13:30 – 14:30 Lunch

Oral and poster presentations

Final discussion

Wednesday, September 11th

10:00 – 14:00 City tour and visit to the mountain **Chimbulak (Medeo)** (Provide a hat, jacket and comfortable shoes.)

15:30 – 18:00 Visit of the **Main Botanical Garden** (NORTHERN ENTRANCE: Timiryazev str.46)

September 12 – 14, Post conference field trip

Post conference field trip

The total trek is about 800 kilometers. For the field trip, you should provide trekking shoes, headgear, and long sleeve shirt. The weather in September is 20-25°C, usually without precipitation.

Thursday, September 12th

7.00 a.m. – Breakfast in the hotel and check-out from the hotel

7.30 - Departure from the hotel, visit of the Charyn Canyons (about 230 Km)

13.00 – Lunch

14.00 - Departure to Zharkent, visit to Zharkent mosque (Cultural monument)

17:30 – 19:30 - Transfer to Altyn Emel National Park (150 km)

Evening: Dinner and accommodation at the hotel in Altyn Emel National Park

Friday, September 13th

9:00 – 13:00 Excursion to Aktau Mountains (key geological section of Cenozoic of South-Eastern Kazakhstan) (80 km)

13:00 – 14:00 Lunch at 700-year-old Willow tree

15:00 – 18:00 Visit to the Singing Dune (40 km)

Evening: Dinner and accommodation at the hotel in Altyn Emel National Park

Saturday, September 14th

9.00 – 18:00 Departure to Almaty city, visit of Tambaly tas Buddhist petroglyphs on the Ili River, Lunch at a restaurant in Konaev city

18:00 Return to Almaty, check-in to hotel

Sunday, September 15th Departure day

Scientific program

Monday, September 9

09:00	Registration
10:00	**Geroy Zholtaev** – Director IGN *Opening of the conference, welcome address*
10:15	**Gulnara Sitpaeva** – Director Botanical Garden *Welcome address*
10:30	**Angela A. Bruch** in behalf of the NECLIME coordination team *Welcome and Introduction to NECLIME*
11:00	***coffee break and posters***
	Chair Ivan Gabrielyan
11:30	**Anna Averyanova,** Svetlana Popova, Valentina Tarasevich & Torsten Utescher *Climate reconstruction of the Late Oligocene flora of East Kazakhstan (Zaisan depression) based on plant macro and microfossils*
11:50	**Svetlana Popova,** Anna Averyanova, Valentina Tarasevich & Torsten Utescher *The Late Oligocene vegetation of Kazakhstan reconstructed on the basis of PFT data*
12:10	**Kseniya Nesterova,** Svetlana Popova, Anna Averyanova & Kate Nosevich *Reconstruction of Oligocene climate of eastern Kazakhstan based on fossil species of Quercus L. with using Coexistence Approach*
12:30	**Aizhan Zhamangara,** B.K. Zhapparova, K. Kashaganova *Change in the taxonomic composition of Neogene charophytes in connection with paleoecological changes*
12:50	***lunch break***

Chair Jian Huang

14:00 **Wilfried Konrad**, Anita Roth-Nebelsick & Christopher Traiser
High productivity at high latitudes under environmental conditions of the Eocene

14:20 **Olesia V. Bondarenko** & Torsten Utescher
Eocene Climate of East Asia – preliminary data

14:40 Vladimir Bozukov, **Dimiter Ivanov** & Daria K. Ivanova
New Macro- and Micropaleobotanical Data on the Palaeogene Flora from the Hvoyna Basin (Central Rhodopes, Bulgaria)

15:00 **Junling Dong,** Anita Roth-Nebelsick, Wilfried Konrad, James H. Nebelsick & Bainian Sun
Evolution of Plant Functional Traits in Response to the East Asian Monsoon from the Early Oligocene to the Late Miocene in South China

15:20 ***coffee break and posters***

Chair Martina Stebich

16:10 **Manuel Casas-Gallego,** Rafael Carballeira, Yul Altolaguirre, Rafael Moreno-Domínguez, José M. Postigo-Mijarra & Eduardo Barrón
The Early Miocene Lacustrine Basin of Rubielos De Mora (Eastern Spain) revisited: A Study of Pollen, Diatoms and Geochemistry

16:30 **Desa Djordjevic Milutinovic**
Rhodomyrtophyllum sinuatum (Bandulska) Walther as a Paleogene relict in the Early Miocene of Berane basin (Montenegro)

16:50 **Katharina Methner,** Emilija Krsnik, Jens Fiebig, Oliver Kempf & Andreas Mulch
Central European temperature response to middle Miocene climate change

17:15 ***Visit of the Geological Museum of the Institute of Geological Sciences***

18:45 ***Welcome dinner at Fahar restorante, Dostyk str. 36***

Scientific program

Tuesday, September 10

	Chair Arata Momohara
10:00	**Oksana Marynirch** *Keynote: Modern vegetation of Kazakhstan*
10:30	**Jian Huang,** Hung Ba Nguyen, Napussawan Thongsangtum, Teng-Xiang Wang & Yupa Thasod *Neogene Establishment of Tropical Monsoon Forest in Indochina*
10:50	**Li Wang,** Shu-Feng Li, Arata Momohara & Tao Su *Leaf morphologies of modern and fossil bamboos and their palaeoclimatical implications*
11:10	**Ivan Gabrielyan,** Johanna Kovar-Eder & Angela A. Bruch *Fossil Oaks of the Early Pleistocene Sisian formation in Armenia*
11:30	***coffee break and posters***
	Chair Dimiter Ivanov
12:00	**Arata Momohara,** Yusuke Matsuda, Nao Miyake & Hakaru Shiroike *Impact of the Aira Caldera Volcanic Eruption on Flora and Vegetation in Southern Kyushu during the earliest Stage of the Last Glacial Maximum*
12:20	**Aleksandra V. Ivanova,** Alexey S. Tesakov & Alexey A. Bondarev *Palynology of Mid-Early Pliocene Deposits in the South of Western Siberia*
12:40	**Ekaterina Nosevich,** Natalia Nazarova & Ljudmila Pestova *Pollen Record of the Sol´-Iletsk Core (Orenburg District) as a new Source of Data about South Ural Gelasian*
13:00	**Shahizada Akmagambet,** Saida Nigmatova, Aizhan Zhamangara *Modern approaches to paleoclimate reconstruction: application of the coexistence approach to the Miocene flora of Zhongar Aktau (on the National park Altyn-Emel)*

13:30 ***lunch break***

Chair Manuel Casas Gallego

14:30 **Jia Li**, Jia Liu, Shu-Feng Li, Tao Su, Zhe-Kun Zhou, Lin-Bo Jia, Shi-Tao Zhang
Plant diversity and paleoenvironment evolution on the southeastern margin of the Tibetan Plateau during the Eocene-Oligocene transition

14:50 Jiangbo Meng, Jiagang Zhao, Jian Huang, Tao Su, Linlin Chen, Zhekun Zhou & **Shufeng Li**
Climate Evolution and Its Driving Factors in the Tethys Region During the Cenozoic Era

15:10 **Yong-Jiang Huang**, Hao-Ran Zong, Shi-Tao Zhang, Arata Momohara & Zhe-Kun Zhou
Palaeoelevation at the southeastern margin of the Tibetan Plateau: new evidence from the Baoshan Basin

15:30 **Zuo Ruohan** & Zhang Shitao
Influence of Climate Change in Glacier Geological Relics of Shangri-La Region

15:50 ***coffee break and posters***

Chair Angela Bruch

16:10 **Christine Hertler**
Dispearse – a family of agent-based models to simulate dispersal scenarios

16:30 **NECLIME final discussion**
Conclusions, comments, and general discussion

Poster Presentations

Nela Doláková, **Marianna Kováčová**, Torsten Utescher & Mine Sezgül Kayseri Özer

Vegetation and climate oscillations during MCO/MCT in Central and Eastern Paratethys

Dana Höfer, Martina Stebich, Lauer, T., Nowaczyk, N., & Katzschmann, L.

