

SUMMARY OF PAPERS BY CZECH PARTICIPANTS AT THE XVIIIITH INQUA CONGRESS IN BERN

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ABSTRACT

The review paper presents the main research topics of the XVIIIth INQUA Congress from selected sessions with contributions from the Czech participants. The results of Czech papers are highlighted and discussed in relation to progress in Quaternary research. Discussed are advances in topical subjects of international studies of Quaternary palaeoenvironments and climate change.

Key words: the Quaternary, the XVIIIth INQUA Congress, palaeoenvironments, climate change

1. Introduction

The International Union for Quaternary Research (INQUA) was founded in 1928 with the basic objective of developing collaboration and interdisciplinary communication in all aspects of Quaternary research. INQUA is a full member of the International Council of Scientific Unions and collaborates with related associations as well as long-term research projects such as the Past Global Changes Programme, the International Geosphere – Biosphere Programme and the International Geological Correlation Programme. It organizes many international workshops and conferences (compare <http://www.inqua.org/>) and also regular congresses every four years involving a broad range of specialists in basic and applied subjects of Quaternary research.

INQUA Congresses were held in Copenhagen (1928), Leningrad (1932), Vienna (1936), Rome (1953), Madrid (1957), Warsaw (1961), Boulder (1965), Paris (1969), Christchurch (1973), Birmingham (1977), Moscow (1982), Ottawa (1987), Beijing (1991), Berlin (1995), Durban (1999), Reno (2003), Cairns (2007), and Bern (2011). The next INQUA Congress will be organized in Nagoiya, Japan. The organization of the sessions at the XVIIIth INQUA Congress in Bern (20–27 July 2011) were mostly prepared by commissions, committees, and working groups of the INQUA with the main emphasis

on reviewing recent research results, and to discuss activities for the next congress. The motto of the congress was “Quaternary Science – the view from the mountains”, which also emphasized the wonderful environment as a substantial source of prosperity and the hospitality of the people of Switzerland.

Contributions of the Czech participants presented during several sections of the XVIIIth International Union for Quaternary Research (INQUA) Congress in Bern (July 20–29, 2011) were in a harmony with the majority of topics specified by the INQUA interdisciplinary commissions. The restored commissions of the INQUA for the period 2011–2015 are: Stratigraphy and chronology, Palaeoclimate, Terrestrial processes, deposits and history, Coastal and marine processes, Humans and biosphere. Advances in the Quaternary research were also expressed by the structure of the XVIIIth INQUA Congress (for details see <http://www.inqua2011.ch/> or <http://www.inqua.org/>). The research programme was mainly realized in the framework of specialized sessions (originally marked from No. 1 to 110, however, 22 of them were not realized) and discussion meetings, plenary talks, general assembly and pre-, mid- and post-congress excursions. Papers of the registered Czech participants were placed and presented in research sessions summarized in Table 1. The original sources of all papers and their relation to specialized sessions are available at <http://www.inqua2011.ch/>.

Tab. 1 Research sessions of the XVIIIth INQUA Congress in Bern with the contributions of the Czech participants (Note: names of presenters are printed in bold, for details see chapters 2 and 3)

No 11: The Palaeorecords of fire in the Earths' System: Climate or Humans?
Přemysl Bobek : <i>Soil charcoal distribution in sandstone landscape. (Charles University in Prague)</i>
No 34: Geoarchaeology: Paleoenvironments and Human Interactions
Eva Jamrichová, Vlasta Jankovská : <i>Natural environment of human societies in Poprad Basin (NE Slovakia) from the Late Palaeolithic to the Mediaeval Period: landscape character and vegetation changes. (Masaryk University in Brno)</i>
No 42: Ecological Responses to Climatic Change at Decadal to Millennial Timescales: From Genes to Biomes
Lydie Dudová, Barbora Pelánková : <i>Central European vegetation of the Early and Middle Holocene as seen from the Southern Urals. (Masaryk University in Brno)</i>
No 53: Palaeohydrological archives, fluvial environments and surface-groundwater flow processes
Renata Kadlecová, František Buzek, Jiří Bruthans : <i>The Jizera River terraces - a vulnerable source of water for Prague (the Czech Republic). (Czech Geological Survey in Prague)</i>
Pavla Žáčková, Libor Petr, Lenka Lisá, Jan Novák : <i>Analysis of vegetation and environmental changes since 11.5 ky BP from an extinct oxbow lake of the flood plain of the Elbe River, the Czech Republic. (Charles University in Prague)</i>
No 63: High and Central Asia - Pleistocene Glaciations and related geomorphological phenomena
Jan Kalvoda : <i>Integration of orogenetic and climate-morphogenetic processes during the landform evolution of the High Asian mountains in the Quaternary. (Charles University in Prague)</i>
Jan Kalvoda, Jaroslav Klokočník, Jan Kostecký : <i>Dynamics of Quaternary landform evolution in High and Central Asia recorded by the gravitational signatures of EGM 2008. (Charles University in Prague)</i>
No 64: Reconciling modern and the Quaternary rates of landscape evolution
Jaroslav Kadlec, Gary Kocurek, David Mohrig, Ashok Kumar Singhvi, D. P. Shinde, M. K. Murari, Filip Stehlík, Helena Svobodová – Svitavská : <i>Late Glacial lacustrine and fluvial processes in the Lower Moravian Basin, the Czech Republic. (Institute of Geology, Academy of Sciences of the Czech Republic)</i>
Jiří Bruthans, Michal Filippi, Mohammad Zare, Renata Kadlecová : <i>Can an increase in aridity trigger rapid surface erosion of diapir surfaces and intensify the brine flow in a semiarid climate? (The Zagros Mountains, Iran). (Czech Geological Survey in Prague)</i>
No 71: Reconstructing historical climate variability using documentary sources
Rudolf Brázdil : <i>Recent progress and the future potential of historical climatology in Europe. (Masaryk University in Brno)</i>
No 81: Chronologies and the Quaternary Record
Dana Homolová, Johanna Lomax, Kurt Decker, Ivan Prachař, Petr Špaček : <i>Building a stratigraphy of fluvial sediments in the Budějovice Basin (the Czech Republic) based on absolute ages – the first OSL-ages of the Vltava river terraces. (University of Vienna)</i>
No 90: Palaeofloods in the Earth's history
Libor Elleder, Anja Nießen, Thomas Roggenkamp : <i>Historic floods in the city of Prague – a reconstruction of peak discharges. (Czech Hydrometeorological Institute in Prague)</i>
Martin Margold, Krister Jansson : <i>Pleistocene Glacial Lake Vitim outburst flood, central Transbaikalia, Siberia. (Stockholm University)</i>
No 103: pan-European correlations in Quaternary stratigraphy
Břetislav Balatka, Philip Gibbard, Jan Kalvoda : <i>Morphostratigraphy of accumulation terraces of the Sázava and Vltava Rivers in the Bohemian Massif and its correlation with the North European stratigraphical classification of the Quaternary. (Charles University in Prague)</i>
Petr Kuneš : <i>Testing the correlation of fragmented pollen records of the middle and late Pleistocene temperate stages. (Charles University in Prague)</i>

