DIMENSIONS AND TRENDS IN HUNGARIAN GEOGRAPHY

Geographical Research Institute
Hungarian Academy of Sciences

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DIMENSIONS AND TRENDS IN HUNGARIAN GEOGRAPHY

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Preface

Since its first publication in 1964 the series *Studies in Geography in Hungary* has been the mouthpiece of Hungarian geography towards the international academic world. The 32 volumes that have been published since then reported regularly about the most important results of Hungarian researchers both in the field of physical and human geography. The present 33rd volume of Studies, dedicated to the 31st International Geographical Congress, would like to follow this long tradition, containing sixteen papers written by physical and human geographers, covering very diverse scopes. This abundance of topics and geographical scales is meant to demonstrate a wide variety of *dimensions* and *trends* that Hungarian geographers have been engaged in over the last few years.

Physico-geographical research is performed at variable scales today. As space exploration proceeds and a huge amount of information on the planets become available on the planets of the Solar System, the conditions are increasingly favourable for planetomorphological investigations based on analogies with the Earth. 2008 is the year when the attention of the world's public is focused on the mission of Phoenix Mars Lander forwarding images of the 'red-planet' and performing scientific operation. F. SCHWEITZER's contribution raises the issue of a probable occurrence of ventifacts on Mars which eventually might testify to the (past or present) existence of a self-supporting chemical system on that planet. Global dimension appears in the article of GY. GÁBRIS in combination with a study of regional scale attempting to correlate the evolution of river terraces in the Carpathian Basin with relatively shorter fluctuations of climate during the Quaternary as they are reflected by Oxygen Isotope Stages, with a special reference to the transition from the glacial cycles to interglacial periods. A consistent methodology is described by F. SCHWEITZER, É. KIS and J. BALOGH to analyse loess sequences from Susak Island and to use them to identify and evaluate climatic and environmental changes in the northern Adriatic during the Pleistocene. The main geographical dimension of physico-geographical research, however, remains the national and regional scale. Water and wind erosion as the most significant triggers of land degradation in Hungary are tackled in a study by Á. KERTÉSZ.

J. SZABÓ, J. LÓKI, CS. TÓTH and G. SZABÓ studying the country's 230 physical micro-regions found the risk posed by earthquakes, mass movements, wind erosion, downpours, floods, waterlogging and droughts as the most serious risks and eventually compiled two summary maps natural hazard maps. M. VERESS reports on investigations by geophysical methods into four regions of Hungary constituted by carbonate rocks (Bakony, Mecsek, Bükk and Aggtelek mountains), and comes to the conclusion that covered karst formation depends mainly on the thickness of the covering sedimentary rock.

Functional landscape analysis is presented in the paper by G. Mezősi and B. Meyer reporting on the test of a methodology at two study sites in Germany and Hungary. Since regular cultivation is the most significant process affecting floodplain sections protected by flood-control dykes, D. Lóczy investigates the role of tillage in the preservation of microfeatures there.

Studies in human geography included in this volume also cover a wide scientific spectrum. The first group of papers focuses more on the changing pattern of society and the social geographical consequences of the transition. Z. Dövényi and P. P. Tóth analyses the main trends of international migrations affecting Hungary over the last two decades. This is followed by two contributions concentrating on the post-socialist transformation of the settlement system and the reorganisation of the society. Firstly, Gy. Enyedi provides a broad overview about the spatial changes of the urban system in Hungary, highlighting the most important socio-economic as well as political factors that influenced these changes. This is followed by a study from P. Bajmócy and G. Hegedűs, who investigate the long term restructuring process of the Hungarian settlement system, focusing on different levels of settlement hierarchy and explaining the wider economic and social background. Finally, T. Egedy and Z. Kovács reports on recent findings of an international research project, funded by the EU, and focusing on the position of the metropolitan region of Budapest within Hungary and in Europe, in terms of accommodating creative activities.

The second branch of human geographical studies is more concerned with recent economic transformation of Hungary and its environs, and the effects of globalisation and global economic (and political) competition on the country. In their contribution K. Kocsis and T. Tiner deals with the hot issue of energy supply security in East Central Europe, and the concomitant geopolitical tensions. Authors point out the controversial role of Russia and its companies in recent discussion about future energy policy of EU member states, including the former state-socialist countries. É. Kiss focuses on the role of newly developed industrial estates in the changing spatial pattern of Hungarian industry. S. Illés and G. Michalkó highlight the interrelationships of migration and tourism in Hungary through the analysis of property acquisition by foreigners. Last but not least, in their study J. Pénzes, G. Tagai and E. Molnár calculate the effect of international borders on the economy of the surrounding areas and demonstrate the transformation of the border areas since the political changes.

We hope that readers of this book will find the different chapters relevant and the contributions will stimulate scientific debate. Finally, acknowledgements are due to all the authors and the technical staff who made the publication of this volume possible.

The Editors

Á. Kertész and Z. Kovács (eds): Dimensions and trends in Hungarian geography
Studies in Geography in Hungary 33, Geographical Research Inst. HAS, Budapest 2008, pp. 9–18.

VENTIFACTS ON MARS

Ferenc Schweitzer[1]

Introduction

Ventifacts (dreikanters) on Earth are individual rocks a few centimeters in size that have been shaped by wind erosion. On Mars images taken by Spirit they can be observed 20° south of Equator, in an arid environment. The best example is "Adirondack", a ventifact ca 40 cm in size with 3–4 side planes, faceted by grains, transported by persistent winds of variable velocity, and ending with tapered profiles. Traces of pitting on ventifacts carved from less resistant rocks by hard grains are common in arid regions of Earth.

On Mars images the ventifacts surfaces are formed by dark brown or black desert crust presumably of ferrous and manganese origin. On Earth they represent 2–5 mm thick desert crust, the formation of which is conceived only in the presence of moisture. Superimposing the dark crust on Mars rocks there is desert varnish. Material of the latter generally is associated with blue-green algae which support life even in most extreme conditions, at least on Earth.

Preliminaries

It has been more than three hundred years since Christiaan Huygens prepared his celebrated drawings portraying surface features of Mars. Already in the 19th century some of these forms were interpreted by Giovanni Virginio Schiaparelli as stream channels (*canali*), subsequently interpreted by Percival Lowell as irrigation channels built by intelligent beings. The real secrets of the planet are being solved only after missions of Mariner (1965), Viking (1975), more recently that of Mars Global Surveyor (1997–2006) and nowadays through the observations and examinations conducted by the two Mars Exploration Rovers, Spirit and Opportunity. The legend of the existence

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of whatever canals and cultivated land had been rejected in the mid-1970s in the wake of the provided evidence.

Characteristics of planet Mars

Mars is a smaller planet than Earth. Its diameter is 6,794 km, the length of the Martian day (sol) is 24 hours and 37 minutes, and orbital period of the planet (length of the year) is 687 sols, i.e. somewhat less than that of the Earth. The average air temperature near surface is -65 °C. Martial atmosphere is mainly composed of CO_2 (95%), and N (3%).

Mars is probably 4.5 billion years old. Its present surface could have formed during some million years' evolution although some Martian landforms might be as young as several thousand years. Judging by the macro features and microforms of the relief, life in incipient forms exists or could have existed in the past; along with presumed river valleys and other waterborn landforms there are phenomena and signs suggesting the presence of water ice and bounded water.

The role of Mars Exploration Rovers in the analyses of Martial ventifacts

Exploration rovers having landed on the surface of Mars on December 25, 2003 and January 24, 2004 have searched for Martian life, past or present. On the other hand, they are promising to furnish geological and geomorphological evidence to surface anomalies caused by glacial action, volcanism, wind and water erosion and meteorite impacts.

The contact with European made Beagle-2 had been lost prior to landing of Spirit in Gusev Crater south of Martial Equator, and that of Opportunity reaching surface in Meridiani Planum. The latter have transmitted remarkable images and analytical results to the Earth.

Examinations of panoramic views and close-up images of Martial rocks transmitted by Spirit and comparisons with terrestrial geomorphic processes and landforms allow some presumptions. Apart from the already known landforms e.g. river valleys, springs, drifting sands, moreover, surface features confined to permafrost (e.g. stony polygonal tundra, minor slumps of ground along slide paths, *Photo 1*), there is a fair probability of the occurrence of *water ice* and *blue-green algae* (*Photo 2*) supporting life in a most primitive form based on the arguments below.

