2nd ASQUA Meeting
Ulan-Ude, the Baikal region, Russia
Geological Institute of Siberian Branch,
Russian Academy of Sciences;
ASQUA;
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INQUA Commission on Stratigraphy and Chronology
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Advances in the Quaternary of Interior Asia

Volume of Abstracts & Field Guidebook

September 9-15

Ulan-Ude 2013

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The Organizing Committee acknowledges with many thanks
the financial support for the providing the field works
on Quaternary study in Transbaikalia granted to the Conference from:

International Union for Quaternary Research, INQUA Project 1308S
Siberian Branch of the Russian Academy of Sciences

The conference is dedicated to the 100th anniversary of my teacher, Prof. Igor M. Gromov, an eminent scientist and the founder of the school of Russian paleontologists — specialists in small mammals.

It is due to Prof. I.M. Gromov, that the conference is held here, in the Transbaikalian Region, as 50 years ago he strongly recommended starting investigations of extinct small mammals first discovered in Transbaikalia. Since then (1962) the studies of fossil rodents and lagomophs are being performed on numerous localities, and the results obtained serve as a basis for the regional biostratigraphy and paleoenvironmental reconstructions and for inter-regional correlation between the Pliocene-Pleistocene events in Eurasia.

Dr. Margarita Erbajeva

ASQUA (Asian Conference on Quaternary Research) was proposed to organize in 2007 during the International Symposium on the 50th anniversary of the Japan Association for Quaternary Research, the aim of which was the progress of study on the Quaternary Research of Asia.

The First Asian Conference on Quaternary Research (ASQUA) was held in Beijing, October 19 — 23, 2009 together with the International Symposium on Paleoanthropology in Commemoration of the 80th Anniversary of the Discovery of the First Skull of Peking Man. Over 230 participants from over 20 countriesattended the conference.

The first ASQUA business meeting was convened during the conference by Professor Jule XIAO, Secretary-General of CHIQUA, and Professor Xing GAO, co-convener of the conference with the participation of Liping ZHOU, Zhaoyu ZHU and Changzhu JIN from CHIQUA Secretariat, Min Te CHEN from Chinese Taipei, Hisao KUMAI and Yoshiki SAITO from Japan, Yong Ahn PARK, Boo Keun KHIM and Sang Hyun YI from Korea, and Margarita ERBAJEVA from Russia.

It was decided that next ASQUA meeting will be held in 2013, and Russia was suggested to be the host country.

The 2nd ASQUA Meeting titled "Advances in the Quaternary of Interior Asia" will be held in Ulan-Ude, the Baikalian region, Russia in September 9-16, 2013 by Geological Institute of the Siberian Branch, Russian Academy of Sciences and ASQUA.

Quaternary research through the ASQUA should serve as an important platform for scientific communication and cooperation among the Quaternary scientists from Asia. It was decided that the ASQUA meeting would be held in Asian countries every four years during the inter-Congress period of INQUA.

Volume of Abstracts

Abstracts are given in author's edition

NEW DATA ON QUATERNARY STRATIGRAPHY OF THE TRANSBAIKAL AREA

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During the last decades comprehensive studies on the Pliocene and Pleistocene were conducted on the territory of Transbaikalian region. A number of new localities with fossils were discovered and the revision of geology were provided for the well known in the East Siberia key sections Tologoi, Dodogol, Zasukhino a.o. As a result abundant addition new fossils of small mammals were collected. These novel, both geological and paleontological, data are allowed to obtain new evidences on the faunal sequence and to recognize successive stages of sedimentation in the region.

Previously five faunal complexes – Chikoian, Itantsinian, Tologoian, Ust'-Kiranian and Late Paleolithic were established (Ravsky et al., 1964; Vangengeim et al., 1966; Bazarov, 1968). More recently these complexes were supplemented with new faunal complex – Udunginian and new faunas – Dodogolian, Ust-Oborian, Zasukhinian, Kudunian, Ivolginian (Erbajeva, Alexeeva, 2000; Alexeeva, 2005).

Continuation progressive studies during the last years resulted in the discovery of new sites with abundant fossils in the region. These new data filled the gaps in the faunal succession and their geological time interval have been refined (Alexeeva, Erbajeva, 2005). At present time in total approximately 15 successive faunas are recognized for the time interval of the Late Pliocene-Holocene of Transbaiakalia. In the Tologoi Key section 14 faunistic horizons are known, the next Zasukhino Key site contains 9 successive faunas of the Early Pleistocene-Holocene and 6 faunas of the Early-Late Pleistocene were established in Dodogol Key section.

In the lowermost horizon of the Dodogol section, located on the right bank of Uda river, peculiar fauna was discovered, it is Dodogol 1 site. It differed from the preceding Early Pleistocene faunas and from following Middle Pleistocene one and by the species composition and by the evolutionary stage of characteristic forms, the new fauna represented slightly younger stage of the Early Pleistocene. The sediments exposed in this horizon consists of reddish sediments with carbonate laminae. This section was elected as the stratotype of the Early Pleistocene Dodogolian fauna. At present time it is not observable any more because slope of the river became filled over by thick sandy beds covered by dense willow shrubs.

In the past, Dodogol section was undergoing natural erosion of river water exposed in long distance. Later due to anthropogenic activities river water flow was cut off and branch of river became smaller and shallow. As a result the erosions of this part of section gradually decreased and stop and gradually has been covered by shrubs. Stratotype Dodogol 1 not exists any more. In this connection the Lectotype of Dodogolian fauna was replaced by one from another section – Zasukhino 2 which contains the same small mammal assemblage as Dodogol 1 site.

The faunas of both Dodogol and Zasukhino 2 sites include the same characteristic taxa which are *Allophaiomys deucalion, Borsodia chinensis laguriformes,* advanced form of *Prosiphneus* cf. *youngi* and latest *Mimomys*.

Moreover restudy and analysis of the geological structure of Tologoi key section are resulted in selection of new stratigraphic unit Ivolginskaya suite for the sediments of the

middle layer of Tologoi 2 locality (Erbajeva, Alexeeva, 2010). Close sediments are exposed in Dodogol 3 and 4, Zasukhino 4 and 5 and Ust'Obor sections. They contain coeval Middle Pleistocene small mammalian faunas.

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POLLEN RECORD OF VEGETATION AND ENVIRONMENT CHANGES SINCE ~37 CAL KYR BP IN CENTRAL ASIA DERIVED FROM LAKE BALIKUN, NORTHWEST CHINA

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Surface and fossil pollen samples were collected reconstruct the vegetation and environments since 37 cal kyr BP in Lake Balikun basin. The results of reconstruction suggest that the steppe vegetation dominated during 37.1-25.1 cal kyr BP. Relatively low pollen sum and A/C ratio during 25.1-17.7 cal kyr BP likely indicated a reduced vegetation cover, implying dry environment conditions. At 17.7-9.4 cal kyr BP, desert vegetation developed under dry condition. The period 9.4-7.9 cal kyr BP was still dry. It was warm and humid between 7.9 and 4.2 cal kyr BP. The reconstructed pattern in Balikun is comparable with the short-term temperature oscillation pattern derived from the $\delta^{18}O$ record from Greenland ice cores. We also provide evidence against cold-moist (warm-dry) during the glacial (interglacial) pattern of late Quaternary environment change in Central Asia. There is no evidence support a wetter and warmer than Holocene conditions during the late MIS 3.

PALEOENVIRONMENTAL INTERPRETATION OF A LATE GLACIAL AND HOLOCENE SOIL-SEDIMENTARY SEQUENCE NEAR BURDUKOVO, SELENGA RIVER VALLEY, BURYATIA

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During the last decades a number of paleoecological studies were carried out in the Lake Baikal area with the objective to reconstruct the Quaternary landscape, climate and vegetation evolution. Here we present data about Late Glacial and Holocene environmental changes based on biogeochemical analyses of the Burdukovo section, located on the right riverbank of the Selenga River north of Ulan-Ude, Buryatia. This section, recently studied by White et al. (2013) and Andreeva et al. (2013), consists of aeolian sediments with a sequence of dark humic A horizons and greyish fine sandy C layers above gleyey silty, laminated, red mottled floodplan deposits of the Selenga River. White et al. focussed on the analysis of texture, inorganic and organic C, magnetic properties and especially on molluscs, whereas we put emphasis on the stable isotope composition, on alkane and fatty acid molecular proxies.

Radiocarbon analyses allow the conclusion that the alluvial sediments with distinct fluvic properties were deposited during the Late Glacial and Early Holocene. Since about 7 to 6 cal ka BP only terrestrial fine sandy sediments accumulated, indicating a pronounced change in the environmental conditions. This is in agreement with recent studies of lacustrine archives in this area giving evidence of increasing aridity at the transition between Early to Middle Holocene. The dark buried A horizons intercalated in the terrestrial upper part of the Burdukovo record most likely developed during periods characterised by high biomass production due to more favourable climatic conditions, whereas the greyish fine sands between the dark layers document less favourable conditions with increased wind erosion and accumulation . This interpretation is supported by the results of texture and stable isotope analyses. In addition, alkane molecular proxies like the ratio of n-C_{31}/n-C_{27} suggest that the parent material of most dark humic horizons mainly derived from grass and not from trees or shrubs.

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THE QUATERNARY OF MONGOLIA: AN OVERVIEW

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The Quaternary study of Mongolia had arisen to the beginning of the last century. Different studies on geology, tectonics, volcanic cycles, stratigraphy, correlations etc. were provided by Obruchev (1947), Mursaev (1948), Marinov (1967), Ravskyi (1972) a.o. However the detail multidisciplinary studies of the Cenozoic of Mongolia were organized by joint Soviet-Mongolian Geological expedition under outstanding Quaternary geologist Devyatkin. Detail study of biostratigraphy, correlations of deposits, sedimentology, lithology,geomorphology, paleogeography etc were provided by team of this International expedition (Devyatkin, 1967, 1970, 1972, 1981;1989; Devyatkin, Liskun, 1967; Liskun, 1967; Devyatkin&Shilova,1970; Devyatkin, Zazhigin, 1974; Korina, 1974, Korina et.al, 1973,1974; Dubrova, 1974, 2001; Golubeva, 1976,1978; Devyatkin et,al,1978; a.o.).

Since 70-ies of last century author of this abstract involved to this study (Badamgarav et al., 1975; Liskun&Badamgarav, 1977). For the last decade first time was known loess deposition in the North of Mongolia (Feng&Khosbayar, 2004; Feng et.al, 2005).

The formation of landscapes physicogeographically, including relief of Mongolia during the Quaternary was influenced mostly by tectonic processes and global climatic changes since the end of Neogene through the Pleistocene. Late Cenozoic tectonic processes as a regional faulting have led to the formation of the main basins of the Western and Northern Mongolia. Volcanic activity is traced on the huge area of Mongolia: from the area of Hangai Mountain through the Lake Terkhiin Tsagaan Nuur in the Central Mongolia, along basins of rivers Orkhon, Khanui in the north and across the area Dariganga Plateau in South Eastern Mongolia.

HOLOCENE PALEOCLIMATIC EVENTS AND ENVIROMNMENT OF THE AMUR RIVER BASIN

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The sublatitudinal extension of the Amur basin results in contrasting climate patterns in its intracontinental and coastal parts. Despite the occurrence of the Amur upper reaches in middle latitudes, its location deep in the interior of Asia away from the ocean and a significant elevation above sea level are responsible for continental and strongly continental climate. The climate continentality is pronounced there stronger than in the same latitudes in West Siberia and the Far East. The climate of the most part of the Lower Amur River displays monsoon features. Mean annual temperatures in the intracontinental part range from –2.7 to –0.5°C; in the maritime part, from –2.2 to 1.6° C. During the last century the mean annual temperature in the Amur basin increased by 1.3° C. The minimum warming (by 0.6° C) was recorded in the eastern portion of the basin; the greater (1.7° C) in the intracontinental part. The mean annual precipitation in the most arid intracontinental area of the basin constitutes 250–300 mm; in the maritime area, 570–750 mm (Petrov et al., 2000; Novorotsky, 2007).

Peat bog, lacustrine, and flood-plain deposits were studied in intracontinental and maritime areas of the basin.

Three significant coolings in the terminal phase of late Pleistocene, terminal stage of early Holocene and terminal stage of middle Holocene are recognized. These cool events were followed by a considerable decline of atmospheric humidity. The environmental response to the decrease of humidity was variable in different parts of the basin. In the maritime part the humidity decline was less than in the intracontinental area and it was manifested in changes of forest formations at all topographic levels. In the mountain regions the proportion of dark coniferous trees was reduced and in the piedmont and plain forests the broad-leaved taxa were missing. The decrease of humidity was resulted in a reduction of rate and in interruption of peat accumulation in various peat bogs. The natural environment of the intracontinental part of the basin responded to climatic cooling and humidity decline far greater. The steppe landscapes markedly expanded with the decrease of forest areas. In the mountains the boundary of subalpine belt was displaced downhill. The reduced precipitation favored the degradation of river systems and lowering of the level of plain shallow lakes, occasionally to the point of their complete drying up.

Three significant climatic warmings are reconstructed: in the middle of early Holocene, middle Holocene (optimum) and terminal phase of middle Holocene. The warmings were accompanied by the increased humidity. In the maritime part of the basin the broad-leaved trees proportion was enhanced. In the Holocene optimum the boundary of the coniferous–broad-leaved forest zone reached the Amur River mouth. Nowadays it occurs over 300 km southward. The stronger impact of the increased humidity was manifested in the intracontinental part of the Amur basin. It was marked by a considerable expansion of forest areas in both plain and mountain regions and by a significant reduction of steppe landscapes. Scarce dark coniferous trees, like spruce and fir that are missing in the modern forests, appeared in the forest formations. The forest communities in the southwestern area of the basin included oak and ash in the river valleys. Owing to the increased precipitation, water level of the plain lakes was elevated. The maximum levels were attained in middle Holocene.

Paleoclimatic events of terminal phases of late Holocene such as the Little ice age and the Little climatic optimum were reconstructed also. These events in different parts of the basin were almost synchronously, whereas dynamics of wetting was contrary.

NEWLY FOUND LOCALITY OF FOSSIL FAUNA IN THE UBUKUN-ORONGOY BASIN (WESTERN TRANSBAIKALIA)

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Bone remains of fossil fauna were found in the course of our works in the Ubukun-Orongoy Basin, at the base of the Guran Mountain slopes. The fossils were recovered from a remnant of the Orongoy R. terrace 14 to 16 m high, about 1 km southwest of the Orongoy settlement (Figure). The terrace remnant surface bears evidence of aeolian modeling. The sedimentary sequence exposed in the scarp consists of three members (from base to top) indicative of changes in sedimentation environments: a) channel gravel and sands, well washed, more than 1.5 m thick; b) fluvial and fluvial-lacustrine, fine to small-grained and medium grained sands, displaying oblique, diagonal, and subhorizontal bedding, 7.4 m thick; c) subaeral fine to medium-grained sands, unstratified, slightly carbonatized, ~2 m thick.

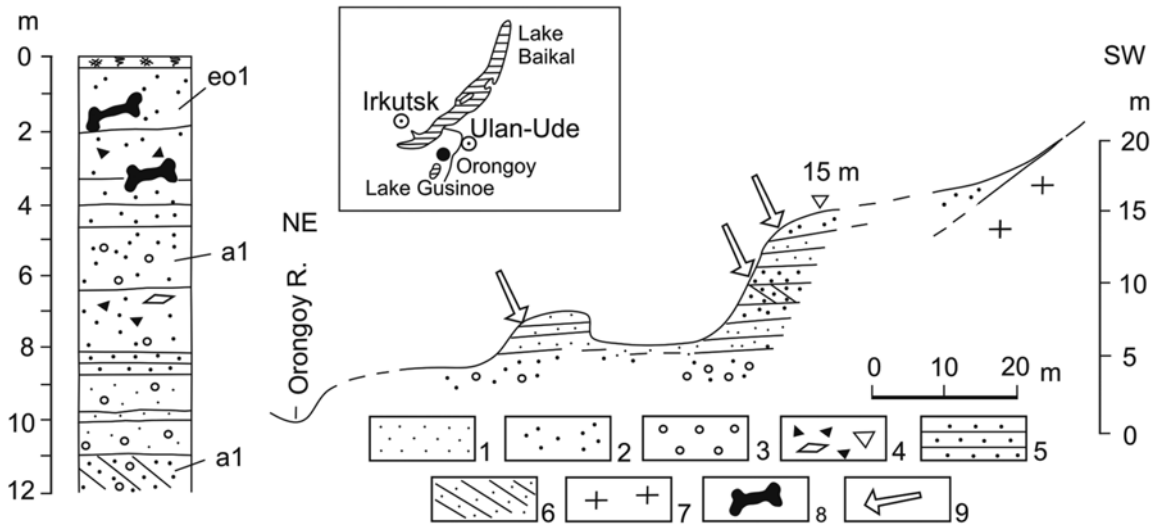

Figure 1. The Orongoy locality of fossil fauna.
1 – sand; 2 – aeolian deposits; 3 – pebble and gravel; 4 – blocks and rubble;
5 – horizontal stratification, 6 – cross (diagonal) stratification;
7 – solid rocks; points of faunal remain finding: 8 – in the section; 9 – in the profile.

In the middle member of the series, in the alluvial sands, there were found large mammal bones, such as: *Bison* sp., *Bos* sp., *Ovis* sp., *Capra* sp.

The uppermost subaeral sands yielded bone remains of amphibians, including: *Bufo* cf. *raddei*.

As follows from the data of earlier investigators, the 4th terrace (15–20 m above the river channel) formed in the river valleys of Western Transbaikalia at the beginning of the Upper Neopleistocene (Antoshchenko-Olenev, 1975; Bazarov, 1986;

a.o.). Integrated multidisciplinary studies of the bone remains and enclosing sediments described in the new faunal locality could provide new interesting information than may serve as a basis for paleoclimatic and paleoenvironmental reconstructions.

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MEDIEVAL WARM PERIOD CLIMATE VARIABILITY INFERRED FROM CHIRONOMIDAE (INSECTA: DIPTERA) IN BOSTEN LAKE, XINJIANG, ARID CENTRAL ASIA

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Dry or humid? Hydroclimatic condition during Medieval Warm Period (MWP, 900 ~ 1300 AD) in westerly-dominated arid northwestern China has aroused heated debate and remained elusive. High resolution chironomid analysis was conducted for the upper 1.2 m of a 9.5 m long sediment core taken from the Bosten Lake, the largest freshwater lake in the inland China. Based on the variations in relative abundances of littoral (e.g. Polypedilumnubifer-type) and profundal (e.g. Chironomusplumosus-type) taxa, lake level history from 800 AD (especially during the MWP) was recovered. We found that littoral chironomid taxa generally dominated the assemblage from 900 to 1340 AD, indicating a low lake level and thus negative water balance. In contrast, the Little Ice Age from 1460 to 1900 AD was characterized by profundal chironomid taxa, suggesting a broadly high lake level period. More interestingly, there existed a relatively high lake level period (1080 ~ 1120 AD) interrupting the generally dry MWP. Taking the chronological uncertainties and sample resolutions into account, there might be a possibility to achieve reconciliation between previous climatic records suggesting different hydroclimatic conditions during that time. Furthermore, this short-term climate anomaly is broadly consist with the failure of Asian summer monsoon from 1000 ~ 1100 AD, implying the reverse relationship in climate change between westerly- and monsoon- dominated region on decadal to centennial scale was an integral part of natural variability rather than an accident in the anthropogenic era.

LANDSCAPE EVOLUTION OF THE ULAN BUH DESERT IN NORTHERN CHINA DURING THE LATE QUATERNARY

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The evolution of arid environments in northern China was a major environmental change during the Quaternary. Here, we present the dating and environmental proxy results from a 35 m long core A-WL10ZK-1 collected from the Ulan Buh Desert (UBD), along with supplemental data from four other cores. The UBD is one of the main desert dune fields and dust sources in China and our results indicate the UBD has undergone complex evolution during the late Quaternary. Most of the present UBD was covered by a Jilantai-Hetao Mega-paleolake beginning well before ~90 ka ago and lasting until that time and possibly later. A sandy desert environment prevailed throughout the UBD during the last glacial period and early Holocene. A wetlands environment characterized by the formation of numerous interdunal ponds in the northern UBD and a rise Jilantai Salt Lake elevations occurred at ~8–7 ka, although a dune field persisted the southern UBD. The modern UBD landscape formed after these wetlands dried up. During the last 2000 years, eolian sand from the Badain Jaran Desert has invaded the northern UBD, while farming and overgrazing resulted in the formation of the eastern UBD. We suggest the formation of UBD landforms is related to the disintegration of megalake Jilantai-Hetao, and to summer monsoon changes during the last glaciation and Holocene.

LATE PLEISTOCENE (MIS 3) MOLLUSCS OF THE BOL'SHOI NARYN SITE (BAIKAL REGION, EAST SIBERIA, RUSSIA)

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A representative mollusc fauna attributable to the Karginian Interstadial (MIS 3) has been found in the Bol'shoi Naryn Paleolithic site (the Fore-Baikalian region). This site is located in the hills facing Osa Bay (Bratsk Reservoir). Cultural layer of the archaeological ex-cavation corresponds to the upper Karginian soil with radiocarbon dates from 32 to 25 Ka (Takao S. et al., 2008). The sediments of the 60 cm section at a huge square of the excavation were sampled at 5 cm intervals during field study (totally 199 samples). Each sample represented a mass of approximately 75-80 kg or a volume of fifty cubic decimeters.

The molluscan assemblage (2445 determined specimens) consists of 7 species and 5 genera of terrestrial molluscs and 2 species and 2 genera of the freshwater molluscs. *Succinella oblonga, Pupilla muscorum* and *Vallonia tenuilabris* are the most numerous species.

Analysis of the mollusc distribution according to the depth shows that greatest number of shells was concentrated in the middle part of the soil which accumulated probably in the most favorable climatic conditions. Perhaps an interval of time with less favorable conditions and lower temperatures could be between the upper and middle Karginian soils.

Molluscs were classified according to their modern ecological preferences in air temperature, humidity and vegetation cover following criteria proposed by Lozek (1964) and Likharev and Rammelmeier (1952). During accumulation of those deposits the landscapes corresponded with humid meadows and forests located in depressions or along banks of the river.

Similar malacocomplex with numerous *Succinella oblonga, Pupilla muscorum, Vallonia tenuilabris* and freshwater molluscs was determined at the Gornovo locality (Southern Fore-Urals, Russia) (Danukalova et al., 2002). Molluscs correspond to the Tabulda Horizon dated 26950±560 LU-3711; 26990±150 LU-3712; 28800±125 BashGI-36; 29700±1250 H-1856/1287 y. BP.

Pupilla muscorum, Succinella oblonga, Trichia hispida and *Vallonia costata* dominated in the MZ3-P3 malacozone of the Nussloch site (Germany) (Moine et al., 2005). Those Middle Pleniglacial deposits (P3, layer 20) with molluscs were dated by OSL: 31.1±4.1, 34±3,2 Ka (Lang et al., 2003).

Numerous *Trichia hispida* and *Pupilla muscorum* as well as rare *Punctum pygmaeum, Vallonia costata, V. pulchella, Nesovitrea hammonis* and *Limacidae* (Danukalova et al., 2012) are known from the Port Morvan Formation (MIS 3) of the La Haute Ville site (France).

Malacocomplex of the Bol'shoi Naryn site differ from the complexes of the listed above sites by species composition and show similarity with molluscs of the periglacial zones of the Late Glacial maximum (MIS 2) (Yakhimovich et al., 1987; Danukalova et al., 2002; Moine, 2008).

