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Lateglacial/holocene sedimentary record from the Labe source area, the Krkonoše Mts.

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Abstract

This paper presents results of geomorphological research carried out in the Labský důl Valley, the Krkonoše (Giant) Mountains. The aim was to gather new evidence regarding landscape development during the Pleistocene glaciations and the Holocene. A variety of research methods have been applied to landforms and sediments in the Labský důl Valley, including geomorphological, sedimentological, macro- and microfossils analyses. Results of relative-age dating confirms the Würmian age for preserved moraines and radiocarbon date (9.572 ± 0.054 ka ^{14}C BP) of basal deposits in the Labský důl Valley cirque show that the sedimentary basin was ice-free since the Preboreal. Particle-size characteristics along with palaeobotanical evidence prove the existence of a lake in the cirque floor of the Labský důl Valley during the Lower Holocene.

Key words: Late Glacial, Holocene, sedimentary record, pollen analysis, Labský důl Valley, Krkonoše Mts.

1. Introduction

During the Middle and Upper Pleistocene, an ice-free corridor in the Central Europe separated the continental Scandinavian ice sheets and the piedmont glaciers flowing from the Alps. Within the corridor, a periglacial environment prevailed within glacial periods, during which fluvial and colluvial deposits along with extensive aeolian sediments originated. These sediments are subdivided by well developed soil complexes of interglacial age, complemented locally by organic horizons and travertine. Among the periglacial zone, there were several isolated areas with local mountainous glaciations such as the Harz, the Vosges, the Schwarzwald, the Bayerischer Wald or the Krkonoše Mountains. Local glaciations of these mid-mountain areas may provide important palaeoclimatic information for large regions of the Central Europe, as small mountain glaciers are very sensitive indicator of climatic oscillations. Moreover, this information is highly significant for establishing local stratigraphy, since mountain environments generally lack a sufficient sedimentary record. In this respect, the Labský důl Valley in the Krkonoše is very important, because it belongs to few mid-mountain areas in Europe with well-preserved glacial record and organic deposits rich in palaeobotanical evidence.

Though a lot of explorations on the Labský důl Valley has been carried out in the past, knowledge of its glacial stratigraphy and the Holocene geomorphological development has been known only in a general way. The glacial morphology was studied by many authors since 1882 (Partsch, 1882; Vitásek, 1923; Kunský, 1948; Král, 1952; Králík et Sekyra, 1969; Treml, 1972), however, the number and extent of glaciations remained speculative till the end of the 2nd Millennium. The situation has changed in the last decade when detailed geomorphological mapping (Engel, 1996), sedimentological methods (Engel, 2003) and ^{10}Be radiometric dating (Mercier et al., 2003; Bourlès et al., 2004) have been applied.

Similar situation was characteristic for the investigation of organic deposits in the Krkonoše Mts. In the form of vast mires these were identified in the source area of the Labe and the Pančava rivers at the beginning of the 20th century. In the 1920ies, first pollen analyses were carried out there (Rudolph et Firbas, 1926, 1927), followed by further detailed research (Firbas et Losert, 1949; Firbas, 1949, 1952) including radiocarbon dating of peat at the end of the 20th century (Fabiszewski, 1978; Hüttemann et Bortenschlager, 1987; Rybníčková et Rybníček, 1996; Speranza et al., 2000; Jankovská, 2001). However, until 2003 there wasn't any research of the organic deposits in the Labský důl Valley cirque floor, which has appeared to be the most complete sedimentary record in the Czech part of the Krkonoše Mountains (Engel et al., 2004).

The current research of the Labský důl Valley is focussed on the periglacial and glacial environment of a characteristic Central European mid-mountain area and its Holocene sedimentary record. The investigation is based on a variety of techniques, combining geomorphological, sedimentological, palynological, absolute and relative-age dating methods. The aim of the ongoing research is to establish ages and timing of geomorphological processes and to reconstruct the Late Pleistocene and Holocene palaeogeographic history of the area.

2. Study area

The upper Labe (Labský důl) Valley is situated in the western part of the Krkonoše Mountains (Fig. 1), extending southwards from Vysoké Kolo Mountain (1508 m a.s.l.). The study area belongs to the highest part of the Krkonoše Mts. massif that has the form of a summit plateau between two parallel ridges of WNW–ESE direction. The upper Labe Valley is curved into the summit plateau of the Labská louka and Pančavská louka Meadows (1300–1400 m a.s.l.), limited by the western part of the Silesian Ridge (1400–1500 m a.s.l.) on the north and by the parallel Krkonoš Ridge (up to 1420 m a.s.l.) on the south. The Silesian Ridge falls northward by an abrupt slope down to the intramontane depression of the Jelenia Góra Basin (350–500 m a.s.l.), the lower Krkonoš Ridge as a part of the Bohemian Ridge verges into wide rounded ridges of N–S orientation that are separated by deeply incised river valleys.