Ventifacts (individual rocks of a few centimeters in size) with *desert crust* and *rock varnish* or *gravel sheets* of oval shape (*Photos 3 to 6*) are indicators of environmental conditions. Spectral analyses accomplished by Thermal

Photo 1. Slumps on Mars attached to slide paths associated with permafrost

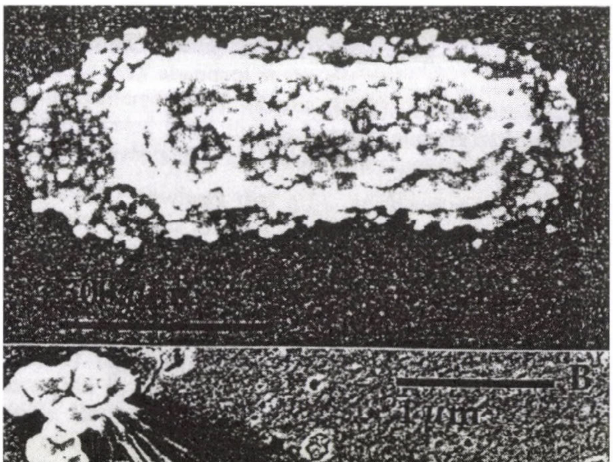
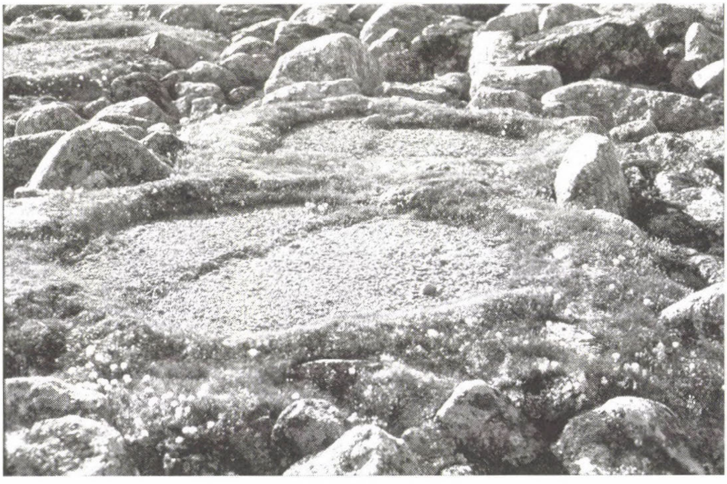


Photo 2. Manganese-fixing bacteria. Scale is in micrometres (microns). Micrograph (A) shows a Metallogenium-type bacterium on black varnish on subsurface shale near Barstow, San Bernardino County, California. Micrograph (B) shows budding bacterium, possibly Pedomicrobium, on black surface varnish from South Mountain Park, near Phoenix, Arizona (DORN, R. I.–OBERLANDER, T. M. 1981)



Photos 3 and 4. Gravel polygons of oval shape on Mars (3) and on Earth surface (4). Permafrost and perennial active zone (of melting–freezing cycles) are preconditions to their emergence. The Martian image was taken in Gusev Crater, the photo showing polygonal stony tundra was from Ogilvy Mountain Range, Canada

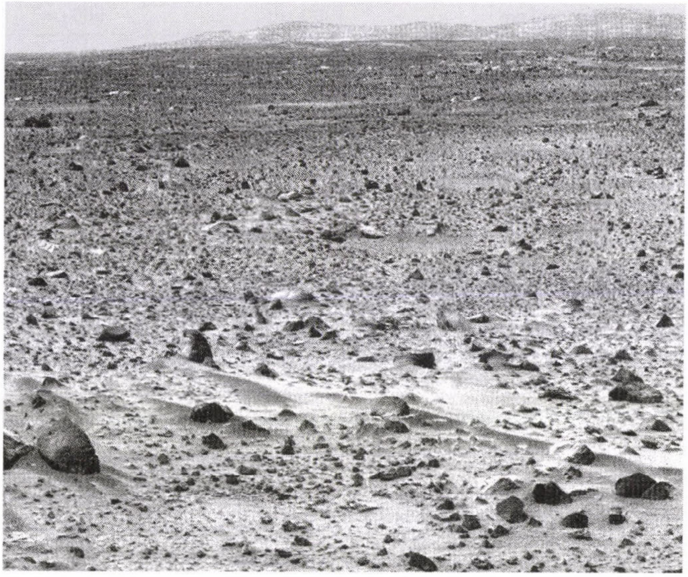


Photo 5. Image of a dry and cold desert on Mars, in the environs of Gusev Crater

Photo 6. A fragment of polygonal stony tundra surface from Mars. Along the edge of circular or oval surface void of stones are pieces of rock pressed upwards from below by frost and subsequently shaped into ventifacts

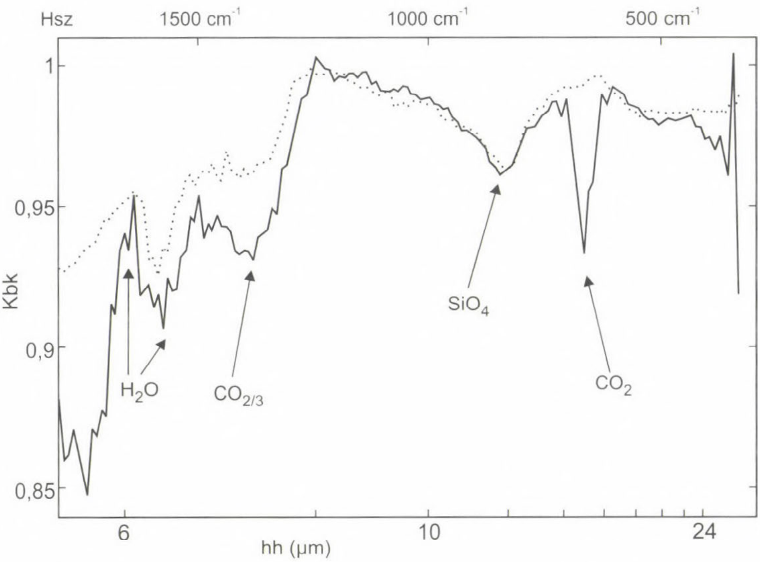


Fig. 1. Spectral analysis by Mini TES (Thermal Emission Spectrometer equipped on Spirit Marsrover) has proven the presence of bounded water in Martian mineral. – Kbk = radiation capability; Hsz = wave number; hh = wave length

Emission Spectrometer equipped on Spirit Marsrover (*Fig. 1)* have provided evidence to bounded water stored in Martian minerals.

Characteristic features of ventifacts

Martian ventifacts (dreikanter) are edged stones referring to the present arid environment in the area 20° south of Martian Equator. Their study led to the following conclusions.

1. As Martian soil cover contains silica (Si, *Fig. 2*) during the dry season quartz grains moved by strong winds of various directions carve keels and planes on the surface of the rocks. One of the finest examples is "Adirondack", 40 cm in size and confined by 3–4 triangular side planes, shaped by the hard (quartz?) grains moved by the prolonged winds of changing direction *(Photo 7).* On the surface of some sorts of softer rocks, features of abrasion by sand grains are discernible in the form of tiny pits *(Photo 8).* Similar features are frequently encountered in warm and dry and cold and dry environments on Earth (SCHWEITZER, F. 2000).

2. On Spirit images it is clearly discernible that ventifacts are coated by varnish of probably manganiferous origin of dark brown or black colour, being very similar to the terrestrial ventifacts with *desert crust* of 2–5 mm

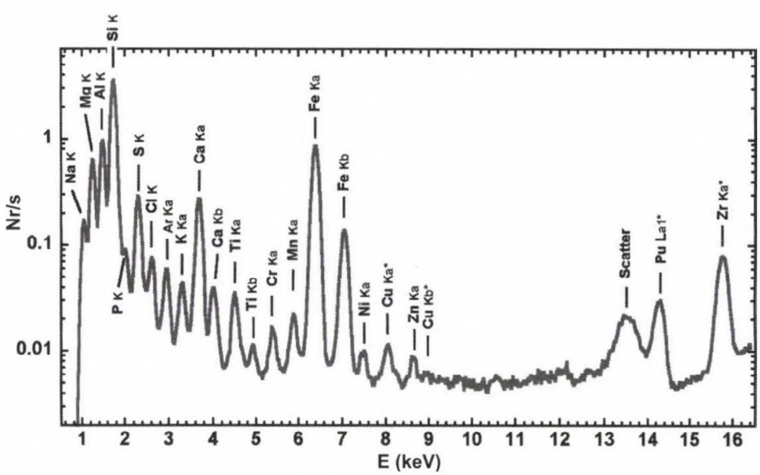


Fig. 2. Chemical analysis conducted by APXS (Alpha Proton X-ray Spectrometer) has proven the presence of silicon (Si, K), iron (Fe, Ka, Fe, Kb), calcium (Ca, Ka), aluminium (Al, K), manganese (Ma, K) and sulphur (S, K) in Martian sediments forwarded to Earth). Figures are borrowed from Spirit website (http://marsrovers.nasa.gov/home/index.html)

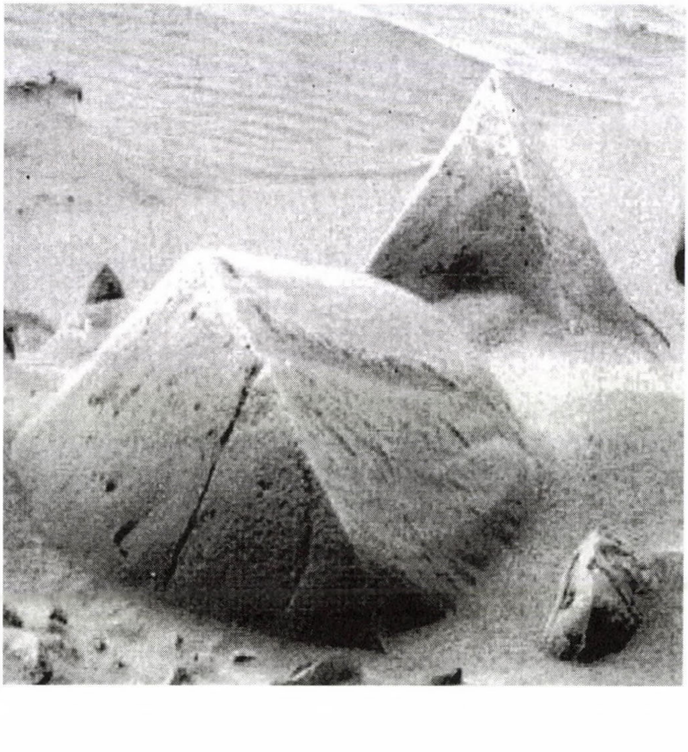


Photo 7. A rock with 3–4 side planes faceted by grains of sand transported by directional variability (the famous "Adirondack" rock)

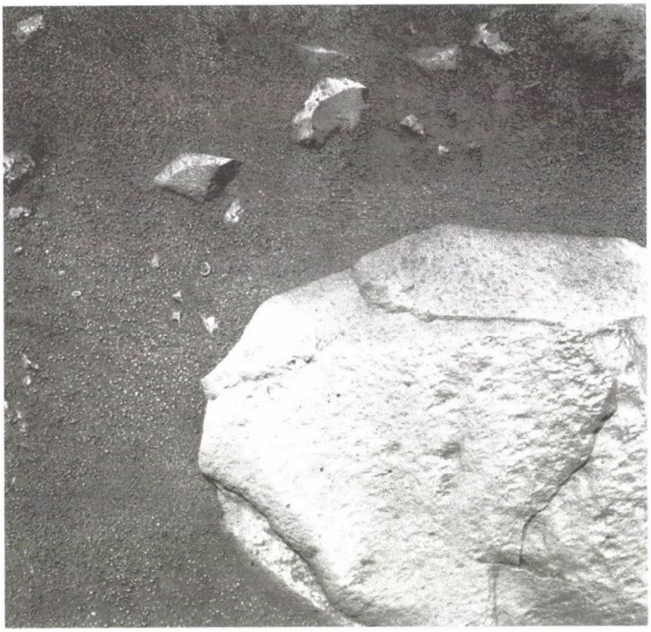


Photo 8. Traces of hard sand grain impact on the surface of less consolidated rocks (Gusev Crater)

Photo 9. Ventifact covered with desert crust and rock varnish from the Namibian Desert

thickness. Formation of this crust is only conceivable in the presence or at least with temporary occurrence of water transporting iron and manganese from the interior of the rock to its surface and leaving there thin precipitation (*Photo 9*). The latter can be seen on Marsrover images.

