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The book presents the proceedings of the International Conference INQUA-SEQS 2014 held in Ekaterinburg, Russia. Reports concern a wide spectrum of issues connected to the study of the Quaternary Epoch (2.6 Ma) in Europe and Asia. Based on the results of local and regional Quaternary studies the authors focus on Quaternary stratigraphy and correlations across the Ural region and Europe and discuss the integration of pan-European and pan-Eurasian stratigraphical frameworks. The special attention is given to palaeontological, palaeoclimatological and palaeoenvironmental issues from the Quaternary of Europe and Asia.

Materials are published with the maximal preservation of the authors’ text.
FIRST RECORDS OF THE SUB-FOSSIL INSECTS FROM QUATERNARY DEPOSITS IN THE SOUTHEASTERN PART OF WESTERN SIBERIA

Keywords: paleoecology, sub-fossil insects, Late Pleistocene, Holocene, paleo-environment, Southern West Siberia

Despite intensive study of Quaternary insects in Northern Hemisphere, some regions are still blank spots on the map of investigations. One of them is the south-eastern part of Western Siberia. This work presents preliminary results of the study of sub-fossil insect remains from this area. Insect remains were found during field works in August 2012 and July-August 2013 in 9 sites situated in the central and southern part of steppe area in Altai and in the central part of Novosibirsk region. Layers with sub-fossil chitin were detected at following places: Aley river valley and its tributaries – Kizikha and Ust’yanka rivers, Ob river near Kalistratikha village (Altai area) and Chik river near Bun’kovo village (Novosibirsk area). Those are the first occurrences of the sub-fossil insects from Quartenary layers in the south of Western Siberia, which allows expanding the geography of paleoentomological investigations in the territory of Northern Eurasia and connecting these data with the results of investigations made in the Urals, central and northern parts of Western Siberia, west Kazakhstan and low reaches of Volga river (Zinovyev, 2008, 2011, Bidasako, Proskurin, 1987).

The most ancient are the layers uncovered at the left bank of the Ob river near Kalistratikha village (Kolmanovo district of Altai area). Insect data were extracted from the buried soils in the bottom of 40-m ravine; this layer has two thermoluminescence dates: 69±7 yr BP for the upper one and 85±8 yr BP for the lower one (Arkhipov, 1997). Insect complex consists of ground beetles, carrion beetles and other groups, more detailed information is not obtained yet.

Localities situated in Kizikha and Ust’yanka rivers are preliminary dated by the final part of the Late Pleistocene, insect data are found in grey and blue clays with plant debris in the bottom of river banks. The most abundant insect material is obtained for Ust’anka-2 site. On the basis of the predominance of the species associated with modern xerophilous steppe ecosystems, the absence of cold-resistant and dendrobiont species and a small amount of the hydrophilic
insects we can reconstruct the open steppe landscapes with the presence of wet meadows and salt-marshes. Most insect species found in Ust’yanka-2 site inhabit modern steppes of Kazakhstan while any connections with Altai and Sayan steppe faunas are not detected. Insect complex found in Ust’yanka-1 site is similar to insect fauna of Ust’yanka-2 locality (situated in 100 m from each other), but characterized by depleted species diversity.

Insect complex of Kizikha-1 site allows reconstructing open landscapes with wet meadows on the basis of predominance of weevil *Otiorhynchus politus*, presence of single steppe insects of beetles enable to propose local steppe communities located on slopes. Cold climate conditions were confirmed by the finding of subarctic ground beetle *Amara torrida*. *Hygrophilous* and halophilic insects are not found here. Insects found in Kizika-2 locality reflect the presence of dry tundra-steppe landscapes, while hygrophilous species *Zacladus geranii*, *Otiorhynchus politus*, etc. allow reconstructing wet meadows located in flood-plain of a river.

Two sites are preliminary dated to the Holocene. The first (Zakharovo) site, situated at Aley river, is attributed to this period according to the geomorphologic level of the floodplain terrace. Moreover, species found here are not found in Pleistocene layers but are known to inhabit these territories at present (weevils *Otiorhynchus velutinus* and *Cycloderes pilosulus* etc.). A small sample of insects was described from Gilevo site (left bank of Aley river), it includes steppe species such as weevil *Otiorhynchus velutinus*.

