

Discussion and conclusion

Paleosols of horizontal chronosequence buried under the different age mounds of the BIK were similar in the most features between each other and with background Solonchic Chestnut soils. Only the depth of gypsum in their profiles was different because it responds quickly to changes of climate moistening. In the paleosol 0-1 buried at 3500 BC the depth of gypsum was 130-160 cm, in the paleosol 0-2 buried at 2550 BC - 90-110 cm, in the paleosol 0-3 buried at 2400 BC - 110-125 cm and in the background soil - 160-210 cm. The driest climatic conditions of pedogenesis were likely to be at 2550 BC. At 2400 BC the climate became more humid.

The features of paleosols in vertical chronosequence are indicative of similar climate changes. The features of the arid stage of pedogenesis were absent in the paleosols 1 and 2, and they occurred in the paleosols 3 and 4.

The paleosol 3 went through two stages of pedogenesis at least. The features of the first stage preserved in ditches where the thick humic horizons developed as a result of additional inflow of water of atmospheric precipitation from the kurgan surface. Then in the second stage of pedogenesis in the upper part of these humic horizons the light coloured carbonate horizons developed. Similar carbonate horizons testified to the considerable dry climatic conditions developed on the surface of the BIK about 2550 BC. On the surface of the paleosol 3 the remains of fired grass were abundant. They may be indicative of fires (conflagrations). At the same time the first desiccation cracks occurred.

The paleosol 4 went through two stages of pedogenesis also. The desiccation cracks up to the 3 m deep and mainly allocated in the south part of the BIK were referred to the first dry stage of pedogenesis (Fig. 1). In passing from dry environment to more humid the slope processes became more active, and thick colluvial deposits occurred in the bottom of the BIK southern slope. The well-developed humic horizons on the flat surface

of the fourth mound of the BIK and the subsident depression as a result of water stagnation on the clay layer covered its flat surface may be attributed to the humid environment.

A very dry climatic period in the Third Millennium BC were found by palinologists in the Don River basin and characterized as a climatic catastrophe (Spiridonova, 1991). Based on conventional ^{14}C dating this period was 3800-3900 years BP or 2200-2400 cal BC.

Similar arid climatic event was determined in the Mesopotamia region (Weiss et al., 1993) but ^{14}C age of its and in the Don River basin as well were some younger than that in Ipatovo.

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The Holocene Sedimentation in Sandstone Rockshelters of Northern Bohemia

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ABSTRACT. Thirty new Mesolithic sites (7-10 millennium BC) were found under sandstone rockshelters of the Northern Bohemia together with abundant fossils. The first half of the Holocene is significantly different from the last few thousand years - the substrate was calcareous, mixed forest prevailed, some 40 species of molluscs lived near searched sites. The gradual environmental change was punctuated by a most intense environmental degradation of the whole Holocene during Late Bronze to Early Iron Age. This environmental crisis can be characterised by erosion (deforestation?), de-calcification of the soils and sediments that resulted in pine forest spreading and consequent profound change of fauna and flora (e.g. only 5-7 species of snails had survived in the searched area).

KEY WORDS: Holocene, Mesolithic, sedimentation, rockshelters.

Introduction

The Upper Cretaceous (Cenomanian-Turonian) sandstones are forming in Northern and Eastern Bohemia large areas that can be characterised by a special landforms called the castellated rocks. A maze of narrow, steep forested canyons and dry gorges some 20-60 m deep, plateaus covered by agricultural, often loessic soils, artificial ponds and numerous villages are com-

posing a specific cultural landscape protected as several landscape protected areas (Kokořínsko, Broumovsko, Český ráj, Labské pískovce) and the České Švýcarsko National Park.

Our multidisciplinary team composed of experts on archaeology, paleobotany, geology, mineralogy, molluscan and vertebrate paleontology discovered during last ten years together with

students of cultural anthropology (Charles University, Praha and several other universities of Czech Republic, Germany, U.S. and Sweden) some 40 sandstone rockshelters containing archaeological materials and more or less valuable Holocene record. The detailed archaeological research was carried in 16 rockshelters and 33 rockshelters were found to contain Mesolithic artefacts (Čílek et al., 1996; Svoboda et al., 1996, 1998, 1999a,b; Peša, 1999). The aim of this extended abstract is the general multidisciplinary overview of the research activities and results. The research project is likely to continue for several more years but the major English monograph might be prepared within next three years.