The review paper presents research patterns of these selected sessions. The submitted report is mainly based on a set of sessions résumé (compare <http://www.inqua2011.ch/>), abstracts of contributions and the authors' experiences gained during the congress. A set of papers

presented by Czech specialists during the XVIIIth INQUA Congress in Bern was, unfortunately, very modest in comparison with the large-scale research activities conducted in the Czech Republic (compare <http://www2.gli.cas.cz/kvarter/> and <http://www.geomorfologie.eu/>).

However, these contributions were accepted (in detail see chapter 3) within the scope of selected sessions of the meeting which were characterised by progressive topics briefly described in the following paragraphs.

2. Topics of specialized sessions with contributions from the Czech participants

The session “*Chronologies and the Quaternary Record*” was focused on a large amount of results obtained by high-resolution dating techniques and many regional chronologies. The main topics were (<http://www.inqua2011.ch/>): a) how chronometric data obtained using different dating techniques can best be combined, b) what additional analysis and combination of chronometric data can be used to improve the resolution and precision of age models, and c) what progress in the understanding of Quaternary palaeoenvironmental changes has been made using variable dating techniques and datasets. Contributions of the session “*pan-European correlations in Quaternary stratigraphy*” aimed to present multidisciplinary approaches to interpretation and comparison of sedimentary sequences and ages of rocks at local and regional scales. Development of European Quaternary stratigraphy is related to extensive mapping of Quaternary deposits. It provided a basic knowledge of geological processes and climate changes during the Quaternary. Comparisons are also possible based on “*Reconciling modern and Quaternary rates of landscape evolution*”. This session was mainly focused on the interaction of geomorphic and tectonic processes at various spatio-temporal scales relevant to the Quaternary. Denudation rate variations reflect strong fluctuations of climate or tectonic activity. The emphasis in this session was to understand a) feedback between climate variability, glacial and non-glacial denudation rates, and neotectonics in mountain systems, and b) how contemporary denudation rates reflect landscape evolution in the past. In the regional session “*High and Central Asia – Pleistocene Glaciations and related geomorphological phenomena*”, selected results were presented from the Himalaya, Karakoram and their neighbouring regions. Geomorphological data of the maximum glacier extent during the Late Glacial Maximum were summarised and traces of older glaciations were discussed. Contributions regarding the glacio-isostatic crustal movement, the snowline reconstruction of the Asian mountains and the palaeo-climatological consequences of the glaciation of High Asia were also included.

The session “*Palaeohydrological archives, fluvial environments and surface-groundwater flow processes*” was concerned with short and long-term fluvial dynamics in response to tectonic, climate and environmental changes (<http://www.inqua2011.ch/>). These cause and effect relationships are especially relevant to understanding the future response of water cycle components (rainfall, runoff, discharge, groundwater recharge) and fluvial regime

indicators (mean discharge, floods, droughts) to expected climate and environmental changes. In this session contributions were presented on a) regional palaeohydrological interpretations of fluvial Quaternary evolution from sedimentary records and landforms, b) interrelations among basin components and processes, c) interpretation of hydrostratigraphic units, distribution of groundwater reservoirs and low-temperature geothermal energy resources, d) advances in applied techniques. “*Palaeofloods in the Earth’s history*” session was focused on the understanding of the origin, mechanisms and dynamics of past high magnitude floods which significantly changed the landscape during the Quaternary. It helps to estimate the potential of current and future high magnitude floods within regional or global environmental changes. Similar aspects of rapid natural processes were presented in the session “*The Palaeorecords of fire in the Earth’s System: Climate or Humans?*”. Palaeofire and vegetation-change observations can be used as records of interplay between climate, vegetation, ignition and people. Fire records in sedimentary archives have been assembled for the last 21 ka, as well as the last glacial period and the past two millennia. Palaeoenvironmental datasets characterize fire regimes across space and time and provide baseline estimates of the historical range of variability in fire for comparison with contemporary fire regimes. They also serve as benchmarks for assessing palaeomodel simulations of fire and vegetation change. The influence of humans, climate and fuel has been investigated on regional and global scales. In this session the weight of fire under different climates was also discussed as well as the nature of fire feedback to the climate system via changes in vegetation and fuels.