The northern point, Bun’kovo (Chik river, Novosibirsk district) is dated to the end of the Late Pleistocene based on radiocarbon dating (11550 ± 125 yr BP; SOAN-8806) (Tshernyshev et al., 2013). Insect fauna of this site is characterized by the large amount of steppe species (*Otiorhynchus karkaralensis*, *Aclypaea sericea*, etc.) and may be determined as tundra-steppe type.

Thereby these sites may characterize the wide chronological interval from the beginning of the Late Pleistocene to Holocene, but it is necessary to make radiocarbon dates for investigated layers; we have only one 14C date made for Bun’kovo site. In most localities steppe species are dominating, the most abundant beetle is weevil *Otiorhynchus karkaralensis*; other species of *Otiorhynchus* genus are abundant too. In some localities halophilic insects are found too, these insects may reflect an arid climate. Single faunas, which may detect cool climate conditions, were found in Kizikha-1 site. The subsequent radiocarbon dating allows correlating this material with synchronous insect faunas from the central and northern parts of Western Siberia.

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DISJUNCTIVE AREAS OF INSECTS AS A REFLECTION OF ENVIRONMENTAL PECULIARITIES OF NORTHERN EURASIA IN THE PLEISTOCENE AND HOLOCENE

Keywords: paleoecology, sub-fossil insects, Late Pleistocene, Holocene, paleoenvironment, Southern West Siberia

Disjunctions of modern areas of some beetle species may be considered as an evidence of their continuous areas during certain periods of the Pleistocene. These disjunctive areas may be divided into two groups: latitudinal-zonal and longitudinal. First group includes arctic and subarctic, steppe and nemoral insects. In some cases these species inhabit extrazonal biotopes (such as isolated steppe areas or mountain-tundra communities in boreal zone). An example of steppe species is dark beetle Oodescelis polita, which inhabits dry slopes with steppe vegetation in boreal forests of the Middle Urals. An example of disjunctions in arctic species is ground beetle Amara alpina found in high mountain tundras of the Northern and Southern Urals. Other disjunctions cannot be explained by the existence of extrazonal biotopes, such as ground beetle Polystichus connexus. Modern area of this beetle covers steppe zone from West Europe to South Altai; isolated occurrences known in middle taiga zone (Sovetskoe settl., Khanty-Mansiysk Autonomous Okrug — Ugra) and in forest-tundra (Salekhard, Yamalo-Nenets Autonomous Okrug) (Zinoviev, Olshwang, 2003; Samko, 1932). The most revealing example of such
distribution is ground beetle *Carabus sibiricus* distributed in the northern part of steppe zone from Middle Russia to South Yakutia; moreover, this beetle inhabits mountain tundras of Northern Ural and plain tundras of South Yamal (Kryzhanovskij et al., 1995; Zinoviev, Olshwang, 2003). Disjunctions of these species may indicate their wider distribution during cold and dry periods of the Late Pleistocene, when open tundra-steppe landscapes existed over the vast territories of Northern Eurasia. Other species which have disjunctive areas are nemoral beetles, living in broad-leaved forests of Europe and Caucasus, but keeping isolate sites in South Ural and Altai Mountains (*Carabus exaratus, Rhysodes sulcatus, Dendroxena quadrimaculata, Rosalia alpina*). It is possible that these species inhabited broad-leaved forests, existing in wide territories of the Central Part of North Eurasia during Eemian Interglacial (130000–115000 yr BP). One of the evidences of continuity of such a belt is the occurrence of sub-fossil remains of trubkovich *Phymatopoderus latipennis* (living now in broad-leaved forests of the Far East) in Eemian (Mikulino) layers of Belorussia (Nazarov, 1986). Another group of disjunctive areas may be determined as longitudinal; these species have modern East Siberian distribution. This group includes such beetles as *Carabus hummeli, C. vietinghoffi*, which have disjunctions in the Polar Urals and South Yamal (Kryzanovskij et al., 1995; Andreeva, Eryomin, 1991), these species might inhabit periglacial landscapes of the Central part of Northern Eurasia during the Late Quaternary. It is possible, that these beetles belong to arctic, subarctic and non-analogue insect faunas, typical for the Late Pleistocene of the Urals and West Siberia. So, analysis of modern disjunctive areas of some beetle species allows suggesting their presence in Pleistocene faunas correlated with both cool periods of the Quaternary and with interglacials, in particular, with the time of wide distribution of broad-leaved forests.