Two different geological units can be found, among which Early Carboniferous granites are prevailing, although Neoproterozoic metamorphic rocks are also present (Chaloupský et al., 1989). The fine-grained biotite granite to aplitic granite forms the Silesian Ridge and its southern slope, the medium-grained biotite granite underlies the

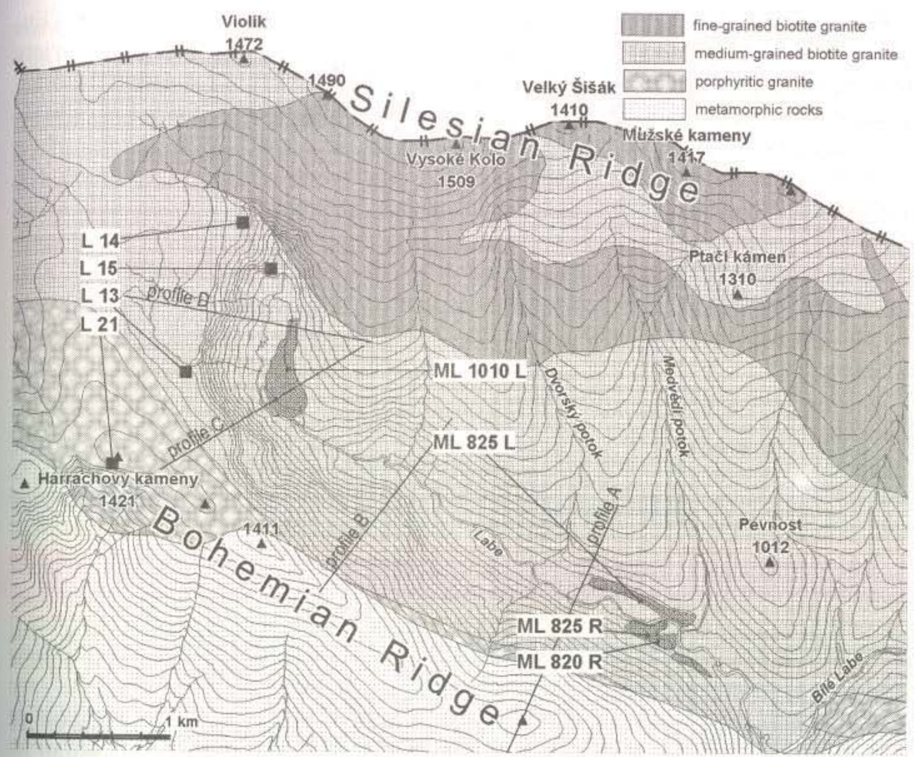

Fig. 1 Geological map of the Labský důl Valley with localization of moraines (ML), selected ^{10}Be dating localities (Bourlès et al., 2004) and cross-section profiles

summit plateau of the Pančavská louka Meadow and the trough area of the upper Labe Valley (Fig. 1). A characteristic joint pattern of the granite influences a distribution of the rock outcrops in the ridge areas and it is also responsible for the shape of the upper Labe valley cirque walls. The southern part of the study area (the Krkonoš Ridge) is a part of a narrow zone of contact metamorphism and consists of porphyritic granite, quartzite, mica schist and metamorphic hornfels (Kunský, 1948).

An overall pattern of the present-day relief of the study area is the result of repeated phases of neotectonic uplift and fragmentation of the Eocene-Oligocene peneplain (Kunský, 1948). Neotectonic vertical displacement, which total amplitude has been estimated to as much as 1000 m (Migoń, 1993), has reactivated the development of the river network. Fragments of the original peneplain have persisted in the ridge areas, though lowered during the cold stages of the Pleistocene by periglacial processes (Králík et Sekyra, 1969). The periglacial lowering along with the chemical weathering during the temperate stages of the Pleistocene have affected also the present lower-lying relief of the study area, which has been subsequently transformed by the glacial erosion of the Labe glacier. Since deglaciation of the upper Labe Valley at the end of the last (Weichselian/Würmian) cold stage, the relief has been formed by diminishing periglacial processes, slope and fluvial processes (Engel, 1996). The periglacial environment of the study area is documented by a variety of the preserved periglacial landforms such as vegetated sorted polygons, unsorted patterned ground, thufurs, solifluction lobes or ploughing blocks (Sekyra et Sekyra, 1995; Treml, 2003).

As to the climate, the study area is located in a transitional belt between oceanic influence and continental type regimes. The annual precipitation is moderately abundant and increases with altitude up to 1500 mm per year in the highest areas (Jeník et Sekyra, 1995). The mean annual temperatures are positive and throughout the area they range from 5 to 0 °C. Winds are mostly of W–E direction and they are responsible for an increased removal of snow from the summit plateaus and accumulation on their lee-side.