3. Superimposing the dark desert crust there is *rock varnish* typical of desert environment. This bright coat is to be attributed to blue-green algae which support life on Earth even within the most extreme physical conditions (DORN, R. I.–OBERLANDER, T. M. 1981; NAGY, B. *et al.* 1991) *(Photo 10).*

Anticipating that it might be of general interest, the above hypotheses were shared with Mr. James B. GRAVIN, scientist of Mars Exploration Program in a letter dated to February 12, 2004. Now the topic is part of the research program of NASA.

If crusts coating the ventifacts on Mars contain remains of blue-green algae – as it could be deduced from their analogues i.e. from rock varnish of Earth deserts – the focal issue is not so the origin of life on Mars but rather its

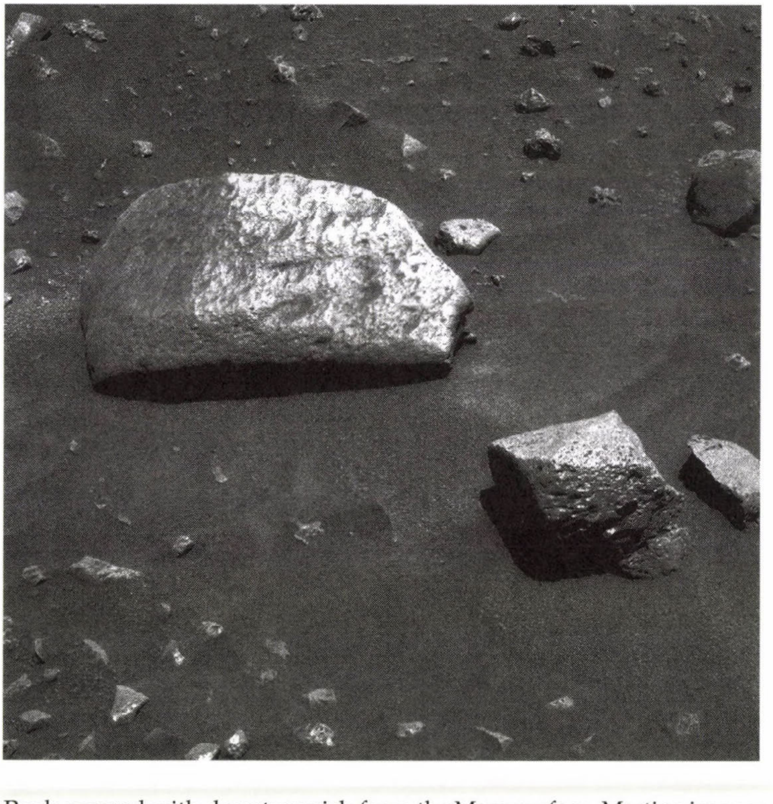


Photo 10. Rock covered with desert varnish from the Mars surface. Martian images are borrowed from Spirit website (http://marsrovers.nasa.gov/home/index.html), photos *4* and *9* are taken by F. SCHWEITZER

history. From the paleoenvironmental viewpoint it is a most relevant question, because it concerns the problem of the formation of ozone shield.

The ventifact → desert varnish → blue-green algae chain in its turn leads to the issue of the nature of life. All theoreticians dealing with the origin of life eventually face the problem. Many of them consider to give an adequate answer to this question impossible emphasising its high complexity.

According to the definition by NASA life is a self-supporting chemical system insuring the evolution by Darwin. Based on cyanobacteria findings in Western Australia and at Isua and Akilia (Greenland) life on Earth might be 3.5 to 3.8 billion years old, with a long prehistory. Cyanobacteria (blue-green algae showing vitality even in extreme physical conditions) have been responsible for oxygen formation during photosynthesis.

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RELATION BETWEEN THE TIME SCALE OF THE RIVER TERRACE FORMATION AND THE OXYGEN ISOTOPE STRATIGRAPHY IN HUNGARY

Gyula Gábris[1]

Introduction

Diverse analyses and results gained from the study of ocean-floor and ice-core samples brought revolutionary methodical and theoretical changes in Quaternary science during the 1970s. This renewal highlighted important, new information about climate change during the Pleistocene compared with the climatic curve by Milanković. Currently, the phenomena controlled by Pleistocene climate are adjusted to fluctuations of Oxygen Isotope Stages (OIS) at a smaller scale of periodicity. Scientists attempt to correlate events, sediments and other formations that are far from each other both in time and space. For the geomorphology it would be important to adjust models of landform evolution (e.g. formation of terraces) according to the number and length of recently confirmed episodes of climate change. This study aims at an overview of the river terrace system in Hungary in relation with its chronology and the alternating mechanism during the periods of its formation. The key element is the novel threshold concept. Two different phases can be recognised in terrace evolution: the state of equilibrium during long glacial phases and short transitional phases at the end of glacial cycles – called termination – when components of environmental change reach threshold values and the fluvial system adapts rapidly to the new circumstances. Based on data collected and published during decades of terrace research the author attempts to outline the evolution and chronology of Hungary's terrace system. This novel system correlates Pleistocene climate changes reflected by the oxygen isotopic curve with different climate events as triggers of Quaternary landform evolution (formation of fluvial terraces and the covering travertine deposits and loess-paleosol sequences) and their ages.

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Evaluation of data provided by strata from ocean-floor and ice-sheet boreholes has brought fundamental methodological and theoretical changes in Quaternary research. Due to sampling of greater frequency and therefore identifying a higher amount of fluctuations within short periods of time compared to the Milanković's curve, it is clear, that the latest results of Pleistocene climate studies have outdated our previous knowledge in Pleistocene chronology thoroughly.

So as to correlate distant events, sediments and landscape formations, all identified Pleistocene phenomena considered to be formed and controlled by climate are calibrated currently by adjusting them to Marine Isotope Stages (MIS) or Oxygen Isotope Stages (OIS) and even to more minute periodical fluctuations within these stages. For geomorphology it would be important to correlate models of surface evolution (e.g. formation of loess-paleosol sequences, freshwater limestone and terraces, cycles of periglacial phenomena, phases of deflation, periodicity of gravitational mass movements such as landslides) – with the frequency, length and intensity of known episodes of climate change. The purpose of this study is to find such climatic events and to detect their relationships with the processes and chronology of landform evolution under fluvial action.

History of river terrace research in Hungary

Research of terraces in river valleys of the Carpathian Basin has given work for generations of scientists and interpretation of findings has always been guided according to the actual level of scientific knowledge. The first synthesis made by Cholnoky, J. (1923) and Bulla B. (1941) and partly based on the findings of Kéz A. (1934), worked out the theory of climate controlled terrace formation, described fluvial terrace system in Hungary and dated their formation. The version developed further by Pécsi, M. (1959) laid down the fundaments for the research of the following 50 years; meanwhile numerous modifications, alterations and refinements have been added to the scheme. The theory of terrace evolution was summarized in a study (Gábris, Gy. 1997) and now it seems that the most important hypotheses have to be revised because their implications can modify views on two major issues of research significantly: defining mechanisms of terrace formation and dating. Previously it appeared reasonable to explain terrace formation as a process connected to glacial-interglacial climate variations of the Alps, because of their close geographical location. Dating was initially done considering mainly and almost exclusively paleontological evidence, and it was only later when researchers began to apply other dating techniques as well (a summary in Pécsi, M. 1959). Early Quaternary models hypothesised three or four simple glacial phases, which in a similarly simple way were thought to have been interrupted by interglacial phases. Process of terrace formation was considered also relatively simple: filling up of valley floors was attributed to climatic factors (glacial), and accordingly, incision into valley floors was identified as a result of the opposite climatic effects (interglacial). Moreover, climatic maxima were believed to coincide with the activity maxima of landform evolution. Application of geomorphological methods that did not allow for a more detailed subdivision than the glacial-interglacial phases resulted in descriptions of four (KÉZ A. 1934), than six (BULLA B. 1941) and later eight (PÉCSI, M. 1959) Pleistocene terraces in the Carpathian Basin controlled by climate change. (Terraces were marked from bottom to top by Roman numerals. Terrace II stood for Würm, III for Riss, IV for Mindel and V was correlated with the Günz glacial.) Based on further geomorphological evidence, the last glaciation was divided into two terrace levels (II/a and II/b) (MAROSI, S. 1955; PÉCSI, M. 1959).