The climate of the Karginian interglacial (32 to 25 Ka BP) of the Baikal region was continental, moderate and humid but cooler than in Europe and Southern Urals during this period.

THE CHARACTERISTIC AND DIFFERENCE OF EAST ASIA VARIATION IN THE LAST TWO GLACIATION: EVIDENCE FROM TERRESTRIAL MOLLUSK IN BEIYAO, LUOYANG,CHINA

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Intensive studies of Chinese loess sequences show that the frequent, large-amplitude climatic oscillations on millennial time scales occurred during the last glacial cycle. These climatic oscillations can not be explained by the Orbital drive mechanism, so exploration the mechanism of these events will help us predict future climate change. The most researches have focused on the last glacial period, and we know little about the model of monsoon variation in the older glaciations, whether there are millennial time-scale fluctuations in the penultimate or even older glaciations.

In this paper, a high-resolution study of terrestrial mollusk from the Beiyao site provides a continuous record of paleoenvironmental and paleoclimate changes in the past 250 ka. 130 samples, collected at an interval of 10 cm, were analyzed for fossil mollusks. Two typical mollusk species were selected to be the proxy indexes of East Asian summer and winter monsoon variations. The results show that the monsoon strengths varied on millennial time-scales during the last glacial. There are also a series of millennium time-scale climatic oscillations in the penultimate glacial, but relatively stable. The instability of the summer monsoon circulation was strengthened since the end of the last interglacial.

Comparing Beiyao profile with Luochuan and Xifeng profile, we found that the glacial climate in Beiyao is more suitable than in other parts of the Loess Plateau, and the temperature and humidity would be earlier increased access to interglacial. It suggested that there is a large radial climate gradient in the Loess Plateau, Beiyao site is located in the southeast margin of the Loess Plateau, more vulnerable to the influence of the summer monsoon.

QUATERNARY MAMMAL FAUNAS OF THE BAIKALIAN REGION: BIOCHRONOLOGY, DISPERSAL AND CORRELATION WITH THE CENTRAL ASIAN ONE

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The Baikalian region is a part of East Siberia located in the middle of continental interior of Asia, it includes the territories of Prebaikalia and Transbaikalia, situated westwards and eastwards of the Lake Baikal. In the past they were the united area at least from the Oligocene to the beginning of Pliocene. Gradual cooling in the Northern latitudes and intensive orogenic processes had led to the prominent environmental change of Eurasia at the Early Pliocene. The climate was warm and rather humid, woodland predominated. It is evidenced by pollen flora and mammal associations of Udunga faunal complex. Progressive cooling and aridification led to decrease of woodland, appearance of savanna-like landscapes, as suggested by the fauna of Late Pliocene Chikoian fauna.

The beginning of Early Pleistocene is characterized by the global cooling registered in Northern Hemisphere. In the Baikal area the cold intervals are recorded at the age of 2.82-2.5 Ma (Prokopenko et al., 2001). Significant changes in biogeocenosis are indicated in the composition and structure of the faunas and vegetation. It resulted in changes of the regional paleoenvironment towards aridity and cool condition. Savanna-like forest-steppes gradually became reduced, grassland and steppes expanded widely and the open landscapes became dominant. The Pliocene taxa completely disappeared except of scarce advanced forms of the genera *Mimomys* and *Prosiphneus*. The most characteristic fauna is Itantsinian complex, which is characterized by the first appearance of the genus *Equus* which replaced *Hipparion*. and for the first time a number of peculiar Pleistocene genera such as *Cromeromys, Spermophilus, Clethrionomys* a.o. appeared in faunas of the whole Eurasia. At the late stage of the Early Pleistocene, during the time interval 1.75-1.45 Ma the evidence of next intensive cooling was established in the Baikalian region (Karabanov et al., 1999). The climate continued to change towards arid. The significant reorganisation in faunal assemblages occurred at that period. All Pliocene taxa disappeared and the genera *Allophaiomys, Borsodia, Lagurodon, Prolagurus, Terricola, Lasiopodomys* and *Eolagurus* appeared.

During the Middle and Late Pleistocene the significant transformation in the relief and structure of the Baikal depression and surrounding territory occurred. At the beginning of the Middle Pleistocene due to the tectonic movements the mountains surrounding of the Lake Baikal uplifted rapidly that became a major orographic barrier. As a result the Transbaikal area was isolated from the influence of Western Humid Atlantic Cyclones which became the main reason for the onset of deep aridification in the Transbaikal region. Significant changes took place in small mammal associations. Among rodents the genera *Mimomys, Borsodia, Prolagurus, Lagurodon, Allophaiomys* and *Terricola* completely disappeared.

Middle Pleistocene paleoenvironmet of the Baikalian region due to further changing of climate towards arid became extremely dry. Inhabitant of dry steppes, semideserts and deserts became the dominant forms that is evidenced by the fauna of

Tologoi complex. Further progressive cooling of the climate during the Late Pleistocene resulted in the formation of the open landscapes with so called mammoth fauna common for both Transbaikalia and Prebaikalia.

However they differ much by species composition: in Transbaikalia the inhabitants of the open dry cold wormwood steppes were predominant, in contrast to it in Prebaikalia the inhabitants of tundra-forest-steppe or mammoth steppe landscapes were characteristic.

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THE QUATERNARY SYSTEM/PERIOD AND ITS MAJOR SUBDIVISIONS

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Summary: The Quaternary System/Period represents the past 2.58 million years and is officially subdivided into the Pleistocene and Holocene series/epochs, with the base of the Holocene assigned an age of 11,700 calendar years before AD 2000. The two lowest stages of the Pleistocene, the Gelasian (base 2.58 Ma) and the Calabrian (base 1.80 Ma), have been officially defined and these effectively constitute the Lower Pleistocene Subseries/Subepoch. The Middle and Upper Pleistocene have yet to be formally defined, representing an important future challenge along with the subdivision of the Holocene, consideration of the Anthropocene, and fine-scale subdivision elsewhere within the Quaternary.

Key words: Quaternary, Pleistocene, Holocene, Anthropocene, GSSP.

In June, 2009, the Executive Committee of the International Union of Geological Sciences (IUGS EC)ratified a proposal to lower the bases of the Quaternary System and Pleistocene Series to that of the Gelasian Stage, with each now defined at their base by the global boundary stratotype section and point (GSSP) at Monte San Nicola in Sicily (Gibbard& Head, 2010; Gibbard et al., 2010). This GSSP has a currently assigned age of 2.58 Ma based on astronomically calibrated sapropel stratigraphy combined with the estimated duration of sapropel deposition (Gibbard& Head, 2009). The Gelasian Stage had previously served as the highest stage of the Pliocene Series (Rio et al., 1998). Ratification brought closure to many years of vigorous debate within the geological community and with it a 10-year moratorium on further official discussions of the boundary. The GSSP is placed at the base of a marly layer immediately overlying a sapropel (the Nicola bed) assigned to Mediterranean Precession-Related Sapropel (MPRS) 250, and corresponds to Marine Isotope Stage (MIS) 103. It lies just 1 m above the Gauss–Matuyamapalaeomagnetic reversal. Figure 1 outlines the official and proposed subdivision of the Quaternary.

On 5 December, 2011, the IUGS EC ratified the Calabrian Stage with a base defined by the GSSP at Vrica, Calabria, Italy, this GSSP having previously defined the base of the Pleistocene Series. The Calabrianthus became the second stage of the Pleistocene Series, defining the top of the GelasianStage and effectively completing the Lower Pleistocene Subseries. The GSSP occurs at the base of the marine claystone conformably overlying sapropelic bed ‘e’ in the Vrica section, and has a presently assigned age of 1.80 Ma based on astronomically-tunedsapropelstratigraphy and consideration of the duration of sapropel bed ‘e’. It coincides with the transition from MIS 65 to 64, and the underlying sapropel bed ‘e’ is assigned to MPRS 176 (Citaet al., 2012). The top of the Olduvai Subchron is identified c. 8 m above the GSSP.

The Lower–Middle Pleistocene boundary has yet to be defined although the Brunhes–Matuyama boundary, dated at ca. 773 ka and coinciding with the middle of MIS 19, is widely agreed to be the best primary guide (Head et al., 2008). The three contending global stratotype sections, Valle di Manche, Calabria, and MontalbanoJonico, Basilicata, both in

southern Italy, and the Chiba section in Japan, are all well researched and all have strengths and weaknesses. Valle di Manche has magnetostratigraphy, MontalbanoJonico has a highly resolved stratigraphy but no magnetostratigraphy, and Chiba has outstanding magnetostratigraphy but a literature mostly in Japanese. Establishing the Lower–Middle Pleistocene boundary is a high priority of the ICS Subcommission on Quaternary Stratigraphy (SQS).

Middle–Upper Pleistocene boundary also has yet to be defined, although the beginning of the last interglacial, which approximates the MIS6–5 transition at around 130 ka, is a widely accepted guide for the base of the Upper Pleistocene. In the Mediterranean itbroadly coincides with the base of the Tarentian, a regional stage yet to be formally defined.

The Holocene Series/Epoch was ratified by the IUGS EC in May 2008, with a GSSP at 1492.45 m depth within the NorthGRIP ice core from Greenland. The GSSP corresponds to an abrupt shift in deuterium excess values that reflects the start of climatic warming following the Younger Dryas/Greenland Stadial 1 cold phase. An age of 11,700 calendar years before AD 2000 is estimated for the base of the Holocene, with a maximum counting error of 99 years (Walker et al., 2008).

The Holocene has not yet been subdivided formally, but this is an important objective of the SQS. A discussion paper by Walker et al. (2012) proposed a Lower/Middle Holocene subseries boundary at 8200 years B.P. and a Middle/Upper Holocene subseries boundary at 4200 years B.P., with suggested GSSPs in the Greenland NGRIP1 ice core, and the speleothem record from Mawmluh Cave, northeast India, respectively.

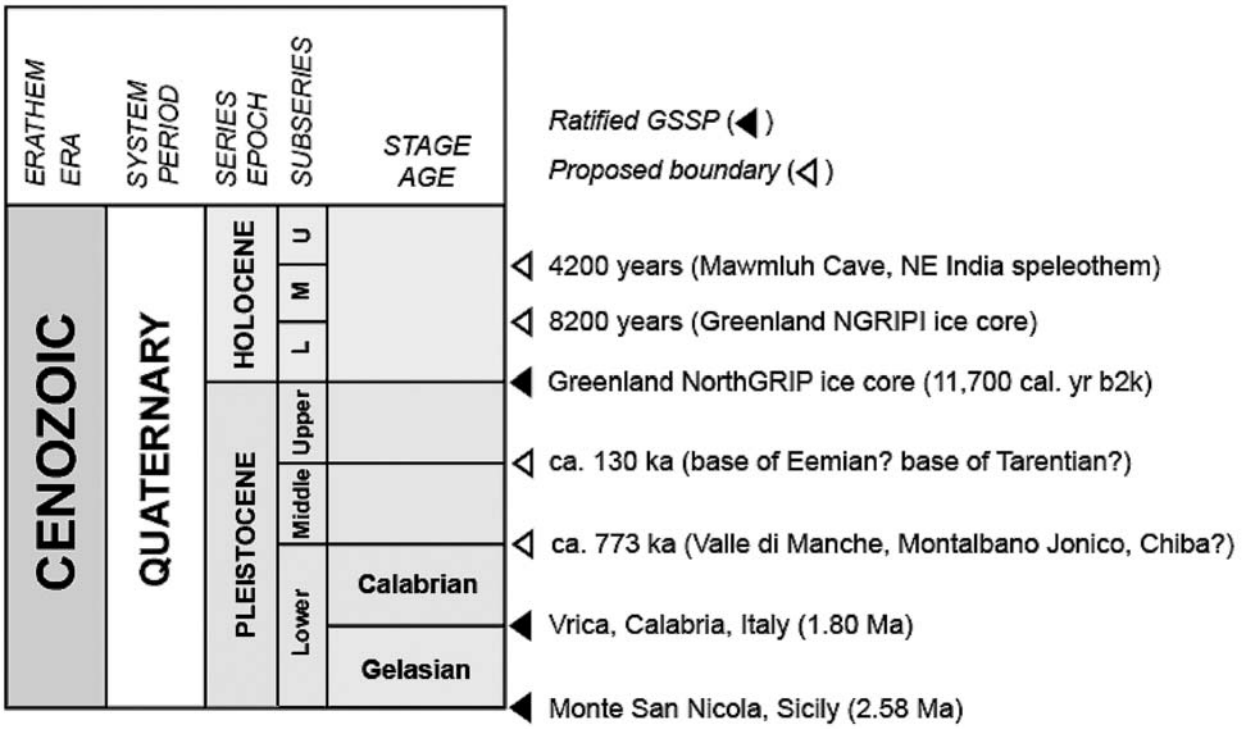

Figure 1. Subdivision of the Quaternary System/Period showing the positions of ratified GSSPs and proposed boundaries as discussed in the text.

The Anthropocene, first proposed by Crutzen&Stoermer (2000), is an attempt to recognize formally the substantial acceleration in human-induced changes to our planet during historical time and especially over the past decades (Williams et al., 2011). An Anthropocene

Working Group has been established by SQS to explore whether the Anthropocene should be treated as a formal chronostratigraphic unit of designated rank and with a defined base, although it currently remains an informal term.

The SQS is also addressing the fine-scale subdivision of other parts of the Quaternary, an example of which is the Last Glacial Maximum, to improve understanding, communication, and stratigraphic correlation, as the demand for ever higher levels of levels of resolution increases. The essential underlying need is to increase precision in communication by drawing clear distinctions between chron-, climato- and event stratigraphical division schemes. SQS intends to take a lead in clarifying these terminological schemes in the near future.

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THE MASTODONTS FROM THE NEOGENE OF MONGOLIA

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Several taxa of mastodonts have been detected from Mongolia during the last century. After systematic revisions by several authors in the time after, the following taxa can be confirmed to make up the Neogene mastodont fauna of Mongolia: *Mammutidae*: *Zygolophodon gobiensis* (including *Z. gromovae*) and *Mammut borsoni*. *Trilophodont gomphotheres: Gomphotherium mongoliense, G.(?) tologojense,* and *Platybelodon* sp.. *Tetralophodont gomphotheres: Tetralophodon sinensis* and *Anancus sinensis*. All taxa were determined from Miocene deposits, only *Anancus sinensis* is known from Pliocene sediments. Two of these taxa have been described for the first time from Mongolia: *G.(?) tologojensis* from its type locality Ulaan Tologoi and *G. mongoliense* from its type locality Loh.

LATE QUATERNARY ENVIRONMENTAL DYNAMICS IN SOUTH CISBAIKALIA RECORDED BY PEDOGENIC CARBONATE COATINGS ON CLASTS

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Increasing of temporal resolution of information recorded by different kinds of natural archives is one of the most actual problems in modern paleoenvironmental researches. Carbonate cutans on stones are often stratified into distinct microlamina, which provide a record of successive local environmental changes and therefore can increase that resolution.

Pedogenic carbonate coatings occurring beneath coarse clasts were investigated in a Late Quaternary (Upper Pleistocene-Holocene) section located in the southern part of the Irkutsk region (Russia) on the Irkutsko-Cheremkhovskaya plain on the left bank of Belaya river — left tributary of Angara river (N 52°52.500′, E 103°28.206′). Coatings are widely distributed in the middle part of describing section. They show a succession of two or three types of laminae with strongly differentiated overall characteristics. Inner and outer laminae of coatings were analyzed for mineralogical and elemental composition, morphological features on different levels of structure organization, stable C and O isotopic composition. All isotopic results are given in relation to PDB.

XRD showed that main mineral constituents of coatings are calcite with *d*-spacing 3,02 A with admixtures of crystalline silicates. The SEM analysis revealed that inner layers of coatings consist of cryptocrystalline calcite with monolithic structure. Microprobe analysis showed Fe and Al peaks which probably inferred from films of sesquioxides on calcite crystals surfaces. Outer layers of coatings consist of silicate matrix with loosely packed radial fibrous calcite spherulites. Microprobe analysis indicated well expressed Ca and Mg peaks inferred from carbonates and Si peaks inferred from matrix. Fe and Al peaks are not detected here. In both cases fast growing of calcite from supersaturated solutions is assumed. Positive $\delta^{13}C$ values (in average – 4 ‰) for all layers of coatings give us evidence to conclude that precipitation of pedogenic carbonates relates to supersaturation of solutes which is induced when soil water is freezing. For our assumption, the main factor, determining differences in morphology of calcite in inner and outer layers is admixtures of sesquioxides, clays and organic matter in soil solutions which can limit the rate of diffusion to crystal surface and cause forming of cryptocrystalline monolithic structure of inner (oldest) layers. Outer (youngest) layers were formed under insignificant influence of these admixtures. This would be evidence of decreasing of illuviation of clays and sesquioxides in solutes and probably related to local changes in vegetation on examined territory.

The $\delta^{13}C$ values of organic matter of modern soil and paleosols in section vary from -24,11 to -22,52 ‰. $\delta^{13}C$ values of pedogenic carbonate coatings are in average – 4 ‰ in inner laminae and – 5,3 ‰ in outer one. Therefore, we suppose that coatings were formed under conditions of clear C3 ecosystems. Simultaneously, they formed under strong influence of atmospheric CO_2. This suggests about low soil respiration rates and therefore about sparseness of vegetation cover on examined territory during coating formation. Thus we can suppose unfavorable environmental con-

ditions for plant growth. In general, a trend towards more negative $\delta^{13}C$ values from the oldest to youngest layers is evidence for shift to warmer climatic conditions. There is a general increase in $\delta^{18}O$ values from the oldest to the youngest laminae (in average, from – 14 ‰ to – 11 ‰). Two major factors are supposed to influence an increase in $\delta^{18}O$ values of meteoric water and carbonates, respectively: an increase of air temperatures and/or decrease in precipitation. It seems reasonable to suppose that $\delta^{18}O$ values in this case were controlled primarily by air temperatures. The data obtained from pedogenic carbonate coatings are important for paleoenvironmental reconstructions. They provide possibility to trace directions of local environmental changes on examined territory.

RECONSTRUCTION OF THE LATE NEOPLEISTOCENE ENVIRONMENTS IN THE SELENGA-ITANTSA BASIN

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The Selenga-Itantsa basin is a part of the Ust'-Selenga depression, the latter being the largest negative morphostructure in the Southeastern Transbaikalian region. Geologically, the most comprehensively studied features are the 2nd and 3rd alluvial terraces of the Selenga and its tributaries. The uppermost series of the alluvial deposits were studied in a quarry at the mouth of the Lovtsovaya R. (a left tributary of the Selenga). The materials obtained formed the basis for the reconstruction of the late Neopleistocene history of the region.

The studies of the terrace alluvial series were performed using standard procedures currently used in lithological and facies analysis, as well as paleobotanical methods (pollen analysis) and thermoluminescence (TL) dating of the lacustrine and fluvial deposits.

There are two levels discernible in the sediments of the 3rd terrace (15–20 m high). The lower part is composed of cross-stratified gravel and pebbles, and of coarse-grained sands with gravel inclusions. The upper part of the sequence opened to a depth of 8 m is of silty and sandy composition (sandy silts and silty sands); they are TL-dated (45 000±4500 and 35 000±5000) and attributed to Blake and Laschamp paleomagnetic subzones of the Brunhes orthozone. The material was deposited in lake-like shallow (less than 2 m) reservoirs within an extensive network of the ancient Selenga braided channels under conditions of a weakly turbulent hydrological regime.

The terrace sediments are facially diversified: silty and sandy varieties were accumulated in mostly undisturbed lake basins with a near bottom currents (limnic microfacies), while medium- to fine-grained sands were introduced by migrating rivers with low velocities of water flow (river microfacies).

The lower portion of the sequence was deposited under warm and wet climate conditions. The pollen and spore content in the samples is high, with light and dark coniferous species prevailing in the assemblages; broadleaved trees (including *Corylus* sp., *Ulmus* sp., *Juglans* sp.) were of secondary importance. Under the forest canopy there was a rich grass cover, mostly of mesophytes. Some diatom algae indicative of warm climate are also present. The early Kargynsky warm interval seems to be dominated by forest landscapes: dark coniferous forests of *Pinus sibirica*, hemlock and fir were gradually replaced with light coniferous taiga of pines (with some broad-leaved species) and with rich diversified cover of grasses and herbs.

The upper part of the terrace sediments yielded pollen assemblages that suggest lower temperatures of both air and soil. There existed parklands of pine and birch, and meadow herbs on open areas (*Labiatae, Scrophylariaceae, Plantago* sp.*, Cyperaceae, Ranunculaceae, Ranunculus* sp.*, Primulaceae, Compositae*, etc.). The climate at that time (TL dated at 35 000±5000 BP) was more or less similar to that of today (according to data by V.V. Savinova).

The sediments of the 2nd terrace dated to the late Karginsky interval (judging from two TL-dates — 27 000±13 500 and 22 000±5500 BP) form two units (in common with the 3rd terrace), the lower is composed of stratified psephitic-psammitic material and the upper of sands and silts.

The upper unit exposed to a depth of 7 m consists of several sub-units (from top downward): massive loess-like sandy loam of pale yellow color; sandy silt of the same color, with wavy lamination; gray silts and fine sands, with a fine rhythmical lamination; brownish-gray fine-grained sands, obliquely stratified. The upper part of the sequence was

deposited in shallow drainage lakes under conditions of slight turbulence; the deposition was mostly confined to the near-shore zone of the lakes (littoral and offshore facies of the limnic macrofacies).

Pollen content is rather low, arboreal pollen slightly prevails in spectra. The data suggest a certain cooling at the middle of the Karginsky Interstadial (TL date 27 000±13 500 BP). Open woodlands of pine and birch dominated in the landscapes.

Later on (TL data 22 000±5500 BP) the sedimentation proceeded in temperate warm and wet environments, the climate warming led to some expansion of forests. The pollen assemblages display a noticeable increase in proportion of arboreal pollen, including that of dark coniferous trees and occasional hazel. The spectra suggest widespread open woodlands with hemlock, fir, pines. Birch, willows and walnut occupied lower places. Grasses and herbs formed mostly meadow communities with *Ranunculaceae, Primulaceae, Urtica* sp.*, Artemisia, Adonis* sp.*, Botrychium* sp.*, Bryales mosses*.

The pollen spectra are dominated by pollen of trees and shrubs (*Pinus silvestris, Abies* sp.*, occasionally Pinus sibirica,* birch*, Alnaster, Salix*). Widely spread were pine forests with admixture of fir, birch forests (the present-day hybrid varieties) with *Alnaster* and willows along streams and in depressions. Meadow communities included various herbs with *Botrychium* sp. and *Bryales mosses*. According to data by V.V. Savinova, the climate was temperate-warm and humid enough, that is, not unlike to the present days.

In the course of deposition of the 3rd and 2nd terrace sediments, over the Karginsky interval, several shallow drainage lakes existed there similar to each other in the hydrodynamic conditions of sedimentation. The rivers transporting the sediments repeatedly experienced changes in hydrological regime during that time — from plain to mountain types and back again to plain regime. This fact is supported by the facies character in the two principal macrofacies: the fluvial (with channel and floodplain facies) and lacustrine (littoral and offshore facies). Towards the final stage of the Karginsky epoch the proportion of channel facies became gradually diminished, in common with intensity of the sedimentation process and with the total water supply, the latter being directly dependent on the climate aridization at that time.