Palynological Studies on Pleistocene Biostratigraphy, Palaeoenvironment and Subrosion History in Thuringia (Central Germany)

Lisa Schiersch, Angela A. Bruch

Quantifying the relationship between the regional vegetation and the pollen record of Armenia and Georgia

Abstracts

MODERN APPROACHES TO PALEOCLIMATE RECONSTRUCTION: APPLICATION OF THE COEXISTENCE APPROACH TO THE MIOCENE FLORA OF ZHONGAR AKTAU (ON THE NATIONAL PARK ALTYN-EMEL)

Shahizada Akmagambet[1], Saida Nigmatova[2], Aizhan Zhamangara[3]

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An analysis of the Miocene flora of the Junggar Aktau was conducted based on the work of G.S. Rayushkina, who identified 56 species belonging to 43 genera and 27 families. However, using modern technologies, such as the Coexistence Approach (CA), it was found that only 21 of these 56 taxa are present in the database used for climate reconstruction. This finding highlights the need to update paleodatabases and adapt methods to new scientific data to obtain more accurate climate data and make more reliable paleoclimate reconstructions.

The analysis of climate data based on the flora of the Junggar Aktau, reconstructed using the CA method, indicates a wide range of temperature and precipitation conditions in the region during the Miocene. Mean annual temperatures varied from moderately cool to warm, with the coldest month temperature possibly dropping to −41.0°C−41.0°C, indicating significant seasonal fluctuations. Precipitation also ranged from extremely low during the driest months to substantial during the wettest periods, suggesting the possibility of both arid and humid ecosystems. However, it should be noted that the obtained data may not be fully valid, as this analysis involves less than 50% of the taxa from the entire flora. This limitation underscores the need for further research and data refinement to achieve more accurate results.

Rayushkina, G. S. "Miocene Flora of the Junggar Aktao (Ili Basin)." Faunistic and Floristic Complexes of the Mesozoic and Cenozoic of Kazakhstan. Almaty (1993): 116-132.

Utescher, T., Bruch, A., & Mosbrugger, V. (2024). The Palaeoflora Database - Documentation and Data (Version 2024) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.10881069

CLIMATE RECONSTRUCTION OF THE LATE OLIGOCENE FLORA OF EAST KAZAKHSTAN (ZAISAN DEPRESSION) BASED ON PLANT MACRO AND MICROFOSSILS

Anna Averyanova[1], Svetlana Popova[1], Valentina Tarasevich[1], Torsten Utescher[2]

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The Late Oligocene is the time of the development of typical warm temperate Turgay vegetation in Kazakhstan and adjacent areas. The studied flora originates from the Oshagandy Formation that correlates with the early part of the Chattian (Late Oligocene). The palaeobotanical analysis of the flora reveals 38 plant taxa, identified by macro- and microfloral remains related to Lycopodiophyta (1), Pteridophyta (3), Gymnospermae (7), Gnetophyta (1), Magnoliophyta (25). Macrofossils include mainly Cupressaceae (Metasequoia, Taxodium and Glyptostrobus), Betulaceae (*Alnus*, *Corylus*) and *Ulmus*, as well as large number of monocots and aquatic ferns. The palynospectrum is dominated by pollen of the genus *Picea* (about 30%) and *Alnus* (about 40 %), with noticeable amounts of pollen from other birch genera (about 7% in total). Climate reconstruction has been performed with using Coexistence Approach it has been revealed a seasonal temperate climate on study area. The pollen data reflect the zonal regional vegetation, the macroflora most probably reflects the lakeside wetland vegetation which may have experienced a warmer microclimate, compared to the upland realm. In whole significant climatic changes was not documented since Early Oligocene Rupelian time. The reported study was funded by Russian Science Foundation project N◦ 23-27-00076.

EOCENE CLIMATE OF EAST ASIA – PRELIMINARY DATA

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Eocene latitudinal continental temperature and precipitation gradients and patterns of East Asia are studied in time and space using the Coexistence Approach (CA), for the first time applied on an extensive regional palaeobotanical record. The palaeobotanical data used in this reconstruction are compiled from literature resources on ca. 240 reasonably well-dated floras, covering the early, middle and late Eocene, i.e. a time-span of ca. 22 myr. The studied localities are located in East Asia, including Western and Eastern Siberia, Far East of Russia, Korea, China, India and Japan. All palaeofloras considered were carefully re-evaluated regarding the validity of taxonomic identifications and the Nearest Living Relatives (NLRs) of the fossil taxa. In this study, three temperature and four precipitation variables are reconstructed: mean annual temperature (MAT), cold and warm month mean temperature (CMMT, WMMT), mean annual precipitation (MAP), and mean monthly precipitation of the wettest, driest and warmest month (MPwet, MPdry, and MPwarm). In order to determine climate seasonality, the mean annual range of temperature (MART) and the mean annual range of precipitation (MARP) are calculated as the difference of WMMT and CMMT and MPwet and MPdry, respectively. To visualize the results, a series of palaeogeographic maps is provided and discussed. The maps, allowing to trace the evolution of all climate variables throughout the Eocene, are based on means of coexistence intervals for each palaeoflora and averaged for the time intervals regarded. The differentiation of climatic zones is based on a significant change in the prevailing mean values. The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (theme No. 124012200182-1).

NEW MACRO- AND MICROPALEOBOTANICAL DATA ON THE PALAEOGENE FLORA FROM THE HVOYNA BASIN (CENTRAL RHODOPES, BULGARIA)

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In the current study new macro- and micropaleobotanical data about fossil flora from Hvoyna Basin (Central Rhodopes) are presented. The Paleogene section of the Hvoyna depression is presented by sedimentary and volcanic rocks. The stratigraphic subdivision of the sedimentary section includes the following units (from bottom to top): Basal marble breccia-conglomerate formation, polymictic breccia-conglomerate formation, and sandstone-siltstone formation. The sandstone-siltstone formation is built up by rhythmic alternation of sandstones, siltstones, argillites, minor marlstones, and clayey limestones. Based on current data (mainly paleofloristic) the suggested age the formation is in the range Late Eocene–Early Oligocene. The paleobotanical material presented in the current study originates from the fine terrigenous sediments of the sandstone-argillite and conglomerate-argillite formation found in the area of the villages of Orehovo (macroflora) and Hvoyna (microflora).