New approach to the mechanism and chronology of terrace evolution

According to recent achievements in geomorphology, it is not the glacials and peaks of interglacials but the transitional periods between these phases that play decisive role in terrace evolution (STARKEL, L. 1983). In the system of fluvial surface evolution different processes and forces controlling the activities of rivers are in a *state of equilibrium* for a longer period of time, which is then followed by radical changes, rapid incision or deposition. The state of equilibrium does not imply passivity but infers the stability of active processes. Any slight modification of single factors is not sufficient to induce changes in an equilibrium system, because changes can be brought about only at reaching/exceeding *critical* or *limiting* circumstances. In these cases changes are abrupt. Fluvial response in landforming is defined by the existence of *thresholds* dividing the balanced states (SCHUMM, S. A. 1979; GREEN, C. P.–MCGREGOR, D. F. M. 1987). When in this model the components of environmental change reach such threshold values the fluvial system adapts to the new circumstances rapidly, hence valley morphology is to be transformed significantly. Apart from the above described theory, results of field studies (e.g. VANDENBERGHE, J. 1987; VANDENBERGHE, J. *et al.* 1994; KOZARSKI, S. 1991) also serve as bases for some general conclusions:

1. Incision can occur with the start of each climate phase change but the process is of longer duration and higher intensity during the transition from the cold-dry phase into the warm-humid one.

2. Incision is relatively fast and restricted to a shorter period of time compared to the longer period of deposition which may last a few thousand years to several ten thousand years. In other words, terrace development does

not take place at a constant rate, because in the process of surface evolution the shorter periods of changes play a considerably more important role compared to the long stable ones. Terrace accumulation takes a considerably longer time in contrast to the more intense erosional phase (downcutting), which occurs within a relatively shorter period of rapid climatic transition.

Global Pleistocene chronostratigraphy and fluvial terraces in Hungary

Studying the oxygen isotopic curve Broecker, W. S.–van Donk, J. (1970) revealed cycles of about one hundred thousand years' duration in the course of climatic fluctuations. These cycles are divided by events called "terminations", i.e. periods of quick deglaciation due to climatic warming. The cycle starts with a warm interglacial period of a certain length, and through continuously weakening warming events during the process gradually cools down to reach the coldest spell towards the end of the cycle. The actual closure for the cycle is marked by the warming, leading into the next interglacial phase.

Generalising the course of the cycle terrace evolution can be explained as follows. During the state of equilibrium lasting thousands of years from the beginning of the cycle, the cold phase is reached by gradual cooling interrupted by minor climatic fluctuations. Therefore the mechanism of river flow shifts towards depositional style. This is called "gravel aggradation", which lasts for several ten thousands years. Rivers reach their critical or limiting factors at the start of terminations, when due to rapid and intense warming the threshold values are exceeded and the downcutting action is triggered. Consequently, within a relatively short period of time (few thousand years) terraces are formed. From this point onward, in geomorphological terms, of the two momentums of surface modelling, i.e. sedimentation and valley incision it is the age of incision that considered by the author as the age of the terrace.

Terminations marked by Roman numerals (T I, T II, etc.) can be characterised differently (*Fig. 1*). Among them there are stages which reflect stronger and weaker, faster and slower, longer or shorter periods of warming. For that reason, the geomorphic effects of these periods – in this case the terrace forming incision – differ in extent. Due to changes of different magnitude, the scope of incision may also vary significantly. In Hungary only those fluvial surfaces are considered to be terraces, which are situated higher than the fluctuations with maximum water level of the rivers that is, the terrace is a flood-free terrain. As down-cutting may form smaller level differences than needed to fit the above mentioned definition, these surfaces are not real terraces (this statement might be regarded as a specific feature of Hungarian geomorphology). It has been proven that similar surface-levels ("terrace" I, lower and higher floodplain) were formed alongside the Hungarian rivers during the Holocene, and it is for

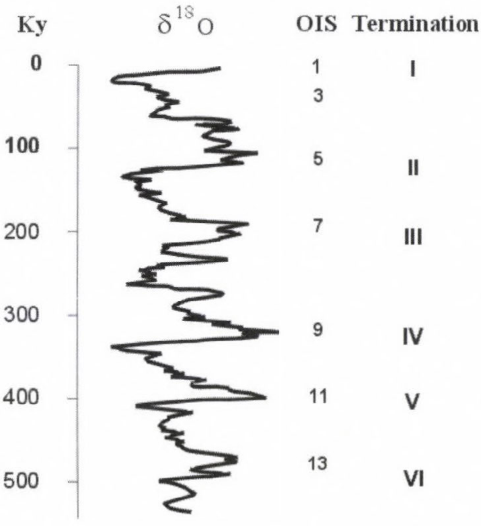


Fig. 1. Oxygen Isotope Terminations (GIBBARD, P.–VAN KOLFSCHOTEN, T. 2005)

sure that in the cases of older terraces similar levels might have also been formed. However, our current research facilities – more precisely our dating techniques – do not yet allow for proof.

Correlation of global Pleistocene chronostratigraphy with terrace evolution chronology is based on the theory that gravel aggradation took place during the glacials i.e. the long, relapsing cooling periods of cycles. Terrace forms were then created during the rapidly warming phases of termination by the downcutting fluvial action within a few thousands or ten thousands years. (Rhythmic evolution controlled by climate may be modified in some places by local "irregularities" of tectonic movements; however, in this paper the author does not intend to reflect on these cases. The role of tectonic uplift and subsidence is essential, however, and must be studied when considering terrace evolution along one particular river at a given location.) Methods of palaeontology used for classic dating of terraces are not applicable in this case because of scattered findings, inefficiency of the traditional dating methods and owing to the lack of OIS system elaborated specifically for large mammals. Fortunately other methods, primarily those elaborated for studying formations – wind-blown sand, loess pockets, travertines, and tephra layers – covering terrace surfaces provide results that may help to establish chronology. The following part of the present study is an attempt to link landform evolution processes to oxygen isotope chronology (GIBBARD, P.–VAN KOLFSCHOTEN, T. 2005) based on the results of datings provided by the fluvial research of the Hungarian rivers.

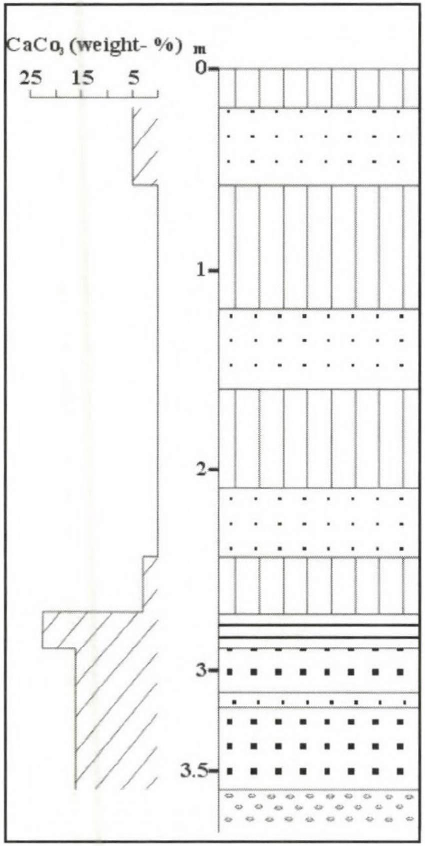
Relations between terminations and the fluvial terraces in the Carpathian Basin

The theory that the youngest Pleistocene fluvial terrace (II/a) level became flood free during the Holocene or a strong incision took place at that time, was previously supported by the fact that on this terrace surfaces no loess cover occurs. Furthermore, its relatively high position (above flood-level) is the result of the covering wind-blown sand layer, which was thought to be formed during Holocene. Since then, significant progress has been made in dating sand movements. Initially, with the aid of C^{14} dating methods (Borsy, Z. *et al.* 1982, 1985; Lóki, J. *et al.* 1994), then luminescent dating techniques provided convincing evidence on late glacial phases of deflation (Ujházy K. 2002; Gábris, Gy. 2003).

Hence, our latest research in the gravel-pit on Szentendre Island (Kisoroszi) II/a terrace modifies the chronology of the geomorphic evolution *(Fig. 2)*. In the two fossil soil strata along the profile, located above the fluvial gravel and sand, charcoals were found, which – by using radiometric techniques of age determination (according to deb-7735 and deb-7734) were dated 12 036±105 C^{14} B.P. (14 129–14 007 cal B.P.) and 12 232±125 C^{14} B.P. (14 938–14 879 cal B.P.) respectively. Between the two soil strata a thin layer of wind-blown sand can be described, which proves dry, flood-free characteristics of this level affected by deflation – in other words, it proves the Danube's previous incision, i.e. the formation of the terrace. According to thermoluminescent dating, the age of the sand is 14 050±2300 years, which data well agrees with and confirms the results of radiocarbon dating. The formation of the two soil horizons with the wind-blown sand layer in between built up during the Bölling Interstadial. Evaluation of facts in the light of OIS is the following. Termination I started with the warming period following the Late Glacial Maximum (LGM), which is called Ságvár-Lascaux Interstadial (Sümegi, P. *et al.* 1998) in Hungary. The exceptionally short warming period, which occurred between 19–17 ka cal BP – and of which geomorphologic effect could be detected at several locations (Gábris, Gy. *et al.* 2002; Gábris, Gy.–Nagy, B. 2005) – also the succeeding Dryas cooling, then an even stronger warming phase of early Bölling all played significant role in making the Danube swing from its balanced status into changes exceeding threshold figures, perform incision and create terrace II/a.

Therefore, the youngest flood-free terrace level dates to the end of the Pleistocene, that is, it has become a real terrace at the beginning of termination I due to powerful incision. The deposition of the fluvial material of terrace II/a, in contrast, might have taken place during the long lasting (tens of thousand years), previous 2–3–4 Oxygen Isotope Stages *(Fig. 3)*.