The paleoenvironmental reconstructions are based on studies of the 2nd terrace lithology and facies, dated to the Karginsky interval. The pollen assemblage composition and vegetation characteristics permitted to distinguish four stages in the environment evolution: two of them featured relatively warm and wet climate (TL dates 45 000±4500 and 22 000±5500 yrs BP) and othe two – less wet and colder climate (TL dates 35 000±5000 and 27 000±13 500). Pollen and spore spectra indicate forest vegetation at the time of sedimentation. Climatic conditions of the time were noticeably wetter and warmer than today's. The uppermost part of the sequence formed at the beginning of the Sartan cold epoch, when broad-leaved species disappeared from the plant communities and were replaced with dark coniferous trees.

ISOTOPIC CHARACTERISTICS OF THE RIVERINE INORGANIC CARBON (DIC) AND PARTICULATE ORGANIC CARBON (POC) OF THE LOWER XIJIANG RIVER, SE CHINA AND IMPLICATIONS FOR DIC-POC TRANSFORMATION

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This study conducted a comprehensive investigation on stable carbon isotopic composition and POC/PN (particulate nitrogen) ratio for the DIC and POC sampled from different seasons in the lower Xijiang and its three tributaries. For better understanding of the origin and evolution of the riverine DIC and POC, detailed analyses are also performed for soil samples across the study region. Downstream increase in $\delta^{13}C_{DIC}$ and downstream decrease in both $\delta^{13}C_{POC}$ and POC/PN have been observed for all the tributaries. Meanwhile, positive shift of $\delta^{13}C_{DIC}$ and negative shift of $\delta^{13}C_{POC}$ are also observed from summer to winter. These observations suggest that the isotopic compositions of both DIC and POC are significantly affected by in-river primary production that converts DIC into organic matter through photosynthesis. It is estimated that the percentage contribution of the riverine aquatic primary production to the riverine POC in the Xijiang and three tributaries of Guijiang, Hejiang and Luoding is respectively 7.1%, 43.2%, 36.4% and 9.9% in rainy season, and 35.6%, 47.3%, 50.3% and 40.1% in dry season. The transformation of DIC into POC may significantly alter the fate of DIC and suggest a new mechanism for the old carbon effect in ^{14}C age of aquatic-environmental sediments.

LATE QUATERNARY MASS-WASTING RECORDS IN THE ACTIVE MOUNTAINS OF TAIWAN

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With rugged topography, the active mountains of Taiwan have recently suffered from landslides and debris flows triggered by severe rains or large earthquakes. In order to understand the nature of these processes, studies of pre-historical mass-wasting histories in Taiwan have started, and more than 400 radiocarbon dates (mostly < 20 ka) have been obtained, from diamict gravels prevalently preserved on hillslopes or in alluvial terraces in the mountains. These studies show that the recent disastrous mass-wasting events could have recurrence intervals varying from < 0.1 to > 10 ka. Also, different catchments, even adjacent to each other and under the same geological and geomorphic settings, could have distinct mass-wasting histories (timing, magnitude, and frequency). Only a few of these paleo-mass-wasting records may be correlated to the known paleo-climate or paleo-seismicity data. The observed ancient diamict gravels commonly exceed several tens of meters, and up to 250 m, in thickness. Their contributing mass-wasting events must have greatly affected the short-term sediment yield and aggradation/incision of river systems in response to long-term tectonic uplift. It is hoped that these data would promote hazard awareness and help land-use management in the mountains of Taiwan.

HOLOCENE SMALL MAMMAL AND AMPHIBIAN FAUNA OF MONGOLIA

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Paleoanthropologists of the National University of Mongolia excavated numerous localities over the vast territory of Mongolia [Erdene, 2008; Tumen, 2008 etc.]. Since 2009 scientists began collecting faunistic remains additionally during their field work by way of sieving loose deposits. These researches would contribute to understanding of the Holocene paleoenvironments and climate. Unfortunately the stratigraphic context of these materials is insufficiently known as yet. This gap is to be filled in the nearest future.

Figure 1: Geographic position of some Neolithic sites, burial grounds and old cities in Mongolia: 1 – Khankh; 2 – Khaschaat; 3 – Dulaan uul; 4 – Zenchermandal; 5 - Tsagaan Chuluut; 6 – Avarga balgas; 7 – Barga els; 8 – Ulaan Suukh, Togootyn gol V; 9 – Sharkhad; 10 – Southern Gobi.

The faunistic materials were recovered from localities of different genesis: burial grounds, old cities, and Neolithic sites in different parts of Mongolia (Fig. 1). The Holocene fauna included birds (not identified yet at the species level), one species of Anura, two species of large mammals; the small mammal fauna is represented by two lagomorph and six rodent species which are the components of the recent fauna also. All mammal species are typical steppe and semi-desert inhabitants of Mongolia both in the past and at present, but toads of the genus Bufo inhabit a wide range of environments, living in forests and grasslands over low-lying terrain and in mountains. The fauna species composition testifies that ancient humans lived in arid environments and in the open landscapes during Neolithic, Bronze and Mongolian time.

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LATE PLEISTOCENE MAMMAL FAUNA OF THE REFERENCE SECTIONS IN TUNKA RIFT VALLEY (SOUTHWESTERN BAIKAL REGION): GEOCHRONOLOGY AND PALEOGEOGRAPHY

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Multidisciplinary researches performed on the sections in the Tunka Rift valley produced rich mammal assemblages dated to the Late Pleistocene. At that time the south-western Baikal region was inhabited by *Spermophilus undulatus* Pall., *Clethrionomys rutilus* Pall., *C. rufocanus* Sundev., *Lemmus amurensis* Vinogr., *Myopus schisticolor* Lill., *Alticola argentatus* Severtz., *Lagurus lagurus* Pall., *Lasiopodomys brandti* Radde, *Microtus gregalis* Pall., *M. mongolicus* Radde, *M. maximowichi* (Schrenk), *M. oeconomus* Pall., *Microtus* sp., *Mammuthus primigenius* (Blum.), *Crocuta spelea* Gold., *Panthera spelea* Gold., *Felis manul* Pall., *Coelodonta antiquitatis* Blum., *Equus* sp., *Moschus moschiferus* L., *Capreolus pygargus* Pall., *Capreolus* sp., *Cervus elaphus* L., *Alces* sp., *Procapra gutturosa* Gmel., *Spirocerus kiakthensis* M.Pavl., *Bison priscus* Boj. The faunistic remains were dated in several radiocarbon laboratories using ^{14}C and AMS-methods. Most of the materials proved to belong to the Karginian interstadial (MIS 3): 37790±310 (OxA-19193) – 32570±340 yr BP (TO-13278).

So, the MIS 3 fauna of the Tunka Rift valley included 27 animals which are commonly inhabitants of steppe, meadows, forests and semi-deserts, those of steppe and semi-desert being prevalent. That suggests predominance of the open landscapes surrounded with forests.

COASTAL TERRACE AND ITS IMPLICATION ON THE QUATERNARY TECTONIC AND SEDIMENTARY ENVIRONMENT IN THE EAST COAST, KOREA

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In Korean peninsula Quaternary coastal terraces are composed of pebbles to pea-gravels on the paleo-erosional surfaces like wave-cut platform or berm, beach-face or shore-face in the eastern part of South Korea. Coastal terrace has 5 main steps, compose of Holocene alluvial plain(< ca 5m, asl), last interglacial low terrace (< ca 25m, asl), middle terrace(< ca 45m, asl), high terrace(< ca 75m, asl), and upper high terrace (> ca 80m, asl). Among these terraces, Holocene coastal alluvial plain and low terrace have been investigated most intensively because of the availability of numerical chronology. In particular the ages of lower terrace have been so far examined by composition of tephras, OSL ages and polarity change of paleomagnetism. In this paper the numerical ages, topographic elevations and base level change of the about 30 terrace sites have been analyzed in order to calculate uplift implication of Korea east coast. The result shows that uplift rates range 0.01 ~0.26m/ka; Temporal change of uplift rate is assumed and it is summarized as 0.10-0.25m/ka during 110~130ka, 0.01-0.12m/ka during 98~106ka, 0.18-0.34m/ka during 81-90ka, and 0.09-0.26m/ka during 54-80 ka. The differential uplift rate is opposite trend to the global sea level fluctuation. It may indicate certain level of hydro-isostacism in the Korean peninsula. This is a consistent uplifting trend, but quite different viewpoint of the traditional mechanism, i.e., neotectonically-driven uplift based on the compression of the Western Pacific and the Amurian plates and/or the Phillipine plate during the Quaternary.

LITHOLOGICAL, STRATIGRAPHIC AND PALEOGEOGRAPHIC ANALYSIS OF SANDY DEPOSITS OF KUYTUNS IN THE BARGUZIN BASIN (BAIKALIAN REGION OF SIBERIA)

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The Barguzin Basin belonging to the eastern flank of the Baikalian rift zone lies between the uplifts of the Barguzin and Ikat mountain ranges. The principal geomorphic units of the basin floor are the sloping piedmont plain along the Barguzin Range, the alluvial complex of the Barguzin River valley, and the zone of sandy hills (kuytuns) fringing the Ikat Range slope. The sandy kuytun deposits of considerable thickness compose at least seven terraces of complex (fluvial and lacustrine) origin.

The sediments present a rather monotonous sequence of rhythmic-bedded fine- to medium-grained sands with silt and clay admixture, as well as occasional interlayers and lenses of gravel and small-size pebbles. The bedding is mostly horizontal, oblique or wave-like. On the whole, the sediments are well to moderately sorted, the sorting coefficient being 0.1 to 0.3. The skewness coefficient Sk<1 with the mode shifted towards larger size particles suggests a relatively high energy of the sedimentation environments. The kurtosis is positive which indicates a steady dynamics of the sediment supply throughout the sedimentation period and a relatively quiet tectonic regime. Apart from the textural characteristics, the supporting evidence for the aquatic genesis of the sediments is provided by coefficient of variation for sand grains; its values (0.7 to 1.2) fall in the field of mixed alluvial and lacustrine genesis as well as in that of turbulent flows with seasonal changes in river discharge.

Judging from the paleo-potamological characteristics, the sedimentation environments may be described as follows. The sands were accumulated in shallow (3–4 m at most) drainage lakes. The paleo-streams transporting the sediments into those lakes were mostly of plain type (Fr <0.1), less common of semi-mountain type (Fr=0.1-0.2), with well developed accumulative channel landforms; the stream flow was free and unobstructed in clean natural channels with a rather smooth bed. The surface velocities of the paleo-rivers did not exceed 0.6 m/s, the stream surface gradients varied from 0.5 to 1.6 m/km. The maximum depth at the low water period was 0.3–0.9 m, the channel width at the highest stand (before overflowing the banks) varied within wide limits — from 20 to 100 m. By the criterion of channel stability (<100) they may be classified among relative stable ones and unlikely were capable of a considerable erosion activity.

Thus, the aquatic genesis of the sandy and silty-sandy sediments of the kuytuns in the Barguzin Basin may be confidently taken to be aquatic. The thermoluminescence (TL) dating permitted to identify several cycles of sedimentation correlatable with tectonic activity phases. The four recognized periods of activation (early Primorye phase — 1.3–1.1 MA, late Primorye phase — 800–600 ka BP, Khubsugul phase — 600–400 ka BP, and Tyya phase — 150–100 ka BP) resulted in four ingressions of Baikal Lake. The water entered the Barguzin Basin as well as other intermountain depressions and river valleys. In this way, numerous shallow drainage lakes came into being, and it was in those lakes that the sandy deposits of kuytuns were accumulated. With the Baikal level dropped, the lake basins ceased to exist.

RECONSTRUCTIONS OF PALEO-ENVIRONMENTAL ELEMENTS BASED ON STUDIES OF THE LATE NEOPLEISTOCENE AND HOLOCENE DEPOSITS IN THE UST-SELENGA BASIN (EAST BAIKALIAN REGION)

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Aeolian deposits are known to indicate a rather dry climate or strong winds in the coastal zone of lakes and in large river valleys. In the Ust-Selenga Basin eolian landforms are widely spread, mostly over the Selenga River terraces. The modeling of the high lacustrine terrace surface by eolian processes at the time of the late Neopleistocene glaciation suggests a drop of the lake level after the mid-Neopleistocene ingression of the lake. In the late Neopleistocene eolian meso-landforms occupied larger areas in the depression than at present. The radio-thermoluminescent dating of the eolian sands permitted to determine periods of arid climate at the Karginsky/Sartanian boundary in the late Neopleistocene. The landforms of eolian deposition developed on the high surface of lacustrine-fluvial terrace (near Stepnoy Dvorets, Istomino and Istok settlements) at the final Karginsky – beginning of the Sartanian intervals (RTL dates are 21 000±2000, 22 000±2000, and 23 000±7000 BP); such an activation of eolian processes indicates a conspicuous climatic change at the initial stages of the second – late Neopleistocene – glaciation in the region.

On the left side of the Selenga R. valley there are distinct traces of eolian erosion (deflation) processes on the 2nd fluvial terrace (8–10 m high) in the neighborhood of Stepnoy Dvorets village. A typical sediment sequence exposed in a residual fragment of the terrace is as follows. Immediately under the recent soil there is an eolian layer of fine-grained unstratified sand about 0.4 m thick. It overlies a fossil soil enriched in humus and plant remains. A sample of the fossil soil yielded a radiocarbon date of 855±65 (COAH-7676). The date thus obtained corresponds to final stages of the Medieval Climatic Warming (1600–900 years ago) in the climate-stratigraphic scale of the Holocene. The subsequent cold interval (the Little Ice Age) could, in all probability, give rise to eolian process activation in the studied region.

Eolian dunes up to 8–9 m high occur in the lowermost part of the Kabanya River valley on the lower terraces of the Selenga R. Some of the terrace sections expose as many as 4 fossil soil horizons (for example, at the Nyuki village). The fossil soil developed on the fluvial deposits of the 2nd terrace and underlying eolian sands was sampled for radiocarbon dating and produced the following dates: 5010±90 (COAH-8115), 2125±55 (COAH-8114), 780±60 (COAH-8113) and 300±50 (COAH-8112). The first of the dates corresponds to the boundary of Atlantic and Subboreal periods of Holocene, the second — to the Subatlantic time. The two last dates corroborate the suggestion of soil formation during the Medieval Climatic Warming and a later increase in climate aridity. The fourth date is suggestive of the cold interval being short and soon replaced by warmer and more humid one; the change in climate promoted soil formation and development of the uppermost fossil soil horizon. At the beginning of the 18th century the climate changed once more and became cooler and drier, thus fostering wind erosion processes.

So, the analysis of sequences of the subaerial sediments in the Ust-Selena Basin revealed a repeated activation of eolian processes through the Holocene. The changes in eolian activity were undoubtedly of cyclic character.

DISTRIBUTION OF CARNIVORA IN NEOPLEISTOCENE OF KAZAKHSTAN

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Materials, taken as a principle of given report are received as the result of works analysis by finds of bone remains of the representatives of Order Carnivora from mammoth faunistic complex on the territory of Kazakhstan in XXth century. These data are placed below in the table, where listed the species composition of carnivores, with indication of sites and accompanying fauna.

System	Section	Subsection	Complex	Locality and carnivores species composition	Structure of accompanying fauna
Quaternary	Pleistocene	Neopleistocene	Mammoth	Zyryanovsk, Eastern-Kazakhstan region: *Canis lupus, Ursus arctos,Ursus (Spelaearctos), Crocuta spelaea, Panthera spelaea*	*Mammuthus primigenius, Equus caballus, Coelodonta antiquitatis, Camelus Knoblochi, Cervus elaphus, Megaloceros gigantheus cf. gigantheus,.Alces alces, Bos primigenius, Bison priscus mediator*
				Settlement Zhamantuz, Akmolinsk region: *Canis lupus, Vulpes corsac Crocuta spelaea, Panthera spelaea*	*Equus caballus, Equus hydruntinus, Equus hemionus, Coelodonta antiquitatis, Alces alces, Bos primigenius, Bison priscus mediator*
				Selim - Dzhevar, Akmolinsk region: *Panthera spelaea*	*Mammuthus primigenius, Equus caballus, Castor fiber*
				Zhelezinka, Pavlodar region: *Crocuta spelaea*	*Mammuthus primigenius, Equus caballus, Coelodonta antiquitatis, Cervus elaphus, Megaloceros gigantheus cf. gigantheus, Cervus elaphus, Bison priscus mediator Gazella subgutturosa, Saiga tatarica*

It must be noted, that remains of cave carnivores: lion, bear, hyena, have deposited in beddings of Upper Pleistocene. Late Pleistocene carnivores should be died after reduction in the number of mass ungulates species at the end of last glacial epoch. The most large conservation of remains and, apparently, the growth of these carnivores number took place in late Pleistocene. Burials of cave lion remains, especially, the cave bear, are connected with cave layers in karst regions, backswamp and flood plain deposits of ancient flows, deposits of lakes and slopes diluvium within vast plains. As to cave hyenas, they have met in Pleistocene alluvium of rivers, open encampment and Paleolithic caves.

CURENT RESEARCH ON QUATERNARY RESEARCH IN JAPAN

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After the Eastern Japanese Earthquake Disaster (March 11, 2011), numbers of the Quaternary scientists change the subject for studies to earthquake and tsunami, for example the ancient earthquake such as the Jyogan Earthquake (July 9, 869). Such kinds of big earthquakes and tsunami were remained some evidence in the Holocene sediments. So, many such event sediments were identified in Japanese Island and some cycle of big earthquake were confirmed. Related of such earthquake cycle, the volcanic activity was also considered. For example, the Mt. Fuji, one of the famous active volcano in Japan, erupted at November 23, 1708. It was estimated the relation with the Hoei Earthquake.

After the Eastern Japanese Earthquake Disaster, numbers of the Quaternary researcher study the favorability of the atomic power station. Especially, the distribution of the active fault is fatal requirement for the atomic power station. The Japanese Association for the Quaternary Research recommends the member of judgment member for the active fault in the station. The basement rocks of station have been investigated and judged security.

Japanese Association for the Quaternary Research has 11 groups such as geology, geography, paleontology, archaeology, anthropology, pedology, geophysics, geochemistry, engineering, paleobotany, paleozoology. The association makes annual meeting at the Tokyo and local places biyearly. The oral and poster session are held by all members, for the synthesis of study fields. It system is very useful for the solution of phenomenon.

At recent studies of the Japanese Association for the Quaternary Research was collected at the Digital Book: Progress in Quaternary Research in Japan (2009). In this CD-ROM, such kinds of topics are recorded, The Quaternary Stratigraphy, Environmental changes in the Quaternary, Assessing changes over time, Human impacts on the nature, Paleoenvironment in the cryosphere, Stratigraphical and chronological studies for Quaternary time scale, Geological and geomorphic evolution of Japanese Islands, Quaternary tectonics and volcanic activities, Anthropology and archaeology in Japan, Quaternary biosphere and ecosystem, Advances in the Quaternary dating method.

GEOLOGICAL REQUIREMENTS FOR THE PALEOLITHIC SITE ON THE VOLCANIC AREA

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Paleolithic siteslocate on the volcanoes in Japan. Especially, a lot of the sites locate around the Yatsugatake volcanic area, central Japan. Almost of them are belong to the Middle to Late Paleolithic sites (about 60 ka BP to 15 ka BP.). After Paleolithic age, so many Jomon sites have been formed at the lower place than the Paleolithic sites. And the Middle Jomon sites are located on the volcanic skirt lowerthan Early Jomon sites. Number of sites of the Middle Jomon had increased than older one. Almost of them situate near the stream. However, before the beginning of the Late Jomon Age, all of them have been disappear. Reason of that estimated for the moving to the valley plain because of stat of rice crop. Concerning on the Paleolithic site, almost of them are located in the deep mountain area such as upstream of the valley and on the mountain ridge near the spring. Especially, the camp sites are located near the spring. It is estimated for the convenience on the hunting.

Amount of the water flow in the revers on the volcanic area are very rich than other area. It is corroborated by the rich fountain water from the volcanic rocks. Almost of the fountainhead of the rivers on the volcanic area are supported by the groundwater fountained from lava aquifer. Especially, the young lavers are excellent aquifer. On of them is the Ikenotaira Lava situated on the east slope of the Middle Yatsugatake volcanic range. The sites situate on the Late Pleistocene lava flow erupted from central part of Yatsugatake volcanic chain, altitude of about 1700 m to 1300 m. The slope on the lava flow is gentle compare to surrounding mountainside and visibility is very well. It is covered mainly *Betula*. Also, the sites distributed along the narrow lava flow surface less than 1 km in wide. Seemingly forming a route to the quarry site exposing obsidian and many obsidian gravels distributed in the streams that situate at the both edge of lava flow.

On account of the assemblage, the Komade-ike site might be assignet as a campsite complex during the last Glacial Maximum Stage. The culture reconstructed from the yielded tools indicates that the age of the site is correlated with the last stage of Paleolithic age and the site seems to be a life center of many ancestor generations.

MID-NEOLITHIC EXPLOITATION OF MOLLUSKS IN THE GUANZHONG BASIN OF NORTHWESTERN CHINA

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Mollusk remains are abundant in archaeological sites in the Guanzhong Basin of Northwestern China, providing good opportunities for investigations into the use of mollusks by prehistoric humans. Here we report on freshwater gastropod and bivalve mollusks covering the time interval from about 5600 to 4500 cal. yrs BP from sites of Mid-Late Neolithic age. They are identified as *Cipangopaludina chinensis* and *Unio douglasiae*, both of which are currently food for humans. The shells are well preserved and have no signs of abrasion. They are all freshwater gastropods and bivalves found in pits without water-reworked deposits and have modern representatives which can be observed in rivers, reservoirs, and paddy fields in the studied region. Mollusk shells were frequently recovered in association with mammal bones, lithic artifacts, and pottery. These lines of evidence indicate that the mollusks are the remains of prehistoric meals. The mollusk shells were likely discarded into the pits by prehistoric humans after the flesh was eaten. However, these mollusk remains may not have been staple food since they are not found in large quantities. Mollusk shell tools and ornaments are also observed. Shell tools include shell knives, shell reaphooks and arrowheads, whereas shell ornaments are composed of pendants and loops. All the shell tools and ornaments are made of bivalve mollusks and do not occur in large numbers. The finding of these freshwater mollusk remains supports the view that the middle Holocene climate in the Guanzhong Basin may have been warm and moist, which was probably favorable to freshwater mollusks growing and developing in the region.

CLIMATE AND ENVIRONMENT CHANGES IN NORTHWESTERN ARID CHINA DURING LATE QUATERNARY: EVIDENCES FROM GEOLOGICAL RECORD OF GLACIAL AND LAKE SEDIMENTS

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Northwestern China is located in central Asia with arid climate condition. Its geomorphological feature shows that three high mountain ranges over 4000 m a.s.l. in altitude (the Kunlun, the Tianshan and the Altay in turn from south to north) distribute alternately with two big basins(the Tarim Basin in the south and the Junggar basin in the north). Regional difference of climate conditions of the warm and dry in the basins and the cold and humid in the mountainous is quite obvious. Therefore, vast area of deserts had been formed in basins and large number of glaciers developed in high mountain areas. In some basins, tens or hundreds meters of Quaternary lacustrine deposits had been drilled, which the proxy data of multi-disciplinary analyses revealed the history of palaeoclimate and palaeoenvironment changes during Quaternary.