Rockshelters

The research was focused on Mesolithic Period (6–10 ka BP) but younger ceramic cultures (Neolithic, Eneolithic, Late Bronze Age and other ones) were frequently found as well. The documented pits up to 2m deep were excavated in about 120 rockshelters on the area approx. 30 x 60 km. The rockshelters (abris) represent a periglacial phenomenon that can develop by several interconnected processes described as follows:

- Lateral erosion of the local (intermittent) streams
- Selective weathering of the different sandstone layers
- Capillary water and salt erosion actions
- Exfoliation undercutting

The size of a rockshelter that contain archaeological materials may reach the dimension of up to 33 m wide, 19 m deep and 6 m high (Kůlna by Všemily in Labské pískovce) to low, several metres wide abris or overhanging rocks. The rockshelters are usually filled by 2–3 m thick layer of Holocene sediments. The "typical" Mesolithic rockshelter is 2–4 m high, more than 10m long and 3–4 m deep. It is often situated on the ecotone zone between dry castellated sandstone interior and flat agricultural landscape so the inhabitants could take advantage of both basic landscape types. The vicinity (20–300 m) of running water or former marshes is typical for many sites. The Mesolithic artefacts are the most often found 60–120 cm under the present surface and at least 2–3 other archaeological cultures are often found in the overlying sediments. The transition

of Mesolithic layers into Neolithic ones is especially important one for understanding one of the main societal changes from hunter-gatherer community to agricultural civilisation.

The sediments contain in some cases abundant charcoals, fossilised seeds, molluscan fauna, Vertebrate bones and some authigenic minerals as pasty calcium carbonate derived from bones. The rate of abris formation under Holocene climatic conditions is usually low, because Mesolithic artefacts are often found in undisturbed layer 2–15 cm from the sandstone wall, thus the shape of many rockshelters have not changed much during last at least 8000 radiocarbon years. 18 radiocarbon ages date the Northern Bohemian Mesolithic Area to be 6600 to 8800 years old (Svoboda et al., 1998, 1999a,b). Two to three distinct Mesolithic layers suggest at least two phases of Mesolithic activities at the same sites.

Sedimentation

The Eemian or older sediments were never found. The loess sedimentation is unusual. The thin loess layer can be sometimes found at the bedrock. The majority of rockshelters was stripped of all the infillings during Late Glacial. The Late Glacial must have represented an extraordinary erosional event. The Late Glacial Holocene sediments (radiocarbon date from Nizká Lešnice abris close to Pavličky states for the upper part of the sequence $10,160 \pm 190$ years) are regularly formed by white, fluvial coarse-grained sands almost without clay minerals. The fluvial transport documented by quartz pebbles took place even in the gorges that are under present conditions dry. The collapse of large blocks of sandstones is documented at several sites, where the Mesolithic layer developed directly above the fallen blocks (e.g. Jezevčí díra - Badger's Hole in the České Švýcarsko National Park).

The Lower Holocene environments (examples from Poloméň hory Mts.) were very different from the second half or last third of Holocene. Ložek (1998) repeatedly discovered rich molluscan assemblages that contain up to 40 species of molluscs. The sediments were calcareous. Mixed oak or beech forest prevailed. We observe during Late Bronze Age (Lusatia culture) the change of environmental conditions. The sediments are



Fig. 1. The profile at Badger's Hole (Jezevčí díra) in Labské pískovce. The Mesolithic artefacts (indicated by crosses) were found directly on surface of the large fallen blocks (Late Glacial-Early Holocene). The sedimentary record is "destroyed" by bioturbation caused by badgers.