3. Methods

3.1. Geomorphological research

Geomorphological mapping was used to identify glacial and periglacial landforms in the study area. An existing 1 : 10 000 scale topographic map of the area as well as corresponding orthophotos served as the base map for the mapping. The geomorphological map was digitised into an integrated GIS and elaborated consequently using GPS data collected within the study area.

Longitudinal and cross section profiles helped reconstruct the glacial history in the study area. The snowline altitude was reconstructed according to the position of morainic accumulations and steps in longitudinal profile (THAR method; Torsnes et al., 1993). The average altitude of preglacial valley floor as well as the erosion rate of the Labe glacier was derived from longitudinal profiles of hanging valleys. The degree of glacial transformation of valley heads was described by their longitudinal profiles compared with a logarithmic curve (Haynes, 1968) of the form

$$y = k\,(1 - x)\,e^{-x},$$

where

x = distance from the headwall to lip,

y = depth of cirque at the upstream headwall,

e = constant (2.718),

k = constant related to the shape of the hollows; the steeper the headwall, the grater the k value.

3.2. Mire investigation

Geometry of the Labský důl Valley cirque floor sedimentary basin was measured using an avalanche probe. Measurements of the deposit thickness were realized every 5 metres along a longitudinal and two cross-section transects across the cirque floor. On the basis of the measurement, the deposit thickness map of the sedimentary basin was constructed and position of the cores was determined (Engel et al., 2004). Deposits

were cored from the deepest part of the sedimentary basin subsequently. The material was collected by digging a pit in the bog, exposing a clean upper part of the peat, and drilling a peat sampler into deposits. The material was taken continuously up to 10.8 m, another two cores were achieved from the depth of 11.4–11.9 m and 12.3–12.8 m. By the deepest core, the lowermost sandy material from the bottom of the sedimentary depression was taken.

Macro- and microfossils analyses were applied to peat material from the Labské meandry Mire. Samples for pollen analyses were extracted from every 10 cm of the section; pollen analyses followed standard procedures (Erdtman, 1960; Moore et al., 1991). Additionally, algaeological and macrofossil analysis (Jankovská et Komárek, 2000) were performed, since limnic deposits were identified within the section.

3.3. Sedimentology

Sedimentological analysis of deposits in the Labský důl Valley cirque floor are based on particle-size analyses and on defining of the organic matter ratio by the loss-on-ignition. Above mentioned analyses were applied to every 25 cm thick section of the core using standard laboratory techniques (Gale et Hoare, 1991).

Size, roundness (Krumbein, 1941) and rock-weathering data (selective weathering features – surface roughness, weathering rinds) were measured on 50 randomly chosen granite boulders on each of moraines at 820, 825 and 1010 m a.s.l.; Schmidt hammer was applied to 6 boulders from the upper parts of these morainic ridges. Relics of two moraines in the cirque of the Labský důl Valley and at the Harrachova jáma Pit were observed briefly, since these sites lack sufficient number of representative clasts to analyse.

3.4. Relative-age and radiocarbon dating

Schmidt hammer rock hardness measuring was used to compare relative age of morainic boulders in the Labský důl Valley. Rock surface properties are influenced by weathering that decrease rock hardness with time. The Schmidt hammer detects the rebound value of the rock surface and has been used in several studies to determine relative age of different types of rock landforms and lithic deposits (Nicholas et Butler, 1996; Evans et al., 1999; Aa et Sjastad, 2000). In the Krkonoše Mts. Schmidt hammer has been used to compare relative age of morainic boulders in the Obří důl Valley (Carr et al. 2003). A calibration of Schmidt hammer measurements (Engel, 2005) was realised using ^{10}Be exposure ages of rock surfaces (Bourlès et al., 2004) to increase the interpretation potential of rebound values.

Radiocarbon dating was applied to organic matter from the deepest part of the Labské meandry core. The AMS ^{14}C method was provided by the laboratory of the Physikalisches Institut der Universität Erlangen (Germany) on peat samples from 205 (Erl-6295), 354 (Erl-6318), 438 (Erl-6319) and 963 (Erl-6184) cm depth. Additionally, LSC ^{14}C dating was used at the Charles University laboratories on sample from 215–251 cm (CU 1916) containing abundant organic material.