With global glacial-interglacial climate cycles during Quaternary, three glaciations had been recognized in high mountain areas according to the series of glacial deposits. The oldest glacial deposit had been dated back to MIS 16. The penultimate glaciation had been occurred during MIS 8 to MIS 6. The last glaciation developed during MIS 4 and 2. The glacial areas during the last glaciation generally are 4-7 times of that at present. But during the Holocene period, several glacial advance events had been occurred and many end moraines formed in the U-shape valley.

Lake sediments are used to reconstruct palaeoclimate and palaeoenvironment history. A 57 m lacustrine core (TS95) (35°21′N, 79°30′E) was retrieved from an altitude of 4840 m a.s.l. in the southern part of West Kunlun Mountains. The core bottom was dated to ca.240 ka B.P. based on the U-series dating and the top ca. 17ka B.P. according to ^{14}C dating. It therefore has the potential to provide valuable palaeoclimate and environmental records for the last interglacial/glacial cycle and the penultimate glacial period. Proxy data show that the lower section represents a fluvially dominated open lake, while the upper core reflects a closed lake environment. This abrupt change in conditions has been linked to sudden strong tectonic movements occurring around 150 ka B.P. After that time, this closed lake has been responding to regional climatic changes. Other proxies point to a palaeoclimate dominated by monsoon circulation during the warmer stages of the interglacial, while a westerly dominated climate during the colder periods of the glacial, although the whole period of 240-17 ka B.P. is very transitional.

RECONSTRUCTED LONG-TERM N-ALKANE RECORDS AND THE INFERRED PALEOENVIRONMENTAL CHANGES OF JHUOSHUEI RIVER DELTA

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The Jhuoshuei River alluvial fan locates in the west coast of Taiwan It has been pointed out that the Jhuoshuei River sediment discharge is the highest of all Taiwan's rivers. With supports by the FATES program, two long sedimentary cores were retrieved at the mouth of Jhuoshuei River, which can cover the last 80 ka according to radiocarbon dating, for investigating the fate of sediments exported out from Taiwan Island and the linked paleoenvironmental variations. Each core has 100 m long in total length. Therefore, these two cores are believed to be the first two long cores recovered from such highly dynamic environment of Taiwan. The ultra-high sedimentation rate (~125 cm/ka) provides us a chance to build up a high resolution record not only for sedimentological but also paleoenvironmental researches under land-sea interactrions. In this study, we focus on core JDR-S, which retrieved from the southern coast of Jhuoshuei River estuary, to build up records. We analyzed organic compounds in sediments, include of total organic carbon and n-alkanes concentrations. Contents and carbon species distribution of alkanes have been broadly used as research tools to assess the vegetation change and accompanied paleoenvironmental and paleoclimatic variations. Previous study based upon foraminiferal census data indicated that the fan area was keeping emerged until 14 ka (47 m). Since then on, the gradually increased sea level finally high enough for allowing sea water to submerge the area. Our biomarker record confirms the fact but displays a higher fluctuated pattern that might be associates with the East Asian Monsoon variations.

ASYNCHRONOUS MARINE-TERRESTRIAL SIGNALS OF THE LAST DEGLACIAL WARMING IN EAST ASIA ASSOCIATED WITH LOW- AND HIGH-LATITUDE CLIMATE CHANGES

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A high-resolution multiproxy record, including pollen, foraminifera, and alkenone paleothermometry, obtained from a single core (DG9603) from the Okinawa Trough, East China Sea (ECS), provided unambiguous evidence for asynchronous climate change between the land and ocean over the past 40 ka. On land, the deglacial stage was characterized by rapid warming, as reflected by paleovegetation, and it began ca. 15 ka BP, consistent with the timing of the last deglacial warming in Greenland. However, sea surface temperature estimates from foraminifera and alkenone paleothermometry increased around 20–19 ka BP, as in the Western Pacific Warm Pool (WPWP). Sea surface temperatures in the Okinawa Trough were influenced mainly by heat transport from the tropical western Pacific Ocean by the Kuroshio Current, but the epicontinental vegetation of the ECS was influenced by atmospheric circulation linked to the northern high-latitude climate. Asynchronous terrestrial and marine signals of the last deglacial warming in East Asia were thus clearly related to ocean currents and atmospheric circulation. We argue that (i) early warming seawater of the WPWP, driven by low-latitude insolation and trade winds, moved northward via the Kuroshio Current and triggered marine warming along the ECS around 20–19 ka BP similar to that in the WPWP, and (ii) an almost complete shutdown of the Atlantic Meridional Overturning Circulation ca. 18–15 ka BP was associated with cold Heinrich stadial-1 and delayed terrestrial warming during the last deglacial warming until ca. 15 ka BP at northern high latitudes, and hence in East Asia. Terrestrial deglacial warming therefore lagged behind marine changes by ca. 3–4 ka.

ON THE METHOD TO REFINE ASIAN LAND MAMMAL AGES USING CRITERIA FOR GLOBAL STRATOTYPE SECTION AND POINT

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Known since 1941[1] land mammal ages (LMAs) as a regional biochronologic system have been widely used in the study of continental sediments for stratigraphic division, age determination and correlation. The system is useful not only at the time when other dating methods, such as the paleomagnetic chrons, were not available, but still remains to be so today although it has not been formally recognized in the International Stratigraphic Guide (ISG) [2]. LMAs are in principle based on evolutionary stages of mammals represented by local faunas. However, the system has not been consistently formatted in the past decades in terms of how such as a unit should be defined. In particular, the definition of the lower boundary of a LMA was often made using different methods, such as the polarity chron or the first appearance datum of a mammal taxon. In the former case, a non-mammalian criterion is used, whereas in the latter the definition is usually out of the context of rocks. Nearly all boundaries of the Asian LMAs are currently defined by either arbitrary correlation with marine chronostratigraphic units, by polarity chrons, by first appearances of several species, or by an abstract first appearance datum of a mammal species.

To refine the land mammal ages in Asia, a more rigorous method has been proposed for the definition of the lower boundary of a mammal age [3]. This method complies with the criteria for the global stratotype section and point as recommended by the IGS [2]. As a special biochronological unit based on mammalian evolution, a land mammal age is best defined as a specific physical point marked by the lowest stratigraphic occurrence of a mammal species in a chosen stratotype section (LOS). The time plane that contains the LOS is the oldest stratigraphic datum (ODS). The stratotype for a LMA must be a section that is essentially continuous, with a rich fauna that can be calibrated with dating methods independent of evolution and permit correlations. Whether the first stratigraphic occurrence of a taxon is synchronous over a specified geographic region is a matter of correlation. A boundary such defined should be flexible, allowing for improvement when new biostratigraphic data emerge, and naturally, it may not coincide with any boundary of the global chronostratigraphic units.

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PRE-CENOZOIC GEOLOGY AND MINERAL RESOURCES OF THE BAIKAL REGION

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The territory surrounding the Lake Baikal (Prebaikalia and Transbaikalia) and situated in the central part of the Eurasian continent is referred to as the Baikal region. Geology and structure of the region have been controlled by three leading structural elements of Central Siberia, namely Siberian craton, Sayan-Baikal fold belt (northern part of the Central Asian fold belt) of the Neo-Proterozoic — Early Paleozoic age, and Mesozoic structures superimposed on older ones [3]. The geological sequence of the Baikal mountain region comprises Archean, Lower and Upper Proterozoic, Cambrian, Lower and Middle Jurassic, Paleogene, Neogene and Quaternary deposits.

The Baikal Lake is shown to be confined to a rift zone stretching for more than 2 500 km from North Mongolia to Stanovoy Ridge; it is dated to 35-25 Ma BP. There is an enormous granite intrusion known as the Angara-Vitim batholith found in Transbaikalia; it is about 150 000 sq. km in size and considered to be one largest in the world.

More than 700 mineral deposits and ore occurrences are known in the considered area. The largest among them are deposits of pyrite-polymetallic ores (Ozernoye and Kholodninskoye), tungsten (Gudzhir, Kholtoson), molybdenum (Orekitkan, Zharchikha, Maly Oinogor), gold (Zun-Kholba, Irokinda, Kedrovskoye, Karalon, etc.), beryllium (Ermakov, Aunokskoye), uranium (Khiagda), fluorite (Egitinskoye, Naran), apatite (Oshurkovo), graphite (Botogol) and a number of smaller mineral deposits and occurrences of gold, lead, zinc, uranium, chrysotile-asbestos, zeolites, bentonite, perlites and building materials [1]. Two large mineral deposits — Ozernoye and Kholodninskoye that contain 48% of Zn and 24% of Pb resources of the Russian Federation resources are at the stage of development. 218 placer and ore gold deposits have been discovered in the Republic of Buryatia; 70.4% of explored gold reserves are in primary ore deposits and 26.9% are placers [2]. As for mined gold, primary Au makes up 36% and placer Au — 64 %. Buryatia holds much promise for discovery of large gold deposits in East Sayan, North Transbaikalia, and Muya ore district.

The Lake Baikal itself is a World Natural Heritage Site; that circumstance essentially restrains mining of mineral deposits in the Baikal region.

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LATE QUATERNARY SEDIMENTATION HISTORY AND CLIMATE OF THE HOVSGOL BASIN, NORTHERN MONGOLIA

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The Hovsgol Lake is second largest fresh water lake in the Central Asia, is located in Northern Mongolia, in southern continuation of the Cenozoic Baikal Rift System. The Lake Hovsgol is 136 km long and 20.3 (36) km wide. Lake Hovsgol covers an area of 2760 sq km and 1645 m above the see level. Maximum depth is 162 m. As Lake Hovsgol is located in interior of Asian continent, far removed from oceans, its sediment keeps excellent records of the inland history for northeastern part of Eurasian continent. From this point of view, the lake Hovsgol is quite unique object of the past environmental and climate changes attracting attentions of international scientific communities.

Systematical studies on Lake Hovsgol for paleoenvironmental and palaeoclimate reconstruction started recently with international Hovsgol Drilling Project. Main purpose of Hovsgol Drilling Project is to retrieving the Pleistocene sedimentary record from the Hovsgol rift basin, in other to develop new long paleoclimate proxy records from the Baikal region of continental interior of Asia.

Here we introduce paleoenvironmental and climate evolution in the Hovsgol basin during the Pleistocene and Holocene based on results of multy-proxy analysis of the HDP-04 core sediment, by Hovsgol Drilling Project Members. The core HDP-04 with length of 81 m was taken from central part of the lake, at coordinates of 50°57′19″N; 100°21′32″E at water depth of 239 m. The basal age of the drilled section is estimated as ca. 1 Ma (HDP members..., 2009). At least 10 transgression events from coarser calcareous clay to carbonate free diatomaceous silt occurred in the Hovsgol basin during the investigated time interval. The deposition of diatomaceous silt corresponds to the past maxima of regional humidity when surface runoff was highest and mineralization of lake water was low. Transgressions to have been associated with lower sedimentation rates and with the deposition of thin turbidite beds in the deep part of the basin The most recent — 100 m lowstand of the Lake Hovsgol occurred to be at ca. 15.4 ka. Most dramatic lake regression appears to have been associated with the deposition of sand and carbonate oolites at HDP site, presently in 239 m of water (HDP members..., 2009). Thus sedimentary record from Hovsgol basin provides a valuable combination of the lithologic evidence for lake level variations with proxy records for regional climate changes.

CLAY MINERALOGY OF THE HIPPARION RED-EARTH FORMATION IN EASTERN CHINESE LOESS PLATEAU AND ITS ENVIRONMENTAL IMPLICATIONS

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The Hipparion Red-Earth Formation (HREF) in northern China, also referred to as «Red Clay», is a climate record of wind-blown origin, covering the period from ~7-8 to ~2.6 Ma. The clay mineralogy of the Xifeng typical section is studied here by using X-ray Diffraction method to investigate its compositions and environmental implications. The results show that the clay minerals are dominated by illite, followed by smectite, kaolinite and chlorite, an assemblage roughly similar to the Quaternary loess-paleosols of the same regions, and major components of clay minerals calculated by comparing major peak areas are estimated as illite (52-65%), kaolinite (8-13%), chlorite (13-18%), and smectite (9-18%), indicating a climate range from temperate, semi-arid to semi-humid conditions as a whole.

The chlorite and kaolinite present slightly variations throughout this profile, whereas the smectite show significantly reverse changes with the illite. However, the chlorite, usually less resistant to weathering than illite, and the S/K, Ch/K and I/K ratios, the mineralogical weathering proxies, don't remarkably change, suggesting the relative changes for the smectite to illite don't attribute to the climatic changes in the Loess Plateau, but a control of original eolian material.

The illite crystallinity (IC) present a gradual decreasing trend, ranging from ~0.54 to ~0.38, and two prominent shifts occurred at ~3.6 and ~2.7 Ma, which is independence of the variations of the clay minerals, indicating the variations of IC being at the result of the chemical weathering. Since the chemical weathering of the eolian deposits in the Loess Plateau depends largely on the temperature and precipitation in summer, the IC therefore can be served a proxy for the summer monsoon. The higher value indicates the strengthened summer monsoon circulation.

The stepwise decreasing trend of the summer monsoon in Loess Plateau revealed by the HREF IC is coupled in phase with the expansion trends of the ice volume in the northern hemisphere, which may be the direct cause and forcing mechanism of the late Miocene–Pliocene summer monsoon evolution in the Loess Plateau.

VARIATION AND PALEOCIMATIC SIGNIFICANCE OF ORGANIC CARBON ISOTOPES OF ILLI LOESS IN THE ARID CENTRAL ASIA

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As an indicator for terrestrial paleovegetation, the stable isotopic composition of total organic matter ($\delta^{13}C_{org}$) in loess sediments has been widely used for paleoclimatic reconstruction in Western Europe, the Great Plains of North America and the Chinese Loess Plateau (CLP). However, little is known about the variation and paleoclimatic significance of the loess $\delta^{13}C_{org}$ in the arid Central Asia (ACA). We report $\delta 13C_{org}$ data from an Axike (AXK) loess/paleosol profile in the eastern Ili Basin, eastern Central Asia. Along the profile, the $\delta^{13}C_{org}$ values are more negative in the paleosol layers observed in the field and further confirmed by environmental magnetic proxies and higher concentrations of total organic carbon (TOC), consisting with results from Western Europe and northwestern CLP. Our results demonstrate that the loess $\delta^{13}C_{org}$ in this region mainly documents the response of the $\delta^{13}C_{org}$ of local predominant C3 plants to paleoclimatic variation, especially that of paleoprecipitation. Our results also suggest that the loess $\delta^{13}C_{org}$ values in this area have the potential for quantitative paleoprecipitation reconstruction on the basis of detailed $\delta^{13}C_{org}$ study results from modern plants and surface soils in the future.

EOLIAN SEDIMENTATION IN PRIBAIKALYE (LATE PLEISTOCENE – HOLOCENE)

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The southeastern (Selenginsk — Baikalsk) and southwestern (Tunka basin) Pribaikalye experienced the accumulation of the Late Pleistocene — Holocene eolian sediments that led to the formation of the eolian loess complex composed of sandy loams and cohesive sands lying over different geological substrates — alluvial stratified sands from the terraces above the flood plain of the Selenga River, coarse fragments and gruss of the Upper Neogene Anosov suite, and sedimentary-volcanogenic formations and fluvioglacial pebbles in the Tunka basin. Whereas the loess covers of the second — fifth terraces of the Angara River and its tributaries in the Irkutsk amphitheater are most likely to be formed by deluvial processes that involve periodic accumulation of eolian sediments, thin loessial sandy loams and cohesive sands on the surface of terraces above the flood plain and other geomorphological elements in Pribaikalye are primarily the eolian complexes ($vQ_3^3 - vQ_{3-4}$).

Loessial sandy loams (1.5–2.0 m) are penetrated at the head of a large ravine near the Village of Elovka (seen on aerial photos taken in 1937) whose developmental history shows the following cycles: early (Q_{1-2}?) – initiation of Neogene erosion; middle (Q_3?) – deposition of lacustrine and proluvial-deluvial sediments in the area and formation of thin eolian loessial deposits in the watershed; present-day (Q_4) – intensification of erosion, sediment transport in temporary streams and deposition in an alluvial fan in the flood plain of the Elovka River, the fan formation time corresponding with the Late Holocene (the absolute age of buried soil separating the floodplain alluvium from proluvium is 1040 ± 40 YA).

The volcanogenic sediments (Tunka basin, near the Village of Tsaganur) are covered by eolian loessial deposits up to 3 m thick. The pit deposits were accumulated in two sedimentation cycles: lower (interval 2.8–1.6 m) with a buried soil horizon (absolute age ?30400 YA) and upper (interval 1.6–0.0 m) with features of cryogenic environment. Therefore, we may suppose that the first cyclite was formed in the Late Pleistocene and the second cyclite appeared in the Early Holocene.

Along the Turan cross-section on the right bank of the Irkut River near the Datsan (lamaist monastery), the loessial deposits (1.5–2.5 m) that consist almost entirely of cohesive sand have a distinct boundary separating them from the Neogene gravel-cobble sediments. They are eolian formations (vQ_{3-4}) that were ordinary sands during sedimentogenesis. The superimposed processes of loessial lithogenesis during the post-diagenetic stage of the Late Pleistocene–Early Holocene eolian sand sheet under periglacial conditions turned the ordinary sands to an atypical variety of loess with cohesion between particles, macroporosity, more pulverescent composition, more unconsolidated structure, and a carbonate content.

In the meantime, a process similar to the overland eolian sedimentation occurred in Lake Baikal. There are a large number of publications on eolian contributions to bottom sediments in Lake Baikal. In a recently published article [Vologina & Fedotov, 2013] the authors conclude that the high chloritoid content in the samples from the Late Pleistocene sediments of the subwater Academician ridge is related to intensive eolian activity.

Likewise, the monograph of engineering geology [Ryashchenko & Akulova, 1998] suggests that the deposition of eolian sediments was simultaneous in the loessial accumulation in the Upper Priangarye and bottom sediment accumulation near the subwater Academician ridge. The evidence presented in support of this thesis statement was obtained by comparison between the continental cross-section (well 273 on the right-bank slope of the Angara River Valley in the Solnechny micro-district located near the Irkutsk reservoir) showing clearly the eolian loess strata and the cross-section of well VDR-1-93. Eolian and slope activities increased during climatic cooling and determined correlation between the continental and aquatic deposits.

THE FORMATION OF PROVAL BAY AS AN EPISODE IN THE DEVELOPMENT OF THE BAIKAL RIFT BASIN

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The formation of Proval Bay in the Lake Baikal region was caused by the largest seismic event that occurred in Siberia during historical times. It had a magnitude of M 7.5, which is an estimation of the seismic potential in the Middle Baikal area. As a result, more than 230 km^2 of the shore was submerged. The Baikal basin almost instantaneously increased in size by more than 1 billion m3. The northeastern marginal segment of the Selenga River delta (fig. 1), with a total area of about 230 km^2, sank beneath the level of the lake and gave rise almost instantaneously to the formation of one of the biggest bays of Baikal, named Proval which means "failure" in English. The earthquake was named after the Tsagan steppe that sank beneath the level of the lake (Tsagan earthquake). The Tsagan earthquake was preceded by a large foreshock with M~6.5 and followed by a series of large aftershocks which lasted for about a year and a half until June 1863.

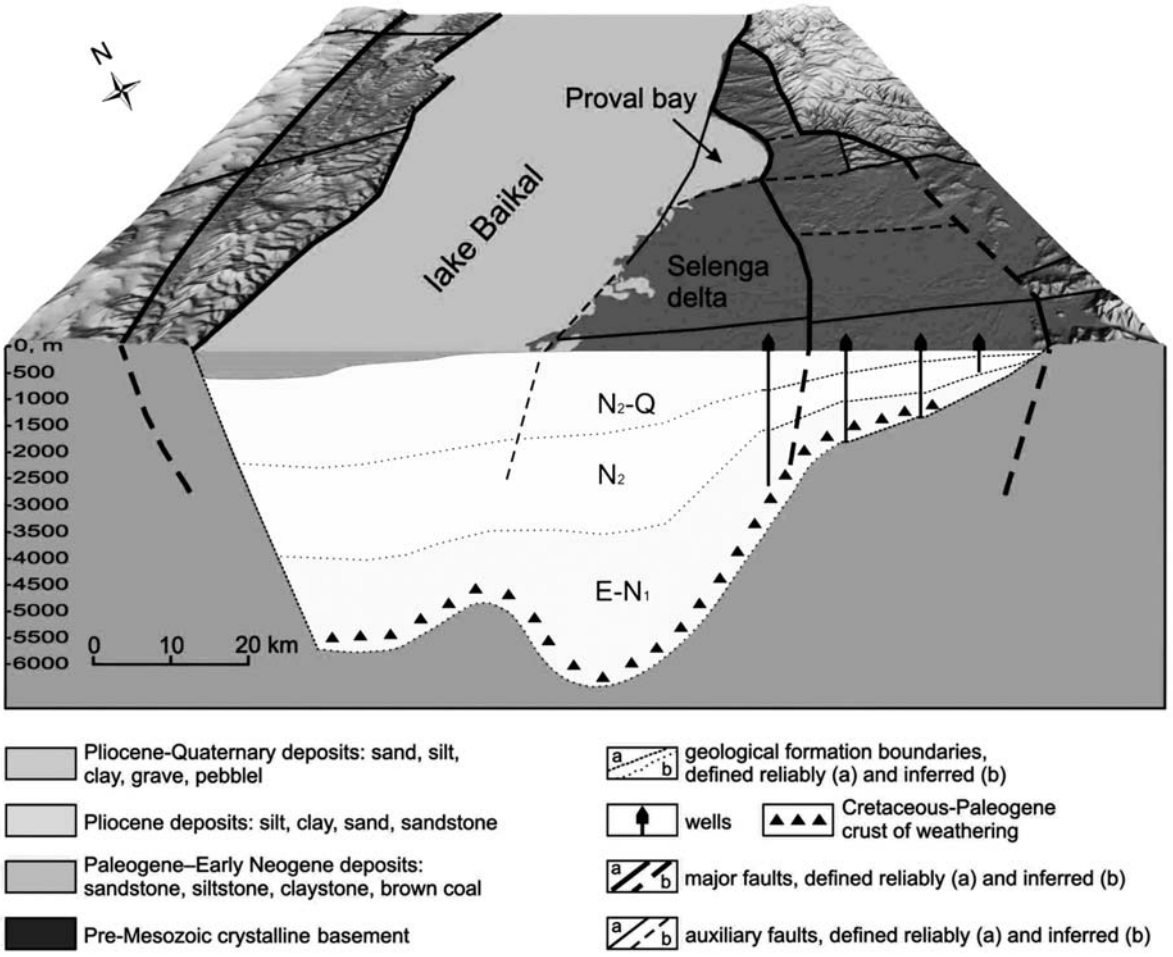

Figure 1. A block-diagram for the structure of the middle Baikal rift

Proval Bay lacks the picturesqueness of the Baikal landscapes; its shores are lowland swampy. Nevertheless, it is unique as a seismotectonic phenomenon and is the key to understanding the mechanism for morphotectonic development of the Baikal basin. This earthquake and its associated phenomena clearly demonstrated the most important features for the morphotectonic formation mechanism of the Baikal basin. It is primarily because of these seismotectonic phenomena — peculiar gravity effects of rifting — that this basin continues to grow in size. In spite of the fact that the northwestern side of the rift has a more pronounced morphological structure whose general elements are high and steepmonolithic tectonic escarpments, major lithospheric extension and its associated extension of the rift, thinning and rearrangement of blocks in the upper lithosphere slab do occur on the more gently sloping eastern side. It is worthy of note that earthquake-associated abrupt subsidence of basement blocks gives way to slow subsidence as in the case of Proval Bay. During high-intensity sedimentogenesis in the bay, sometimes of an avalanche-type form, there was little compensation of this newly formed sedimentary basin subsidence by sediment infilling. The tectonic block continues its slow-phase development until the next occurrence of a large earthquake. This results in rather longlasting bay structures controlled by active faults, with seismotectonic impulses occurring repeatedly therein. This is evidenced by numerous facts, though unfortunately there is still a lack of precise data on the time of occurrence of pre-historical earthquakes. In this regard the results of deep drilling and associated studies of bottom sediments in Proval Bay and its analogs are rather interesting and promising. Scaled subsidence of crustal blocks in coastal zones of large bodies of water, similar to Proval Bay, is not only an interesting phenomenon in terms of regional neotectonics and geomorphology but also rather concerning for human society. Seismogenic destructions in such cases are often followed by large hydrospheric catastrophes, having dramatic effects that are many times more dangerous.

