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Palaeoecology of Small Peat Bogs in the Sandstone Region of the NE Czech Republic

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ABSTRACT. *The sandstone nature reserve of ADRŠPAŠSKO-TEPLICKÉ SKÁLY Mts. in NE Czech Republic represents a very specific kind of landscape. In rocky depressions are accumulations of organic and anorganic material where the degree of decomposition is very low. The extreme acid conditions of sandstone preclude to conserve the calcium containing remnants, so that palaeoecological reconstruction can use only plant macro-remains, pollen grains and spores. The peat profiles under study can be generally characterised by natural and probably continuous development. An antropogenic impact is not visible prior to the Late Subatlantic period. Although each profile has a unique signature, which was probably the result of specific hydrological, taphonomic and microclimatic conditions, generally the profiles display similar overall development. This relatively uniform history of profiles probably shows limited vegetation reactions, which are determined by the acid sandstone environment.*

KEY WORDS: *NE Czech Republic, sandstone region, buried peat bogs, macro-remain and pollen analyses, cuticular analysis, Holocene.*

Introduction

In the acid sandstone region are many places with unique microclimatic and geomorphological conditions. Intimately related to this "sandstone phenomenon" is the character of present resident fauna and flora (glacial, montane species - Sýkora and Hadač, 1984). Hydrological and sedimentational conditions within depressions in the sandstone bedrock have led to the development of buried peat bogs from which three peat profiles were studied. On the basis of the macro-remain and pollen analyses (Chaloupková, 1995; Kuneš and Jankovská in this volume) it has been possible to reconstruct the palaeoecological conditions existing from the beginning of the Holocene period until present day within the area.

Methods and material studied

A set of samples (volume approximately 200 ml) was extracted from the peat bog sediments and under laboratory conditions macro-remains of botanical and zoological origin were separated. After species determination (Schweingruber, 1990) some

samples were removed and dated by radiocarbon (lab. Lund, Prague and Utrecht), the remainder being conserved for future analysis. In addition to the analyses of macro-remains and pollen grains cuticular analysis was also used. By this method of comparing the fossil cuticular membrane in size and shape with that of recent stomata (Kvaček, 1985), it was possible to determine small fragmented willow (*Salix*) leaves and pine (*Pinus*) needles and to specify the genus. Detailed research concerning the dynamics and the origin of anorganic deposits within the profile Kancelářský příkop was carried out by the X-ray analysis of mineral material from the peat and from the surrounding rocks. The palaeoecological data were analysed statistically by detrended correspondence analysis (DCA) with the Canoco software (ter Braak and Šmilauer, 1998).

Description of the profiles

The distance between each of the depressions is several km. The Kancelářský příkop and Kraví hora depressions are both approximately 1.5 m deep while the depression at Vlčí rokle is

4 m deep. The Vlčí rokle and Kancelářský příkop depressions are both located in valley bottoms, but Kancelářský příkop is topographically at a higher gradient. In the Vlčí rokle a full Holocene suite of phases are preserved. The age of the wood samples is 3866 ± 143 BP conv. (CU 1107) at 1.13 m, 5795 ± 163 BP conv. (CU 1108) at 2.2 m, 9333 ± 211 BP conv. (CU 1159) at 3.18 m, $10,563 \pm 240$ BP conv. (CU 1109) at 3.57 m, 8500 ± 60 BP conv. (UtC 9277) at 3.65–3.7 m and 8500 ± 60 BP conv. (UtC 9278) at 3.95–4 m level. The Kraví hora depression differs from the other two by being located on a plateau, however it is a very narrow depression and the peat deposit is therefore greatly riched throughout by water permeating from the surrounding sandstone, it is topogenic peat bog. A peat sample at the 1.22 m level is dated by radiocarbon 3836 ± 141 BP conv. (CU 1157) and at 0.65 m is of the age 1851 ± 34 BP conv. (UtC 9805). The Kancelářský příkop depression is much wider and the peat deposit within it is both ombrogenic and partly topogenic. Wood samples are dated to 2300 ± 100 BP conv. (LuA-4644) at 0.85–0.90 m and 4140 ± 90 BP conv. (LuA-4643) at 1.20–1.25 m. The presence of an adjacent active stream in the valley bottom at Kancelářský příkop may at some early date have prevented the formation of peat deposits until onset of the Subboreal phase. However the same conclusion is difficult to contemplate regarding the similar situation that occurs at Kraví hora because there is no evidence to suggest that a stream has ever existed at that location.