4. Results

4.1. Glacial morphology and sedimentology

The transformation of the relief by glaciers was strong, according to the morphology of the Labský důl Valley cirque closure and the trough. The cirque is markedly asymmetric with gently inclined eastern slopes and 300 m high and steep (60–90°) headwalls, delimiting the cirque area with morphologically pronounced upper edge at 1290–1340 m a.s.l. on the west. The upper part of the walls is transformed by periglacial and gravity processes, the lower one (up to 1150–1100 m a.s.l.) displays distinct features of glacial erosion. The transformation of the headwall by glacier is documented by a belt of smoothed rock surfaces that stretches along the western and north-western part of the cirque between the mouth of the Navorská jáma Pit (up to 1140 m a.s.l.) and the beginning of the trough. The cirque was relatively strongly deepened by glacier, as shows the value of the constant ($k = 1.28$).

The lower part of the valley was also transformed significantly. Cross-sections (Fig. 2) show, that the valley has the form of the trough at least to the confluence of the Labe and Bílé Labe rivers. The lower part of the Labský důl Valley between the mouth of the Pudlava and the Dvorský potok Brook was deepened by 65 m at least, according to longitudinal profile and cross section analyses. With respect to this value, that is similar to that of the Obří důl Valley (Engel, 2003), it seems that the valleys were deepened by glaciers prior to the last (Würmian) period of glaciation, during which moraines were embedded into the pre-existing valley.

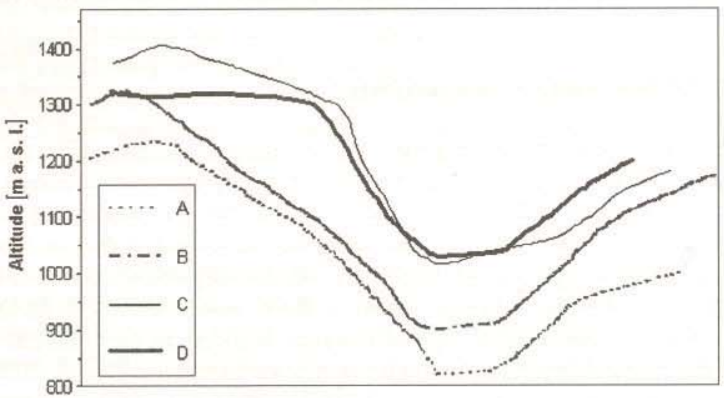

Fig. 2 Cross-section profiles of the Labský důl Valley (position of profiles: see Fig. 1)

The bottom of the slightly inclined lower part of the Labský důl valley is wide and filled by flat accumulations. Though morphologically pronounced moraines cannot be recognised there, relics of morainic sediments may possibly be included in the accumulation cover of the valley bottom. The lowermost preserved morainic relics extend to the mouth of the Medvědí potok Brook, the nearest glacier retreat have deposited terminal moraine above this mouth at 825 m a.s.l. Relics of lateral moraine

cover slightly inclined eastern slope of the Labe Valley cirque (at 1010 m a.s.l.) where these are appended by two morphologically indistinct morainic accumulations (1020 m a.s.l.). The highest relics of moraine are included in the accumulation cover on the cirque step of the Harrachova jáma Pit at 1170 m a.s.l.

The morainic accumulations in the Labský důl valley consist of material with small differences of surface characteristics (Tab. 1). Most of boulders fall into either sub-rounded or round classes (4 and 5 respectively), range of roughness scale is relatively narrow too: percentage of weathering microforms exceeds 82% at all moraines. Weathering rinds were identified at almost all boulders (86–100%) with thickness up to 20 mm. Schmidt hammer rebound values generally correlate with roughness variable, ranging from 27.4 to 30.5. These values in combination with ^{10}Be dating of rock surfaces (see Fig. 1) have been used for tentative correlation with age (Engel, 2005). Thus, the best preserved moraines at 820, 825 and 1010 m a.s.l. appear to be of the late glacial origin (Würm 3). Morphologically indistinct relics of moraines at 1020 m a.s.l. and the accumulation on the cirque step of the Harrachova jáma Pit have not been tested yet, however, according to their position, these accumulations has to be younger.

Tab. 1 Values of rock-weathering characteristics at each moraine

Moraine	Selective weathering microforms	Presence of weathering rind	Thickness of weathering rind	Mean size of boulders	Roundness	Number of sampled boulders	Schmidt hammer rebound values
	(% of sampled clasts)		(mean)	(m)	(mean)		
ML820R	*87.5*	*100.0*	*17*	*1.75*	*4.1*	*8*	*27.35*
ML820L	88.5	100.0	20	2.55	4.5	52	28.14
ML825	82.4	98.0	12	1.80	4.3	51	30.47
ML825R	82.4	100.0	14	2.10	4.3	51	29.77
ML1010L	82.0	86.0	15	1.75	3.9	50	27.93

4.2. Labské meandry section

A sedimentary record for the Late Glacial and Holocene was acquired from the cirque area of the Labský důl Valley. The cirque floor lies in the centre of the asymmetric valley closure at an elevation of 1025–1055 m a.s.l. (Fig. 3). On the south it is delimited with morphologically pronounced cirque step (920–1025 m a.s.l.) that connects the upper part of the valley with a trough. The western part of the cirque floor is covered by thick gravity accumulations. They have arisen as a result of rock fall, debris avalanche and snow avalanche processes at the foot of steep headwalls. A margin of an alluvial fan deposited below the Labská rokle gorge covers the northern part of the cirque floor while glacial deposition form its eastern limit.