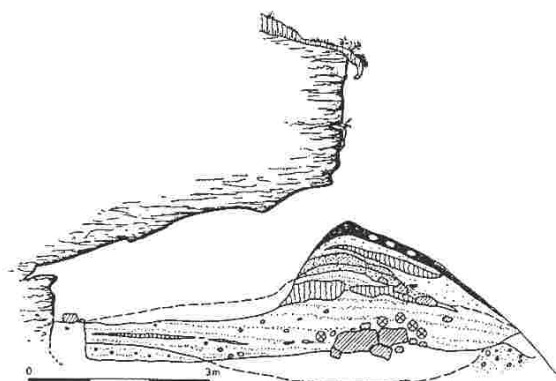


Fig. 2. The profile at Sweden Hole (Švédská díra) in Labské pískovce. This rockshelter was re-used during early New Age (Thirty-year war?) as a hideout. The Mesolithic artefacts (indicated by crosses) concentrate on the rim formed by sandstone blocks some 20–50 cm in diameter. The origin of the rim is unclear - it may even represent the relict of Mesolithic settlement structure.

mostly oligothrophic and former rich molluscan fauna is replaced by 5–7 species that live in the area now. The Subboreal sensu Ložek (1998; 750–1250 BC) very probably represents the most catastrophic event of the whole Holocene as witnessed in karst sediments of numerous Czech and Slovak sites. The bones, bone artefacts and mollusc are preserved only under rockshelters because of two factors:

- generally very dry conditions (we excavated e.g. buried letter from the second world war that could be partly read)
- the horizons of the burnt bones gave origin to thin, some 2–8 cm thick, calcareous layers that function as carbonate barrier for descending, slightly acidic precipitation.

The open-air sites were degraded by acid rains and the bones decomposed.

The Holocene sedimentation can be characterised by very gradual, „grain by grain“ sedimentation sometimes disrupted by erosional torrential rains or more often by sudden deposition of slope sediments. The Middle and Early New Ages (14–16th century) land use resulted in enhanced episodic erosion. The post-sedimental changes such as uneven ferritisation, illuviation and leaching are dependent on the boundary between dry and humid part of the strata that is directly exposed to the rainfall. The special attention must be dedicated to bioturbation because the profiles unearthed in dark fissure where the bioturbation was limited differed much from diffuse layers excavated several metres apart (see Mikuláš and Čilek, 1998; Mikuláš, 1999).

Results and directions of future research

1. More than 30 new Mesolithic sites and numerous prehistoric sites of younger cultures were found under sandstone rockshelters of Northern Bohemia. About 10,000 of flintstone artefacts were collected, small collection of bone artefacts

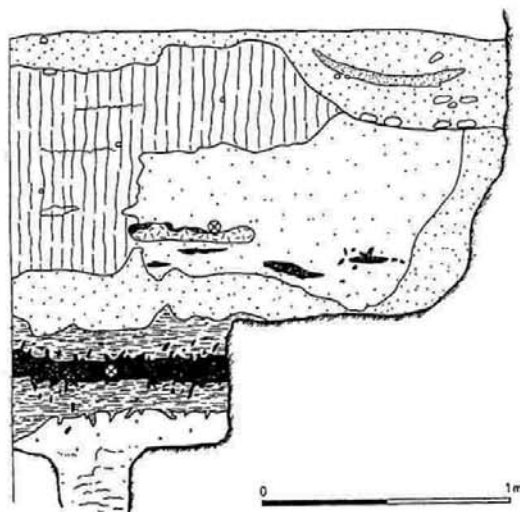


Fig. 3. The profile at Vysoká Lečnice close to Pavlíčky (Kokořínsko) indicates several erosional events and intense bioturbation caused by insects. The upper dark layer (cross) belongs to Mesolithic settlement, while the lower dark layer influenced by insect bioturbation may belong even to Late Palaeolithic. The lower cross indicates a place where human tooth was found.

tefacts was unearthed, several thousand ceramic fragments of several prehistoric cultures (some of them unknown in this region) were documented. The archaeological research is focused on the hierarchy of sites in different time-slices, the environmental reconstruction, seasonal migrations of the Mesolithic groups and hunter-farmer transition.