The session “*Ecological Responses to Climatic Change at Decadal to Millennial Timescales: From Genes to Biomes*” presented amassed records of palaeoecological studies which are often based on pollen and macrofossils. It is essential for reconstructing past species distributions, developing ecological theories, evaluating human impacts, and testing model predictions of climatic and biotic changes from the past to the future (<http://www.inqua2011.ch/>). Selected issues of global change were studied, e.g. spatial patterns of genetic diversity in relation to past climatic and ice-sheet dynamics, vegetation shifts in response to novel climatic conditions, biogeochemical processes associated with abrupt climatic events, and biospheric feedback to the global climate system. These topics were close to the main tasks of the session “*Reconstructing historical climate variability using documentary sources*” which emphasized research at the forefront of climate reconstruction and impact studies, new methods and sources used in historical climatology and improvements in the analysis of historical texts. These sources incorporate pre- and early- instrumental data and include references to frost dates, droughts, famines, the duration of snow and sea-ice cover, and other phenomena valuable to reconstructions of the past climate.

They are used as an extension of instrumental records, corroboration of evidence from natural archives (e.g. tree rings, ice cores and coral reefs), and exploration of essential impacts of historical climate variability and extreme climatic events on society. The session “*Geoarchaeology: Palaeoenvironments and Human Interactions*” was focused on the application of geoarchaeological knowledge to the investigation of environmental processes in the Quaternary. Recent geoarchaeological surveys and related modern methods were presented, providing evidence of changes in historical environments, ecosystems, and geomorphology that affected regional archaeology. The geoarchaeological session highlighted multidisciplinary reconstructions of past landscapes, palaeoenvironments, and various human footprints on natural systems.

3. The main results of research presented by Czech participants

(Note: Names of presenters are printed in bold and numbers indicate interdisciplinary sessions with topics specified in Table 1. Abstracts of all papers are available at <http://www.inqua2011.ch/>).

Soil charcoal distribution in sandstone landscape (**Přemysl Bobek**, No. 11)

Distribution of soil charcoal in places with low erosion activity reflects the frequency of wildfires during the Holocene. Concentration of soil charcoal was measured in the highly variable relief of the sandstone area in Northern Bohemia providing an opportunity to observe diverse environmental conditions, ranging from deep moisture gorges to dry rock plateaus. A semiquantitative chemical method, based on nitric acid digestion and loss on ignition technique, was used to differentiate between soil organic carbon, mineral matter and charred plant particles in soil samples. It was found that considerable heterogeneity in the concentration of charcoal in soils ranges from 0.0006 g kg⁻¹ to 21.0234 g kg⁻¹. The highest concentrations are distributed particularly on exposed rock plateaus.

The natural environment of human societies in Poprad Basin (NE Slovakia) from the Late Palaeolithic to the Mediaeval Period: landscape character and vegetation changes (**Eva Jamrichová**, Vlasta Janovská, No. 34)

This study is based on results from pollen analyses, which have been confronted with archaeobotanical information obtained from the archaeological material of the studied area. These results were used for palaeoecological reconstruction of the natural environment of Poprad Basin from the Late Palaeolithic to the Mediaeval Period. Vegetation of this area had the character of coniferous taiga, forest-tundra and mountain tundra at its highest elevations during the Late Glacial (Weichselian) Period. *Larix* together with *Pinus cembra* were the dominant

trees in the taiga and forest-tundra stands. Anthracological analysis of the material from the Palaeolithic Period proved the presence of coniferous stands and undemanding deciduous tree species. During the Early Holocene, there was an expansion of *Picea*, a decrease of *Larix* and *Pinus cembra*, and the first occurrence of species of *Quercetum mixtum*. During the Atlantic Period, there was an expansion of spruce stands and a spreading of *Quercetum mixtum* in climatically and edaphically favourable biotopes. Primary anthropogenic indicators started to appear in the Subboreal Period as a reaction to occupation in the Poprad Basin at the end of the Aeneolithic, but mostly during the Bronze Age. Poprad Basin was largely inhabited during the Subatlantic Period. Human impact on the vegetation was reflected by a decrease of deciduous and a complete dominance of coniferous trees in the pollen spectra. It is possible to assume that this is a reaction to the exploitation of the deciduous wood, because of metal mining in the Poprad Basin.

Central European vegetation of the Early and Middle Holocene as seen from the Southern Urals (**Lydie Dudová**, Barbora Pelánková, No. 42)

Modern vegetation and the environments of the Southern Urals are very similar to those of Early and Middle Holocene Central Europe. This area lies outside the distribution range of beech and hornbeam, whose invasion of Central Europe in the Late Holocene significantly changed the species composition of forest vegetation. It contains tree species that were found in Early to Middle Holocene Central Europe, such as oak, elm, lime, maple, birch, pine and larch, combined with steppe vegetation. The paper reports the analysis of 50 surface pollen samples obtained from six main vegetation types of the Southern Urals: dry steppe, mesic steppe, hemiboreal coniferous pine-larch forest, small-leaved birch-aspen forest, broad-leaved oak forest and broad-leaved maple-lime-elm forest. In turn, these types represent the main vegetation units as they had replaced one another from the Late Glacial/Holocene transition to the Middle Holocene.