Relatively small sedimentary basin (1.1 ha) creates the bottom of the cirque. The surface of the basin is covered by peat (up to 3 m thick) underlain by fluvial and limnic sediments. In form it has wide (150–200 m) and slightly inclined surface (1–3°) in the centre and convex-up profile towards the eastern margin. According to depth me-

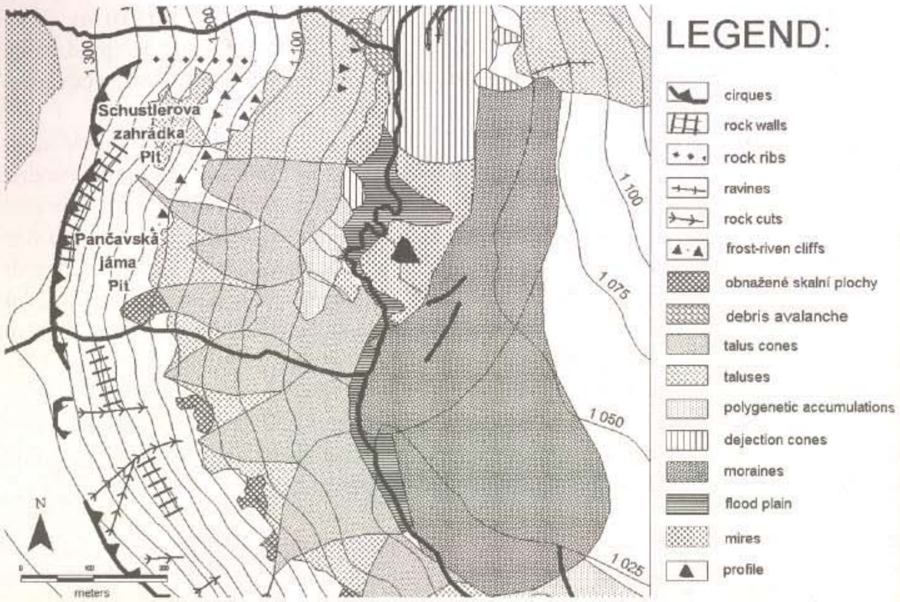

Fig. 3 Geomorphological map of the Labský důl Valley cirque area

asurements (Fig. 4), the bottom of the sedimentary basin lies below the surface of the lower part of the cirque floor. The deepest place (12.83 m) of the basin was located about 200 m above the confluence of the Labe and Pančava rivers. At this place the whole section of the sedimentary record was cored. Five lithostratigraphic units (Fig. 5) have been recognized in the core:

Unit 1 (1283–1271 cm): The deepest part of the core consists of coarse grained sand with only slight volume of organic matter (< 3%). Pollen spectrum shows significant peaks of *Pinus sylvestris* type, *Betula nana* and *Betula alba* type, *Cyperaceae*, *Poaceae*, *Artemisia* pollen grains (Late Glacial pollen zone).

Unit 2 (1271–808 cm): This lithostratigraphic unit is dominated by bluish grey silty sand (Fig. 6A), organic matter content is very low (3–6%). The uppermost part is characterised by dominancy of *Pinus* and *Betula* type pollen (Preboreal zone). Presence of phytoplankton species *Pediastrum boryanum* var. *longicorne* and *Pediastrum integrum* was detected. The transition between unit 1 and unit 2 is very distinct. On the contrary, unit 2 gradually grades into unit 3.

Unit 3 (808–537 cm): Unit 3 is homogenous, consisting of brownish sandy silt (Fig. 6B). LOI values range from 10.7 to 20.2%. Arboreal pollen spectra are represented particularly by *Pinus* and *Betula* type and *Corylus* (Boreal and Younger Atlantic zone). *Pediastrum boryanum* var. *longicorne*, *Pediastrum integrum* as well as several *Diatolmae* species (*Navicula, Tabellaria, Surirella, Cymbela, Pinnularia, Melosira*) were recognised in the unit.