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STRATIGRAPHY AND CHANGES OF ENVIRONMENT AND CLIMATE IN THE LATE CENOZOIC OF WESTERN SIBERIA

Key words: stratigraphy, environment, climate, Late Cenozoic, Western Siberia

Western Siberia is one of the few areas of the world where the continental Upper Cenozoic is very completely represented, there are detailed paleontological sequences, and where abundant data are available for dating. This provides an opportunity for a reliable reconstruction of environmental changes. The Upper Cenozoic deposits of Western Siberia are unique archives containing substantial information on the environmental evolution of this territory. The Pliocene record of West Siberian Plain is composed of lacustrine, river and subaerial deposits. The most peculiar feature of the southeastern part of the plain is a loess-soil sequence, which is highly valuable as it reflects climatic changes in the Quaternary. The climatic record obtained by the analysis of the loess-soil sequence correlated with the oxygen isotope scale of oceanic sediments and other global records of climate.

Currently received new data on the structure, composition, distribution, geochronology, biostratigraphy and paleomagnetism of the Late Cenozoic deposits of Western Siberia 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.

As for degree of completeness of reflection of geological, paleobiological and paleoclimatic events, the composite section of the West-Siberian Pliocene is one of the most complete sequence for the continental Pliocene. This sequence distinctly reflects global climatic changes. Pliocene deposits have lateral and vertical stratification and distinct cycle structure. Changes of zoogeographic structure fauna of freshwater mollusca is the best suited for paleoclimatic reconstructions due to high sensitivity of freshwater mollusca to alterations of environmental temperature. The Pliocene of West Siberia is divided into Early Pliocene (about 5.3–3.4 Ma) with a warm climate and Late Pliocene (3.4–2.6 Ma) with a relatively cool climate.

The Early Pliocene is characterized by a relatively stable continental sedimentation under river, lake and subaerial conditions. The Lower Pliocene Formations have complete cycles that is closed by montmorillonite
clays with compact soils. At that time, a sufficiently well-developed, little entrenched drainage system with northward runoff existed at absolute heights considerably higher than the low water level of the modern rivers oriented toward the high ocean level. The soils in the south of the plain were formed under a high level of groundwater according to the type of compact soils. The mammalian fauna corresponds to that of the Ruscinian of the Western Europe (Zykin et al., 2007). The fresh-water mollusca fauna is characterized by the wide distribution of thermophilic Indo-Chinese and West Siberian endemic genera of East Asiatic origin.

At the boundary of Early and Late Pliocene, about 3.3–3.2 Ma, the climate in the southern West Siberia became considerably colder and, probably, drier. The result was a radically restructured biota. Nearly all thermophilic species of fresh-water mollusca (10 genera) became extinct. The malacofauna acquired the Palaearctic character. The Ruscinian fauna of mammals was replaced by the Villafranchian fauna with no vole-toothed hamsters. The generic composition of shrews was drastically reduced and Mimomys voles became quite abundant (Zykin et al., 2007). The Upper Pliocene Formations have imperfect cycles of river sedimentation. The recognized climatic event is in agreement with the climate cooling documented in both marine and continental settings in various regions of the world by drastic changes in biota. Those events coincided with uplift of the Tibet, Himalaya, Tien Shan, Altai, the increase in tectonic activity in many regions.