This study has been carried out with the financial support from the Russian Fund of Fundamental Research (projects 12-05-33003, 12-05-31214).

NEW DATA ON THE AGE OF LATE PLEISTOCENE SEDIMENTS IN THE TUNKA RIFT VALLEY (SOUTHWESTERN BAIKAL REGION) DERIVED FROM ^{14}C DATING OF LARGE MAMMAL FOSSILS

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The Tunka rift is one of the main test areas for investigating basin terrestrial Pleistocene sediments of the Baikal rift zone. This area hosts several stratotypes of Cenozoic sedimentary formations of the Baikal region. In recent years, detailed lithological–stratigraphic investigations of Quaternary sediments have been carried out in natural outcrops of Cenozoic sections in the Tunka rift with revision of known sections and thorough examination of new sections. These investigations provided a representative collection of fossil organic remains, which were dated by the radiocarbon method. This allowed age limits of key representatives of the large mammal fauna used for paleontological substantiation of Pleistocene reference sections of the Baikal region to be specified for southern East Siberia.

Summing up the data on faunal assemblages from sections of the Tunka rift, it may be stated that they include large mammal species indicative of the Karga time (OIS3) with radiocarbon ages ranging from 29 to 46 ka ago: *C. spelaea, M. primigenius, C. antiquitatis, Equus* sp., *Hemionus hemionus, Sussemionus* sp., *C. elaphus, C. pygargus, Alces* sp., *B. priscus,O. ammon, S. kiakhtensis*, and *P. gutturosa*.

By their ecological features, most species (70%) point to open steppe environments. Similar landscapes were characteristic of the Karga time in the western Transbaikal region. Only species of the Cervidae family characterize forest and forested steppe landscapes. The almost complete absence of species from the late Karga time fauna in the interval dated back to 24–30 ka ago indicates likely reorganization of climatic settings at that time and onset of habitat environments less favorable for its representatives (cooling).

Information on the age of the large mammal fauna of the Sartan glacial (OIS2) available for the Tunka Baikal region is limited to single dates obtained for bone remains belonging to *P. spelaea* and *C. antiquitatis*. The absence of fossil assemblages may be considered as one of the consequences of unfavorable environments prevalent likely in the late Karga time that prevented wide development of macrotheriofauna in this area.

Thus, bone fragments sampled in the Pleistocene reference sections of the Tunka rift valley belong mostly to the Late Pleistocene mammoth faunal assemblage with an admixture of Central Asian species. The confinement of fossils to different stratigraphic levels and radiocarbon dates allow the successive development of large mammals to be reconstructed for the region under consideration. For example, *C. antiquitatis* bone from the Belyi Yar II section yielded one of the youngest age estimates for Siberia: 12 405 ± 125 years ago. Of particular interest are finds of *C. spelaea, P. spelaea*, and *S. kiakhtensis*. They are relatively rare and stratigraphically significant representatives of the local fossil fauna, finds of which are scarce in East Siberia. Bones of these animals were dated by the radiocarbon method. More over, remains of the spiral-horned antelope were never dated before, while bones of the cave hyena are dated for the first time in Russia. The available dates ranging from 18 000 to 35 000 years ago allow the life period accepted for these animals in the southern part of East Siberia to be widened. According to these dates, the cave

hyena and spiral-horned antelope dwelt in the Tunka Baikal region up to the late Karga time, while the cave cat and wooly rhinoceros survived through the Sartan (OIS2) cryochron maximum.

The bone remains found in the examined sections, which are dated by the radiocarbon method, confirm the previous our assumption that the observable Quaternary part of the sedimentary cover filling depressions of the Tunka rift is lacking sediments older than the late Pleistocene. The lower and middle Pleistocene sediments are buried in proximal parts of depressions and are inaccessi ble for immediate observations.

This study has been carried out with the financial support from the Russian Fund of Fundamental Research (projects 12-05-33003, 12-05-31214, 11-05-00666).

ENVIROMENTAL EVOLUTION OF XINGKAI (KHANKA) LAKE SINCE 200 KA BY OSL DATING OF SAND HILLS

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Xingkai Lake is the largest freshwater lake in Northeast Asia. In addition to the lakeshore, there are four sand hills on the north side of the lake that accumulated during a period of sustainable and stable lacustrine transgression and were preserved after depression. Analysis of well-dated stratigraphic sequences based on 18 OSL datings combined with multiple index analysis of six sites in the sand hills revealed that the north shoreline of Xingkai Lake retreated in a stepwise fashion since the middle Pleistocene, and that at least four transgressions (during 193–183 ka, 136–130 ka, 24–15 ka and since 3ka) and three depressions occurred during this process. The results of this study confirmed that transgressive stages were concurrent with epochs of climate cooling, whereas the period of regression corresponded to the climatic optima. Transgressions and regressions were primarily caused by variations in the intensity of alluvial accumulation in the Ussuri River Valley and fluctuations in regional temperature and humidity that were controlled by climatic change. Moreover, one obvious transgressive process that occurred in MIS3 may have been related to enhanced precipitation that was reportedly widespread in the west of China, while short-term fluctuations in the lake level might well be a direct response to regional precipitation variations on the millennial scale.

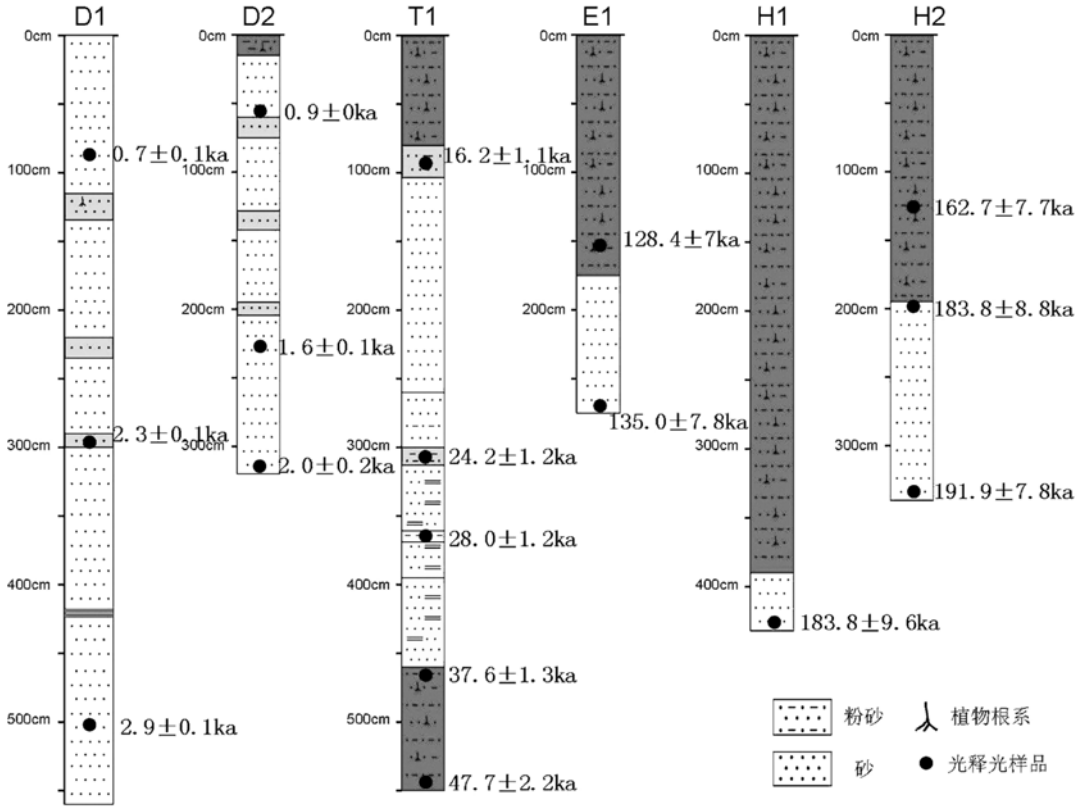

Figure 1. Lithology of each sand hill section.

RESULTS OF A NATURAL GAS FIELD MONITORING IN THE UPPER ANGARA BASIN ALONG THE YANCHUKAN –UOYAN – LAKE BAIKAL PROFILE

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The Baikalian rift zone (BRZ) is fringed on the northeast with a series of smaller rift basins the largest of which are Kichera and Verkhneangarskaya (the Upper Angara) ones. The Verkhnyaya (Upper) Angara River flows from the southern slope of the Delyun-Uran Range into Baikal, its most important tributaries being rivers Kholodnaya, Kichera, Svetlaya, Kotera and some other. The main river is 438 km long, with the drainage area of 21 400 km^2. At the river mouth there is a vast delta with numerous distributaries, channels, and oxbow lakes.

The geochemical party of the Irkutsk State University studied geochemical zones of the nitrogen-methane gas concentration within two rift basins (Verkhneangarskaya and Kichera ones) bounded by major fault systems on both sides. The northern side of the basin is formed by two mountain ranges of Alpine type, namely the Upper Angara (Verkhneangarsky) and Delyun-Uran, up to 2600 m high. The total thickness of sediments in the basin varies between 700 and 2500 m. The basin characteristics appeared to be similar to those previously described in other basins of the Baikalian rift zone, such as Barguzin, Ust'-Selenga, Tunkin, South Baikalian, Ust'-Barguzin, and others. Typically, the basins are asymmetric, with steep northwestern and gently sloping southeastern sides. The sedimentary sequence includes Neogene and Quaternary deposits. It is quite conceivable that the sedimentation processes in the region are mostly controlled by the Kichera Basin structure; systems of numerous faults typical of the Kichera drainage basin are hardly pronounced here.

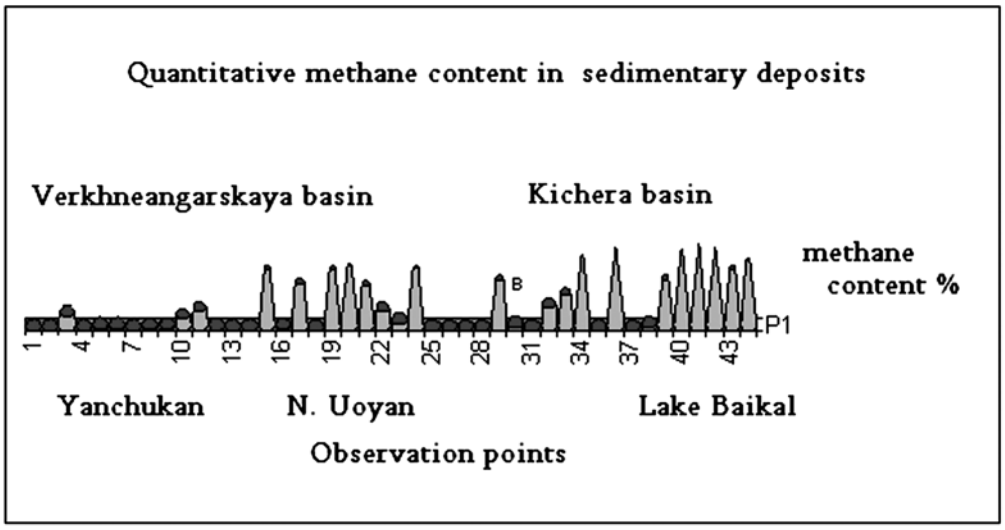

Figure 1. Methane concentration (%) in the gas samples taken from bottom sediments along the profile Yanchukan – Nizhniy Uoyan – Lake Baikal.

Geochemical studies have been performed in the Verkhneangarskaya and Kichera basins (between the Yanchukan railway station and Baikal Lake). Studies of gas, soil and water samples taken along the whole route revealed the total prevalence of geochemical zones with high nitrogen concentration. Such data suggest the studied Verkhneangarskaya and Kichera basins to be sedimentary basins marked by the presence of geochemical zones of the nitrogen-methane gas concentration, the methane proportion being markedly higher of the two. As follows from the study results, the geochemical composition changes drastically over the region, the Kichera basin being dominated by nitrogen-methane gas, while a high nitrogen content is recorded in the Verkhneangarskaya basin

The earth's crust seems to be most heavily fractured at the divide between the Verkhneangarskaya and Muyakan basin (measuring points 25 to 28). The methane series homologs are present in most (practically up to 90%) samples.

LATE PLEISTOCENE LOESS RECORD IN THE SOUTH OF WEST SIBERIA

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There are unique loess-soil sections which fully reflect climate changes during the Quaternary in the south part of the West Siberia. This record of climate shows a good correlation with marine oxygen isotope curve and other global climate records, and consequently loess-soil sequence of West Siberia is a detailed reference scale for the accurate loess study. According to stratigraphy there are three Late Pleistocene loess layers in West Siberia: the Bagan, the Eltsovka and the Tulino. Both the Bagan loess and the Eltsovka one are a part of Sartan horizon and equal to MIS-2. The first one lies directly under the Modern soil, and the second lies on deposits of the Karga interstadial (MIS-3). According to the stratigraphy scale there is the Sumino soil layer between them, but in the section under study it is absent. The Tulino loess correlates with MIS-4 and lies on the Berdsk pedocomplex [1].

The section Lozhok is a key loess-soil section of Novosibirsk Priobie, it is located on the south-east part of West Siberia. To get more reliable information about environmental conditions during each of Late Pleistocene loess accumulation period a complex of methods was used. It includes sand quartz grain morphoscopy, micromorphology, detailed elemental ratios Ba/Sr, Sr/Ca, Mg/Ca, Mg/Sr, detailed bulk chemical and grain-size analysis, magnetic susceptibility. Also loess sedimentation rates were calculated.

Sand quartz grain morphoscopy [2] revealed that layers under study were formed by aeolian processes with presence of cryogenic activity, and partly by chemical weathering. The presence of cryogenic processes is also confirmed by annular distribution of mineral part in micromorphological structure of loess. These facts prove that these Late Pleistocene loess layers were formed in conditions of dry cold deserts.

The distribution of fine-grained sand and coarse-silt fractions and the mean grain size, as it was shown by grain-size analysis, rises from the Tulino loess horizon to the Bagan one. It is the evidence of environment activity intensification from the Tulino loess accumulation period to the Bagan. The wind strength expressed by U-ratio [3] also confirms the intensification of environmental dynamics to the Last Glacial. It goes with higher loess accumulation rates during that time. Data obtained by bulk chemical analyses show decrease of Fe_2O_3 and Al_2O_3 and increase of CaO content from the Tulino loess to the Bagan. It proves that the climate of cold and arid epochs from 130000 to 10000 yr has been gradually coming drier and colder.

Magnetic susceptibility (XFD) revealed in each loess layer the presence at least of three peaks of higher values. These peaks are also fixed by elemental ratios and by distribution of Fe_2O_3 and CaO. Data obtained reveal the presence of paleoclimatic variations during each loess accumulation period of the last 130000 years. There are several clear short-term periods of insignificant humidification of climate, during which the wind strength was reduced. It is the evidence, that the tendency of aridization and cooling was not constant.

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SOURCES AND TRANSPORT OF RIVERINE CARBON IN THE SONGHUA RIVER, NE CHINA

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Riverine carbon represents a crucial part of carbon exchange between terrestrial, oceanic and atmospheric environment and provides important clues for understanding natural processes and anthropogenic activities on basin-wide scale. The Songhua River, draining the well-known black soil region in Northeast China, ranks the third largest river in China in terms of discharge. Over the last century, the Songhua basin has undergone more significant land cover change than any other region in China owing to intensive migration and cultivation activities. This study has for the first time examined the riverine carbon and its controlling factors in the Songhua basin. Seasonal field sampling of the river water has been conducted on the main trunk of the Songhua River and its seven major tributaries. Laboratory measurements of the samples were performed for DIC (dissolved inorganic carbon), pCO_2 (partial pressures of CO_2), DOC (dissolved organic carbon), POC (particulate organic carbon) and stable carbon isotope composition. Results show that the mean concentrations of DIC, DOC and POC are 22.3mg/L, 7.0mg/L, and 1.8 mg/L, respectively. pCO_2 ranges from 803 to 12406 uatm with an average of 5604 uatm. Stable carbon isotope and C/N ratio suggest that POC is dominated by C3 plant and is significantly influenced by phytoplankton production. The pCO_2 level in the Songhua river system is a function of the organic carbon concentration, indicating that its main source is from in-river decomposition of organic matter. The spatial variation of DOC concentrations is positively correlated with forest cover and negatively correlated with farmland area, while POC is, on the contrary, negatively correlated with forest and positively correlated with farmland. Land use change from forest to farmland may increase both rivereine DIC and POC fluxes by enhancing chemical and physical weathering.

AREA OF EURASIA ANTELOPE (*SAIGA TATARICA* L.) IN THE PLEISTOCENE OF KAZAKHSTAN

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Appearance of saiga in Kazakhstan is considered within the end of Middle Pleistocene. Area of saiga – contemporary of mammoth fauna — had wide distribution in vast zone of cold tundra-steppe of Eurasia and Northern America — from the shores of Atlantic ocean to Alaska. In Asia, the area of saiga was stretched through the territory of Kazakhstan, plains of such rivers, as Irtysh, Enisei, Lena, passing through to Novosibirsk islands. On the territory of Kazakhstan, the most ancient fossil remains of saiga are found together with representatives of middle Pleistocene fauna (*Mammuthus chosaricus, Megalocerocs giganteus ruffi* in alluvium of the second bottom terrace of Sarlybai river in Primugodzharie and near villages of Podpusk and Yamyshevo in Pavlodar Priirtyshie.)

Then, the paleontological chronicle of saiga in Kazakhstan is connected with Moustier epoch. Remains of horn cores and parts of saiga skeleton were discovered together with archaeological artefacts in Mustie encampment Ushbas (north-eastern slope of Bolshoi Karatau ridge). In Late Paleolithic epoch, saiga, according to available finds, has inhabited the whole northern half of Kazakhstan. Beginning from the 60-th of last century, on the territory of Kazakhstan was revealed 35 localities with remains of fossil saiga from Late Paleolithic encampments from the lower Ural and Kazakhstan Priirtyshie. In more late epochs, in settlements of Neolithic, Eneolithic and Bronze age, their remains are met in Western, Central and Southern Kazakhstan. About it are evidenced rock pictures of saiga contour of Bronze Age in Kazakhstan: gorge Tamgaly and in Semirechie (YII-Y cent B.C.), in environs of sovkhoz Baikonur (Central Kazakhstan), on Usturt (Dongyztay, Zheltau). By A.V. Sher (1967), the area of fossil saiga in Siberia was stretched from Kazakhstan steppes to Arctic tundra of North-East, on latitude between 50° and 60° N.L. Results of our researches are allowed to widen the ideas of area boundaries of saiga paleopopulation in Kazakhstan in Late Pleistocene to 43-44° N.L. The presence of saiga remains in Paleolithic encampments is indicated on favorable conditions of Eurasian antelope inhabitation in Pleistocene landscapes of Kazakhstan. Simaltaneously with them, are found the remains of mammoth fauna animals. *Mammuthus chosaricus, Coelodonta antiquitatis, Megalocerocs giganteus ruffi , Alces alces, Bison priscus mediator, Camelus Knoblochi, Equus (Hemionus) hemionus*. Area of these Eurasian forms has involved almost the whole northern half of Eurasia, including the territory of Kazakhstan. All listed above species, besides saiga, elk and kulan, have died in Kazakhstan to the end of late Pleistocene. Received results are said, that area of Kazakhstan fossil saiga, especially, at the end of Late Pleistocene, was significantly more to the north of modern area boundaries. At the beginning of Holocene, its area is coinsided with those of modern saiga. Presence of this highly specialized animal, with a number of ecologicaly mentioned organism peculiarities in Pleistocene, is allowed to say on succession of paleogeographic conditions of saiga localitiess connected, first of all, with flat relief, dryness and density of soil and also by weak thickness of snow cover. Process of historical changes of landscape — climate conditions has favoured the formation of ecological niche, good for separating and acclimatization of saiga paleopopulation on the territory of Kazakhstan in post-glacial epoch.

ESTIMATED AGE OF KAZAKHSTAN FOSSIL VERTEBRATES BY EPR-RADIOSPECTROSCOPY METHOD

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Presence in paleozoocenoses communities of vertebrates in Pliocene and Pleistocene of Kazakhstan, of different vertebrates species is indicated not only to specific peculiarities of landscape-climate conditions of their inhabitation time but gave the possibility to define the relative geological age of deposits, containing their remains. For definition of absolute age of ancient vertebrates remains is used EPR-radiosperctroscopy method [1,2]. We studied paramagnetic centers of teeth enamel of fossil proboscidea, Kazakhstan camels by EPR — radiospectroscopy method, with the aim of estimate of their absolute geological age. For researches was used the teeth enamel of fossil proboscides, camels from deposits of different age of Kazakhstan late Cenozoic: early Villafranchian, Akchagyl, early Neopleistocene [3,4]. Received by us results of absolute ages by EPR spectra of proboscides teeth enamel — *Anancus* and camels are practically confirmed the earlier defined for them geological ages. So, for *Gigantocamelus longipes* Aubek. (Esekartkan, Tekess depression) is defined the absolute age — 3.4 m. years. Somewhat earlier, almost the same age (3,5-3,6 m. years) was defined by EPR –spectrum of teeth enamel of mastodons *Anancus kazakhstanensis* Aubek. from the same site [3,4]. On the basis of paleomagnetic researches in Esekartkan mountains, Esekartkan bone-bearing layers are attributed to the upper part of Gilbert epoch. Received by us age data by EPR-radiospectroscopy are confirmed the position of this fauna (MN 15), corresponding to the lower part of European Villafranchian and level Piacentzian of International Stratigraphic scale [5]. Absolute data for *Paracamelus praebactrianus* Orlov (Tasty r., Torgai depression) are within the limits of middle Akchagyl epoch. It must be said, that from this locality were collected the teeth of *Pliolagomys kujalnikensis, Hypolagus* sp., *Orientalomys* sp., *Hipparion* sp. – of late type, *Anancus arvernensis* Cr.et Job., the distribution of which is limited by temporal interval of epoch Gelazian (MN 16) [4,5]. Absolute age data by EPR-spectra of teeth enamel of different stage of wear *Paracamelus gigas* Schl. (Koshkurgan, Southern Karatau) are within 0.62-0.70 m. years. Remains of *Paracamelus gigas* Schl. are found together with *Archidiscodon* sp., *Equus mosbachensis* Reich., *Elasmotherium* sp., *Dicerorhinus kirchbergensis* Jaeger., what is quite corresponded to age interval of early Neopleistocene epoch.

Used by us method is presented large perspective for dating of archeological finds age (from 100 years to 1 m. year) and decision of interesting chronologilcal enigmas.