Up to now, four localities of Paleogene flora are known in the region, namely - Hvoyna, Malevo, Orehovo, and Pavelsko. So far, only the following four species are known from what is found near the village of Orehovo: *Gleichenia rhodopaea*, *Dryophyllum dewalquei*, *Eugenia splendens* and *Rhodomyrtophyllum sinuatum*. Based on new research, 14 more species were found in the area. Five of them - *Cassiophyllum ambiguum*, *Cyperacites chavannesii*, *Dalbergia rectinervis*, *Sapindus ungeri*, *Typha latissima* - are new to the fossil flora of the Hvoyna Basin.

The species studied here, which were recorded for the first time in the Orehovo paleoflora, are known for the Paleogene flora of the Rhodopes. This is in accordance with its tropical to subtropical character, and the re-establishment of the Rhodope endemic species *Pinus palaeorhodopensis* is an expression of the peculiarity of the paleoflora of this region.

The microflora consists of 23 fossil taxa. The ferns show high taxonomic variety (9 taxa) as well as angiosperm plants (10 taxa). The best presented angiosperm family is Juglandaceae with 4 fossil taxa.

Based on the floristic composition, forests, and shrubs of four types are differentiated, the mesophylous and mesohygrophylous forest paleocommunities were widely distributed. Our stratigraphic interpretation of the fossil data is in accordance with the suggested Late Eocene to Early Oligocene age.

VEGETATION AND CLIMATE OSCILATIONS DURING MCO/MCT IN CENTRAL AND EASTERN PARATETHYS

Nela Doláková[1], Marianna Kováčová[2], Torsten Utescher[3], Mine Sezgül Kayseri Özer[4]

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Originally, we analyzed the Late Burdigalian to Serravalian pollen spectra from the Czech and Slovak regions of the Central Paratethys, as well as the Mura-Zala basin and Transylvanian basin. These were compared with spectra from Eastern Paratethys in Turkey. The climax of the Miocene Climatic Optimum (MCO) revealed oscillations in climatic factors, such as increasing seasonality in temperatures and precipitation. Subsequent cooling and observable precipitation fluctuations were documented as evidence for the Miocene Climate Transition (MCT) (Doláková, Kováčová, Utescher, 2021). The vegetation character in Central Paratethys underwent significant changes due to the Alpine uplift of the western Alps and Carpathians, initiating altitudinal zonality. Differences mainly in quantitative representation of zonal elements between northern localities (Czechia and Slovakia) and southern parts of this are (Slovenia, Romania) indicates increasing of latidudinal zonality. In Eastern Paratethys, palynospectra indicated an earlier trend of gradual cooling and a notable shift towards more arid and continental climate conditions. This trend may be linked to the presence of the vast moderate Eurasian continent (Vernyhorova et al., 2023).

Doláková, N, Kováčová, M, Utescher, T. (2021): Vegetation and climate changes during the Miocene climatic optimum and Miocene climatic transition in the northwestern part of Central Paratethys. - Geological Journal.56, (2), 729–743.

Vernyhorova, Y.V., Holcová, K., Doláková, N., Reichenbacher, B., Scheiner, F., Ackerman, L., Rejšek, J., De Bortoli, L., Trubač, J., Utescher,T. (2023): The Miocene Climatic Optimum at the interface of epicontinental sea and large continent: A case study from the Middle Miocene of the Eastern Paratethys. - Marine Micropaleontology 181, 102231

EVOLUTION OF PLANT FUNCTIONAL TRAITS IN RESPONSE TO THE EAST ASIAN MONSOON FROM THE EARLY OLIGOCENE TO THE LATE MIOCENE IN SOUTH CHINA

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Plant functional traits are essential characteristics that define how plants respond to and adapt to the environment, and these traits are intimately connected to numerous ecosystem processes and functions. The East Asia Monsoon (EAM) has significantly influenced on ecosystem processes and functions since its gradual establishment after late Eocene. The origins (stem age) of the flora in East Asia, which occurred after early Oligocene, are related to the establishment of the EAM. The climate of South China has been chiefly dominated by the East Asian monsoon since that time. While the impact of climate change on evolution of plant diversity has been widely discussed, how plant physiological traits change with enhancement of EAM remains unclear.

In this study, we investigate the changes in plant traits from the early Oligocene to late Miocene in response to the EAM. We quantify the leaf size of dicotyledonous expressed as leaf area, petiole width and leaf mass per area, from three fossil floras in the South China. The results suggest that changes in plant traits have a positive correlation with the ratio of three wettest months precipitation (3WET)/ three driest months precipitation (3DRY) and the mean annual precipitation (MAP). This research highlights the impact of the EAM on plant functional traits, providing insights into how long-term climatic shifts influence plant adaptation and ecosystem processes.

THE EARLY MIOCENE LACUSTRINE BASIN OF RUBIELOS DE MORA (EASTERN SPAIN) REVISITED: A STUDY OF POLLEN, DIATOMS AND GEOCHEMISTRY

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The Rubielos de Mora basin in eastern Spain comprises a 600-800m-thick lacustrine sedimentary succession of early Miocene (Burdigalian) age (Ramblian continental stage). It contains *Konservat-Lagerstätten* deposits that have yielded remarkable fossil assemblages of plant macroremains, arthropods, amphibians and mammals. Additionally, various palynological studies have been conducted in the basin. In this study, we revisit previous interpretations by performing new palynological, diatomological and geochemical (carbon and nitrogen stable isotopes and XRF) analyses on outcrop samples from the eastern and western margins of the paleolake. The results indicate that the vegetation was dominated by conifers, mainly *Pinus* and Taxodioideae, and a mixture of temperate deciduous and thermophilous evergreen trees such as *Alnus*, *Carya*, *Ulmus*, *Engelhardia*, Fagaceae (*Tricolporopollenites pseudocingulum*), *Myrica* and *Olea*. Due to their scarcity in the Iberian Miocene fossil record, the occurrence of several taxa like *Parrotia*, *Pistacia, Rhamnus* and *Emmapollis* (Chloranthaceae) is significant. The relative abundance of herbaceous taxa is overall low, below 10% of the assemblages studied. This vegetation composition fits well in the conceptual framework of a mostly forested Iberian Peninsula during the Burdigalian. The assemblages are rich in paleotropical elements, indicating a warm and humid climate. Alternation in the abundance of Taxodioideae, *Pinus* and *Botryococcus* reflects the cyclical influence of climate on the vegetation adjacent to the paleolake. The diatom assemblages are relatively diverse (52 species). The changes in composition of the

diatom communities, the benthic:planktonic ratio, and the chemical composition of the samples provide insights on the hydrological regime, particularly on the water oxygenation and on the oscillations of the lake level through time.

Keywords: Early Miocene (Burdigalian), Iberian Peninsula, paleolake, palynology, diatoms

FOSSIL OAKS OF THE EARLY PLEISTOCENE SISIAN FORMATION IN ARMENIA

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The Sisian formation in the Vorotan basin in southern Armenia contains an exceptional rich fossil flora with more than 230 taxa of higher plants, identified by macroremains of various organs (leaves, fruits, seeds, shoots, etc). The accumulation of those diatomaceous lake sediments began in the Early Pleistocene before 1.3 Ma after the damming of the Paleovorotan river by volcanic activity and ended approximately 950 thousand years ago with the drainage of the palaeolake. Outcrops of the lake sediments cover a fairly large area of approximately 100 square kilometres.