The Jizera River terraces – a vulnerable source of water for Prague (Czech Republic) (**Renata Kadlecová**, František Buzek, Jiří Bruthans, No. 53)

One of the strategic sources of water used for supplying Prague is located in river terraces developed at the Labe and Jizera river confluence about 30 km north-east from the capital. The fluvial sands and sandy gravels overlaying Cretaceous marine marlstones and sandstones were deposited by the Jizera R. during the middle and late Pleistocene and formed several terrace levels. The average thickness of terraces is 15 m with a water saturated zone 4–6 m thick. The riverbank filtration system (RBF) pumps groundwater infiltrating into these sediments from the underlying sandstones (40%) and from the modern Jizera R. channel (60%). The RBF supplies the capital with

15,000 m³ of water a day. The CFC concentrations measured in groundwater flowing from the Cretaceous aquifer show a residence time of several decades. The groundwater reveals nitrate concentrations (up to 40 mg l⁻¹) due to longer exposure to anthropogenic pollution sources. This water is diluted by an artificial recharge network when water from the Jizera R. channel with low nitrate content (1–15 mg l⁻¹) is conducted by conduits to the terrace sediments. The quality of water infiltrating into the fluvial sediments from the unsaturated zone is affected by local agriculture management – mainly fertilizing – in the yield area. Based on model scenarios, the simulated impact of present warming on the total runoff of the fluvial sediment aquifer will be more affected. Increased temperatures will cause a groundwater level decrease due to higher evapotranspiration. The resulting decrease of discharge of groundwater in surface streams during summer seasons increases the contribution of infiltrated precipitation from the unsaturated zone to discharge.

Analysis of vegetation and environmental changes since 11.5 ky BP from an extinct oxbow lake of the flood plain of the Elbe River, the Czech Republic (**Pavla Žáčková**, Libor Petr, Lenka Lisá, Jan Novák, No. 53)

The Late Glacial palaeomeander Chrast is situated in the area of the middle Elbe river floodplain, where a huge number of paleomeanders with a unique complex of relict wetlands and fen meadows of Holocene age are preserved. The investigated profile (total depth 285 cm) was obtained from an oxbow lake. Plant macro- and micro-fossils were studied with supportive evidence from geochemical and sedimentological data. Based on the results, the profile was divided into 5 zones (A1–A5). The last 110 cm (A1–A3) contains a unique record of Allerød vegetation. Sediment of the base of the palaeomeander (11,450 ± 60 years BP) contains a record of macrophyte vegetation (*Nuphar lutea*, *Batrachium*, *Potamogeton* ssp). The local pollen spectra give evidence of the occurrence of aquatic species (*Myriophyllum spicatum*-type, *Pediastrum*, *Sparganium*/*Typha angustifolia*). Subsequently, organic production increased rapidly during 11 523 ± 120 years BP (A2) and the shallow lake was filled in. This is supported by the presence of macroremains of *Carex vesiraria/rostrata*, *C. riparia* and *Menyanthes trifoliata*. *Salix*, *Betula* and *Pinus* wood fragments were also recorded indicating the presence of birch-pine forest intermingled with spruce. Fires, which were frequent during the end of the Last Glacial, are documented by the record of a large number of burnt seeds and charcoal. Calcium carbonate accumulations of the lake marl originated at the beginning of the Younger Dryas (11,010 ± 60 years BP). Increased sand deposits (A4) indicate a change from a meandering type of river to a braided one. The end of the sand deposition might be linked with the Glacial/Holocene transition phase. Local human impact (A5) is documented in the middle of the Holocene (6510 ± 40 years BP).

Integration of orogenic and climate-morphogenetic processes during the landform evolution of the High Asian mountains in the Quaternary (**Jan Kalvoda**, No. 63)

The High Asian mountain ranges were presented as a particularly suitable region for research on the topical aspects of landform evolution under the very variable orogenic and palaeoclimatic conditions which occurred during the late Cenozoic. Geomorphological observations in the Himalaya, Karakoram, Pamirs and Thian-Shan suggest significant feedback between the rate of orogenic processes and the intensity of climate-morphogenetic processes during the Quaternary. The extreme exhumation of deep crystalline rocks in the Himalaya and Karakoram during the late Cenozoic was the result of morphotectonic processes as well as the effective tuning of paleogeographical changes in the extension of the main climate-morphogenetic zones. Moreover, the observed landform changes on a decadal scale indicate the high intensity of recent climate-driven morphogenetic processes. The latter are especially very effective in the erosion and transport of weathered material by a combination of diverse exogenetic factors, integrated with active morphotectonic processes.