Unit 4 (537–250 cm): Unit 4 consists of several layers of medium to coarse grained sand and silty fine grained sand. Fine grained sand with intercalated thin layers of

Fig. 4 Map of sediment depth in the Labský důl Valley cirque floor basin

coarse/medium grained sands were detected in the core between 465–371 cm depth. This section grades into layers of sand and clayey silt with pieces of wood (371–355 cm), followed by silty sand (354–277 cm), fine grained sand (270–265 cm, Fig. 6C) and coarse grained gravely sand (265–251 cm, Fig. 6D). LOI value varies from 10.3 to 25.0%. Recognised pollen suggests Younger Atlantic and Older Subboreal zone. Besides dominant tree species (*Pinus, Picea*), also the *Eriophorum vaginatum* and *Pediastrum angulosum* var. *angulosum* were detected.

Unit 5 (250–0 cm): The upper part of the core is formed by peat with two silty layers in 23–40 cm and 120–129 cm depths. Organic matter content ranges from 75.3 to 92.9%. Tree species (*Picea, Abies, Fagus*) prevail in pollen grains spectra.

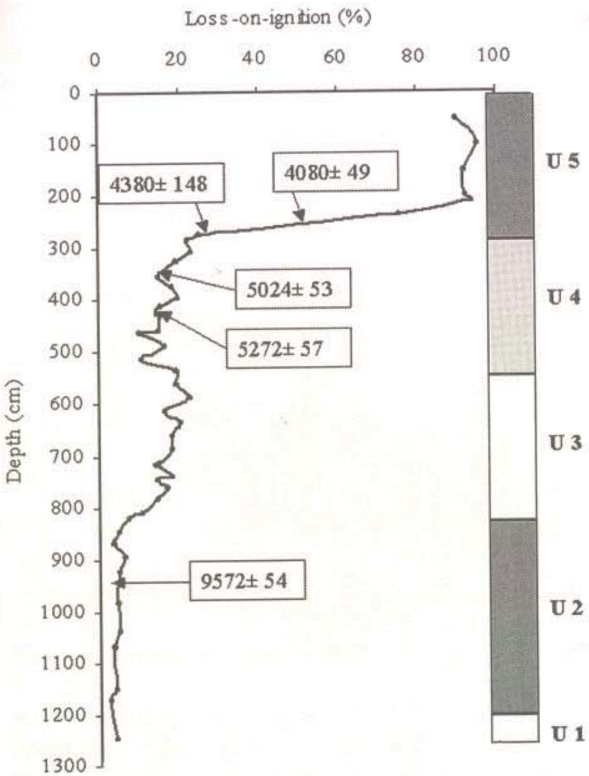

Fig. 5 Sediment depth in the cirque floor basin, lost-on-ignition values, radiocarbon data (uncal. ^{14}C age BP), and lithostratigraphic units of the Labské meandry core

5. Discussion and conclusion

5.1. Glaciation

The results of the geomorphological and sedimentological investigations prove that variations of the rock-weathering characteristics of morainic boulders are small and that all moraines preserved in the Labský důl Valley have been accumulated within a single glaciation period. In case of earlier glaciation origin of some of tested accumulations, its surface has to differ substantially from those accumulated during the last glaciation, because of its exposition to interglacial conditions. Schmidt hammer measurements confirm the conclusion that all moraines preserved in the Czech part of the Krkonoše Mountains originated during the last (Weichselian/Würmian) cold stage (Engel, 2003).

According to ^{10}Be exposure ages (Bourlès et al., 2004) the deglaciation of the Labský důl Valley started before 14.4 ± 1.3 ka ^{10}Be BP. As the elevation of snowline had risen, accumulation area of the Labe glacier decreased and the terminus of the glacier retreated. No lately than at 10.3 ± 0.9 ka ^{10}Be BP ago the glacier melted back over the cirque step, and subsequently recessed in the cirque. Recent results of the