Imprints of oak leaves were collected from 31 assemblages of 14 localities. 1321 imprints of leaves and 2 imprints (imprint and antiimprint) of an acorn cup of *Quercus* were collected. Ten taxa of fossil oak were identified here: *Quercus* cf. *macranthera, Q.* cf. *robur*, *Q.* cf. *petraea* ssp. *iberica, Q.* cf. *petraea* ssp. *pinnatiloba*, *Q.* cf. *hartwissiana, Q.* cf. *infectoria*, *Q.* cf. *castaneifolia*, *Q.* cf. *cerris, Q.* cf. *alnifolia,* and *Q.* cf. *ilex*.

The high diversity of oaks indicates diverse ecological conditions in the paleo-Vorotan basin. Moreover, *Quercus* cf. *castaneifolia* and *Q.* cf. *cerris* occur together in several fossil assemblages, but today grow in relict centres, in Hyrkanica on the shores of the Caspian Sea and in Colchis and Illyria on the shores of the Black Sea, respectively. In all likelihood, in the Early Pleistocene, the Illyrian refuge of the thermomesophilic flora of the Balkans had a connection with the Colchis refuge through the southern coast of the Black Sea. The Colchis in turn was connected through the Southern Caucasus to the Hyrcanian refuge, which in turn extended along the Elbourse and Kopetdag ridges further to the east due to fluctuating but generally warmer and wetter climatic conditions.

DISPEARSE – A FAMILY OF AGENT-BASED MODELS TO SIMULATE DISPERSAL SCENARIOS

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Agent-based modelling is a simulation-based approach which can be applied to test and compare the outcome of behavioural options of agents in a variety of environmental settings. It offers a series of benefits particularly for palaeontology, palaeobiogeography and archaeology, because it allows to simulate processes which already lie in the past, so that systems are no longer available for direct observation, or accelerate processes which are simply running too slow to be amenable to direct observation.

In the ROCEEH modelling centre we focussed on tools to simulate dispersal processes across barriers in the first place. The barriers we prioritized in our studies are sea straits. The HoWCrossing model permits for instance to test various scenarios for humans. With SEAcross we can compare dispersal performances of terrestrial mammals swimming across sea straits. This model is quite flexible and can be adapted to other terrestrial vertebrates like monitor lizards or crocodiles practicing a different swimming style.

In the next step we would like to develop the ABM into a tool, which can be used to compare dispersal performances of plants, particularly across sea straits. In this paper, I will introduce the family of models, explain how to design experiments, introduce some of the variables we apply to quantify success, and suggest some scenarios addressing seed distribution.

PALYNOLOGICAL STUDIES ON PLEISTOCENE BIOSTRATIGRAPHY, PALAEOENVIRONMENT AND SUBROSION HISTORY IN THURINGIA (CENTRAL GERMANY)

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A joint project of the Senckenberg Research Station of Quaternary Palaeontology Weimar and the Thuringian State Office for the Environment, Mining and Nature Conservation is providing new insights into the biostratigraphical classification of Calabrian and Ionian sedimentary sequences. The palaeobotanical investigations primarly aim at better understanding the Pleistocene vegetation and climate dynamics as well as the subrosion history in central Germany. Furthermore, the investigations are intended to clarify existing uncertainties in the correlation of locally recorded warm and cold periods with transregional standard profiles and their classification within the MIS framework. In addition to the palynological results, infrared radiofluorescence dating and paleomagnetic data provide further information on the stratigraphic classification of the sedimentary sequences.

The majority of the investigated sequences are located in northern Thuringia in the catchment areas of the Unstrut and Helme rivers (Artern, Esperstedt, Görsbach, Voigtstedt). Other sequences originate from the Werra catchment area in southern Thuringia (Kieselbach, Möhra). So far, a total of 23 interglacial sequences have been analyzed, which could be assigned to different interglacials.

Although the interglacials of Möhra, Voigtstedt and Esperstedt could be biostratigraphically correlated with the palynological sequences of the Middle Pleistocene interglacials of Osterholz, Augustovian and Holsteinian, respectively, the results including palaeomagnetic data call for revision of the current Central European stratigraphic framework. Moreover, several interglacial sections could be assigned to the Saalian complex of warm and cold stages. A comparison of these records with the pollen data of the Neualbenreuth Maar, whose sediments comprise a complete sequence from MIS 8 to MIS 5, shows clear parallels. However, infrared radiofluorescence data support the biostratigraphic assignment of both younger interglacials to intra-Saalian warm stages, but suggest an assignment of the oldest warm period to MIS 9.

In addition to the biostratigraphic results, the new palaeobotanical data provide information on the spatial and temporal heterogeneity of the subrosion processes in the Werra valley as well as in the large subrosion depressions that overlie the salt slope south of the Harz and Kyffhäuser mountains. As predominantly weak interglacials were recorded in the study area, other factors in addition to precipitation amounts also appear to influence the subrosion processes in the study area.

NEOGENE ESTABLISHMENT OF TROPICAL MONSOON FOREST IN INDOCHINA

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Tropical Monsoon Forest is a vegetation type that is widely distributed in the Indochina Peninsula today, and it is also the forest type with the largest coverage in this area. It is characterized by a tree layer composed of deciduous tree species, most predominantly Fabaceae and Dipterocarpaceae and etc., which completely lose their leaves during the dry season to avoid intense high temperature transpiration. However, there is no clear evidence of when this vegetation type appeared in Indochina and how it spread throughout the region.

The species composition reflected in plant fossils can be used to infer the outlook and type of vegetation. We have collected a large number of plant fossils from 6 fossil sites in Thailand and Vietnam, covering the Oligocene, Miocene and Pliocene. The species composition of these six flora was identified and the paleovegetation was reconstructed. The results show that northern Thailand was still a humid evergreen forest during the Oligocene-Early Miocene, but it was transformed into a tropical monsoon forest during the Late Miocene and Pliocene. The northern part of Vietnam has been a humid tropical forest since the Oligocene, the Miocene, and until now. But tropical monsoon forests were established in the central Vietnam in Pliocene. This series of vegetation type transitions may be a combination of tectonic plate movements and the gradual intensification of the Asian monsoon.

Keywords: macrofossil, Thailand, Vietnam, palaeovegetation, tropical forest

PALYNOLOGY OF MID-EARLY PLIOCENE DEPOSITS IN THE SOUTH OF WESTERN SIBERIA

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Neogene sediments are widespread throughout the West Siberian Plain with more frequent exposures in the south (Zykin, 2012). Limited data on Pliocene palynology were obtained here mainly in the 1970s with a poor link to stratigraphy. In 1980s, a system of superposed Neogene formations chronologically controlled by successive small mammal assemblages was established for the region (Zykin, Zazhigin, 1984). The Peshnevo Formation is characterized by the eponymous faunal complex of the Early Ruscinian (MN 14 Zone, 4.9-4.2 Ma). Previously these sediments were variably dated in the range from Lower Miocene to Upper Pliocene. According to Volkova et al. (2002), no data on palynoflora of the Peshnevo level have been known.