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PALEOENVIRONMENT AND ANCIENT CULTURES OF THE PLEISTOCENE-HOLOCENE TRANSITION (BAIKAL REGION)

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One of the important directions in modern archaeology is the comparison of paleoclimates and ancient cultures data. Such studies allow revealing the dependence of various cultural changes from climatic rebuildings.

Reconstructions of paleoenvironment on the «Initial»-neolithic archeological sites in comparison with the data of the Late Paleolithic objects will answer on the question about the dependence between the origin of ceramic and Pleistocene-Holocene transitional environmental changes.

Transbaikalia is one of the parts of Asia, are characterized by the early ceramic invention. Complexes of Ust-Karengskaya culture, located on northeast of the region are dated around 11,5 KA (Vetrov, 2012). Krasnaya Gorka site (layer 2), located not far from it has also an early date - 8345 ± 66 (KIA 42073) (Tsydenova, 2011). About the same time are dated the ceramic materials of Studenoye I (8, 9), Ust-Mensa I (8) and Ust-Mensa II (5, 6) settlements (Kuzmin, Orlova, 2000; Razgildeyeva et.al., 2013). For them were obtained absolute dates 11,5 - 8,7 thousand KA. The stone industries of these complexes mostly originate from yubetsu-like industries with the dates about 12 KA. The absolute dates referred ceramic horizon 2 of Ust-Kyakhta 3 settlement, which probably had other basis of techno-complex — «Selenga» type (Aseev, 2003; Tashak, 2000). The sporo-pollen spectra which were received for the period of 12-11 — 8 thousand years KA in Baikal region, indicating the considerable warming and humidifying of climate in the Pleistocene — Holocene transitional period (Bezrukova, 2012; Razgildeyeva et.al., 2013). Probably, the emergence of the first ceramics in the region is connected with these changes.

A similar situation is observed on the materials of synchronous settlements with ceramics of the Far East (Khummi, Goncharka-1, Osipovka and others) (Lapshina, 2000; Shevkomud, Yanshina, 2012). The Late Pleistocene — Early Holocene ceramic lies in loamy layers with chestnut color. Sporo-pollen spectra of these layers reflect warming and humidifying of climate, the distribution of deciduous trees. Ceramic potteries appear in the Late Pleistocene complexes with the stone tradition of yubetsu-type (selemdjinskaya culture).

The comparison of Pleistocene-Holocene complexes Japan has led researchers to conclude about the change adaptation strategies at the turn of the Pleistocene-Holocene and the emergence of pottery in connection with the reorganization of ecosystems (Sato et al., 2011). It is interesting that to the similar results led the study of the Late Pleistocene — Early Holocene materials in Northern China (Elston et.al., 2011).

COLD COMFORT: IS TIBET A CRADLE OF ICE AGE MEGAFAUNA?

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Recent discovery of an ancestral woolly rhinoceros in the Pliocene of southern Tibet has led us to propose an «out-of-Tibet» hypothesis that links cold-adapted large mammals in pre-Ice Age high Tibet to Ice Age megafaunas in northern Eurasia (Deng et al., 2011). This hypothesis offers a fresh look at a possible scenario of how low latitude, high altitude Tibet may have been an important training ground for cold-adapted large mammals before the Ice Age and they became pre-adapted when dispersing to Siberia and other high latitude habitats as the Ice Age began around 2.6 Ma. The woolly rhino may be the most charismatic of such an example, but we are beginning to recognize connections to other members of the megafauna. Other high plateau-arctic faunal tele-connections include Tibetan yak (*Bos grunniens*) and North American bison (*Bison bison*), Tibetan argali (*Ovis ammon*) and Dall and snow sheep (*Ovis dalli* and *Ovis nivicola*), Tibetan wild ass (*Equus kiang*) and late Pleistocene fossil horses in Alaska, and an extinct Tibetan fox (*Vulpes* sp.) and Arctic fox (*Vulpes lagopus*). Our research highlights interesting tele-connections between Arctic faunas of Pleistocene and Recent time, and their Tibetan relatives. We suggest that the northward dispersal was mostly one-way during the Pleistocene exodus from Tibet to Siberia. As Holocene warm climate replaces the glacial maximum, cold-adapted Ice Age megaherbivores retreated toward northern latitudes and were further isolated from their ancestral habitats in high Tibet.

Our fossil records suggest that Tibetan Plateau as a cold-climate refugium can be traced to the late Miocene, when the first endemic taxon, *Qurliqnoria*, appeared, which presumably gave rise to the chiru, or Tibetan antelope (*Pantholops*). In addition to the chiru, we can also identify endemic originations within the Tibetan Plateau of the bharal, or blue sheep (*Pseudois*), and the snow leopard (*Panthera uncia*). The latter two are known to form a close predator-prey relationship because of their preference to steep mountains (Schaller, 1998) and such a relationship may have been formed some 3-4 million years ago.

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THE FIRST STEPPE MAMMOTH (*MAMMUTHUS TROGONTHERII*) REMAINS OF THE MIDDLE PLEISTOCENE FROM SHANGYI, HEBEI, NORTHERN CHINA

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Mammuthus is one the most prominent proboscidean taxa during the late Cenozoic in northern China. During the last several years, some achievements have been gained on the research of Chinese mammoth remains, and the Plio-Pleistocene biostratigraphic framework based on mammoth fossils of northern China has been established.

The earliest global steppe mammoth (*Mammuthus trogontherii*) remains were recovered from Majuangou and Shanshenmiaozui, Nihewan basin, China, with palaeomagnetic dating of 1.3-1.66 Ma. The mammoth remains recently found from Gaoling (Shaanxi Province), Zalainuoer (Inner Mongolia) and Yuxian (Hebei Province) indicate that *Mammuthus trogontherii* survived in northern China into the late Pleistocene. So North China is considered as the locus of origin and extinction of *M. trogontherii*. However, there has not been any reported steppe mammoth from northern China of Middle Pleistocene.

The present study deals with the new elephantid materials, including one complete M3, fragmentary incisor and some postcranial bones, which have been recovered from the sandy deposits of an ancient channel from Shangyi, Hebei, northern China. The abrasion surface of the new M3 bears typical morphological characters of *Mammuthus*. The enamel layers of the mesial and distal sides are parallel with each other in medium or advanced wear. The labio-lingual length of the central enamel loop is nearly equal to those of the two lateral enamel loops. A prominent and obtuse mesial and/or distal median sinus is developed in the central part. The M3 should be assigned to *Mammuthus trogontherii* while all the measurements of this molar, such as plate number (P), lamellar frequency (LF), enamel thickness (E), and width (W) and height (H) of crown, fall within the ranges of steppe mammoth.

The fine-grained and coarse quartz single-aliquot regenerative-dose (SAR) optically stimulated luminescence (OSL) results for six samples from Shangyi deposits indicate that the age of the remains of steppe mammoth should be beyond the last interglacial (~ 130 ka). The first discovery of *Mammuthus trogontherii* from the Middle Pleistocene in northern China has significant implications for discussing the evolution, dispersal and paleoecological variation of *Mammuthus* lineage in Eurasia.

THE EAST ASIAN WINTER MONSOON OVER THE LAST 15,000 YEARS: ITS LINKS TO HIGH-LATITUDES AND TROPICAL CLIMATE SYSTEMS AND COMPLEX CORRELATION TO THE SUMMER MONSOON

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The East Asian winter monsoon (EAWM) not only plays an important role within the Asian climate system, but also carries cold air from the high northern latitudes across the Equator to the Southern Hemisphere, acting as a link between the polar and tropical climate systems. However, past changes of the EAWM have not been clearly established so far due to the lack of suitable proxy records. Here, we at first establish an index of the EAWM by comparing the results of a sediment trap experiment and 100-year sedimentary record from Huguang Maar Lake (HML) with modern records of the EAWM, Siberian High (SH) and Arctic Oscillation (AO). Secondly, we present a continuous record of the strength of the EAWM for the past 14,500 years based on sedimentary diatom assemblages in HML. The record is derived from fluctuations in the relative abundance of two planktonic diatom species. The link with the EAWM intensity is through high wind speeds inducing turbulent mixing, which stimulates the productivity of the meroplanktonic species *Aulacoseira granulata*. The diatom record of the past 14,500 years shows that the EAWM shifted from strong to weak from the early to late Holocene. This linked to both changes in winter temperature at high-latitudes and in El Nico conditions in the tropics. Our record shows that the EAWM and East Asian summer monsoon (EASM) as recorded in stalagmites, were in-phase instead of anti-correlated on orbital time scales during the Holocene. On a millennial time scales, the EAWM was anti-phase with the EASM during the Last Glacial Holocene transition. However, during the early-middle Holocene the relationship between the EAWM and EASM shows spatial variations. In northern China, the records show significant anti-phase, but in southern China the anti-phase was not observed. During the late Holocene, we did not find any clear relationship between the EAWM and EASM. We also explored the link between the EAWM and the Australian summer monsoon (ASM). Anti-phase of the ASM with summer insolation in the Southern Hemisphere is an enigmatic exception that cannot be explained by the classic theory of insolation. During early Holocene the EAWM was in-phase with the Australian summer monsoon (ASM), which provides the first direct evidence to support the hypothesis that the intensity of the EAWM affected, at least in part, the strength of the ASM.

TERRESTRIAL MOLLUSC RECORDS FROM XIFENG AND LUOCHUAN L9 LOESS STRATA AND THEIR IMPLICATIONS FOR PALEOCLIMATIC EVOLUTION IN THE CHINESE LOESS PLATEAU DURING MARINE OXYGEN ISOTOPE STAGES 24-22

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Marine Isotope Stages 24-22 is a key period of the Mid-Pleistocene Transition. However, its climate variability is still unclear. The coarse-grained loess unit L9, one of the most prominent units in the Chinese loess stratigraphy, yields a high potential terrestrial record of paleoclimatic and paleoenvironmental changes during this period. In this study, two high-resolution terrestrial mollusc records of L9 loess strata from the Xifeng and Luochuan sequences in the Chinese Loess Plateau were analyzed. Our mollusc results show that the MIS 24, the early and late parts of MIS 22 were dominated by cold and dry climate. Relatively mild-humid climate occurred in MIS 23 and the middle part of MIS 22. The climatic conditions at Xifeng region were cooler and more unstable compared to Luochuan region. A comparison of mollusc species composition and other proxies of L9 strata (MIS 24-22) with those of L1 loess units (MIS 4-2) indicates that the L9 loess was not deposited under the most severe glacial conditions in Quaternary climate history as suggested in previous studies. Our study shows that climatic conditions in the Loess Plateau during the L9 loess forming period were similar to that of gentle glacials (MIS 24 and MIS 22) and interglacial (MIS 23), as suggested by the marine $\delta^{18}O$ record. Three cooling fluctuations occurred at 930 ka, 900 ka and 880 ka, which might hint to the global "900 ka cooling event". The "900-ka event" in the Loess Plateau does not seem to be a simple long glaciation, but rather several complex climatic fluctuations superposed on a general cooling trend. The uplift of the Tibetan Plateau and the general cooling experienced by the Earth during this period may have resulted in abundant dust sources and increased dust transport capability, as indicated by increased grain size and the mass accumulation rate of L9 loess.

A MODEL FOR LINKING GRAIN-SIZE COMPONENT TO LAKE LEVEL STATUS OF A MODERN CLASTIC LAKE

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Grain-size distributions of fluvial, eolian and marine sediments were explicated decades ago. For lake sediments, however, there is still great uncertainty in explaining the genesis of grain-size components due to the inherent complexity of their polymodal distributions. In this study, the grain-size components of the surface sediments of Daihai Lake, Inner Mongolia, were partitioned using a lognormal distribution function and the relationship between the identity of each component and the specific sedimentary environment was investigated. The data indicate that the modern clastic sediments of Daihai Lake contain five distinct unimodal grain-size distributions representing five grain-size components. Each of the components retains its identity including modal size, manner of transportation and environment of deposition although the relative percentage varies with the hydraulic condition throughout the lake. These components are specified from fine to coarse modes as long-term suspension clay, offshore-suspension fine silt and medium-to-coarse silt, and nearshore-suspension fine sand and saltation medium sand. The percentage of the components interpreted as an indication of nearshore environments displays a negative correlation with water depth across the modern lakebed, suggesting a model for linking the nearshore components in sediment cores to the lake level status in the geological past. The model was applied to a sediment core from the lake where high percentages of the nearshore components in the core sediments were correlated with low regional precipitations reconstructed on the pollen profile of the same core. The coincidences between two independent proxies do not only demonstrate the validity of lognormal distribution function in partitioning polymodal sediments but also reveals the potential of the grain-size component–lake level status model for lake's paleohydrological reconstruction.

STACKED 249-KYR GRAIN SIZE RECORD FROM THE CHINESE LOESS BASED ON EIGHT SECTIONS

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To construct a stacked climatic record of millennial-scale variability for northern China, grain size was measured for 12,330 samples from eight thick loess sections. Between-section correlation of these grain size records shows that although small depositional hiatuses may be present in places within a single section, most parts of the sections display continuous dust deposition. By correlating the eight records with the precisely-dated Chinese stalagmite $\delta^{18}O$ record, we constructed a stacked 249-ka-long grain size time series, termed the "CHILOMOS" record, which is the first high-resolution stack of millennial-scale variability in northern China. This stack shows millennial-scale climatic events superimposed on a prominent cooling trend during the last and penultimate glaciations, consistent with the pattern of increasing global ice volume. However, this cooling trend is dampened in the stalagmite record and is totally suppressed in the low-latitude ocean record. It follows that the Loess Plateau, far from the low-latitude ocean, is influenced largely by the northern high-latitude ice sheets, while the proximal stalagmites of southern China mainly document signals from the low-latitude ocean. Cross-correlations of climatic records from the high and low latitudes demonstrate that the millennial-scale abrupt changes originated in the northern polar area and were propagated into East Asia largely through the East-Asian winter monsoon. Our results also confirm the driest and coldest interval of the last 249 ka occurring in the late marine isotope stage (MIS) 6, and MIS 7d to have been extremely cold and dry similar to the stadials in MIS 6.

RECONSTRUCTION OF LATE PLEISTOCENE GLACIATIONS IN THE SOUTHERN PAMIR AND GISSAR RANGE (TAJIKISTAN) BASED ON ^{10}BE SURFACE EXPOSURE DATING

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The landscape in Central Asia is characterised by high mountain-ecosystems and vast semiarid to arid regions. Both are very sensitive and seriously endangered by climate change. For modelling future landscape fluctuations of such regions and their socioecomomic development, the knowledge about past climate changes is essential. Suitable archives are for instance loess-paleosols sequences, lacustrine sediments and glaciers.

Here we present insights into past climate changes in the Southern Pamir and Gissar Range, Tajikistan, based on glacial chronologies. In humid mountain regions moraines may contain enough organic material for radiocarbon analyses whereas in semiarid to arid mountains, other methods like surface exposure dating and optical stimulated luminescence must be applied. Our focus is on ^{10}Be surface exposure dating since both mountains are relatively dry.

In the Southern Pamir we studied moraines in the Bogchigir valleys, south of Lake Yashilkul [Zech et al., 2005; Abramowski et al., 2006; Roehringer et al., 2012]. The older ones, sampled with nine boulders, yielded surface exposure ages varying between 80 ± 8 ka and 70 ± 6 ka, thus likely documenting the early local LGM in the Southern Pamir during MIS 5. Besides these older moraines, at least three younger generations could be identified yielding exposure ages between 64 ± 7 to 50 ± 5 ka, between 26.7 ± 2.5 to 18.6 ± 1.8 ka, and the youngest one between 15.8 ± 1.6 and 11.2 ± 1.1 ka. These results document glacier advances during MIS 4, the global LGM, and during the Late Glacial.

In the more humid Gissar Range, southwest of Iskanderkul, also several moraine generations could be identified. The older ones were not suitable for sampling because their boulders are deposited on steep slopes in unstable position. The younger ones yielded exposure ages between 66 ± 6 to 44 ± 4 ka (seven boulders), between 21.8 ± 1.9 to 18.4 ± 1.6 ka (four boulders) and between 16.8 ± 1.5 to16.5 ± 1.5 ka (two boulders). Applying the "oldest age model" on account of post-depositional geomorphological processes, the moraines with ^{10}Be exposure ages between 66 and 44 ka likely document glacier advances during MIS 4, a period characterised by cold and dry conditions [e.g. Shackleton, 1987]. This is in agreement with results from the Ailuitek pass in the NW-Pamir, where Abramowski et al. [2006] described an early local LGM glacier advance between 66 ± 6 ka and 56 ± 5 ka. Our exposure ages of 21.8 to 18.4 ka probably reflect glacier advances during the global LGM [= 26.5 ka to 19 ka, Clark et al., 2009] whereas the youngest moraine generation, deposited closely to the actual glacier tongue, likely document Late Glacial ice advances.

Despite a systematic dating uncertainity of about 13% [Gosse & Phillips, 2001], our results document that in the study areas the most extensive glaciations (local LGM) occured early in the last glacial cycle during MIS 5. Glaciations during the global LGM and the Late Glacial became more restricted, probably caused by the growing strength of the Siberian Anticyclone throughout the last glacial cycle, which blocked westerly moisture supply during spring and

early summer [e.g. He et al., 2004; Svendsen et al., 2004]. Up to now, more detailed chronologies are necessary to reliably reconstruct the influence of the westerlies versus monsoon, and the effects of temperature versus precipitation fluctuations.

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PALAEOCLIMATIC CHANGES SINCE THE DEGLACIATION REVEALED BY LACUSTRINE SEDIMENTS IN MIANCHI BASIN OF WESTERN HENAN PROVINCE, CENTRAL CHINA AND THE IMPLICATION FOR CHINESE CULTURE DEVELOPMENT

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Mianchi Basin is located at the Middle Yellow River, west of Henan Province, central China. It is on the transitional zone of Loess Plateau and North China Plain; it is also on the transitional belt of humid to semi-humid region. This place is one of the birthplaces of the Chinese culture. On the basis of AMS dating, as well as the analysis of grain size, total organic content (TOC) and geochemical elements, five palaeoclimatic stages are identified:(1) During 19543~9240 cal. aBP, the soil weathering and eluviation process was weak and the climate was dry. The lake was not formed; (2) during 9240~8039 cal. aBP, it was a transition period of the climatic changes; the palaeoclimate was much warmer and humid than that in the earlier time, as evidenced by intensification of the soil weathering and the eluviation was stronger, lake environment was formed;(3) during 8039~5368 cal. aBP, the climate was turned to a warm and humid phase. The palaeoclimate was warmer and more humid, and the paleolake level was higher than that in before; (4) during 5368~3439 cal. a BP. It was also warm-humid, but the temperature and humidity were lower then that in the previous phase. The lake level declined; (5) during 3439~2423 cal.aBP, it was a dry and cold period , and the paleolake gradually dried up. The cultural development and the environmental changes probably are coupled in the investigated regions, where the Peiligang Culture, the Yangshao Culture, the Longshan Culture and the Xia and Shang Culture were sequently evolutive and were associated with the palaeoenvironmental changes.

THE DISTRIBUTION OF ANCIENT HOMINID SITES AND RELATIONSHIP BETWEEN ENVIRONMENTS IN THE YISHU RIVER BASIN, CHINA

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The study of the distribution of ancient hominid sites is important in exploring the relationship between the human evolution and the environmental change. ShanDong province is the main part of *HaiDai* Culture area, where *HouLi* (8.3~7.5ka B.P.), *BeiXin* (7.5~6.3ka B.P.), *DaWenKou* (6.3~4.6ka B.P.), *LongShan* (4.6~4.0ka B.P.) and *YueShi* (4.0~3.6ka B.P.) Cultures were the mainly five prehistoric civilizations. In this article, the spatial distribution of ancient hominid sites in five civilization times were studied by GIS (Geographic Information System). The *YiShu* River Basin, in the south of ShanDong Province, was taken as the study area in order to analyze the relationship between the sites distribution and natural geography environment characteristics, which included the slope, aspect, elevation, and the horizontal distance to river principally. The spatial analysis method of GIS, Kolmogorov Smirnov statistical detection method and weight stack analysis method were the main methods used in the article.

The sites of *HouLi* Culture distributed sparsely, which located in the piedmont plain in north of Taishan Mountain primarily. In the *BeiXin* period, the sites expanded its range southward, and the numbers increased less. However, the number of sites in the *DaWenKou* period increased sharply, and the sites distributed almost in the whole province, in addition to the northwest of Shandong Province. The sites increased continuously in the *LongShan* period, compared to the *DaWenKou* period, and the sites of *LongShan* were the most in the five prehistoric civilizations. Compared to the *LongShan* period, the sites instead decreased in the *YueShi* period, the reason for the phenomenon is not known yet.

The study results in *YiShu* River Basin in the period of *LongShan* Culture showed that, elevation, slope and horizontal distance to river were the main environmental parameters affecting the distribution of relics, aspect was the less affection. The sites distributed in both sides of middle river of *YiShu* River basin, where the elevation was between 0 meters and 400 meters, the slope was less than 27.5° and the horizontal distance was less than 1000 meters. While the distribution was less in and northern Mountain and the southern area, where was near the main stream and the low altitude. So the natural environmental conditions gave a great influence for the man to choose the place of residence.

SEQUENCE OF THE EARLY PLEISTOCENE *GIGANTOPITHECUS* FAUNAS FROM ZUOJIANG RIVER AREA, SOUTH CHINA

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The Karst caves nearby Zuojiang River area, South China, contains a plethora of Quaternary mammalian remains, especially the conspicuous fossils of *Gigantopithecus blacki*. During the past few years' excavations in this area, several new *Gigantopithecus* layers belonging to different ages of Quaternary have been found nearby the Chongzuo Eco-Park, which belongs to the north tropical zone.

In this area, six vertical horizons of caves have been recognized. The sediments of the karst caves of the fifth horizon with an elevation of about 200 m above sea level yield the early Pleistocene *Gigantopithecus* fossils, such as Baikong Cave (Liyu Mtn.), Juyuan Cave (Boyue Mtn.), Sanhe Cave and Queque Cave (Wuming Mtn.).

As the highest cave in Chongzuo area (216 m ASL), Baikong Cave has excavated the small sized *G. blacki, Ailuropoda microta* and *Sinomastodon jiangnanensis*. The faunal analysis indicates its age as the early Early Pleistocene, with the paleomagnetic dating at least 2.0 Ma BP.

Juyuan Cave (206 m ASL) has unearthed more than 40 species of mammalian fossils, including the relatively smaller *G. blacki, Ailuropoda microta, Tapirus sanyuanensis,* and *Sinomastodon* sp. The characteristics of the Juyuan fauna are roughly similar to those of the Wushan fauna and Liucheng fauna. So the age of this fauna is considered to be the early Early Pleistocene, with the paleomagnetic dating approximately 1.8 Ma BP.

The fauna from Sanhe cave (203 m ASL) consists of more than 80 mammal species, including *Gigantopithecus blacki, Ailuropoda wulingshanensis*, and *Sinomastodon yangziensis*. The age of this fauna is considered to be the middle Early Pleistocene, with the paleomagnetic dating of at least 1.2 Ma BP.

Queque Cave is very close to Sanhe Cave, though a little lower (198 m ASL). This cave has produced a plethora of relatively complete fossils than other caves of this area. Considering the extremely larger *Gigantopithecus* teeth and the appearance of stegodon orientalis from this cave, the age is considered to be the late Early Pleistocene, with the paleomagnetic dating approximately 1.0 Ma BP.