Results and conclusions

The deposit within Kraví hora has a homogenous character. The deposition of the organic material commenced about 4000 years ago in the Subboreal Phase. Macro-remains of spruce (*Picea abies*) permeated the entire deposit suggesting a light, but consistent open forest environment with acidophilous herbs and moss species (*Polytrichum*, *Sphagnum*) in the underwood.

The Kancelářský příkop material is of similar age and composition as the previous profile except that the anorganic material at the bottom of the peat profile appeared to be of unusually fine texture. Mineralogical analysis suggested that the material possibly came from the surrounding sandstone bedrock being washed into the newly formed depression as a primary silt. In the organic deposit charcoal layers, most likely from naturally occurring forest fires, were usually stratigraphically followed with niggerhead (*Eriophorum vaginatum*) and peatmosses (*Sphagnum fallax*, *S. magellanicum* etc). This vegetational composition is typical for the Late Subatlantic period. Next to this herbs and mosses appear in the dry section of the profile growing acidophilous species from the family *Vacciniaceae* (bilberry etc.) and tree species, spruce (*Picea*), birch (*Betula*) or pine (*Pinus*).

In the case of Vlčí rokle the sedimentation of the organic material began at the end of the Late Glacial Period (Younger Dryas). At this time there is the appearance of fen type vegetation with sedges (*Carex rostrata*, *Carex panicea*) in the moist places and poplar (aspen) (*Populus tremula*) with willow (*Salix aurita*) and probably also reed (*Phragmites australis*) appearing. This composition was typical for the locality for the Younger Dryas, Preboreal and part of Boreal periods. The Atlantic and Subboreal periods were dominated by open spruce forest with niggerhead (*Eriophorum vaginatum*) and mosses with species from family *Vacciniaceae*. The appearance of *Scheuchzeria palustris* at Late Subatlantic time is noteworthy.

Forest management is visible in all of the profiles during the Young Subatlantic period. On the rock plateau light pine-

birch woodlands together with acidophilous herbs (bilberry, cranberry and heath) were planted during the Holocene until the present day.

Discussion and conclusions

Every studied profile has its own history which is identified by a set of specific hydrological, taphonomical and microclimatic conditions, but these are set within a general framework. This is generally a situation dominated by light spruce forest with cryptogams (*Sphagnum*, *Polytrichum* etc.), niggerhead (*Eriophorum vaginatum*), acidophilous brushes and with some pine (*Pinus*) and birch (*Betula*). An exceptional period is found during the early phase of the Holocene when fen vegetation (com. *Salicion cinereae*) appears in the profile at Vlčí rokle, but this is due to the greater depth of deposits present and to a lesser degree of destruction from water flow in this particular depression. An additional exceptional phase occurs during the younger phase of the Holocene when *Scheuchzeria palustris* appears in the record. The paleoecological reconstruction from the available set of macro-remains has been supported by the use of applied statistical technique (DCA). The appearance of charcoal deposits possibly of natural origin, potentially has a great influence on the dynamics of the attendant vegetation. For example in the profile Kancelářský příkop it is possible to see a cyclic changing deposits consisting of spruce (*Picea abies*), birch (*Betula*) and bilberry (*Vaccinium myrtillus*) carbonised remains, replaced by heliophilous and hydrophilous species as niggerhead (*Eriophorum vaginatum*) or *Sphagnum* section *Cuspidata* and on dryer places probably species from the family *Vacciniaceae* and phanerogams of spruce (*Picea*), pine (*Pinus*) or birch (*Betula*). Furthermore the character of the profiles can be affected by the destructive power of the water, which can evoke problems of the re-deposition of the material in the profile.