Three new small mammal sites of the Peshnevo level with the index species of *Promimomys antiquus* were studied near Irtysh and Om rivers, Omsk region, Russia. The analysed samples from the deposits yielded well-preserved palynomorphs (pollen, spores, freshwater algae and plant remains).

The lower part of Strizhevo section, north of the Omsk region, produced palynological spectra with dominant arboreal group: most often *Picea*, *Pinus*, *Tsuga*, *Salix*, *Betula* sect. Albae. The pollen of Elaegnaceae, Caprifoliaceae and *Alnus* is sporadic. *Quercus*, *Ulmus* and *Tilia* was found among broad-leaved species. The herbaceous part includes Poaceae, Asteraceae, *Persicaria*, Caryophyllaceae, Ericaceae and some hydrophytic elements (Nymphaeaceae, Liliaceae). Spores of Polypodiaceae and liverworts of *Riccia* are numerous. Different fragments (massulae with microspores, glochidiae) of ferns *Azolla* were also noted.

The Rostovka site is located in lower reaches of the Om River. The fossil-rich bed occurs in the lower part of the section composed of river channel sediments. The samples show a very high diversity of both taxa and total number of pollen and non-pollen palynomorphs. The arboreal group is mainly represented by gymnosperm plants, *Pinus* s/gen Haploxylon and Diploxylon, *Picea*, *Abies*, *Tsuga* (several types), cf *Cedrus*. Broad-leaved (*Quercus*, *Ulmus*, *Juglans*, *Tilia*), small-leaved (*Betula* sect. Albae, *Alnus*, *Salix*) and other species like *Lonicera*, *Ephedra*, Dipsacaceae, *Diervilla*, Elaegnaceae are less frequent. The non-arboreal pollen includes Poaceae, Cyperaceae, Asteraceae, Cichoriodeae, Amaranthaceae, Ericaceae, Lamiaceae, Onagraceae, Ranunculaceae, *Persicaria*, *Fagopyrum*, Caryophyllaceae, Valerianaceae, *Artemisia*, and aquatic plants (Nymphaeaceae, *Nuphar*, *Potamogeton*, *Typha*, *Trapa*, *Sparganium*). Spores of ferns

make up to 60% of the complex. Besides Polypodiaceae, spores of *Riccia*, *Azolla*, *Sphagnum*, *Lycopodium*, *Osmunda*, *Botrychium* are also present. In addition, there are a lot of scalariform perforation plates fragments as well as other fragments of plant tissues.

Small mammals from the Polovinka site at the Om River indicate a slightly earlier evolutionary level. In general, the palynological spectra are quite similar to those described above with a noticeably lower presence of dark conifer pollen.

In summary, the pollen data on the Peshnevian time indicate predominant forest-steppe environment. Arboreal pollen accounts for up to 40%, indicating mixed forests with dark coniferous as well as broadleaved species. The study was supported of the Russian Science Foundation (project № 24-27-00401).

Zykin, V.S., 2012. Stratigraphy and evolution of environments and climate during late Cenozoic in the southern West Siberia. Geo, Novosibirsk, 485 pp. [In Russian]

Zazhigin V.S., Zykin V.S. 1984. New data on Neogene stratigraphy of Western Siberia. In: S.A.Arkhipov (ed.), Stratigraphy of Neogene and Anthropogene transitional deposits of Siberia. Novosibirsk: IGG, 1984. 29-53 pp. [In Russian]

Volkova V.S et al. Stratigraphy of oil and gas bearing basins of Siberia. Cenozoic of Western Siberia. Geo, Novosibirsk, 246 pp. [In Russian]

PLASTID PHYLOGENOMICS AND FOSSIL EVIDENCE PROVIDE NEW INSIGHTS INTO THE EVOLUTIONARY COMPLEXITY OF THE 'WOODY CLADE' IN SAXIFRAGALES

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The "woody clade" in Saxifragales (WCS), encompassing four woody families (Altingiaceae, Cercidiphyllaceae, Daphniphyllaceae, and Hamamelidaceae), is a phylogenetically recalcitrant node in the angiosperm tree of life, as the interfamilial relationships of the WCS remain contentious. Based on a comprehensive sampling of WCS genera, this study aims to recover a robust maternal backbone phylogeny of the WCS by analyzing plastid genome (plastome) sequence data using Bayesian inference (BI), maximum likelihood (ML), and maximum parsimony (MP) methods, and to explore the possible causes of the phylogenetic recalcitrance with respect to deep relationships within the WCS, in combination with molecular and fossil evidence. Although the four WCS families were identically resolved as monophyletic, the MP analysis recovered different tree topologies for the relationships among Altingiaceae, Cercidiphyllaceae, and Daphniphyllaceae from the ML and BI phylogenies. The fossil-calibrated plastome phylogeny showed that the WCS underwent a rapid divergence of crown groups in the early Cretaceous (between 104.79 and 100.23 Ma), leading to the origin of the stem lineage ancestors of Altingiaceae, Cercidiphyllaceae, Daphniphyllaceae, and Hamamelidaceae within a very short time span (~4.56 Ma). Compared with the tree topology recovered in a previous study based on nuclear genome data, cytonuclear discordance regarding the interfamilial relationships of the WCS was detected. Molecular and fossil evidence imply that the early divergence of the WCS might have experienced radiative diversification of crown groups, extensive extinctions at the genus and species levels around the Cretaceous/ Paleocene boundary, and ancient hybridization. Such evolutionarily complex events may introduce biases in topological estimations within the WCS due to incomplete lineage sorting, cytonuclear discordance, and long-branch attraction, potentially impacting the accurate reconstruction of deep relationships.

Keywords: phylogenetically recalcitrant lineage, radiative diversification, incomplete lineage sorting, ancient hybridization, ancient extinction

HIGH PRODUCTIVITY AT HIGH LATITUDES UNDER ENVIRONMENTAL CONDITIONS OF THE EOCENE.

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Greenhouse conditions of the Eocene allowed for lush Arctic forests to thrive under elevated CO_2, a temperate climate and high precipitation. We studied ecophysiology and primary productivity of deciduous broad-leaved trees for Eocene climate conditions and annually extremely different daylengths which represent a quite spectacular no-analogue habitat of Earth's greenhouse past.

We present results from a study whose aim was to 1. model photosynthesis and transpiration for deciduous broad leaves in Arctic forests under Eocene climate and CO_2 conditions, 2. calculate whole-tree primary productivity, 3. evaluate the impact of leaf size.

For this study, a model of annual photosynthesis was derived and run for Eocene palaeoclimate conditions, including annual day lengths (derived by celestial mechanics) and different light regimes (indicating different cloud cover situations) for two fossil Eocene sites, Svalbard and Ellesmere Island. In addition, a mid-latitude comparison site was studied to identify the effects of CO_2, site-specific day length and climate.