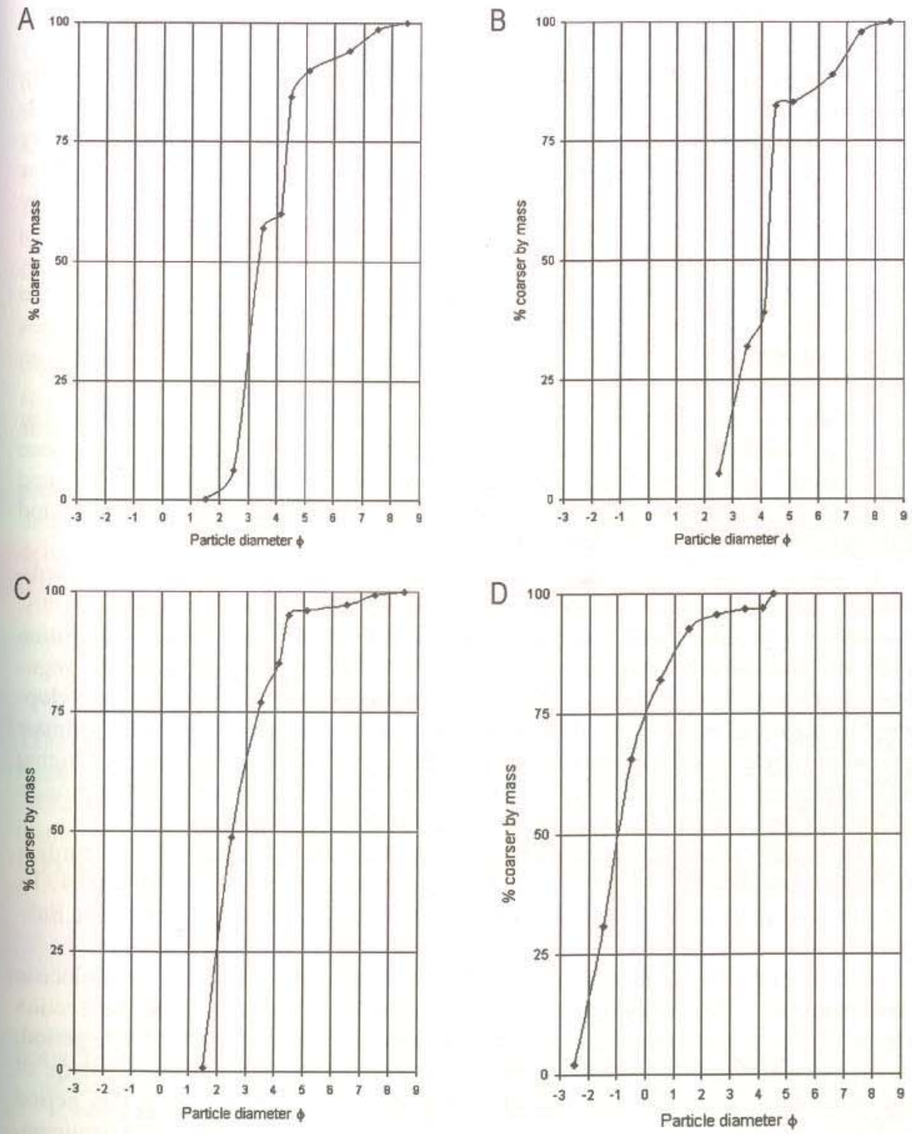

Fig. 6 Particle-size distribution of sediments from the Labské meandry core. **A**: 967–917 cm, **B**: 755–706 cm, **C**: 270–265 cm, **D**: 265–251 cm

radiocarbon dating of deposits from the cirque prove that the sedimentary basin was ice-free before 9.572 ± 0.054 ka ^{14}C BP at least. However, small glacier relics could persist in suitable relief positions higher up in the cirque-in-cirque depressions of the Labský důl Valley.

5.2. Sedimentary record

Lithostratigraphic unit 2 underlain by coarse grained sand can be classified as silty sand. Very low organic matter content, pollen spectra and radiocarbon data indicate its deposition in the Lateglacial/Holocene transition. Particle-size distribution, together with algaeological analysis suggest limnic origin of the sediment. Low LOI values have probably resulted from both poorly or non-vegetated surroundings and relatively high depth of the lake (9–13 m in the deepest part). Identified phytoplankton species (*Pediastrum boryanum* var. *longicorne*, and *Pediastrum integrum*) indicate clear, cold, oligo-dystrophic water environment. Considering the radiocarbon age from the depth of 963 cm (9.572 ± 0.054 ka ^{14}C BP), the rate of sedimentation since a lake rise until dated strata deposition time was high and/or long enough to ensure 300 cm high sediment input.

Particle-size and algae species composition of lithostratigraphic unit 3 are similar to unit 2. However, organic matter content is remarkably higher. It suggests presence of lacustrine environment in ameliorated temperature conditions and vegetated surroundings of the lake. According to macro- and microfossils analyses this period belongs to the Boreal and the Older Atlanticum pollen zones.

In contrast with described units, lithostratigraphic unit 4 features unstable sedimentary conditions. Both LOI values and particle-size distribution vary significantly. Numerous remnants of wood are preserved in the sediment layers. Algae composition indicates shallow water environment (presence of *Pediastrum angulosum* var. *angulosum*), macroremnats and pollen of *Eriophorum vaginatum* suggest gradual development of oligotrophic mire. Initial interpretations suggest that unit 4 represents ultimate period of lacustrine deposition. Fine grained silts with shallow water algae and higher LOI values are frequently intercalated by coarse grained fluvial sands. According to pollen analysis, the unit 4 was deposited during the Younger Atlanticum.

The uppermost part of the section (unit 5) consist of almost uniform peat. According to radiocarbon data (2.15–2.51 m: 4.380 ± 0.148 ka ^{14}C BP, 2.05 m: 4.080 ± 0.049 ka ^{14}C BP) and pollen analysis, raised bog started to grow at the beginning of the Subboreal.