The dynamics of Quaternary landform evolution in High and Central Asia as recorded by gravitational signatures of EGM 2008 (**Jan Kalvoda**, Jaroslav Klokočník, Jan Kostecký, No. 63)

Landform patterns in High and Central Asia provide evidence of the nature of the very dynamic landscape evolution through the late Cenozoic, including intense morphotectonic processes, high rates of denudation and sediment transfer and deposition. The resulting landforms are also controlled by litho-structural features within uplifting ranges. Gravity data are therefore very valuable for establishing a better understanding of the processes driving uplift and erosion in these active orogenic regions. The results of the correlation of regional features of the Earth Gravitational Model 2008 (EGM 2008) with morphogenetic and orographical patterns in High and Central Asia were presented. Strong coincidences between large-scale morphogenetic styles of these regions and the extension of areas with very high positive values of the radial second derivative of the disturbing gravitational potential T_{zz} , and the most likely in combination with conspicuous areas of high negative values of T_{zz} in their close neighbourhood have been identified. The variable values of T_{zz} , computed from EGM 2008, display significant gravitational signatures of extensive differences and changes in mass density and/or rock massif and regolith distributions. It is suggested that areas discovered in High and Central Asia where very conspicuous combinations of significantly high positive or negative values of radial second derivatives of the disturbing gravitational potential T_{zz} , computed from EGM 2008, are under the

strong influence of present-day active geodynamic and geomorphic processes.

Late Glacial lacustrine and fluvial processes in the Lower Moravian Basin (the Czech Republic) (**Jaroslav Kadlec**, Gary Kocurek, David Mohrig, Ashok Kumar Singhvi, D. P. Shinde, M. K. Murari, Filip Stehlík, Helena Svobodová-Svitavská, No. 64)

The Lower Moravian Basin extends along the lower Morava River, close to the Czech, Slovak and Austrian borders. Its Miocene base is overlain with Pleistocene and Holocene terrestrial deposits. A key for deciphering the late Pleistocene history of the basin is in the sediments exposed in the Bzenec sand quarry and in a cut bank of the meandering Morava R., both located about 4 km northwest of Straznice in the Hodonin District, the Czech Republic. The exposed sandy deposits reveal a 9.5 m thick section dominated by cyclic horizontal beds. Capping the horizontal beds is an interval of trough cross-stratified beds which are in turn overlain with well-sorted laminated fine sand. The following interpretation for this sedimentary succession is proposed: (1) the cyclic beds were deposited by turbidity currents in a lacustrine environment; (2) the uppermost section of the lake turbidites was reworked by running water; and (3) wind-blown sand dunes were formed after draining of the lake. OSL dating of the lake sediments indicate deposition between 20 and 13 ka. Elevation of the sedimentary sequence documents that the lake level was 15–17 m higher than the Morava R. level today. The dam required to produce this lake could have been formed by aeolian sand dunes sourced from the late Pleistocene terraces at the Morava and Dyje river confluence. After collapse of the dam that formed the lake, the Morava R. constructed large meander bends across the newly developed floodplain. Radiocarbon ages together with pollen data from organic fill drilled in a paleomeander located at the floodplain edge document that the Morava R. channel was incised 18–20 m below the former top of the lake sediments during the Alleröd Interstadial.

Can an increase in aridity trigger rapid surface erosion of diapir surfaces and intensify the brine flow in a semiarid climate? (Zagros Mountains, Iran) (Jiří Bruthans, Michal Filippi, Mohammad Zare, **Renata Kadlecová**, No. 64)

Zagros Mts. host numerous salt diapirs, which differ in uplift rate and relief. Some diapirs are exposed to arid conditions; some are situated at higher altitude in less arid climate. A few diapirs are formed by vast surfaces built predominately by halite, at others, the rock salt is covered by an up-to-30 m thick surficial residuum, which even enables the planting of crops thanks to recharge concentration at sinkhole bottoms. Erosion rates were measured for a period of up to 10 years by plastic pegs as benchmarks. Salt exposures are eroded at a rate of 30–120 mm year⁻¹, while thick surficial deposits cove-

red by vegetation show negligible erosion. Salt exposures produce huge amounts of dissolved and clastic load, thus affecting the land use in the vast surroundings of the diapirs. Based on field observation, most of the rainwater will infiltrate, while overland flow predominates on rock salt exposures. As most of the water evaporates from vegetated surfaces the amount of water generated by percolation in the underlying rock salt is very low. This enable the distinguishing (based on aerial imagery) of the alluvial fans in diapir surroundings, which will likely be heavily polluted by brine from those potentially interested in groundwater abstraction. Radiocarbon and U-series dating of calcretes capping some diapir surfaces indicates that diapirs reached their largest extent during the Last Glacial. Since then, the original thick surficial deposits have been undergoing erosion on many diapirs. During less arid periods, vegetation cover protected the diapir surfaces. After the onset of an arid climate, the erosion rapidly accelerated thanks to vegetation degradation and consequent changes in the surficial deposit types and thicknesses.

Recent progress in and the future potential of historical climatology in Europe (**Rudolf Brázdil**, No. 71)

Several groups of documentary evidence (narrative written records, visual daily weather records, personal correspondence, special prints, official economic records, newspapers, pictorial documentation, epigraphic data, early instrumental observations, early scientific papers and communications) and their use for the creation of a series of weighted monthly temperature and precipitation indices were presented. Alternatively, a series of (bio) physically based documentary proxies usually reflecting any systematic economic activity (e.g. from agriculture or transport) were also discussed. Methodology of climate reconstruction from data based on application of the standard paleoclimatological method (calibration and verification procedures) working with the overlap of documentary-based series and instrumental measurements was described. The study also demonstrates examples of the analysis of droughts, floods, windstorms, tornadoes and hailstorms in Central Europe based on documentary evidence from the viewpoint of their occurrence, severity, seasonality, meteorological causes, perception and human impacts during the past millennium.