The main results are as follows:

a) Annual productivity at the Eocene polar sites is in the range of extant tropical forests and about 30%–60% higher than for a mid-latitude continental European forest.

b) Atmospheric CO_2-level, atmospheric transmissivity and temperature have a high influence on annual assimilation, whereas the effects of the length of daylight and the ratio of diffuse light are small .

c) In contrast to speculations, no evidence for a selective advantage of large leaf size (as shown by various fossil leaves from high latitude sites) could be found.

PLANT DIVERSITY AND PALEOENVIRONMENT EVOLUTION ON THE SOUTHEASTERNMARGIN OF THE TIBETAN PLATEAU DURING THE EOCENE-OLIGOCENE TRANSITION

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The Eocene-Oligocene is one of the most significant climate evolution events of the Cenozoic, marking the transition of global climate from a "greenhouse" to an "ice room". In recent years, an increasing number of studies have shown that the global response to the EOT transition was not synchronous. The southeastern edge of the Tibetan Plateau is a world biodiversity hotspot, but it is still unclear how plant diversity evolved in this region. This study conducted high-precision palynology and isotope geochemistry research on the coal-bearing strata in the Puyang Basin on the southeastern edge of the Tibetan Plateau, aiming to reveal the response of plant diversity and paleoenvironment to the EOT. According to our U-Pb zircon dating results, the sedimentary age of the Puyang Basin is 34.33-32.79Ma. The results of the palynological analysis show that during the Eocene-Oligocene transition, the plant composition changed from a Taxaceae-dominated wet forest to a subtropical evergreen broad-leaved forest dominated by evergreen oaks, indicating that the Eocene-Oligocene transition was a key period for the formation of modern plant diversity in southeastern Yunnan. The next phase of this project will continue to carry out isotopic chemistry research to reveal the paleoenvironment and will use orbital tuning to uncover the driving factors behind the evolution of the paleoenvironmentand plant diversity.

CENTRAL EUROPEAN TEMPERATURE RESPONSE TO MIDDLE MIOCENE CLIMATE CHANGE

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The middle Miocene was an overall exceptionally warm period accompanied by major perturbations of the global carbon cycle and rapid changes in oceanic and continental temperatures, sea level, and Antarctic ice sheet cover. It offers the opportunity to study a period of major global change during the global warm period of the middle Miocene Climatic Optimum (MCO, 14.7-16.9 Ma) and the subsequent high-latitudinal cooling (and drying?) during the middle Miocene Climate Transition (MMCT, 14.7-13.8 Ma). However, data of temperature and precipitation changes in continental interiors remains sparse, but crucial for paleo-environmental and paleo-ecological studies of ecosystem and biome evolution.

Here, we investigate coupled temperature and precipitation change during this dynamic period through the integration of paleosol carbonate stable ($\delta^{18}O$, $\delta^{13}C$) and clumped isotope temperature ($T(\Delta_{47})$) data with sedimentological and paleontological information. Paleosol samples from five well-dated alluvial mega-fan sequences within the Northern Alpine Foreland Basin (NAFB, Switzerland), spanning the Burdigalian and Langhian (19.84-13.35 Ma), provide a composite soil temperature record with a highly dynamic pattern and strong short-term (~200 kyr) variations. Absolute $T(\Delta_{47})$ values range between 17.6 ±1.2°C and 45.4 ±2.0°C, reflecting seasonal biases on soil carbonate growth temperatures. The pre-MCO phase is generally marked by moderately elevated soil Δ_{47}-temperatures (24-36°C), similar to the MCO with 26°C to 34°C. Peak temperatures (>40°C) occur at 19.12 Ma, at 16.72 Ma, and at 14.76 Ma, whereas a $T(\Delta_{47})$ drop to 22°C occurs at 16.28 Ma, coinciding with marine isotope event Mi2. The MMCT is marked by a sharp temperature drop to 17.6 °C (14.13 Ma), coinciding with marine isotope event Mi3a (14.1-14.4 Ma), followed by a brief warm phase and then a final cooling after 13.97 Ma, coinciding with marine isotope event Mi3b (13.5-13.6 Ma). We observe maximum soil temperatures at times when global and North Atlantic SST estimates reached high temperatures of up to >30°C. This suggests a strong climate coupling between the North Atlantic and Central Europe in the middle Miocene.

Overall, our composite NAFB Δ_{47}-paleotemperature record highlights continental temperature dynamics in Northern Hemisphere mid-latitudes and documents high temporal congruence to temperature (and ice volume) change records from the global oceans and especially from the North Atlantic.

RHODOMYRTOPHYLLUM SINUATUM (BANDULSKA) WALTHER AS A PALEOGENE RELICT IN THE EARLY MIOCENE OF BERANE BASIN (MONTENEGRO).

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On the basis of a considerable number of very well-preserved leaf adpressions (cc 40 specimens), the presence of the species *Rhodomyrtophyllum sinuatum* (Bandulska) Walther has been established in Early Miocene flora of the Berane basin (Montenegro).

Considering that *Rhodomyrtophyllum sinuatum* disappeared from the best part of Europe as early as Eocene, its occurrence in Early Miocene flora of the Berane Basin could be considered as the appearance of a relict taxon.

The extraordinary frequency and taxonomic diversity of other floral elements (cc. 250 specimens and cc. 50 taxa of dendroflora) allows a quite accurate reconstruction of the habitat and the physiognomy of the community in which *Rhodomyrtophyllum sinuatum* existed. It was a temperate continental community consisting of almost the same percentage of BLE (broadleaf evergreen) and BLD (broadleaf deciduous) floral elements, with the fact that the taxonomic diversity of BLD is much higher, while the highest percentage of BLE consists mainly of rhodomyrtophyllum leaves.

CLIMATE EVOLUTION AND ITS DRIVING FACTORS IN THE TETHYS REGION DURING THE CENOZOIC ERA

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Since the Cenozoic, there has been a lack of comprehensive data-model research on the climate evolution in the coastal regions of the Tethys Sea. This study integrates plant macrofossil data from 368 fossil sites along the Tethys Sea coast during the Cenozoic and reconstructs several paleoclimate parameters using the joint probability density function method. These parameters are comprehensively compared with paleoclimate simulations from the HadCM3L model. Spatial distribution analysis reveals that the western and central Tethys regions, influenced by the retreat of the Tethys Sea, experienced a trend of initial warming followed by cooling, with a slow decline in precipitation. Conversely, the eastern Tethys region, influenced by the uplift of the Tibetan Plateau, showed temperature fluctuations and increased precipitation variability. The Mediterranean climate, characterized by wet winters and dry summers, was already established in Europe from the very early Eocene. However, there is no evidence of such a climate existing in the eastern regions or the areas surrounding the Tethys Sea (eastern Asia) during the same period. In the Miocene, the Mediterranean climate almost disappeared in Europe, only to reappear in the Pliocene.

The Oligocene to early Miocene period was a critical time for climate evolution in the Tethys region. Global CO_2 concentration changes, along with geological structural changes such as land-sea distribution patterns and topography, were the main driving factors for climate evolution in the Tethys region. This research provides significant insights into how climate changes since the Cenozoic have driven ecosystem and species diversity evolution in the Eurasian continent.