2. Several rockshelters contain rich fossil record including fossil seeds, charcoals, Vertebrate bones, molluscan assemblages, authigenic minerals and even human teeth. One fragment of the human skull dated by radiocarbon to 10 ka BP that may belong to Late Palaeolithic hunter was discovered. The archaeological material is so abundant that the detailed documentation will take another 2 or more years.
3. The environmental analyses based on sedimentology and fossil content of the Holocene strata display profound differences in forest type, soil fertility, erosion, decalcifica-

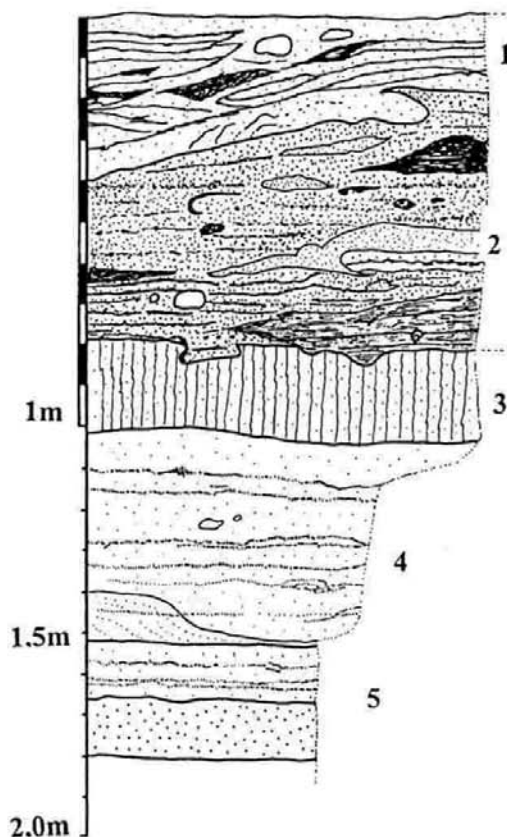


Fig. 4. The profile at Srní rockshelter close to Lhota (Kokořínsko). 1- modern sandy layer with 18–20th century ceramic fragments, dark layers are individual fireplaces, 2- mixed sandy to clayey prehistoric layers containing ceramic fragments and Mesolithic artefacts in the lower part of layer, however some ceramic fragments were found below flintstone Mesolithic artefacts, 3 - brown sand with molluscan fauna - of the Early Holocene age, 4 - yellow sand with uneven post-depositional ferritisation, 5 - white, coarse grained sand with marks of fluvial transport, probable Late Glacial.

tion and probable dessication and deforestation to happen during Subboreal (Lusatia culture of the Late Bronze Age) some 3 ka BP.

4. The Late Glacial represents the most important erosional and downcutting event of the last 20 thousand years.
5. The future direction of research will lead in next two years to field research in Hradčany area close to Mimoň and probably in Labské pískovce area. Then the synthesis of the broad interdisciplinary research is planned to be published as English monograph.
6. The sandstone rockshelters of Northern Bohemia yielded after a decade of the intense research more facts about Mesolithic life than a century of previous studies, because of the accompanying fossil relicts that became preserved in dry, calcareous environment. We believe that sandstone rockshelters may represent such a unique record of prehistoric cultures (e.g. hunting activities of Neolithic population) that we plan to stop our research in order not to destroy the sites for future more detailed excavations.
7. The next plans will concentrate on the protection of the sites in cooperation with the offices of landscape protected areas and ministry of environment.

Acknowledgements

The research is supported by National Geographic Society project 6330-98 "The last foragers of the Northern Europe" and by Academic project CEZ Z3-013-912.

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The Influence of Climate on the České Středohoří Mts. Slope Deformations - Data Analysis since the 18th Century

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ABSTRACT. Data from localities showing the highest occurrence of catastrophic slope deformations have been summarised in frames of the České Středohoří Mts. slope stability failure research. Even though the oldest data come from 1531, a serious data sequence before the middle of the 18th century are not available. Periods when the slope deformations occurred were correlated with climatic variations. For the period preceding established climatic observations, an assumed course of climate has been derived studying data scattered in historical files.

KEY WORDS: landslides, debris flows, frequency of slope movements, precipitation, floods.

Introduction

Making investigation into the slope deformations in the area of the České Středohoří Mts. within a grant project of the Grant Agency of the Czech Republic, Reg. No. 205/98/1551, data about sliding phenomena in the period of the last 300 years

were collected. The data were correlated with climatic conditions, with an aim to evaluate the influence of individual climatic factors, and to improve slope deformation prognosis.