Termination II, a rapidly warming period lasted approximately 8000 years indicated the transition from OIS 6 (end of Riss) to OIS 5e, i.e. the Eem Interglacial (Broecker, W. S.–Henderson, G. M. 1998). Quick climate change also resulted in incision, consequently terrace II/b was created. Pécsi, M. (1959) described it as a late Riss or early Würm terrace because by assessing paleontological evidence the time of gravel aggradation proved to be indefinable. Dating of the formations covering the terrace had become possible applying modern techniques, so the time of incision could be estimated more precisely. Most of the independent data stem from dating of the travertine layers covering level II/b. The following data set could be collected from the works of several authors.



Formation	Sample number	IRSL age (ka) B.P.	TL age (ka) B.P.	Radiocarbon age (ka) B.P.	Calibrated radiocarbon age B.P.	Climatic stage
Modern soil	——	——	——	——	——	Actual
Aeolian sand	KOR1	0.63±0.07	0.48±0.5	——	——	Anthropo-genic
Paleosoil	KOR3	8.4±1.6	7.2±1.5	——	——	Lower-Atlantic or Boreal
Aeolian sand	KOR	8.5±?	——	——	——	Boreal
Paleosoil	deb-7735	——	——	12.04±0.1	14.129-14.007	Bölling
Aeolian sand	KOR7	16.0±2.0	14.05±2.3	——	——	
Paleosoil	deb-7734	——	——	12.23±0.12	14.938-14.879	
Fluvial clay	——	——	——	——	——	
Fluvial sand	——	——	——	——	——	Upper-pleniglacial
Fluvial pebble	——	——	——	——	——	?

Fig. 2. The generalised sketch of the Kisoroszi profile and dating results (Ujházy, K.–Gábris, Gy.–Frechen, M. 2003)

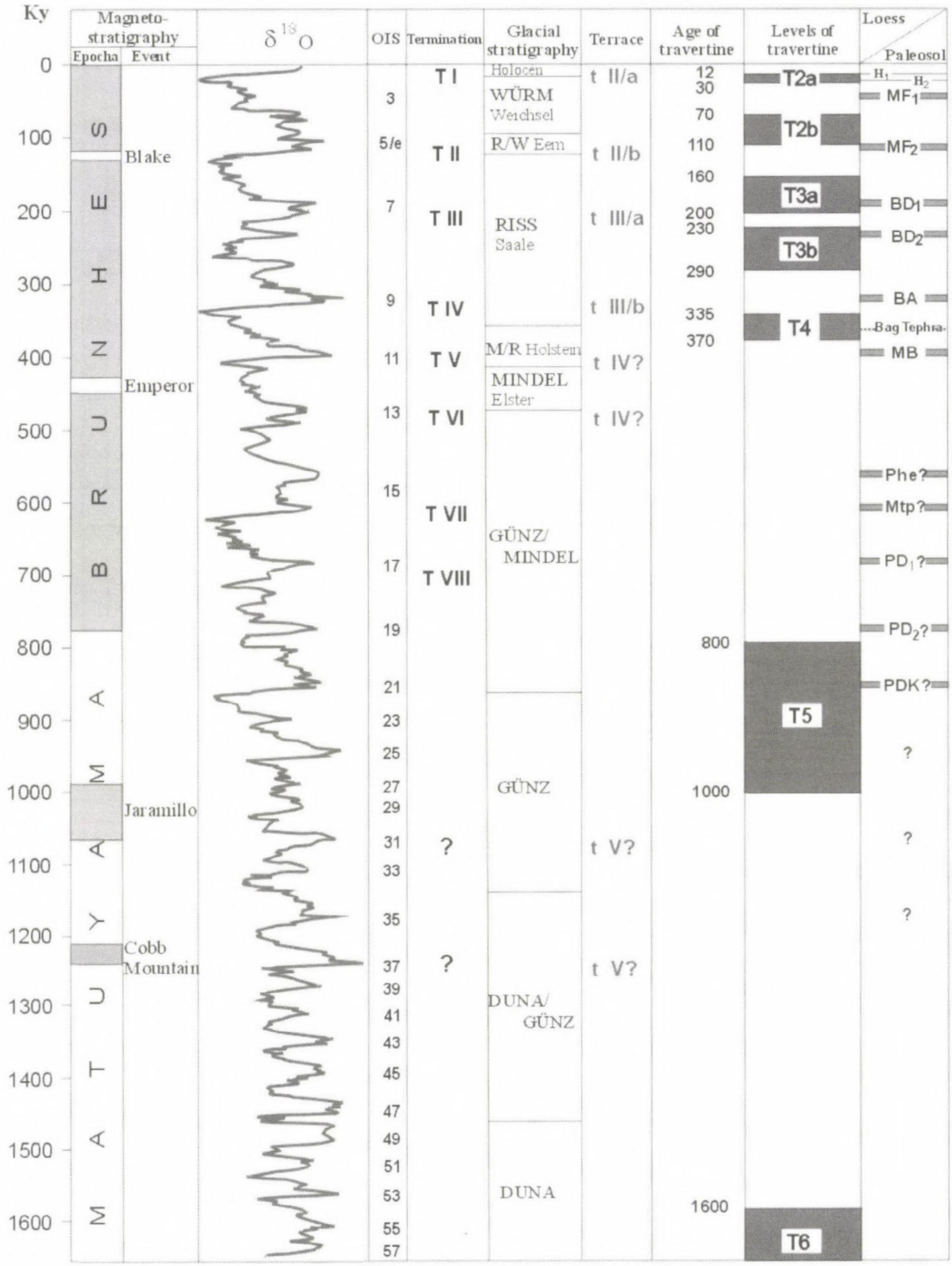


Fig. 3. Correlation between river terraces, travertine layers, paleosols and oxygen isotope stratigraphy (Gábris, Gy. 2006)

The travertine covering the surface described as II/b in Óbuda is known to have been dated at 70 thousand years (Scheuer GY.–Schweitzer F. 1988). Central part of the travertine strata of terrace II/b in Tata is also 70 thousand years (Pécsi, M.–Osmond, J. K. 1973; and Pécsi, M. 1990). In samples taken at the same location but from lower layers Hennig, G. J. *et al.* (1983) measured 101 ka±10 and 98 ka±8 years. Data of Schwarcz, H. P. (1980) 120–105 ka±6 and Schwarcz, H. P.–Skoflek I. (1982) 99.4 ka and all the above mentioned figures mark dates younger than termination II! Near Vértesszőlős the data of Hennig, G. J. *et al.* (1983) 135 ± 12 (123 ka ± 25 ESR) – considering the error margin – also suggest a time following termination II. *Consequently, the formation or incision of the terrace referred to as II/b in Hungarian terminology can be regarded as completed during termination II.* Its gravel aggradation must have happened during Late Riss *(Fig. 3).*

Chronological data of travertine covering the successive terrace level, marked as III show strong deviation, but they can be classified into two groups. Younger terraces were formed after termination III, whereas the older ones were created following termination IV. For interpretation of data it is necessary to see, that after proving the doubling of terrace II (see above), from the 1950s researchers eagerly searched for a similar doubling of level III. Aided by dating facilities of the time – which consisted of palaeontological techniques and of the relative dating methods based on results of loess studies – this attempt could not be successful.

In the group of younger terraces covered by travertine ages detail as follows. Th/U dating resulted in 175–190 thousand years for the freshwater limestone of the Kiscelli plateau (Scheuer Gy.–Schweitzer F. 1988), while other layers coating terrace III had proven to be somewhat older: limestone layers covering terrace III near Vértesszőlős were found to be 219±40 thousand years and 202±80 thousand years old (Schwarcz, H. P.–Latham, A. G. 1990). The travertine deposited in a 2 m thick layer on the terrace III of Tata-Tóváros is 190 thousand years old (Pécsi, M.–Osmond, J. K. 1973). Hennig, G. J. *et al.* (1983) dated the limestone found on the southern lower level/terrain of the Buda Castle Hill and determined its age as 160±30 thousand years. By collecting and assessing chronological data gained by different techniques of radiometric dating of samples taken from the travertine overlying this terrace it can be concluded that *at the above described places a provable surface can be found. This is to be correlated with **termination III** and its morphological appearance can be interpreted as terrace **III/a.***

Termination IV represents the transition into the warm OIS 9 and it took place between 330–315 thousand years BP. Similar to the above ones, it is primarily the chronological data acquired from the travertine of Vértesszőlős profile, which provide bases for the analysis of the events. The data set of 225±35 thousand years, >250 thousand years (Cherdintsev, V. V.–Kazachevski,

I. V. 1990) and 248±67 thousand years (Hennig, G. J. *et al.* 1983) show that these freshwater limestones were deposited onto the terrace built up of fluvial sediments of Által-ér (Által stream) following termination IV but before III. In Dunaalmás this terrace was described as II/b previously (and according to the above reasoning incorrectly) but later proved to be 291±82 thousand years old (Hennig, G. J. *et al.* 1983) based on travertine dating. Consequently, *formation of* ***terrace III/b*** *can be placed to the time period of termination IV.*

Termination V occurred 410–390 thousand years ago and meant transition into OIS 11. Its temperature curve shows striking resemblance to the course of termination I, it even displays a temperature drop, that is a parallel to Younger Dryas. Considering again travertine deposits the following data sequence can be attached to this termination: Vértesszőlős 350 thousand Th/U, 333 thousand ESR (Hennig, G. J. *et al.* 1983), >350 thousand years (Schwarcz, H. P.–Latham, A. G. 1990) and 370 thousand years (Cherdintsev, V. V.–Kazachevski, I. V. 1990). These datings seem to support the theory that *the fluvial incision having occurred during termination V as suggested above, must have been the period of formation of terrace IV.*