Building a stratigraphy of fluvial sediments in the Budějovice Basin (the Czech Republic) based on absolute ages – first OSL-ages of the Vltava river terraces (**Dana Homolová**, Johanna Lomax, Kurt Decker, Ivan Prachař, Petr Špaček, No. 81)

The Budějovice Basin, situated in Southern Bohemia is a fault-bounded sedimentary basin with a multiple subsidence history overlying the Variscan crystalline base of the Bohemian Massif. The Vltava River, crossing the basin from the south to the north, accumulated terrace bodies of different extent during the Pleistocene and

probably further back in the past. The presented study is focused on the mapping and dating of Pleistocene river terraces in the vicinity of Hluboká nad Vltavou in order to establish a chronology of terrace development. Currently available data were derived from about 100 outcrops and hand drillings and 17 shallow boreholes. Stratigraphic correlations are based on 19 OSL ages. Pilot results show five terrace levels in the crystalline base and at least four levels in the Budějovice Basin. The uppermost terrace levels are out of the dating range of the method, but for the lower river terraces, it was possible to create a consistent stratigraphy with ages ranging from about 80 ka to the Holocene.

Historic floods in the city of Prague – a reconstruction of peak discharges (**Libor Elleder**, Anja Nießen, Thomas Roggenkamp, No. 90)

The oldest reliable record of flooding in Prague is related to the disastrous 1118 flood. About 150 floods are mentioned in documentary sources. About half of these are described in a qualitative way, i.e. regarding the damage and impact. The level of the important cases is recorded more exactly, mostly as flooding of different buildings in the Old town area of Prague. Approximately 20–30 maximum water levels since 1481 are denoted by flood marks, or marked at the Bearded Man, a gothic relief on a wall near Charles Bridge, or by early instrumental measurements. The main challenge of this reconstruction is the consideration of man-made floodplain modifications influencing the cross-section area and the hydraulic roughness significantly. The presentation of this approach includes the procedure of reconstructing the hydraulic parameters of the river channel and the inundated floodplain as well as a final verification of the reliability of estimated peak discharges. Due to the different hydraulic background, all winter-flood events are excluded to avoid calculating floods with a possible ice jam effect. 14 reconstructed discharge maximums were found. The validation of the technique by comparison with the recent gauged flood of 2002 reveals results of adequate accuracy. The comparison also shows that the flood event of 2002 was conspicuously greater than all calculated flood events between the years 1481 and 1825.

The Pleistocene Glacial Lake Vitim outburst flood, central Transbaikalia, Siberia (**Martin Margold**, Krister Jansson, No. 90)

The prominent Glacial Lake Vitim in Transbaikalia, Siberia, was formed when glaciers descending from the Kodar Range dammed the Vitim River. Evidence for the existence of the lake, such as fossil shorelines and deltas, infers that the lake filled the Muya-Kuanda intermontane depression and branched into many tributary valleys in the upper catchment of the Vitim River. The total area of the lake at its maximum extent was 23,500 km² and the water volume was ca 3000 km³, which makes it one of the largest documented glacial lakes dammed by mountain

glaciers. A large canyon incised in the bedrock (300 m deep, 2 km wide and 6 km long) cuts through the slope of the Vitim valley in the vicinity of the postulated ice-dam. The canyon was formed during an outburst flood from the lake. The flood path followed the Vitim River and the water was subsequently drained into the Arctic Ocean through the Lena River.

Morphostratigraphy of accumulation terraces of the Sázava and Vltava Rivers in the Bohemian Massif and its correlation with the North European stratigraphical classification of the Quaternary (**Břetislav Balatka**, Philip Gibbard, **Jan Kalvoda**, No. 103)

The results of geomorphological research in the Sázava and Vltava basins in the Bohemian Massif were presented with regard to identifying the main remains of river terrace sedimentary sequences. The construction of the long profiles through the river terraces and of a series of transverse-valley profiles, has enabled the differentiation of 7 main terraces with several subsidiary levels and 2 levels of Neogene fluvial to fluvio-lacustrine sediments. The typically developed incised meanders and bends were mostly formed during the Middle Pleistocene. Their comparison with the terrace system of the Labe River, as well as correlation with the North European stratigraphical classification of the Quaternary was presented. The surfaces of pre-Quaternary deposits occur at up to 135 m higher than the present river levels. The Quaternary incision of the Sázava and Vltava valleys reaching to an average depth of more than 100 m was induced by neotectonic uplift of the Bohemian Massif. Based on the current Quaternary stratigraphical scheme, the entire Sázava and Vltava terrace system was mostly formed during the Middle and Upper Pleistocene Subseries, that is to the period from the Cromerian Complex to the Weichselian stages. Erosional events, before the accumulation of terrace I, fall at the end of the Early Pleistocene.