According to the sedimentary record of the Labské meandry section the Holocene development of the valley could be reconstructed. The lower part of the section (up to 705 cm) has deposited during the Preboreal to the Older Atlanticum period, as was revealed by the pollen analyses and radiocarbon dating. Interpretations of the sedimentological and palaeobotanical analyses suggest that during this period sediments were deposed in the limnic sedimentary environment. During the Atlanticum, the sedimentary environment on the Labský důl valley cirque floor changed from lake to peat-bog, which has persisted until the present.

5.3. Holocene development with respect to lake localities on the northern side of the Krkonoše Mts.

Several lakes have risen in the Krkonoše Mts. during the deglaciation period. Some of them have persisted until the present (Wielki and Mały Staw lakes, Śnieżne Kotły lakes), the others (Labské meandry and Domek Myśliwski sites) had been gradually filled with deposits and turned into the peat bogs. Fine grained mineral deposits, followed by fine grained organic sediments and peat give evidence for this process at both sides of the main ridge of the Krkonoše Mts. The high rate of sedimentation during the Lower Holocene, suggested by Chmal et Traczyk (1999) for locations on the northern side of the mountains, wasn't confirmed yet due to missing data from the lowermost part of the section. However, similar development at the bottom of the basin is supposed, considering the presence of thick (3 m) deposits below the lowermost dated strata (963 cm: 9.572 ± 0.054 ka ^{14}C BP) and the deglaciation start close to the Lateglacial/Holocene transition (Bourlès et al., 2004).

A second period of increased deposition in the Younger Atlanticum mentioned by Chmal et Traczyk (1999) was confirmed in the Labské meandry section. Deposition of organic sediment yields a value of 2 mm per year during the 5.300–4.400 ka ^{14}C BP time span. The high rate of deposition probably results from small depth of the lake and low anorganic inputs during the Holocene climatic optimum, as was defined by Kral (1979).

Frequent layers of fluvial sands in the Younger Atlanticum/Subboreal turn are probably evidences of local development of the Labe river channel. Afterwards, in the first half of the Subboreal, raised peat bog started to grow. This process had certain delay, compared to Atlanticum origin of raised bogs situated on the summit plateaus (Fabiszewski, 1978, Speranza et al., 2000, Jankovská, 2001).

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NOVÉ POZNATKY O VÝVOJI LABSKÉHO DOLU V POZDNÍM GLACIÁLU A HOLOCÉNU

Résumé

Cílem současného výzkumu v Labském dole je získání nových paleogeografických poznatků, které umožní rekonstruovat vývoj zdejšího reliéfu ve svrchním kvartéru a rozšíří současné představy o geomorfologickém vývoji Krkonoš. Při výzkumu byl využito metod geomorfologických (mapování, konstrukce profilů), sedimentologických (granulometrie, analýza obsahu org. hmoty), pyloanalytických (analýza makro a mikrofosílií) a metod relativního (zvětrávací charakteristiky, Schmidt hammer) a radiokarbonového datování.

Rané období ledovcové modelace Labského dolu dokládají erozní tvary reliéfu, období posledního (würmského) zalednění je již dokumentováno morénami. Vznik dochovaných morén v závěru posledního glaciálu vyplývá z relativního stáří morénového materiálu, které bylo odvozeno ze stupně navětrání materiálu a z publikovaných výsledků radiometrického datování. Ústup zalednění, datovaný Bourlèsem et al. (2004) mezi ústím Medvědího potoka a karovým stupněm metodou ^{10}Be, skončil rozpadem ledovce v karovém uzávěru Labského dolu nejpozději před 9572 ± 54 lety ^{14}C BP. V tomto období již karové dno vyplňovalo jezero, jehož existenci dokládají makrozbytky a charakter sedimentů v nejhlubší části karu. Sedimenty jezerního původu byly zjištěny pod povrchem rašeliniště v oblasti Labských meandrů v hloubce 12,72–8,08 m. Tato část profilu sedimentovala dle pylové analýzy v časovém úseku preboreálu až staršího atlantiku, na jehož sklonku došlo k postupnému přechodu jezera v rašeliniště. V období mladšího atlantiku již dno karové části Labského dolu pokrývala vegetace oligotrofního rašeliniště, které je v profilu zaznamenáno v hloubce 2,5–3,5 m. Tato část profilu vznikla v období zvýšené intenzity organické sedimentace (2 mm/rok), podobně jako sedimentární záznam mladšího atlantiku v karech Lomničky a Sněžných jam (Chmal, Traczyk 1999). Nejvyšší část sedimentárního záznamu svědčí o pokračujícím růstu rašeliny, přerušovaném občasnou fluviální sedimentací.