Results provided by diverse examinations carried out on the limestone layers covering the Buda Castle Hill gave the issue different aspect. Fluvial sediment deposited below the travertine horizon marks terrace IV (Schweitzer F. in Krolopp, E. *et al.* 1976). Based on microfauna evidence the age of these strata can either be OIS 14 or OIS 12. (Kordos, L. 2004–2005). However, travertine strata stretching over the terrace are multi-layered: when freshwater limestone formation came to an end, karst and soil forming processes transformed the travertine surfaces. The Th/U age of rejuvenated travertine is 358 ± 60 thousand years (Hennig, G. J. *et al.* 1983). After springs had dried up, loess formation took place, which can be attached to OIS 10 or a younger cold stage. Based on the above, it is possible, that the Buda Castle Hill's *terrace IV* had already *become flood-free* during termination VI and travertine layers deposited onto this surface. Finally it is difficult to decide, whether the formation of terrace IV occurred in the course of termination V or termination VI (*Fig. 3*). *Data can also be interpreted as a doubling of terrace IV.*

Formation of higher and older *terrace V* of the Hungarian rivers might take place before terminations VII and VIII. Currently, though, we do not have sufficient amount of data for determining the ages more precisely. At the same time, evaluation of the above cited data set also highlights, that in some particular cases former terrace classification has not proven to be correct therefore it needs further refinement. It is also important to perform similar reclassifications at other sites as well. For example, the Basaharc terrace is described as II/b, but based on the well developed paleosols BD and BA along the profile, the terrace should be identified as III (more precisely III/b) or even as terrace IV.

Conclusions

Revising the previous and latest results of research work conducted in Hungary, the present study aims to find and detect relationships between the climatically triggered processes, which lie in the background of oxygen isotope stratigraphy and the evolution of fluvial terraces, travertine deposits and their chronology.

Connecting global Pleistocene *chronostratigraphy with the chronology of fluvial terraces* was backed up by the new idea, according to which the long period of *terrace material deposition* can be identified with the slow cooling phases of *glacial cycles*, which were often burdened by climatic setbacks. Formation, that is, the carving of the terrace was done by incising erosion during a few thousands or tens of thousand years in the rapidly warming periods of termination. The key element of the novel *threshold concept* explaining terrace evolution lies in the transformation occurring *during rapid and intense climate change* (termination). The author attempted to provide evidence for this novel system of terrace formation using results and data gathered and published during several decades of Hungarian terrace research and was primarily supported by evidence stemming from the formations covering the terraces and from the results of recent research. *Fig. 3* displays *this novel system* of connecting Pleistocene climate changes reflected by oxygen isotopic curve with *different climatically triggered events of Quaternary surface evolution* (formation of fluvial terraces and their covering travertine deposits and loess-palaeosol sequences) and *their ages*.

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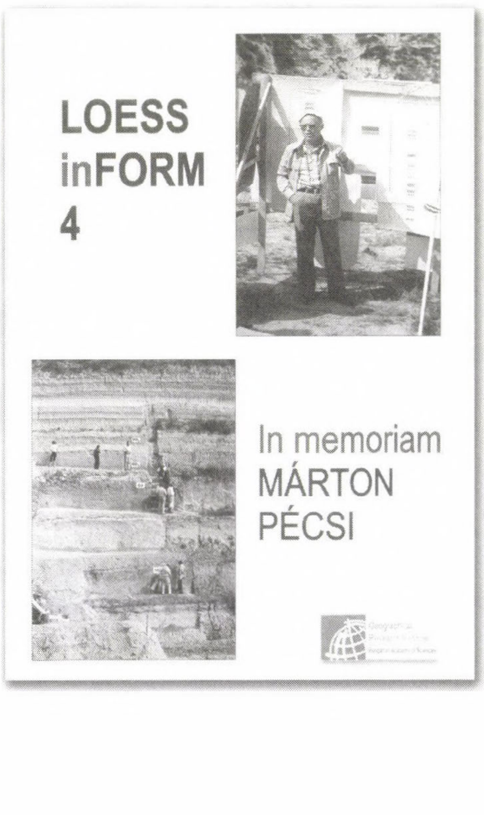
Loess inForm 4 (In memoriam Márton Pécsi)

Loess inForm 4. Regional studies on loess. *Ed. by Éva Kis. Budapest 2004. Geographical Research Institute Hungarian Academy of Sciences. 110 p.*

The present issue of the periodical is intended to pay tribute to its former editor, the late Professor Márton Pécsi (1923–2003), a prominent representative of geomorphology and Quaternary research. Pécsi acted as president of the INQUA Commission on Loess between 1977 and 1991.

Loess inForm was launched by Pécsi in the late 1980s. In the previous numbers theoretical and methodological issues of loess research were published. The regional studies of this edition cover Quaternary paleoclimates and paleoenvironments in northern Eurasia established through palynological studies, results of terrace morphological investigations in the Yenisey valley, of mineralogical analysis of the Chinese loesses, of thermoluminescence and malacological studies of loess in the Carpathian Basin.

The number starts with a brief account of Pécsi's scientific concepts and academic career and closes with photos showing moments of his professional life.



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STUDIES ON PALEOENVIRONMENTAL CHANGES: ANALYSES OF LOESS AND LOESS-LIKE SEDIMENTS ON SUSAK ISLAND IN THE NORTHERN ADRIATIC

FERENC SCHWEITZER[1]–EVA KIS[2]–JÁNOS BALOGH[3]

Introduction

Loess as a result of periglacial dust accumulation during the Pleistocene is a widespread surface deposit in the northern Adriatic region. The determination of granulometric properties such as grain size distribution, sorting, kurtosis and median grain size together with that of the fineness grade, the degree of weathering and calcium carbonate contents were used to characterize the loess deposits within the northern Adriatic region. The results of this sediment analysis were then used to identify the paleogeographic conditions of extremes of cooling and warming during deposition, to separate eolian sediments from the fluvial ones and to reconstruct wind energy regimes and prevailing wind directions within various stages of the Pleistocene as well as rates of sedimentation. The results of the granulometric analyses allowed paleogeographic maps of the area to be constructed (LIU, T. *et al.* 1965; PÉCSI M. *et al.* 1977). The main aim of the study was to provide a detailed investigation of a loess profile located in the northern Adriatic in order to make it a type locality for southern European loess formation. A consistent method was used to analyse Quaternary deposits of primarily loesses and loess-like sediments from Susak Island in the northern Adriatic deposits and use those results to identify and evaluate climatic and environmental changes during the Pleistocene. An important component of this study was the determination of simple and easily accessible information about paleogeographic and paleoenvironmental conditions in the region during the Pleistocene.

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Main geomorphic features and history of landform evolution

This study concentrated on the examination of Pleistocene deposits on Susak Island, which is situated in the southern part of the Kvarner Bay in the northern Adriatic (*Fig. 1 Photo 1*). A 32 m high profile with a steep cliff face running along the Bay of Bok in the south-eastern part of the island overlies a basement consisting of Cretaceous limestone form the rudist facies. A sequence of red clays (Schweitzer, F.–Szöőr, Gy. 1997; Schweitzer, F. 1997, 2003; Balogh, J. 2003) followed by a sandy loess and sand layers have been deposited on the limestone *(Photo 2, Fig. 2)*. During periods of greater warmth and humidity, paleosols developed, whereas warm but drier periods are indicated by the presence of semi-pedolites. Within the sedimentary sequence there is some evidence of deposition within alluvial environments.

Susak is a low-lying island, its highest point is 98 m a.s.l. with a tableland topography *(Photo 3)*. The surface of the island is subdivided into two distinct levels by a escarpment, a higher level at 60–98 m a.s.l., and a lower level at 30–50 m. The loess plateau, especially in the higher north-western part, is minutely subdivided by radial transversal valleys and by a dense network

Fig. 1. Geographical setting of the study area

Photo 1. The lower level of the loess plateau with heavily degrading bluff featuring slumps and slides

Photo 2. The Susak loess exposure

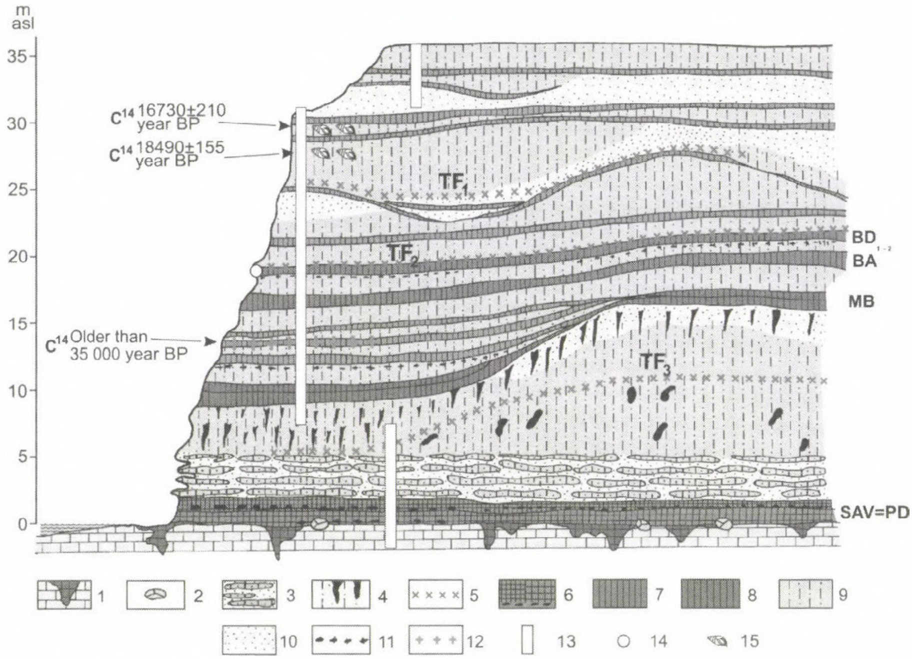

Fig. 2. A geomorphological cross-section of Susak (SCHWEITZER, F.). – 1 = Mesozoic (rudist) limestone, with infillings of typical red clay in the karstic depressions; 2 = ventifact; 3 = sandstone bench; 4 = old loess with loess dolls; 5 = tephra horizons (TF_1, TF_2, TF_3); 6 = reddish clays with horizons of $CaCO_3$ accumulation; 7 = chernozem paleosols; 8 = reddish brown forest soil; 9 = sandy loess; 10 = sand; 11 = charcoal horizon; 12 = charcoal horizon with ^{14}C dating; 13 = sampling sites along the Susak profile; 14 = Paleolithic artefact finds; 15 = ^{14}C datings of Mollusc fauna

Photo 3. South-western part of the island. The surface is subdivided by a well developed step into a lower (30–50 m a.s.l.) level and a higher (60–98 m) level. Here the limestone plateau has undergone a more intense uplift than in the north-eastern part, consequently the superimposing loess and loess-like deposits are thinner

of gullies. The original plateau characteristic has only survived at the summit level, as indicated by the low relative relief of this level (0–2 m, 2–5 m).