The recent *G. blacki* discoveries from Zuojiang River area provide new perspective on understanding the evolutionary progress and mode of the Quaternary *Gigantopithecus fauna*, and establishing the Pleistocene biostratigraphic framework of South China.

STRATIGRAPHY AND ENVIRONMENTAL DYNAMICS IN THE QUATERNARY OF INNER ASIA

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Recently received new data on the structure, composition, distribution, geochronology, biostratigraphy and paleomagnetism of the Quaternary deposits of Inner Asia allowed us to refine considerably the stratigraphical sequence, define main stratigraphical boundaries, correlate major regional events with global ones, reveal in more detail the sequence of biotic, geologic and climatic events, carry out paleogeographic reconstructions of certain temporal periods.

One of the most debatable issues of the Quaternary stratigraphy concerns the boundary between the Neogene and the Quaternary systems. The Quaternary, as accepted by International Union for Quaternary Research and proposed by the International Commission on Stratigraphy in 2007 year begins at 2,6 Ma. As a result, a large segment of the Pliocene has been included into the Quaternary. The decisions complicate the identification of the accepted boundary in various regions of the world, especially in inland areas. In Inner Asia, the only section which is well-documented paleontologically and where the Gauss-Matuyama was detected is a section on the Irtysh River near Lebjazhie village. In this section, near this boundary, the Lower Villafranchian mammal fauna was replaced by the Middle Villafranchian one and identificated a strong climatic cooling. In south Western Siberia loess accumulation in cold periods began near Lower and Middle Pleistocene boundary.

Loess-soil sequences of the Quaternary make up the most complete and detailed natural account of climate and environment events in mid-latitude continental Asia. The Siberian loess-soil sequence stores record of long- and short-period changes of paleoclimates. The loess-soil sequence of West Siberia consists of rhythmically alternated thick layers of loess and complexes of fossil soils interbeded by 1-2 more thin loess horizons. The complete loess-soil sequence in Brunhes chron of West Siberia includes ten soil complexes alternated with thick loess layers. The structure of pedocomplexes in the West Siberian loess-soil sequence well reflect the structure of global odd warm stages consisting of closely spaced warm events interfered with brief cold intervals. Pleistocene warm and wet periods corresponded to soil formation in conditions of weak air circulation. Cold times were associated with climate drying and more intense air transport of dust. The loess deposition in the Siberia was accompanied by the formation of large deflation surfaces and closed deflation basins in an environment of cold deserts. Spectral analysis of frequency-dependent magnetic susceptibility time series revealed a periodicity corresponding to the orbital cycles of eccentricity (100-kyr cycles), obliquity (40-kyr cycles), and precession (23-kyr cycles). Interregional correlation of climatostratigraphic horizon of the full Pleistocene loess-soil sequence of Siberia with coeval units loess regions of Asia was established synchronism of arid and humid stages both in zone of west-to-east motion of the atmosphere and in the monsoon circulation zone. Short-period climate variations were investigated in sedimentary sections of closed lakes and in sediments of Late Glacial and Late Holocene eolian landforms in West Siberia. The Late Holocene dunes are composed of eolian sands with buried soils and are overlain by an immature modern soil. They are localized along the eastern sides of lakes and reach 10 m high. The dry and cold intervals were associated with eolian processes, fall of lake levels, deflation, and accumulation of dunes, while the relatively wet and warm stages were the times of soil formation. Radiocarbon ages and correlation with tree-ring data indicate that the subaerial deposition represents a 200-300 year quasi-periodicity of dry and cold cycles alternating with periods of wet climate at air temperatures about those at present.

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Field Guidebook

Editors:
N.V. Alexeeva, M.A. Erbajeva

General characteristics of the Transbaikalian region

The Transbaikalian region is located in the middle of the continental interior of Asia. It is a part of the Central Asian mountain belt ranging from 49° to 58° N and from 99° to 122° E. The regional topography is characterized by deep intermontane depressions alternating with mountain ranges; the altitudes of the latter vary from just above 1000 m in the southern part of the region to over 2600 m in the north (the Kodar Range). The climate is extremely continental, with considerable amplitudes of both daily and seasonal annual temperatures, sunny weather being dominant during winter time.

Spatial variability of topography and climate accounts for a high diversity of landscapes — the region includes mountain tundra and taiga, forest steppe, meadow steppe and dry steppe. This offers a clue to the diversity of plant communities and faunas.

As a part of the Baikal rift zone, the Transbaikalian region experienced a complicated geological history during Pliocene and Pleistocene. The Cenozoic sedimentary deposition in the region was strongly influenced by tectonic processes. At the beginning of the Pliocene, tectonic movements within the Baikalian rift zone and the adjacent areas induced conspicuous changes in the sedimentation rate.

Early Pliocene sediments belong to the Anosov Formation which is the oldest Neogene unit in Western Transbaikalia. They are overlain with deposits of the Chikoi Formation dated to the Pliocene and Early Pleistocene. The Chikoi Formation is known in several sections containing fossil mammal remains, such as Udunga, Tologoi, Beregovaya, Klochnevo I, Klochnevo II, Zasukhino, Dodogol a.o. Among them multilayered Tologoi and Zasukhino sections are most informative. In the lower part of these sections the red beds of the Chikoi formation are exposed.

During the Late Cenozoic the mountains surrounding the Lake Baikal experienced noticeable tectonic uplifts; as a result, a major orographic barrier developed that prevented humid West Atlantic cyclones from coming into the Transbaikalian area. The uplift is considered to be the main reason of the aridization of Transbaikalia.

Since then, mammalian faunas of Transbaikalia began to differ significantly from faunas of the adjacent Prebaikalian territory, though earlier (Pliocene and Early Pleistocene) faunas of the two regions were quite similar to each other.

In our work we follow the Standard chronostratigraphy, according to which the Pliocene consists of two units — Lower and Upper, and the Quaternary includes Pleistocene and Holocene. The lower boundary of the Pleistocene lies at 2.6 Ma.

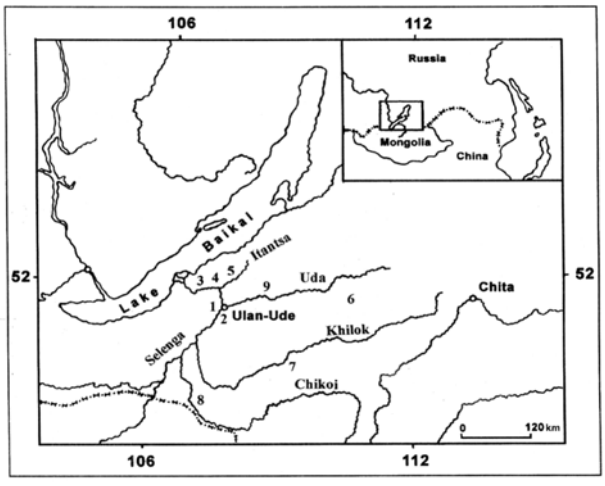

Fig. 1.The main fossil mammal localities of the Baikal region: 1 - Tologoi, 2 - Krivoy Yar, 3 - Klochnevo I, 4 - Klochnevo II, 5 - Zasukhino, 6 - Kudun, 7 - Ust'-Obor. 8 - Beregovaya, 9 - Dodogol

September 13, 2013

Stop 1. Tologoi Key section

Tologoi Key section: early Late Pliocene — Holocene colluvial deposits, with 14 sequential mammalian faunas (among them, the Middle Pleistocene Tologoi faunistic complex and Ivolginian fauna).

Tologoi is a key section not only for the West Transbaikalian Region, but for entire East Siberia. This multi-layered section is unique in that it presents a sequence of continental deposits accumulated in the Ivolga depression since early Late Pliocene up to Late Pleistocene, with only minor gaps (early Early Pleistocene).

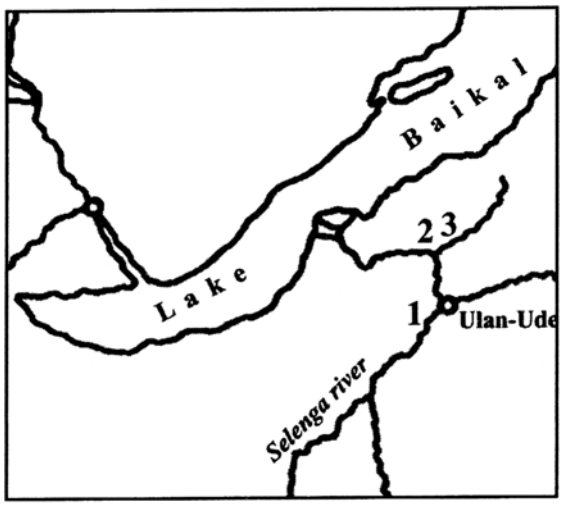

Fig. 2. The position of Tologoi locality - 1.

In the Tologoi Key Section the stratotypes of the Tologoi Faunal Complex and the Ivolginian Fauna are recognized (Ravsky et al., 1964; Vangengeim et al., 1966; Erbajeva, 1970; Erbajeva, Alexeeva, 2000; Alexeeva, 2005).

Moreover, studies of magnetostratigraphy in this section revealed the Brunhes/Matuyama boundary position in it, and fossil remains were recovered from both under and above the Brunhes/Matuyama boundary (Gnibidenko et al., 1976; Alexeeva, 2005). The earliest permafrost evidence in the Western Transbaikalia (dated to the Early Pleistocene) was also found in this section (Alexeeva, 1994; Vogt et al., 1995; Alexeeva, Erbajeva, 2000).

The Tologoi key section is situated on the left bank of the Selenga river in a meander 15 km southwest of Ulan-Ude (51°45′N, 107°29′E); the Tologoi ensemble exposure is more than 200 m wide, the total thickness of exposed layers is about 40 m.

This site was discovered by academician Okladnikov A.P. in 1951 and the first information on mammal faunas was given by Vereshchagin et al. (1960).

All the researchers who studied the section since then agree in recognizing three units in the sequence (Ravsky et al., 1964; Bazarov, 1968; Vangengeim et al., 1966; Erbajeva, 1970; Alexeeva, 2005):

— lower unit (section Tologoi 1) — red sandy clays up to 2.0 m thick with debris and calcareous concretions at the base. The sedimentary series leans to a granite wall. The sediments contain the early Late Pliocene Chikoian fauna, referred to as Tologoi 1.1 (Vangengeim, 1977; Erbajeva and Alexeeva, 2000). That fossiliferous horizon shows a reversed polarity and belongs to the Gauss epoch (Gnibidenko et al., 1976). The red beds are separated from the overlying rose-coloured loams abounding with calcareous nodules by an erosional unconformity. The rose loams contain rare remains of Borsodia chinensis laguriformes, typical of late Early Pleistocene Transbaikalian faunas; this fauna is here referred to as Tologoi 1.2 (an analogue of Dodogolian fauna).

— middle unit (section Tologoi 2) — about 12 m of non-sorted, compact yellow-gray and brown sandy loam, with occasional grains of coarse sand and small lenses of fine gravel up to 1.5 m thick. In the middle part of this unit, within a fossil soil horizon (Tologoi 2.3), the Brunhes/Matuyama reversal occurs (Gnibidenko et al., 1976). As for fossil remains, there are two faunas recovered from the sediments below the magnetic reversal and dated to the latest

Early Pleistocene (Tologoi 2.1 and Tologoi 2.2); other faunas occur above the reversal and are dated to the early Middle Pleistocene (Tologoi 2.4, Tologoi 2.5 with Tologoi faunistic complex and Tologoi 2.6 with Ivolginian fauna) (Alexeeva, Erbajeva, 2000; Alexeeva, 2005).

— upper unit (section Tologoi 3) — up to 12 m thick of non-sorted yellow-gray and brown sandy loam with admixture of fine gravel and sand; the sediments are coarser than those of the underlying unit. There are scarce small mammals remains, belonging to late Middle Pleistocene (Tologoi 3.1; 3.2; 3.3) and Late Pleistocene faunas (Tologoi 3.4) (Alexeeva, 2005). Recently, the geological sequence exposed in the Tologoi 3 section has been re-examined by the joint team of the Sobolev Institute of Geology and Mineralogy of SB RAS (Novosibirsk) and Geological Institute SB RAS (Ulan-Ude). This study resulted in new data and new outlook. The upper part of section previously considered to be of latest Pleistocene age appeared to be the Holocene; this revision is based on paleosols study (Zykina, Zykin, see below) and on its absolute dating provided by W. Zech (Andreeva et al., 2011). Moreover, in the nearby section Tologoi VIII some new fossils of small mammals (mostly modern species) have been collected in abundance; their Holocene age is supported by ^{14}C date of 2035±45 (COAH-8410).

Below the units will be discussed in more detail.

Lower unit – section Tologoi 1

The lower part of the sequence, about 3 m thick, consists of red and reddish-brown sandy clays with carbonate concretions overlain by sandy loam and loess-like sediments. Three profiles (1, 2, 4) are exposed here. Profiles 1 and 2 show almost the same stratigraphic sequence (Fig. 3) which is described below (from base to top):

1. red, reddish brown and dark brown clays and sands 2 m thick (exposed); at the base of these sediments there is a hard calcrete 20-30 cm thick, seemingly broken and displaced. It is overlain with 1.4 m of dark-colored silty sand with reddish lenses; it is affected by post-sedimentary disturbances, as testified by 5 oblique (30°) cracks 0.5 m wide and 0.7-1.2 m deep, filled with sand and powdery limestone, folds and injections. This horizon (Tologoi 1.1) yielded a fauna of the Chikoi Faunal Complex with Hipparion tchikoicum.

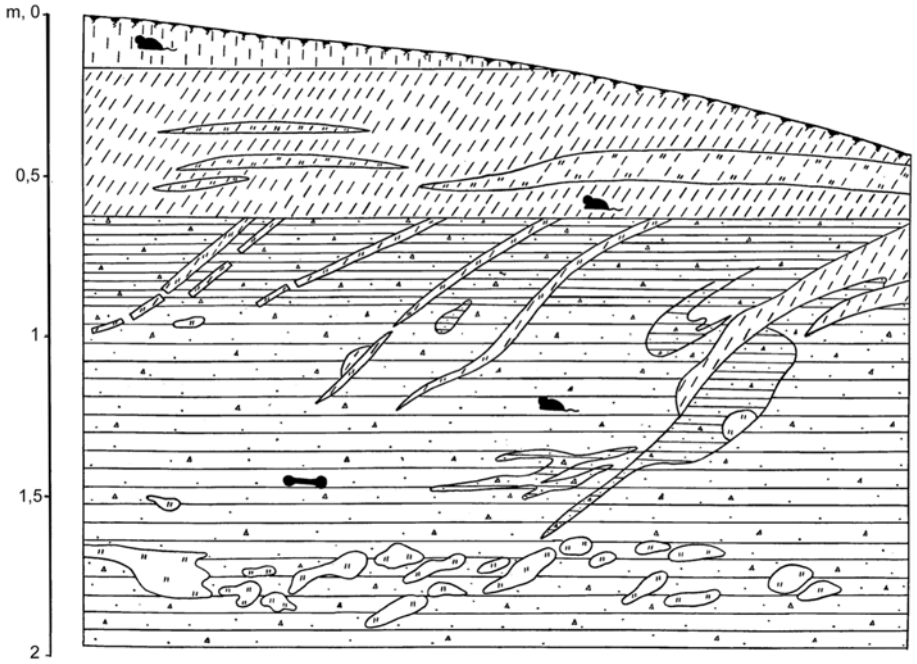

Fig. 3. Tologoi 1 locality: lithological scheme (legend see Fig.4).

2. The overlying pinkish discontinuous fine-grained calcrete 0.2-0.6 m thick is separated from the lower sediments by an erosional surface. A few fossil remains have been collected here, and among them Borsodia chinensis laguriformes which is a characteristic late Early Pleistocene form (Tologoi 1.2).

3. Light gray sandy loam up to 0.6-1.0 m thick with thin lenses of carbonate loam pinkish and whitish in colour. Fossil remains discovered here are attributed to the genera Crocidura, Ochotona, Prosiphneus, Spermophilus. This horizon corresponds to the basal layer of Tologoi 2 section.

4. Loess-like sediments 0.5-0.75 m thick with scarce gruss and occasional small lenses of carbonate loam and a thin interlayer of carbonate.

5. Recent dark greyish soil.

There is a stratigraphical hiatus between horizons 1 (Tologoi 1.1) and 2 (Tologoi 1.2), as no early Early Pleistocene sediments are preserved in this section.

Vogt et al. (1995) mentioned that the red bed of Tologoi 1.1 consists of sand with gruss and debris to the extent of 63 %. Liskun and Rengarten (1963) were of the opinion that this horizon was the product of the redeposition of disintegrated granite in an aqueous medium.

The fauna from the red beds (horizon 1, Tologoi 1.1.) of the Tologoi 1 section is referred to as belonging to the Chikoi Faunal Complex. It includes the following species: *Petenyia hungarica, Sorex* sp., *Ochotonoides complicidens, Ochotona* cf. *intermedia, Hypolagus* sp., *Marmota tologoica, Orientalomys sibiricus, Orientalomys* sp., *Cricetinus* cf. *varians, Cricetulus* cf. *barabensis, Kowalskia* sp., S*icista pliocaenica, Promimomys gracilis, P.* aff. *stehlini, Mimomys minor, M.* cf. *pseudintermedius, Villanyia eleonorae, Pitymimomys koenigswaldi, Prosiphneus* aff. *lyratus, P.* cf. *praetingi, Hipparion tchicoicum, Gazella* cf. *gutturosa, Canidae* indet., *Felidae* indet., *Mustela* sp.

The faunas belonging to the Chikoi Complex are identified at the Beregovaya locality as well. The following species have been identified there: *Beremendia fissidens, Petenyia hungarica, Sorex mirabilis, Hypolagus multiplicatus, H. transbaicalicus, Pentalagini* indet., *Ochotonoides complicidens, Ochotona gromovi, Ochotona intermedia, Ochotona sibirica, Castor* sp., *Sicista pliocaenica, Orientalomys sibiricus, Micromys* cf. *minutus, Cricetinus* cf. *varians, Cricetulus* cf. *barabensis, Mimomys minor, M.* cf. *reidi, M. pseudintermedius, Villanyia eleonorae, Prosiphneus praetingi, Hipparion tchicoicum, H. houfenense, Canis* cf. *chihliensis minor, Acinonyx* sp., *Lynx shansius, Euryboas* cf. *lunensis, Nyctereutes* cf. s*inensis, Parameles suillus, Dicerorhinus* sp., *Gazella* cf. *sinensis, Antilospira* sp., *Palaeotragus* sp. (Vangengeim, 1977; Sotnikova, 1989; Erbajeva and Alexeeva, 2000).

This fauna in the Beregovaya site is distinct for abundance of rooted arvicolids of the genus Villanyia. The proportion of the latter is up to 70% of the total number of small mammals, while in the Tologoi fauna it does not exceed 15%. It is also marked by considerable diversity of the genus Mimomys voles and of ochotonids. Tologoi 1.1 fauna differs considerably from Beregovaya fauna in the species composition and in relative proportion of individual taxa; there are also evident differences in evolutionary levels of some small mammal taxa (especially voles). The fauna from Tologoi 1.1 represents an older stage within the Chikoian Complex, while the Beregovaya fauna signifies a more advanced stage.

The red bed is overlain by Early Pleistocene sediments of horizon 2 (Tologoi 1.2) represented there with thin pinkish calcrete; in its turn the latter is overlain by a slightly younger Early Pleistocene pale yellowish-gray sandy loam of horizon 3. That horizon contains fossil remains of *Ochotona tologoica, Spermophilus tologoicus* and *Prosiphneus* cf. *pseudarmandi*, the latter have been also found in the basal part of the middle unit of the Tologoi 2 section.

Middle unit — sectionTologoi 2

Total thickness of the unit exceeds 12 m. The time span of the deposition is late Early Pleistocene — Middle Pleistocene. It consists mainly of sandy loam with occasional grains of coarse sand and small lenses of fine gravel (Fig. 4).

The sequence of layers of Tologoi 2 (section V) is as follows (from base to top):

1. 0.8 m (exposed) of uniform compact pale yellowish-gray sandy loam with of slightly undulating interbeds of sandy loam and fine sand. The layer contains relatively abundant small mammal fossils such as: *Ochotona tologoica, Spermophilus tologoicus, Prolagurus pannonicus, Prosiphneus youngi, Crocidura* sp., *Allactaga* sp. (Tologoi 2.1). A cryogenic structure found in the layer is a wedge (15 cm wide at the top) with calcareous powder on both sides.

2. Gray sandy loam 1.0 m thick with discontinuous carbonate interlayers and thin beds of coarse sand with gravels; with lens ($0.5\frac{3}{2}0.3$ m) of medium and coarse sand. 1.0 m of reddish-brown clayey loam (silt) with inclusions of poorly rounded grains of coarse sand; the layer is heavily deformed by cryogenic processes. On the left side of the horizon there is a microfault due to uneven settling of thawing ground. As the upper silty layer took much longer to thaw than the underlying sandy deposits, it was broken up into large blocks which were displaced relative to each other. A block 1.5 m wide subsided by approximately 20 cm below the top line. At the right part of the exposure the block of silt is penetrated by ground veins of SE strike. Remains of Spermophilus tologoicus were collected here (Tologoi 2.2).

3. Compact pale-grey sandy loam 2.0 m thick, with abundant coarse sand grains; in the upper part of this horizon there is a packet 0.6 m thick consisting of three thin silt layers and two layers of sandy loam with coarse sand grains. The horizon is broken by a cryogenic polyphase wedge-like crack (0.7 m deep and 0.5 m wide at the top) containing vertical partings of coarse sand and calcareous powder. The host material shows folds and plications, larger (up to 10 cm) in the coarse sand and narrower and smaller (5 cm) in finer material. The wedge strikes from north to south.

4. Pink-brownish silt (1.3 m) with injections

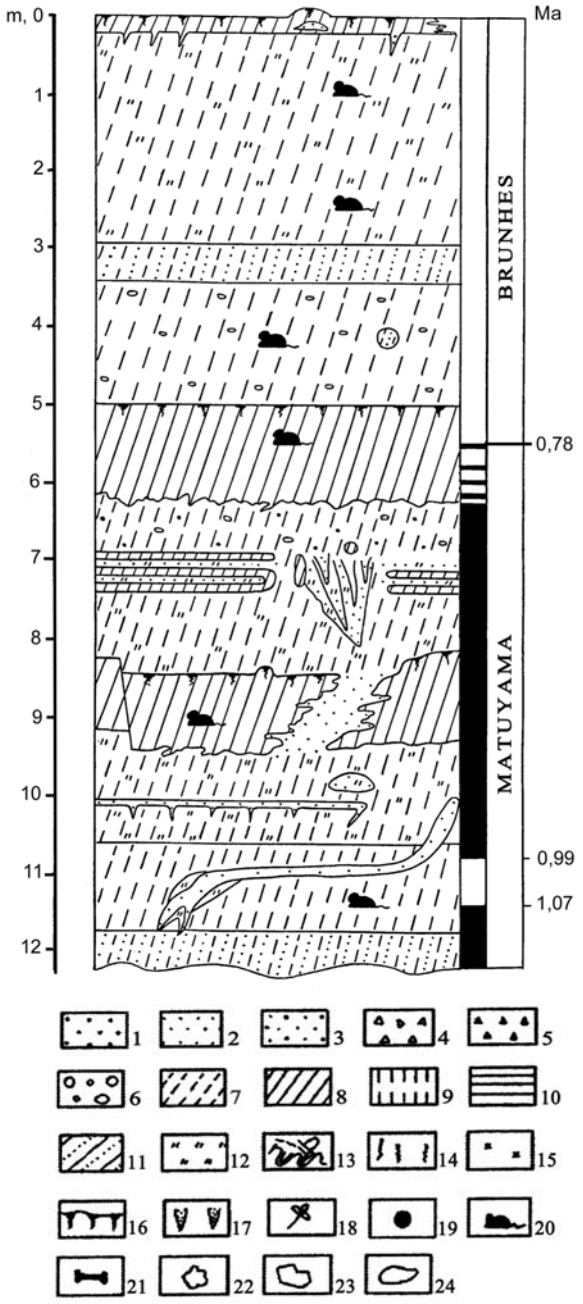

Fig. 4. Tologoi 2 locality: lithological scheme.