Testing the correlation of fragmented pollen records of the middle and late Pleistocene temperate stages (**Petr Kuneš**, No. 103)

Existing continuous chronosequences from Southern Europe provide good chronologies and thus enable a biostratigraphic definition of at least younger MIS. However, in Northern Europe, the fragmentary character of the records and the weaknesses of absolute dating prevent good age estimates. Age-determination of the majority of fragmentary records depends on site-to-site correlations. In the presented study, a correlation of well and poorly known pollen records of the middle- and late-Pleistocene temperate stages from Northern-Central Europe, as well as evaluations of the usefulness of several numerical techniques, was performed. TWINSPAN analysis identifies groups of temperate stages based on the presence/absence of their indicative taxa and may be useful for distinguishing between older and younger interglacials. Site-to-site sequence slotting allows the determination of the most

similar pairs of records, based on sample dissimilarity following their stratigraphic constraints. Sequence slotting performs well when correlating the Holsteinian interglacial and Cromerian stage II, and also provides tentative correlation of some problematic records. Ordination compares the main trends in pollen stratigraphies of all pollen sequences. It finds very similar patterns between Eemian records and Cromerian stage II. The implications for progress suggest focusing on better sampling resolution, multi-proxy approaches to climatic reconstruction and obtaining better independent dating.

4. Discussion

Quaternary research involves a broad range of specialists because the study of environmental changes during the last 2.5 million years of the Earth's history has a strongly interdisciplinary character. The complex environmental changes in glacial and interglacial ages of the Quaternary are studied in order to understand the causes, timing and dynamics of the Earth's surface events during the period of human evolution. An evaluation of significant Quaternary environmental changes, which are stimulated by an integration of endogenic and climatic processes, also contributes to endeavours to calculate realistic prognoses of the future existence of mankind. The main subject of the presented report consists of an evaluation of interdisciplinary research patterns of the XVIIIth INQUA Congress.

The integrated endeavour for understanding the evolution of Quaternary environments can be summarized by topical clusters of complex subjects: a) stratigraphy and chronology of Quaternary marine and terrestrial deposits, processes and events, b) Quaternary climate changes and their palaeoenvironmental consequences, c) human history in the Quaternary, d) key regions of the Earth for Quaternary research.

Research results related to the stratigraphy and chronology of Quaternary processes and events were part of concerned almost all sessions of the congress. However, the main progress has been made in chronostratigraphy and methods of dating. Advances in Quaternary stratigraphy and correlation of regional records about glaciations (e.g. Antarctic, Europe) have contributed to substantial improvements of knowledge about palaeoclimate evolution. Development in Quaternary chronologies in "classical" areas is strongly supported by relevant studies in orogenetically active settings including high-mountain regions. Global and regional correlations of climate events using marine ^{14}C reservoir ages, atmospheric pCO_2 and $\delta^{18}\text{O}$ records were systematically performed. Rapid advances in dating methods were reported in determination of $^{40}\text{Ar}/^{39}\text{Ar}$ and ^{14}C ages of Quaternary events and processes, dating of landforms by cosmogenic nuclides, radiometric dating of speleotherms, applications of tephrochronology and magnetostratigraphy in archaeological

and palaeoenvironmental studies, amino-acid geochronology and DNA datasets.

The presentations of research results concerning Quaternary marine and terrestrial processes and deposits made a substantial contribution to the better understanding of present-day (and future) natural processes and events. Corresponding sessions highlighted several fundamental and applied themes such as a) integration of ice core, marine and terrestrial global records during the period 60,000 to 8000 years ago, b) sea-level changes during the Quaternary and records about coastal evolution including rapid coastal changes such as co-seismic uplift or subsidence, tsunamis and storm impacts, c) assessing the spatio-temporal resolution of fossil proxies and large extinction events, d) long-term and rapid slope processes including landslides in historic and prehistoric times, e) reconciling modern and Quaternary rates of landscape evolution. The traditional cluster of research topics was connected with Quaternary continental and mountainous glaciations. Extraordinary attention was given to the Antarctic, Greenland and British Ice Sheets and/or to High- and Central Asian, South- American and Alpine mountainous glaciations. Papers about Quaternary glacier variability from the tropics to the poles include enormous amount of field and interpretation data about palaeo-ice stream dynamics, glacial processes, sediments, landforms and ecosystems including their dating.

The most investigated and discussed subjects at the INQUA Congress were Quaternary palaeoclimate and palaeoenvironments. A multidisciplinary research approach in these topics is conspicuous from Antarctic, South American, African and North Atlantic studies, e.g. comparison of multiproxy records and past circulation patterns, polar ocean efficiency in CO_2 storage, Late Quaternary history of humans and regional climate changes during the last 2000 years. Special attention was also given to Late-glacial and Holocene climate change in continental Asia, catastrophic palaeoenvironmental processes and events in large water bodies of SW Asia and sea-level changes related to climate during the last 140 ka in the Mediterranean. Of fundamental significance are the complex studies of drowned landscapes and continental shelves of the last glacial cycles, past dryland and deserts dynamics as well as palaeohydrological archives concerning palaeogroundwaters, fluvial environments, surface- and groundwater flow processes and palaeofloods in the Quaternary.

A cluster of studies related to a) reconstruction of environmental impacts of climate changes from MIS 5 to present and especially over the last millennium (based mainly on terrestrial and lacustrine archives), b) ecological responses to climatic change at decadal to millennial timescales, c) inter-hemispheric climate perspectives from high-precision glacier records and d) reconstruction of historical climate variability using documentary sources provide great potential for predictions and/or prognoses of future environmental changes.