Keywords: Tethys Sea, Cenozoic, paleoclimate, plant fossils, climate simulation

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IMPACT OF THE AIRA CALDERA VOLCANIC ERUPTION ON FLORA AND VEGETATION IN SOUTHERN KYUSHU DURING THE EARLIEST STAGE OF THE LAST GLACIAL MAXIMUM

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On the northern foothills of Mt. Kirishima in southern Kyushu lacustrine and fluvial deposits from the late MIS 3 to early MIS 2, containing plant macrofossils, are distributed. These macrofossils are the southernmost records in the last glacial stage in Japan and contain diverse temperate broad-leaved tree species, while the Japanese archipelago was covered with coniferous forests. Meanwhile, in the earliest MIS 2 (ca. 29ka), the Aira Caldera, located 50 km south of this locality, experienced a massive eruption, and the Kirishima area was covered by thick pumice flows (Ito pyroclastic flow). In this presentation, we compare compositions of plant macrofossil assemblages below and above the pyroclastic flow and discuss climate and vegetation changes from MIS 3 to the Last Glacial Maximum (LGM) and impact of pyroclastic flows on flora and vegetation.

Plant macrofossil assemblages below the Ito pyroclastic flow, dated to 35.6 – 31.9 ka, indicate paleovegetation dominated by Pinaceous conifers and mixed with diverse broad-leaved tree taxa. Assemblages above the pyroclastic flow, dated to 27.2 – 26.4 ka, exhibit various vegetation types, including coniferous tree forest, broad-leaved forest, and shrub vegetation. An assemblage dominated by broad-leaved trees may indicate the composition of a local forest at lower altitude during a warmer climate phase. Another assemblage dominated by shrubs, including *Empetrum nigrum*, an alpine dwarf shrub, and *Macleaya cordata*, a forb inhabiting collapsed slopes, indicates a harsh and open environment on the pyroclastic flow. This evidence suggests that the pyroclastic flow created diverse habitats for plants and maintained local plant diversity despite its large-scale disturbance on geomorphology and vegetation.

RECONSTRUCTION OF OLIGOCENE CLIMATE OF EASTERN KAZAKHSTAN BASED ON FOSSIL SPECIES OF *QUERCUS* L. WITH USING COEXISTANCE APPROACH

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The purpose of the present study is the comparison of the climate data obtained with using Coexistence Approach for the early (Kiin-Kerish) and the late (Ashutas) Oligocene palaeofloras of eastern Kazakhstan (Zaisan depression) with data reconstructed on the basis of genus Quercus. Special interest here is fossil species of Quercus L. which were found in the both palaeofloras. To perform Coexistence Approach the Nearest Living Relatives list for the both floras and particularly for the seven species of *Quercus* genus has been updated. Using diffrent techniques the distribution maps of Oak species needed for the climate analysis have been completed. These data have been compared with original previously published climate parameters of early Oligocene Kiin-Kerish flora (Averyanova 2021). For the late Oligocene flora of Ashutas the data was recalculated. As a result it was shown that data received on the basis of genus *Quercus* indicate colder climate and have a little bit wider interval of parameters in comparison with the climate data which has been reconstructed on the taxa lists of the both floras. Although it was shown that fossil representatives of *Quercus* genus well reflect the climate of the fossil flora generally, additional research is recommended. The reported study was funded by Russian Science Foundation project N◦ 23-27-00076.

POLLEN RECORD OF THE SOL'-ILETSK CORE (ORENBURG DISTRICT) AS A NEW SOURCE OF DATA ABOUT SOUTH URALS GELASIAN

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Stratigraphy of South Urals is considered to be well studied, yet it contains many gaps in Gelasian paleobotanical history. Palynological evidences of Pliocene-Quaternary boundary are few. In 2023 near Sol'-Iletsk town of Orenburg district 105.0 m of Gelasian-Quaternary deposits were taken during geological drilling works. These deposits were found in the profound depression and consist almost of yellowish and reddish clays and sands. They were sampled for pollen analysis almost without gaps and then studied. The results obtained allow us to establish, that more than 80 m of deposits were collected during Akhchagyl time and were covered with Apsheronian deposits. These also provide us data to describe main characteristics of vegetation changes during this time and even to distinguish some rhythms, which were not described before in the region and can be correlated with the data, obtained for Caspian sea.

THE LATE OLIGOCENE VEGETATION OF KAZAKHSTAN RECONSTRUCTED ON THE BASIS OF PFT DATA

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In the given study the five (macro- and microfossil) Late Oligocene floras of Kazakhstan have been analyzed at a regional scale using the Plant Functional Type concept. PFT spectra have been obtained (pollen flora of southeast part - Tekessk, pollen and carpoids based floras of central part - Dyusembay), the Aral Sea macrofossil flora of Kumsuat and Western Siberia pollen based flora from south part of WS – Irtysh. The complete set of PFT data for the studied floras have been used to calculate the diversity proportions of the main vegetation groups. Due to the geographical location of the palaeo sites the vegetation dynamics on the territory of Kazakhstan in longitudinal and latitudinal direction have been described.

Obtained data point to open forests with a diverse shrub and herb layer in the study area, with minor gradients in latitudinal and longitudinal direction. As it is points that midlatitude suggests a less dense, drier forest type with very diverse shrubs layers (22%) and deciduous trees (62%) in the east of Kazakhstan and with 11% and 53% accordingly in the central part of Kazakhstan. For Central Kazakhstan the Kumyrtas flora of Aquitanian age, both, the pollen and fruits and seeds-based spectra show a decreasing trend of mesic herbs. This might denote that the forest became more dense on this territory. Climate analysis did not reveal significant changes from the Chattian to Aquitanian in central Kazakhstan. The analysis of PFT spectra obtained from microfloras indicates a trend towards more open landscapes with herbs and shrubs in the eastern part of Kazakhstan, a gradient that is much more distinct at present. The same applies to climatic conditions that did not yet have a clearly defined gradient, more characteristic of the end of the Neogene and modern times. The reported study was funded by Russian Science Foundation project N◦ 23-27-00076.