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 2009 year begins at 2.58 Ma. As a result, a large segment of the Pliocene has been included into the Quaternary. This decision complicate the identification of the accepted boundary in various regions of the world, especially in inland areas. In Northern Asia, the only section which is well-documented paleontologically and where the Gauss-Matuyama boundary was detected is the 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 (Zykin et al., 2007). The freshwater molluscs complex along with recent West Siberian species includes only one early Pliocene endemic species Borysthenia pronaticina (Ldh.) and indicates a significant climate cooling. Among not numerous ostracodes remains of Irtysh Formation of the section first appearance of the widespread in West Siberia Pleistocene species Limnocythera vara. The changes in flora composition (Volkova, 1977) indicate humidization and cooling of climate.

Loess-soil deposits are widespread over a vast territory of West and Middle Siberia, from 50° to 61°N and 70° to 100°E. Their overall thicknesses are a few tens of meters (up to 120 m) with an age range of more than 800 kyr. Thick loess layers in the loess-soil sequence of Western Siberia alternate with pedocomplexes (soil complex) consisting of two or three soils with thin loess
interbeds between them. The Middle and Late Pleistocene Western Siberian loess-soil sequence is one of the most significant terrestrial palaeoclimate archives in the Northern Asia. West Siberia loess sediments, deposited during Lower and Middle Pleistocene, occupy uplift territories — the CisAltai plain, Altai low mountains river valleys, west slopes of Salair and the Kuznetsk depression. During the Late Pleistocene loess distribution expanded abruptly, it developed widely in West Siberian plain and Kazakhstan.

Middle and Late Pleistocene loess-soil sequence of West Siberia consists of rhythmically alternated thick layers of loess and complexes of fossil soils consisting of two or three soils with thin loess horizons. 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. The complete loess-soil sequence from West Siberia includes ten soil complexes alternated with thick loess layers. Soil formation mostly occurred in periods of weak circulation, whereas loess deposition was associated with active wind transport when the air was thickly saturated with dust. The presence in microstructure of loess indications of cryogenic processes and traces of aeolian treatment on quartz grains evidence that loess layers were formed by wind in cold conditions. 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. Fossil soils of pedocomplexes formed during warming periods of the Pleistocene. 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. The lower soils of all pedocomplexes as a rule have the more thick profiles, and were thus deposited during the longest and warmest interglacial periods. The comparison of interglacial soils with modern soils, formed in similar geomorphological conditions, reveals larger thicknesses of interglacial Late and middle Pleistocene soils and more less thicknesses of the Holocene soil horizons. The obtained data evidence that large interglacials, including the last interglacial were more prolonged than Holocene. It seems that Holocene represent the initial phase of continuous warming.

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DENTAL MICROWEAR IN LATE QUATERNARY RODENTS: METHODOLOGICAL ISSUES IN THE ANALYSIS OF CLETHRIONOMYS AND SYLVAEMUS

Key words: microwear analysis of molars, diet reconstruction, rodents, Holocene

Dental microwear in fossil mammals is used to reconstruct their diet and also to make inferences about paleoenvironments (Lewis et al., 2000; Rodrigues et al., 2009; Oliver et al., 2014). This study focused on rodents with different type of dental system: voles with flat occlusal surface of hypsodont molars and mice with bunodont molars. We analyzed the dental microwear of modern/fossil Cl. glareolus (n=16/5) and S. uralensis (n=18/5) from the Middle Urals localities using scanning electron microscope TESCAN VEGA3 (IPAE UrB RAS) at the same ×1560 magnification. We studied modern samples first (voles and mice were captured in the dark coniferous forest, in the same biotopes) (Fominykh, Zykov, 2012). Based on that, the method was approved on the fossil samples from the Mironovskaya-III cave (layer 6, radiocarbon date: 5340±80 years BP (Ki-15494)).

All types of the microwear scars (pits and scratches) of the hypoconid and entoconid enamel found on molars of modern bank voles and Ural field mice were also found on sub-fossil Holocene specimens. But the difficulties of morphological diagnostics of isolated molars of Cl. glareolus–Cl. rutilus and A. agrarius–S. uralensis and poor state of enamel surface preservation in sub-fossil specimens complicated our study. Correct interpretation of microwear patterns and diet reconstruction of modern and Late Quaternary rodents (voles and mice) require further study. Therefore, we examined the main methodological issues in dental microwear analysis with our sub-fossil specimens and make the methodological proposals to address those issues (Table).

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