A topical cluster of subjects in Quaternary Science is concerned with human history. It was demonstrated how lifelike present-day critical problems of a society can be defined through many topics of the INQUA Congress sessions with relation to the history of humans in the Quaternary. Main attention was given to Mio-Pliocene hominid evolution and its environmental context, geoarchaeological studies of human interactions with Quaternary palaeoenvironments and understanding of the last glacial cycle ice sheets and meltwater impact through data and modelling interactions among fauna, vegetation, and humans. Similarly, studies of water ecosystems as a component of the geographical mantle and the anthropogenic influence over them as well as high-resolution records of climate and human impact in mountain regions were presented. Humans history during the Late Quaternary was represented by various clusters of subjects: a) quantifying and modelling human and climatic impacts on hillslope and fluvial sediment dynamics during the Holocene; b) the palaeorecords of fire in the Earth System (climate or humans?); c) mechanisms and impacts of agricultural transitions. Recent and present-day practical aspects of Quaternary research were also emphasized by palaeoseismological contributions related to megacities and critical social infrastructures. A plenary lecture about living with the uncertainty about climate change and insurance was remarkable.

The general and practical subjects mentioned above were complemented by studies in selected key regions of the Earth for Quaternary research. Evolutionary, behavioural and cultural ecology of Plio-Pleistocene hominin populations in Africa and Asia was emphasized. Quaternary human, climate and ecosystem interactions in Africa were studied as well as East and Southeast Asian palaeoanthropological multidisciplinary records. Special attention was also given to a) palaeoenvironmental change and human response during the last 30,000 years in a corridor from the Western Mediterranean to the Caspian Sea, b) environmental and cultural dynamics in Western and Central Europe during the Upper Pleistocene, and c) climate, environment and economy in the North and Central European Neolithic. The Magdalenian period was highlighted from the point of view of human adaptations to the Late Last Glacial in Western and Central Europe. A lecture about the impacts of Quaternary sciences on the philosophy of radioactive waste disposal in Switzerland was also very topical.

5. Conclusions

Attention to both basic and applied aspects of Quaternary research is a very conspicuous methodological attribute of the presented results of the Czech participants at the XVIIIth INQUA Congress in Bern. It is

strongly desirable to present central European Quaternary research in larger regional and/or global contexts. The presented papers contribute to regional and/or global correlations, which are very effective tools for progress in Quaternary science. Unfortunately, a comparison of a large spectrum of long-term Czech activities in Quaternary research with the modest Czech participation at the XVIIIth INQUA Congress gives evidence of economic limits to the participation of Czech scientists at important international meetings. On the other hand, the dominance of young specialists from the Czech palynological community, who successfully presented their results, incited very promising experience. The range and multidisciplinary spectrum of Quaternary research performed by the Czech specialists are undoubtedly significantly larger than could be exposed during the XVIIIth INQUA Congress in Bern. However, it is a sad reality that apart from Dr. Vlasta Jankovská no other representative of the INQUA Czech National Committee joined the meeting. Will this still unfavourable situation be improved in 2015, when the XIXth INQUA Congress will be held in Nagoya, Japan?

In Central Europe, including the Czech Republic, essential dating of palaeoenvironmental records is a problem. Erosion has been dominating in most of the Czech Republic territory during the Quaternary. Major thicknesses of Quaternary deposits are preserved mainly in the Moravian basins developed along a large zone of the morphotectonic contact between the eastern margin of the Bohemian Massif and the Western Carpathians. Large bodies of fluvial deposits and loess/palaeosol sequences represent traditional subjects of regional palaeoenvironmental studies.

Recent glacial, fluvial and geomorphological studies in the Central European region have also improved knowledge of natural processes driven by Pleistocene cold oscillations. At present, palynology is the most advanced research topic focused on Late Quaternary natural archives represented mostly by peat and ox-bow lake deposits. However, traditional stratigraphical divisions based on mammal or mollusc palaeontology should be verified and advanced using modern dating techniques. Unfortunately, with the exception of magnetostratigraphical studies, only one radiocarbon laboratory using the conventional dating method is available in the Czech Republic. Development of OSL and U-series dating laboratories would be very helpful for progress in Quaternary palaeoenvironmental studies.

What is encouraging is the long-term international cooperation of Czech specialists in the framework of Quaternary research projects not only in the territory of Central Europe, but also in various environments of the Earth such as Antarctic and other polar regions, mountainous ranges of High Asia and the Andes or semi-arid and/or humid landscapes in Africa.

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RÉSUMÉ

Příspěvky českých účastníků na XVIII. kongresu INQUA v Bernu. Referativní práce se zabývá odborným podílem českých účastníků na XVIII. kongresu INQUA, který se konal ve dnech 20. 7. až 29. 7. 2011 v Bernu. Jsou uvedeny výsledky českých výzkumů předložené v 10 vybraných víceoborových sekcích, které byly zaměřeny na chronologii a kvartérní záznamy, pan-evropskou korelaci kvartérní stratigrafie, vývoj krajiny v kvartéru, pleistocénní zalednění Asie, paleohydrologické archivy ve fluvialních prostředích, příčiny a význam povodní a požárů v přírodním systému a historii Země, ekologické odezvy klimatických změn v měřítku desítek až tisíců let, rekonstrukce historických změn klimatu podle dokumentárních záznamů a na geoarcheologické aspekty vztahů mezi přírodním prostředím a člověkem. V diskuzi jsou komentovány hlavní tématické okruhy oborově integrovaných výzkumů kvartérního období: a) stratigrafie a chronologie kvartérních mořských a suchozemských sedimentů, procesů a událostí, b) klimatické změny v kvartéru a jejich paleoenvironmentální důsledky, c) historie člověka v kvartéru, d) identifikace klíčových oblastí Země pro výzkum kvartéru.