1 — sand; 2 — fine sand; 3 — sand of variant grain size; 4 — debris; 5 — gruss; 6 — pebbles, gravels; 7 — sandy-loam; 8 — loam; 9 — silt; 10 — clay; 11 — alternation of sands and loams; 12 — carbonate traces; 13 — deformations; 14 — Mn-Fe concretions;15 — Mn; 16 — fossil soil; 17 — ice wedges; 18 — plant remains; 19 — burrows; 20 — small mammal remains; 21 — large mammal remains; 22 — re-deposited blocks; 23 — blocks; 24 — boulders.

of the underlying material. The silt contains grains of coarse sand. In the middle of this horizon the Brunhes/Matuyama reversal occurs (Gnibidenko et al., 1976). Scarce fossil remains of *Ochotona* and *Myospalax* were found here (Tologoi 2.3).

5. 1.6 m of pale-grey sandy loam with rare small-size gravel. The horizon yielded abundant fossil remains of small mammals belonging to the Tologoi Faunal Complex (Tologoi 2.4). The sandy loam is overlain with 0.5 m of fine sand.

6. 3.0 m of grey sandy loam, darker in the lower part of horizon and lighter in the upper part due to spots and thin intercalations of carbonates. In the upper part of horizon there are several small and short wedge-like features and one deeper (up to 40 cm). This horizon contains abundant fossil remains of both large and small mammals of Tologoi Faunal Complex (Tologoi 2.5). List of mammals is given below.

7. Pinkish-brown silty sediments 0.2-0.3 m thick extending to the right to the neighbouring sections of the Tologoi site (sections VIII and IV). Fossil remains found here are refered to the Ivolginian fauna (Ochotona daurica, Eolagurus cf. luteus, Marmota sibirica, Spermophilus undulatus, Lasiopodomys brandti etc.). This horizon forms the uppermost part of Tologoi 2.

8. 0.0-0.2 recent soil.

Cryogenic deformations recorded in the lower part of this unit are dated to the interval between 0.78 and 0.99 Ma BP on the basis of paleomagnetic evidence, as they are located below Brunhes/Matuyama boundary, though above the positive Jaramillo event.

The faunas referred to as Tologoi 2.1 and Tologoi 2.2 are of the late Early Pleistocene age, and the faunas of Tologoi 2.3, Tologoi 2.4 and Tologoi 2.5 are dated to the early Middle Pleistocene are recognized as the Tologoi Faunal Complex. The latter includes: *Ochotona gureevi, Marmota nekipelovi, Spermophilus gromovi, Cricetulus* cf. *barabensis, Allactaga sibirica transbaikalica, Dipus* cf. *sagitta, Ellobius tancrei, Meriones unguiculatus, ,Eolagurus simplicidens, Microtus gregalis, M. mongolicus, Lasiopodomy brandti, Myospalax wongi, Pachycrocuta brevirostris sinensis, Canis variabilis, Vulpes* cf. *vulpes, Martes* sp., *Coelodonta tologoijensis, Archidiscodon* sp., *Equus* ex gr. *sanmeniensis*, *Spirocerus* cf. *peii, Cervus* ex gr. *elaphus, Bison* sp. (Vangengeim et al., 1966; Vangengeim, 1977; Alexeeva, 1996; Erbajeva, Alexeeva, 2006). The fauna of the Tologoi Complex resembles that of Choukoutien 1 in species composition and in evolutionary development of some taxa.

The upper unit — Tologoi 3 (section 1)

Total thickness of the unit is 14 m. The time span of the deposition is late Middle Pleistocene to Holocene. The unit is composed of non-sorted yellowish-grey and brown sandy loam with admixture of small gravel and sand; the sediments are much coarser than those of the underlying unit (Tologoi 2). The successive continental deposits are exposed (Zykina, Zykin, Smolyaninova, see scheme on Fig. 5):

Layer XII (1.5 thick). The lower 1 m is composed of sandy silt alternating with interlayers and lenses of sand, yellowish or light gray in color; there are numerous horizontal bands and lenses of carbonates. The upper part of the layer features some thin (less than 1 cm) horizontal or wavy carbonate lamina whitish in color, as well as isolated spots of the same color enriched in carbonates.

Layers XI and X (1.75 m). The horizon consists of yellowish-gray sandy loam with inclusions of coarse sand grains and calcareous bands in abundance.

Layer IX (0.7 m). The lower part of the layer displays coarse-grained sand interlayering with rock detritus and sandy loam. The fossil soil is present here as separate pockets 10 to 25 cm in size; its complete profile may be seen 50 m east of the section.

The upper part of the layer is represented by carbonate-rich sandy loam, including numer-

ous lenses of coarse grain with rock fragments.

Layer VIII (0.25–0.5 m). Sandy loam loosely packed, weakly effervescing when treated with acid, occurs as lenses between whitish carbonate cryogenic structures. There are occasional thin laminas of medium-grained sand – supposedly remains of the horizon separating two carbonate cycles. This horizon is found in all the overlying sedimentary cycles as residual lenses between cryogenic carbonate structures.

Layer VII (1 m). The upper part is calcareous light loam with a considerable admixture of sand, distortions of solifluction type are noticeable at the top of the unit. The lower part of the layer is weakly calcareous sandy loam greyish-brown in colour. Lenses of coarse sand and rock fragments occur at the base of the layer.

Layer VI (15 cm). Light-brown sandy loam occurs as separate spots within frost fissures. The top of the layer is eroded and preserved only between the cryogenic structures of the lower lying calcareous loam.

Layer V (0.35 m) — greyish-brown sandy loam with a weak whitish hue, calcareous, with a sizeable admixture of coarse sand grains and small rock debris. The upper boundary of the unit is uneven, wavy, locally intruding into the overlying layer.

Layer IV (1.1 m) — in the upper part beds of pale yellow sandy silt alternate with those of sandy loam, brown in color, with calcareous concretions. The upper boundary is irregular, with folds and mounds due to cryogenic deformations. One of the frost mounds is ~ 1 m in diameter and 40 cm high, the calcareous layers enveloping its surface.

Layer III (0.3 to 0.6 m) — grayish — light brown loam with admixture of sand; its occurrence is mostly controlled by the cryogenic deformations of the underlying layer IV. This horizon forms pockets (up to 45 cm deep) and gently inclined wedges (the biggest one is 60 cm deep). There are coarse sand and rock debris occurring within the pockets and wedges near their sides or in lenses.

Layer II (1.5 m) consists of non-sorted polymictic sand interlayering with grayish-yellow sandy loam or silty loam; there is a concentration of loose calcareous concretions in the upper part of the layer. The presence of coarse-grained sand with rock fragments (up to 0.7 cm in size) at the base of the layer suggests intensified wind erosion and a gap in sedimentation preceding its deposition.

Layer I — the modern soil profile consisting of horizons A and B1ca.

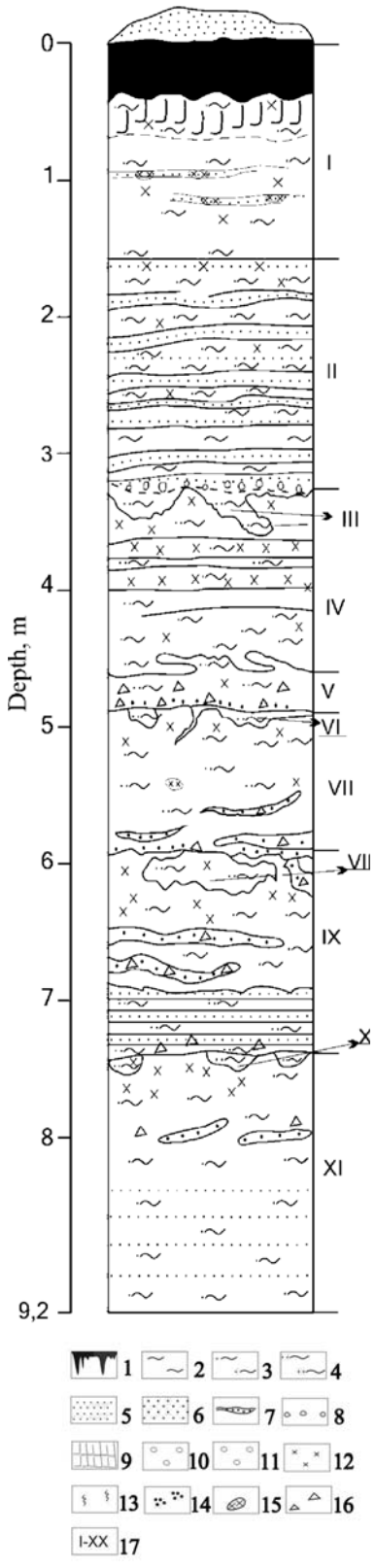

Fig. 5. Tologoi 3 locality: lithological scheme. 1 – humus horizon; 2 – loam; 3 – sandy-loam; 4 – loamy sand; 5 – fine-medium sand; 6 – coarse sand; 7 – sand lens and sublayers; 8 – basal horizon; 9 – illuvial horizon; 10 – manganese concretions; 11 – iron hydrogen oxides; 12 – carbonates; 13 – ferrization; 14 – manganese tab; 15 – carbonate concretions; 16 – fragments of rocks; 17 – the number of layers

Humus horizon A (0.4 m) — light sandy loam, dark gray with brownish hue, moderately compact, noncarbonate; it is overlain by light gray eolian deposits about 40 cm thick. The horizon A is broken into blocks by vertical fissures. The lower boundary of the horizon is wavy, locally with rounded pockets. The transition to lower horizon is noted by change in color.

Horizon B1ca (0.3 m) — compact loam greyish-yellow in color, weakly calcareous, with lesser admixture of sand grains. The lower boundary is wavy, transition is clearly marked by considerable increase in sand proportion and by accumulation of calcareous neoformations (nodules, etc.).

Horizon BCca (0.9 m) — grey-yellow sandy loam, compact, with horizontal interlayers of coarser sand including loose calcareous concretions. The horizon is weakly porous, with root tubules. The lower boundary is sharp.

Altogether, small mammal fossils have been collected from 14 faunistic horizons of the Tologoi key section; at least 7 faunas replaced each other successively over the period from the early Late Pliocene to Holocene.

September 14th, 2013

Stop 2. Itantsa Key section

Itantsa Key section includes two profiles: Klochnevo I fossil site and Zasukhino locality: Early Pleistocene-Holocene colluvial deposits, with 9 sequential mammalian faunas (among them the early Early Pleistocene Itantsinian faunistic Complex, Lectostratotype of the middle Early Pleistocene Dodogolian fauna and the late Early Pleistocene Zasukhinian fauna).

Itantsa Key section is located in the Itantsa River valley at the foothill of the Morskoy Ridge.

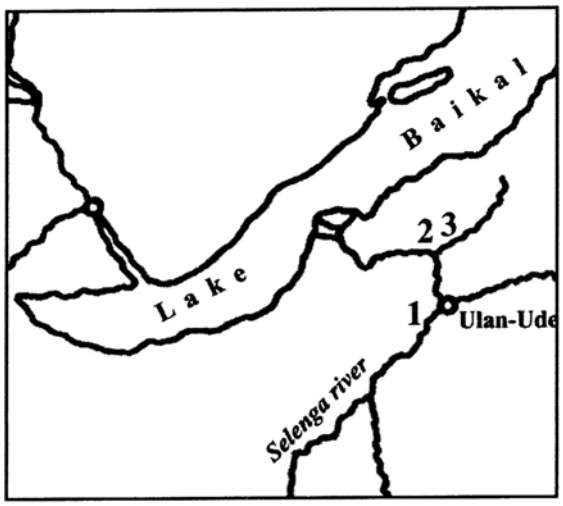

Fig. 6. The position of Itantsa Key section: 2 - Klochnevo I, 3 - Zasukhino.

Klochnevo I fossil site

The Klochnevo I fossil site was discovered in 1959 by geologist N. Mikhno and named after the Klochnevo village nonexistent at present. It is located on the right bank of the Itantsa River, a tributary of the Selenga River.

The Late Cenozoic sequence includes three clearly identifiable horizons as described by Ravsky et al. (1964) and Bazarov (1968). The mammal fossil remains were studied by Vangengeim at al. (1966), Erbajeva (1970, 1998), Alexeeva et al. (2001), Alexeeva (2005).

The exposed part of the section is as follows (from base to top):

1. The lower horizon (1.0 m — exposed thickness) — dark red clay with rock debris and occasionally found unidentifiable damaged bones;

2. The middle horizon (2.0 m thick) — reddish-brown loam with abundant remains of both large and small mammals attributed to the Itantsa Faunal Complex (Klochnevo I.1).

3. The upper horizon (up to 2 m) — pale yellow loess-like sandy loam lying on the eroded surface of the middle horizon. There are some fossil remains of small mammals belonging to the Tologoi Faunal Complex (Klochnevo I.2).

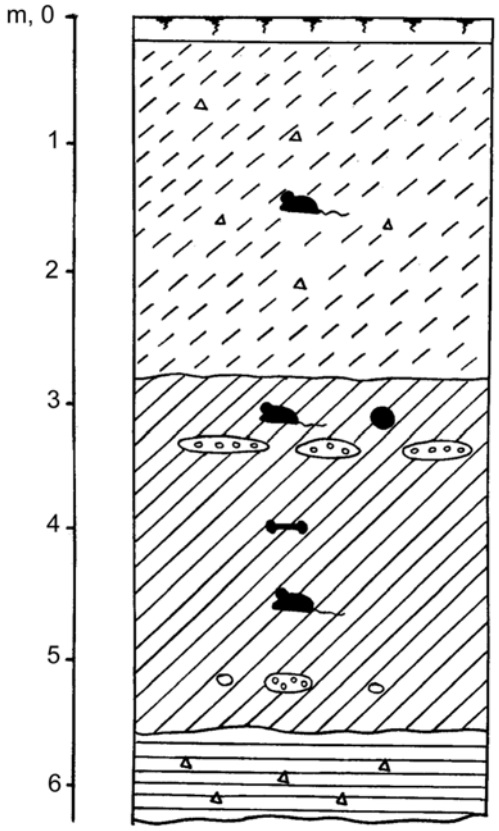

Fig. 7. Klochnevo I fossil site: lithological scheme.

The mammal remains, mostly those of large mammals, recovered from the middle horizon were described for the first time by Vangengeim (Ravsky et al., 1964) as the Itantsa Faunal Complex. Later the list of remains was supplemented with those of small mammals studied by Erbajeva (1970). The faunal complex includes: *Ochotona* cf. *intermedia, O.* cf. *nihewanica, Spermophilus (Spermophilus) tologoicus,*

Spermophilus (Urocitellus) itancinicus, Marmota sp., *Castor* sp., *Allactaga* sp., *Cricetinus* cf. *varians, Cricetulus* cf. *barabensis, Clethrionomys* cf. *kretzoi, Villaniya klochnevi, Cromeromys* sp., *Mimomys* cf. *pseudintermedius, M.* cf. *pusillus, Episiphneus youngi, Equus sanmeniensis, Itanzatherium angustirostre, Gazella* cf. *sinensis, Ovibovini* gen. (Vangengeim, 1977; Erbajeva, 1998).

The most remarkable feature of this fauna is the first appearance in Transbaikalia of some genera, such as *Equus* (replacing the genus *Hipparion*), *Spermophilus* (both subgenera), and *Allactaga*.

In contrast to the preceding Chikoian faunas of Transbaikalia, the Itantsinian fauna displays much less species diversity in ochotonids and rooted voles of the genus *Mimomys*, while the *Villanyia* and *Episiphneus* genera are represented by more advanced forms as compared with the earlier fauna.

Among small mammals recovered from the upper horizon (sandy loam) there are *Ochotona* sp., *Spermophilus (Urocitellus)* sp., *Allactaga* sp., *Eolagurus simplicidens, Cricetulus* cf. *barabensis*, which are typical constituents of the Tologoi Faunal Complex.

In a bend of the Itantsa River, away from the Klochnevo I site towards the Zasukhino locality, there is an exposure of Late Cenozoic deposits. The outcrop of brownish red loam (known as Klochnevo II site and dated to the Early Pleistocene) yielded a few small mammal remains near its left border; the right side of the outcrop produced an isolated teeth of *Equus sanmeniensis* as well as fossils of small mammals in abundance, the species composition being practically identical to that in Klochnevo I.1.

Zasukhino fossil site

The fossiliferous locality of Zasukhino is situated on the right side of the Itantsa River valley on the spurs of the Morskoy Ridge 1.4 km southwest from the Zasukhino village. The locality was discovered in 1966 by Quaternary geologist I. Rezanov and studied first by Bazarov, Erbajeva, and Rezanov (1976), later by Vangengeim and Sotnikova (1981), Erbajeva (see Agadjanian, Erbajeva, 1983) and Alexeeva (2005).

The bone-bearing beds of the Zasukhino site are confined to series of gully fills deposited in an ancient small flat-bottomed valley cut into Mesozoic bedrock. Here lateral erosion of the Itantsa River undercut a complex structure of the ancient valley infilling; as a result, the latter forms a steep slope rising 30 m above the Itantsa floodplain.

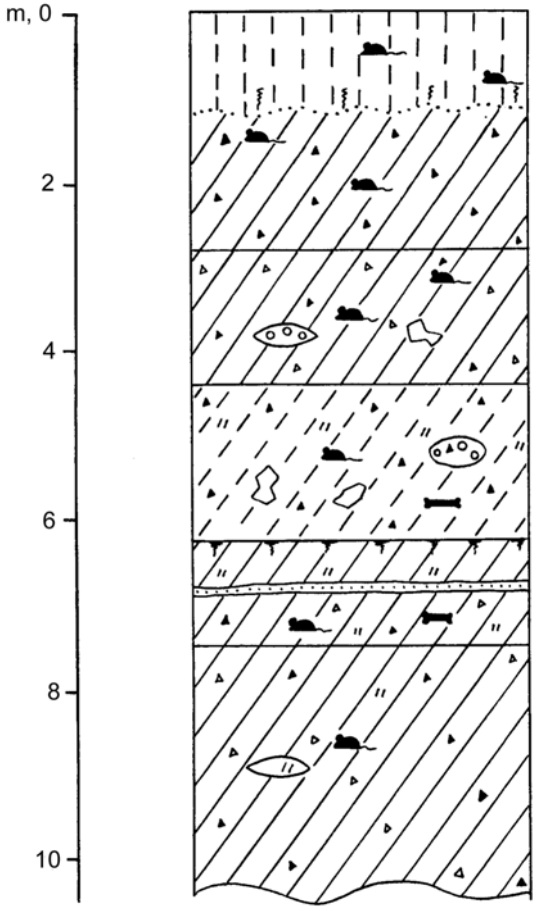

Fig. 8. Zasukhino fossil site: lithological scheme.

The sequence of the gully deposits exposed is as follows (from the base upwards):

1. Dark cherry or brown clay and loam with weathered rock debris and scarce bone pieces, apparent thickness is up to 1.0 m;

2. Reddish-brown and light brown loam with interbeds of small debris and grit, up to 2 m

thick; there are remains of small mammals attributable to the Itantsa Faunal complex (Zasukhino 1).

3. Yellowish-brown loam, with sand, gravel and lenses of rubble, 1–2 m thick. Small mammal fossils recovered from this layer include *Allophaiomys* and *Borsodia* (Zasukhino 2). It is the Lectostratotype of the middle Early Pleistocene Dodogolian fauna.

4. Brownish-grey sandy loam and sands with minor admixtures of rubble and occasional boulders detached from the bedrock; the total thickness is up to 3 m. This layer has been found to contain large lens-like accumulations of fossil remains of both large and small mammals belonging to the latest Early Pleistocene Zasukhinian fauna (Zasukhino 3). These deposits overlie the lower horizon 3 with a sharp erosional disconformity.

5. Pale-yellow sandy loam and loam with debris dispersed in abundance and a small admixture of rubble, 2.0–3.0 m thick. Remains of fossil small mammals recovered from two subhorizons belong to taxa of the Tologoi Faunal complex and may be tentatively considered reflecting two stages of evolution: typical and slightly advanced (Zasukhino 4).

6. Pale-greyish sandy loam and fine to coarse sand, 2.0 to 2.5 m thick altogether, with carbonates occurring as small spots, streaks and thin bands; there are also dispersed grit and rock debris. Fossil remains derived from two subhorizons belong practically to a single faunal assemblage recognized as the Zasukhino 5 fauna.

7. Yellowish-grey loess-like loam and sandy loam 2.0 m thick, with rare fossils dated to the Late Pleistocene and Holocene.

The Zasukhino multilayered site is one of the key sections of the Transbaikalian area. The time span of sediment deposition at this site spans the interval from the Early Pleistocene to Holocene. There is a possibility, however, that the lowermost horizon could be of the Pliocene age.

Layer 2 enclosing the Zasukhino 1 fauna resembles closely in species composition the Itantsinian fauna of the middle horizon described in Klochnevo I locality. It includes *Villanyia klochnevi, Clethrionomys* sp, *Episiphneus youngi* and other taxa dated to the Early Pleistocene (Bazarov et al., 1976; Agadjanian, Erbajeva, 1983). Recently the Zasukhino 2 fauna of (horizon 3) was replaced the Lectotype of the Dodogoloian fauna (Erbajeva, Alexeeva, 2011).

The stratotype of the Dodogolian fauna was established in the lowermost faunistic horizon represented by reddish sediments with carbonate laminae in the Dodogol section located on the right beach of Uda river (Erbajeva, 1973). In the past the exposed section was undergoing natural erosion of river water. Later natural bed was cut off river water erosion due to the anthropogenic activity and gradually this part of beach became covered by dense shrubs. At the present time this stratotype section is no longer observable due to it covered over by thick sandy beds with dense willow shrubs.

The small mammalian fauna being the stratigraphic analogue of Dodogolian fauna was established in Zasukhino 2 site (Agadjanian, Erbajeva, 1983). On the base of study the geology and the analysis of new addition fossil materials in this site we are in agreement that Zasukhino 2 locality can be proposed as new Lectostratotype of Dodogolian fauna. The sediments exposed in Zasukhino 2 are represented by reddish sediments with carbonate laminae as in the Dodogol site. The faunas of both sites include the same characteristic taxa which are *Allophaiomys deucalion, Borsodia chinensis laguriformes*, advanced forms of *Episiphneus* cf. *youngi* and *Mimomys*.

The faunal assemblage from horizon 4 with advanced *Allophaiomys, Terricola, Lasiopodomys, Ochotona zasuchini* is reffered to as the Zasukhinian fauna (Zasukhino 3) and dated to the late Early Pleistocene.

The faunas from horizons 5, 6 and 7 are attributed respectively to the Middle and Late Pleistocene and the Holocene.

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