Generally all investigated profiles are of natural, probably continuous development, only being influenced by man during the Young Subatlantic Period. From comparison of pollen (Chaloupková, 1995; Kuneš and Jankovská in this volume) and macro-remain analyses it can be observed that each method is valuable at different scales and the most viable re-construction is obtained by the combination of methods (Birks and Birks, 1980). In this connection the results of pollen analysis indicate distinct macroclimatic changes, but the analysis of macro-remains shows that usually local conditions prevail and need not necessarily correspond with changes of global climate throughout the Holocene. A discrepancy in the results of the radiocarbon dating in the profile Vlčí rokle is very informative. Two kinds of the samples were used of which some were excavated from the peat section, but which may have become compressed during extraction. The other samples were retrieved using an aluminium column box, which retained the original structure of the peat sequence.

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Late Glacial and Holocene History of Lakes, Climate and Vegetation in the Middle Urals, Russia

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ABSTRACT. Pollen evidences derived from the study of lacustrine and bog deposits in the Middle Urals, were used to reveal the main stages in the development of lakes and vegetation during the Late Glacial and Post Glacial time, from the Older Dryas. History of plant assemblages was traced as related to the fluctuations of water level in lakes and climatic changes during the Holocene period. A particular kink period was proposed to exist in the Post Glacial history of lakes and vegetation development at the boundary of the Atlantic and the Sub-Boreal periods. It was an interval when the climate turned to change towards cold and aridity thus providing gradual elimination of nemoral elements in the forests, shrinkage and paludification of numerous water basins, many of which transformed to become peat-bogs.

KEY WORDS: pollen analyses, sapropel, peatbogs, vegetation, climate.

Introduction

The work presented was performed in relation to archaeological investigations held in the surroundings of the city of Ekaterinburg in the Middle Urals, Russia. The location of the bank sites and Neolithic settlements found in the upstreams of the Iset' River indicate that numerous lakes existed there at that time, many of which later turned to become peat bogs, while the others changed their sizes significantly. Our work sought to study history of lakes and peat bogs of the territories where archaeological sites had been found and to describe paleoenvironments of the ancient people, especially features of paleovegetation and paleoclimates.

The region of our studies is situated in the central lowland part of the Middle Urals, the eastern macroslope, 250–300 m over the sea level. Modern vegetation dominates the south-taiga forests of birch and pine, sometimes added with spruce. The climate is now continental, with mean annual temperature ranging about +1 °C. The mean annual rainfall is about 500–550 mm. Four peatbogs originating from the lakes were studied.

1. The peatbog adjacent to the lake of Peschanoe, approximately 20 km west from the centre of Ekaterinburg city (56°54'N, 60°19'E).
2. The peat-bog named Romanovskoe is situated at the right bank of the Iset' River (56°54' N, 60°22'E), being adjacent to a Neolithic-aged settlement, excavated by V.F. Kerner.

3. The peat-bog near the island named Kamennie Palatki is situated at the left bank of the Iset' River (56°54'N, 60°25'E). The multi-layer sites (Mesolithic, Neolithic, Bronze and Iron Age) situated at the island are excavated by V.D. Viktorova, S.N. Panina et al.
4. The peat-bog around the lake named Karas'e is situated at the eastern borderline of the city of Ekaterinburg (56°46'N, 60°45'E). The archaeological site at the island of Razboinichiy was excavated by N.M. Chairkina.

Methods and material studied

The deposits of lakes and bogs were studied mainly by pollen analysis. The samples were collected by the author by means of Instorf's hand borer. At the Karas'eozersky peat-bog, samples were taken from the pit wall directly. The frequencies of each individual pollen group were calculated as a percentage of a total sum of trees and bushes pollen grains. Radiocarbon dates were obtained for the site of the Karas'eozersky peat-bog by N.G. Erokhin (Institute of Plant & Animal Ecology RAS = IPAE, Ekaterinburg) based on the buried-wood samples. Other sections were dated by the author by correlation of the pollen diagrams to the C-14 dated pollen records from the Ayatsky peat-bog in the Middle Urals (Khotinsky, 1977).