INFLUENCE OF CLIMATE CHANGE IN GLACIER GEOLOGICAL RELICS OF SHANGRI-LA REGION

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Glacier geological relics are the recorders of the Earth 's evolution history and climate change, and are one of the important factors in the study of climate change. Due to global warming, the consequent changes in glacier relics are obvious. In this study, the geological control effect, the natural form of glacial geomorphologic landscape and the genetic mechanism of glacial geomorphologic landscape were used to classify the landscape types, and the multi-period remote sensing image information of each type of landscape was extracted. Combined with the regional meteorological data, the control effect of climate change on the types of glacial geological heritage landscape in Shangri-La area was analyzed. The Shangri-La region is located on the southeastern margin of the Qinghai-Tibet Plateau, in the central part of the Hengduan Mountains. Under the joint action of the violent uplift of the Qinghai-Tibet Plateau and the Hengduan Mountains and the erosion and cutting of rivers in the Cenozoic, a unique geological landscape with snowy mountains and deep canyons has been formed. Since the Pleistocene, the development of Quaternary glaciers in Shangri-La has provided a good geological environment for the formation of glacial geological heritage landscapes in the region, and has formed many systematic and complete glacial geological heritage landscape resources. Glacier relics such as ice-eroded lakes, ice-eroded residual mountains, ice-eroded mounds, ice-eroded troughs, sheepback stones, blade ridges, side sulfur dykes (ridges, final hard dykes (ridges) have highlighted the characteristics of glacial activity since the Quaternary. The classification of glacier geological relics in the region shows that there are six landscape types: mountain landform, ice erosion landform, moraine landform, water erosion landform, water accumulation landform and alpine karst landform.A variety of meteorological data in the region show that since 2000, the annual average temperature change in Shangri-La area has been on the rise, and the warming trend is significant. The highest average temperature appeared in 2009, which was 7.54 ℃. The general trend of climate change in Shangri-La is consistent with the general characteristics of climate warming in the Qinghai-Tibet Plateau, but the temperature growth rate is higher than that of the Qinghai-Tibet Plateau as a whole in the same period of 0.23 ℃ / 10 years. From the interdecadal perspective, the annual average temperature showed a downward trend after 2010. The remote sensing images of different periods in Shangri-La area were analyzed and processed by means of information extraction and spatial analysis. The results showed that the area of glacier lakes in Shangri-La area increased continuously after 2000, the number of glacier lakes increased as a whole, the water level increased, the area of glaciers

decreased significantly, and the edge of glacier coverage area shrank continuously. The unique complexity and uncertainty of the climate system in Shangri-La increase the difficulty of studying geological relics in the region. The long-term sequence of climate change will aggravate the phenomenon of glacier ablation and will have a direct impact on the geological environment in Shangri-La. Keywords: geoheritage,shangri-la region,glacier,climate change a.fluvioglacial accumulation landform b.mountain landforms c.mountain landforms d.highcold karst landforms e.water encroach landforms Glacier geoheritage landscape in Shangri-La area.

QUANTIFYING THE RELATIONSHIP BETWEEN THE REGIONAL VEGETATION AND THE POLLEN RECORD OF ARMENIA AND GEORGIA

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The Southern Caucasus, a biodiversity hotspot and rich in all kinds of resources, plays an important role for scientific investigations, as various groups of hominins occupied the region during the Pleistocene. In order to get a wider understanding of the circumstances and behaviors of our ancestors it is necessary to understand the paleoenvironmental conditions.

Pollen analysis provide information about vegetation and climate processes and can be used for paleoclimatic reconstructions. Applied to the fossil record, regional differences in plant communities can be detected as well as their development during different time periods indicating climatic changes. In this study modern soil surface samples will be the base to establish a regional statistical relationship between the standing vegetation, climate and the pollen record.

Preliminary results show strong correlations between vegetation type and pollen assemblage. Open environments, represented by steppes and alpine meadows are characterized by grasses and herbaceous plants, especially Asteraceae, with little to no woody vegetation. Semi-deserts stick out due to a high abundance of Amaranthaceae and other herbaceous plant pollen. Whereas closed environments are characterized by a high abundance of woody plants, primarily trees including few herbaceous plants and grasses.

The resulting statistical correlation will be applied on fossil assemblages from Pleistocene sites of Armenia to reconstruct the past vegetation and climate for different groups of hominins in the Southern Caucasus. Preliminary results confirm, that this method is a useful tool for the palaeoecological reconstructions, providing information about the dynamics of vegetation and climate during the Pleistocene in the Southern Caucasus.

LEAF MORPHOLOGIES OF MODERN AND FOSSIL BAMBOOS AND THEIR PALAEOCLIMATICAL IMPLICATIONS

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Bamboos, with important ecological and economical values, have very high species and habitat diversities in the world. They are mainly distributed in the monsoonal regions in subtropical and tropical areas, as well as in some temperate regions and high mountains. Due to the rarity of bamboo fossil records, the detailed morphology of fossil bamboos is not clear. This hinders the taxonomical research of fossil bamboos as well as their paleobiogeographical and palaeoclimatical implications. Many bamboo fossils preserved as leaves and culms. Leaf venation is easily preserved in fossil leaves.Therefore leaf venation is a good subject for the taxonomical, paleobiogeographical and palaeoclimatical researches of bamboos.

In this research, 236 bamboo species including tropical and temperate woody bamboos belonging to 34 genera are investigated for their leaf venation characteristics. It shows that (1) most temperate woody bamboos except some basal ones have tessellation patterns of venation, while all tropical woody bamboos have non-tessellation patterns of venation, and (2) the vein density are generally higher in temperate woody bamboos than tropical woody ones. These results indicate that the presence of tessellation and the vein density can be effectively used to distinguish between temperate and tropical woody bamboos and to identify genera within the temperate woody bamboos, respectively. The differences of vein density between temperate and tropical woody bamboos may reflect their different climate adaptability.

The vein characteristics of Miocene fossil bamboos from China, Japan and Europe are measured for the comparison with modern ones. It shows that all these venations exihibit tessellation patterns. Especially, fossil bamboo leaves from Japan have the shortest rectangles composed of two third-order parallel veins and two cross veins, which are similar with vein patterns from modern native Japanese bamboos such

as *Sasa* species. These results implies that leaf venation characteristics of bamboos have important taxonomical and palaeoclimatical implications.

Key words: bamboo fossils; tropical woody bamboos; temperate woody bamboos; leaf venation; vein density; classification; palaeoclimate

CHANGE IN THE TAXONOMIC COMPOSITION OF NEOGENE CHAROPHYTES IN CONNECTION WITH PALEOECOLOGICAL CHANGES

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The burials of the remains of charophytes are autochthonous in most cases and can be used for paleogeographic and paleoenvironmental reconstructions.

The remains of charophytes, presented by gyrogonites, were studied from the Late Neogene deposits of the intermountain depressions of the Northern Tien Shan (Ili, Zhalanash). The largest accumulation of gyrogonites was found in the residual mountain ranges of the Dzhungar Aktau. Lake deposits of the Santash and Ili Formations contain different complexes of charophytes. In the Santash Formation, represented by associated reddish-brown and greenish-gray clays, siltstones and gray inequigranular sandstones with added marls and limestones. Here were found mainly *Niltellopsls merianii* (Al.Braun ex Unger) L.Grambast & Soulié-Märsche, *Chara globularis*, *Lychnothamnus barbatus* f. breviovatus. In the Ili Formation, in layers with siltstones and inequigranular sandstones with interlayers of gray marls and blue clays, the species *Lychnothamnus barbatus* (Meyen) v. Leonh., *Chara pappii* Soulié-Märsche, *Nitellopsis aubekerovii* Zhamangara were dominated.

The gyrogonites of Niltellopsls merianii are characterized by thick spiral cells, which probably indicates the presence of a high calcium content. The modern species of this genus *Niltellopsls obtusa* is an ecologically plastic species. The lithological characteristics of the sediments containing the species *Niltellopsls merianii* indicate some aridization of the environment.

The modern *Lychnothamnus barbatus* (Meyen) v. Leonh. is typical for shallow and cool water. Areal of the species covers mainly regions of humid subtropical and sometimes humid continental climate. In Kazakhstan, this species has not been found in modern lakes. Thus, the change in the taxonomic composition of charophytes was probably associated with changes in both the hydrochemical composition of water and climatic conditions - from arid in the Miocene to relatively humid in the Pliocene.