The increase in the depth of loess deposits moving north-east suggests that the limestone plateau experienced more intense uplift in the south-western part than in the north-eastern one. As the block was tilted it also experienced minor fracturing along transversal faults. The resulting fractures and fissures within the limestone determined the network of erosional valleys and gullies.

Loess and eolian sand on Susak Island

A considerable amount of eolian sand and loess was deposited on the limestone plateau during the Pleistocene generally around 30 to 50 meters. But borehole data indicates that these deposits can be up to 90 m deep in the north-west of the island. The morphological features of the present-day topography are characterised by accumulational and denudational loess landforms. The relief of loess plateau is determined primarily by original forms of loess mantle.

The development of the loess mantle has had two effects. On the one hand thick sand and loess cover has veiled the structural land forms of karst denudation over the initial limestone surface, on the other hand new landforms resulting from the denudation of the loess have developed on the surface of the loess. Thus there are two relief types on Susak; the buried landforms of the initial surface (structural steps, abrasional limestone cliffs) and the specific loess landforms.

The morphological features are most strikingly represented by pseudokarstic (corrosional-suffosional) landforms of loess. Apart from the loess plateau which represents the initial form of the accumulating dust, landforms such as loess ravines, loess wells, loess pyramids, corrosional-suffosional hollows, steep banks associated with roads cutting in the loess, derasional valleys and gullies in loess and a large numbers of terraces that have resulted from thousand years of human activity.

Derasional processes occur most intensely on the margins of the island where collapses, slumps, slides and slope wash are primarily responsible for the morphological evolution of high bluffs. The limestone bedrock, owing to its tectonic comminution predestines the development of gullies and derasional valleys. Derasional valleys with regard to their morphogenetics can be associated with landslides or with the further development of gullies. Between the loess high bluffs and the coast the limestone bedrock has been exhumed by abrasional process everywhere. In the Upper Cretaceous limestone the waves have formed a relatively low cliff (Bognar, A. 1987). The micromorphological characteristics of this cliff have resulted from corrosion by sea wave and atmospheric precipitation, causing karstification of the limestone.

Granulometric parameters of loess

On the basis of the granulometric parameters shown in *Table 1*, several cycles of sedimentation markedly differing from each other and associated with distinctly different physical environments can be distinguished along the Susak profile (Schweitzer, F.–Kis, É. 2003; Schneiderhöhn, P. 1954). To specify our knowledge of the profile four traditional granulometric parameters (sorting, kurtosis, skewness, median) were applied together with two new indices of environmental discrimination; the fineness grade (FG) and the degree of weathering (Kd), $CaC0_3$ content and variations in the percentage of clay silt, loess and sand fractions were also obtained. The characteristics of these six parameters were determined for the sediments from Susak Island in order to build up a better understanding of the changes in the dynamics of sedimentation during the Pleistocene, grain size variations were used to recognise major lithological units, identify any gaps in sedimentation or mutations within an apparently homogeneous horizon and to distinguish between layers of apparently similar genesis.

In a summary table characterising the profile by layers the values of the two newly added parameters, fineness grade (FG) and degree of weathering (Kd) are presented. FG is used to distinguish between sediments and for the reconstruction of paleotopography The origin of the dust and wind direction and velocity during dust transportation and deposition can be deduced from the decrease and increase of the FG percentage value. The Kd index allows periods of warming and cooling to be identified within the profiles. Of the traditional granulometric parameters sorting (So) serves to reconstruct the environment of deposition, kurtosis (K) identifies loess and paleosol boundaries, whereas asymmetry (Sk) helps identify areas of accumulation and denudation. Md values were not specified in the table as FG value provides a greater range of more reliable information about grain size variations within the deposits. Also interpretation possibilities are offered by layers for the respective parameter values together with geographical characteristics: FG: value, sediment; Kd: value, sediment; So: value, origin; K: value, loess/paleosol boundary; Sk: value, formation (*in situ* or redeposited); comment: sedimentation gaps.

The determination of the granulometric characteristics of the Susak Island deposits allows both vertical and horizontal correlation of the sedimentary sequences. The parameter values for the most important sequences can be obtained from a database which contains all the granulometric data for 93 samples.

The newly introduced index FG shows maxima in soils and minima in sands. Thus, maximum values can be used to identify the paleosol layers, values less than the median indicate young loesses whereas old loesses display fineness maxima. Minima fineness grade can be identified within sands and

Table 1. Granulometric parameters of the Susak profile (KIS, É., laboratory analyses by di GLERIA M.)

Depth of layer, m	Fineness grade (FG)		Degree of weathering (K_d)		Sorting (So)		Kurtosis (K)		Asymmetry (S_k)	
	value	sediment	value	sediment	value	origin	value	sediment	value	formation
0.00–1.75	58.58–59.47	loess	4.72–5.87	loess	1.66–1.87	eolian	0.22–0.31	–	0.59–0.84	in situ
2.05–2.15	57.06	weak humus horizon	5.28	weak humus horizon	1.57	–	0.24	–	0.92	redeposited
2.15–6.10	58.20–59.38	loess	4.4–7.14	loess	1.61–1.74	eolian	0.23–0.25	–	081–1.37	redeposited
6.10–6.55	56.48–57.06	weak humus horizon	7.47–7.33	weak humus horizon	1.53–1.66	eolian	0.23–0.27	–	0.86–1.03	redeposited
6.55–9.78	56.69–57.20	loess	8.00–8.83	loess	1.46–1.54	eolian	0.21–0.24	–	0.83–0.95	redeposited
9.78–9.85	57.68	upper tephra	9.56	upper tephra	1.61	eolian	0.26	–	1.1	redeposited
9.85–10.95	56.52–56.67	loess	7.83–8.26	loess	1.47–1.61	eolian	0.23–0.27	–	0.91–1.02	redeposited
10.95–11.35	54.91–55.6	loess	11.1–11.94	loess	1.43–1.49	eolian	0.22–0.26	–	0.83–0.97	redeposited
11.35–11.70	56.53–57.34	soil	6.86–7.83	soil	1.47–1.48	–	0.2–0.23	–	0.7–0.77	in situ
11.70–13.50	31.46–31.53	coarse grained sand	2.1–2.76	coarse grained sand	0.84–0.85	eolian	0.36–0.43	–	2.5–2.52	redeposited
13.50–14.00	55.84–56.00	loess	7.9–8.65	loess	1.53–1.56	eolian	0.25–0.27	–	0.84–0.87	redeposited
14.00–14.35	54.13–54.23	soil	16.82–22.8	soil	1.25–1.49	–	0.27–0.28	–	0.64–0.9	in situ
14.35–16.45	56.09–56.37	sandy loess	9.75–12.4	sandy loess	1.53–1.62	eolian	0.27–0.28	–	0.88–0.9	redeposited
16.50–16.52	57.79	middle tephra	7.95	middle tephra	1.66	eolian	0.23	–	1	in situ
16.52–17.50	57.00–59.24	soil	4.59.24	soil	1.68–1.72	–	0.23–1.2	–	1.91–0.96	in situ
17.50–17.90	55.57	loess	8.95	loess	1.56	eolian	0.31	–	0.5	redeposited
17.90–19.10	56.53–60.79	soil	2.49–2.94	soil	1.32–2.15	–	0.14–0.32	–	0.69–0.86	in situ
19.10–19.60	43.90–49.60	fine grained sand	2.59–3.08	fine grained sand	1.28–2.21	eolian	0.2–0.32	–	0.32–0.91	in situ
19.60–20.33	54.44–64.82	soil	2.77–4.23	soil	1.53–2.42	–	0.2–0.34	–	0.51–0.84	in situ
20.33–20.55	45.9	fine grained sand	5.09	fine grained sand	1.37	eolian	0.21	–	0.79	in situ
20.55–21.40	51.59–53.68	loess	6.01–6.58	loess	1.48–1.65	–	0.24–0.27	–	0.8–0.84	in situ
21.40–21.75	53.03–54.6	soil	3.76–4.73	soil	1.68–2.03	–	0.16–0.32	–	0.46–0.89	in situ
21.75–22.10	53.16	loess	8.05	loess	1.93	eolian	0.24	–	0.88	in situ
22.10–22.18	53.16–55.19	skeletal soil	6.18	skeletal soil	1.7	–	0.24	–	0.24	in situ
22.18–22.23	52.59	loess	7.8	loess	1.62	eolian	0.25	–	0.78	in situ
22.23–24.10	60.08–70.87	soil	1.1–2.98	soil	1.1–5.48	–	0.14–0.23	–	0.1–25	in situ
24.10–26.40	54.73–56.03	loess-like sediment	10.5–12.9	loess-like sediment	1.39–1.51	eolian	0.21–0.23	–	0.78–0.84	in situ
26.40–26.43	55.09	lower tephra	11.32	lower tephra	1.53	eolian	0.27	–	0.84	in situ
26.43–28.70	56.72	loess-like sediment	6	loess-like sediment	1.57	eolian	0.25	–	0.81	redeposited
30.10–31.00	53.44–56.58	fine grained sand	10.27–15.17	fine grained sand	1.39–1.84	eolian	0.24–0.36	–	0.72–0.93	redeposited
31.00–31.66	69.19–74.61	reddish clay	1.03–1.71	reddish clay	2.86–4.42	–	0.19–0.33	–	0.27–0.62	redeposited

the layers containing higher values indicate silt interbedding. Consequently FG values can be used to help delimit boundaries between horizons. An increase or decrease of the values indicates finer or coarser granulometry and help make distinction between young and old loesses and identify inhomogeneities within paleosols.

Apart from the identification and separation of sediments the Kd index enables conclusions to be reached about the climatic conditions that prevailed during the period of sedimentation. Its minima coincide with a period of warming and paleosols development (their exact depth in the paleosol layer can be determined), whereas maxima refer to a period of cooling and dust deposition (their exact depth in the loess layer can be determined) and gaps in sedimentation can be identified.

The use of both the FG and Kd index values and the traditional granulometric parameters makes it easier to distinguish more clearly between sediments within a stratigraphic sequence based on their sedimentary characteristics, and to draw some conclusions about the environmental conditions during deposition, including hiatuses in deposition.

Eolian (So>2.5) and fluvial (So = 2.5–3.0) deposits can be distinguished on the basis of sorting (So) (Trask, D. P 1931). Values of 3–5.59 (along some profiles values of up to So = 10 occur) indicate deposits containing a mixture of sediments of eolian and fluvial origin and in almost all cases represent paleosols.

Determination of kurtosis (K) allows a precise identification of the boundaries between loesses and paleosols, with extreme values indicating mixing of these two kinds of deposits. Asymmetry (Sk) demonstrates a relative rate of sedimentation in accumulation area. Values higher than 0.80 represent redeposited material, thus determination of asymmetry allow a distinction to be made between *in situ* and redeposited sediments (Folk, R. L.–Ward, W C. 1957).

Loess chronology

Using the granulometric parameters described above 30 layers could be distinguished along the section (*Kis, É.*) (*Fig. 3*):

I. 10 paleosol layers:

– 1 double, sometimes triple reddish clay *(Photo 4)*;

– triple reddish brown so called Susak soil of MB type;

– chocolate brown chernozem-type soils frequently with fire places resembling paleolithic sites i.e. horizons with charcoal remains *(Photo 5)*;

– 3 weak humus horizons (index values show less of them than found during sampling) with a thickness of 20–40 cm containing gypsum.

II. 4 sand layers:

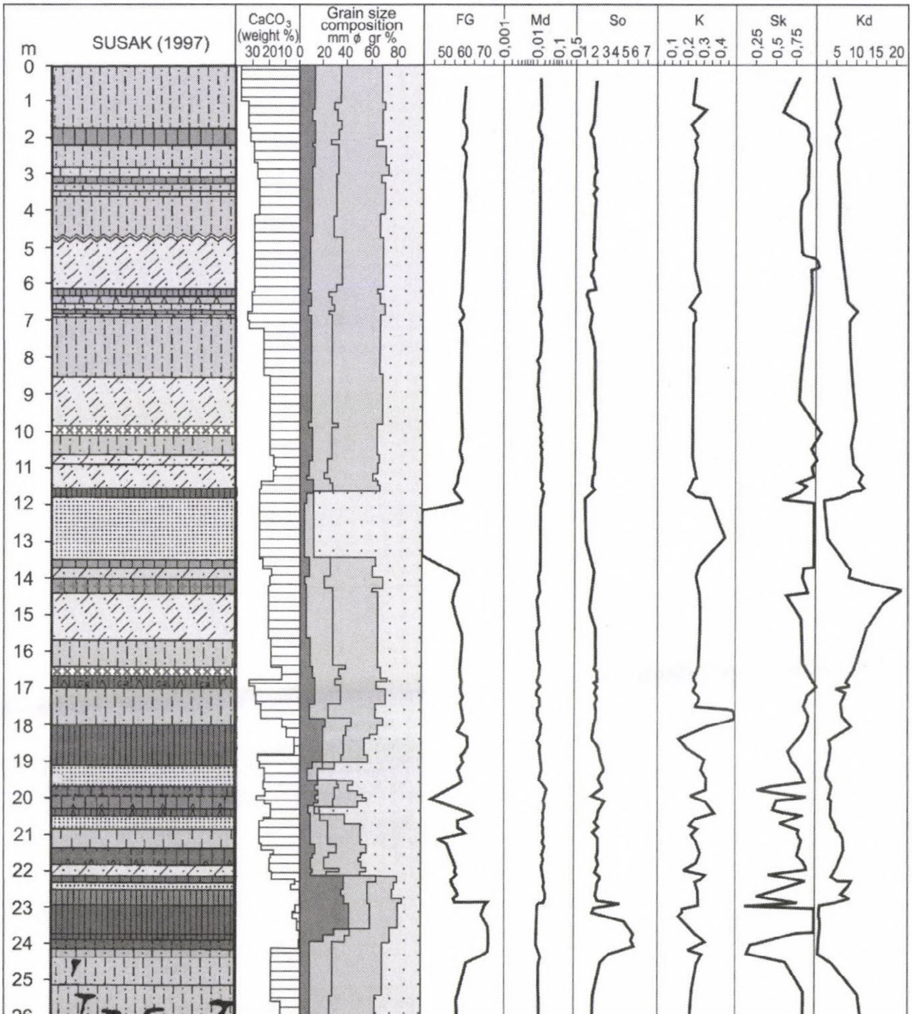

Fig. 3. Granulometric parameter values of the Susak profile (KIS, É.), stratigraphical analysis by SCHWEITZER, F.–KIS, É.–SZÖŐR, GY.–BOGNAR, A.–BALOGH, J.–DI GLERIA, M.

Photo 4. Double, sometimes triple layers of reddish clay

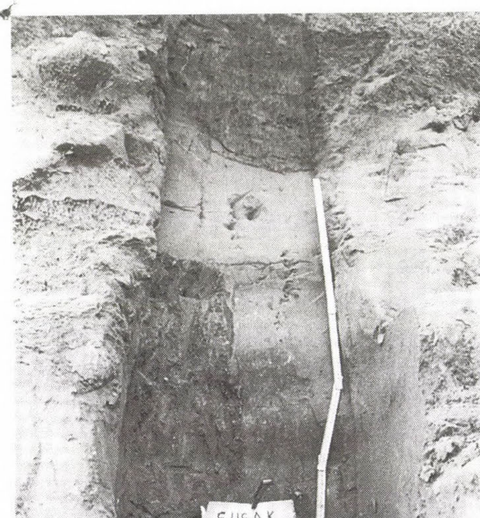

Photo 5. Chocolate brown chernozem-type soils

– 1 coarse grained sand (11.70–13.50 m; *(Photo 6)*);
– 2 fine sand (19.10–19. 60 m and 20.33–20.55 m);
– 1 tidal sand layer (30.10–31.00 m.
III. 13 layers of loess and loess-like deposits:
– 11 loess layers;
– 2 loess-like layers.
IV. 3 tephra horizons:
– upper tephra horizon (9. 78–9.85 m): a reddish brown layer in loess with fine sand, redeposited in several places;
– middle tephra horizon (16.50–16.52 m): a yellow layer superimposed upon a chocolate brown paleosol;
– lower tephra horizon (26.40–26.43 m): a grey layer overlying silty sand.

Boundaries of the layers within the section can be localised from *Table 1*. Denuded horizons between loess and paleosols can be assumed by the occurrence of extreme values of Kd. For samples, Kd shows a strikingly high value (22.80) within a paleosol between 14.00 m and 14.35 m. A hiatus in loess deposition can be assumed to have occurred here.

Sands of three fineness grades are of interest in relation to the origin of the sediments:
1. coarse grained sand (FG = 31.46–35.53);
2. fine grained sand (FG = 43.90–49.60; 49.90);
3. "flood plain" sand (FG = 53.44–56.58);

The asymmetry (Sk) value of the first of these sands is three times greater than average (2.50–2.52), whereas its sorting (So) is half of the median value (0.84–0.85). Plotting the values on average grain size versus standard deviation diagrams, upon asymmetry versus standard deviation diagrams and on asymmetry-kurtosis diagrams, we arrive at a fluvial origin for the sand. This is quite possible that the river channels became longer during Pleistocene marine regressions. At that time the Isonzo delta faced to the Adriatic was located 70 km west of Mali Losinj and its tributary Rasa stretched up to Susak (Melik, A. 1952). It is probable that the sand was blown out from the bed of the Rasa and a cross-bedded dune of approximately 2 m height was built up. Fine sands represent *in situ* dune sands.

The fineness grade values of "tidal" sands (*Photo 7*) resemble those of loesses, though the weathering grade is five times greater than that of coarse sands. The sorting values indicate marine littoral sediment, which was arranged by the prevailing winds into dunes, consequently the latter are labelled as eolian sands (So = 1.39–1.84).

The granulometric parameter values obtained from the tephras which are superimposed on the loesses, loess-like sediments or paleosols (1: upper/redeposited/tephra So = 1.61; 2: middle/*in situ*/tephra So = 1.66; 3: lower/*in situ*/ tephra on loess-like sediments So = 1.53) appear to have an eolian origin.

Photo 6. Dune sand blown out of fluvial sand

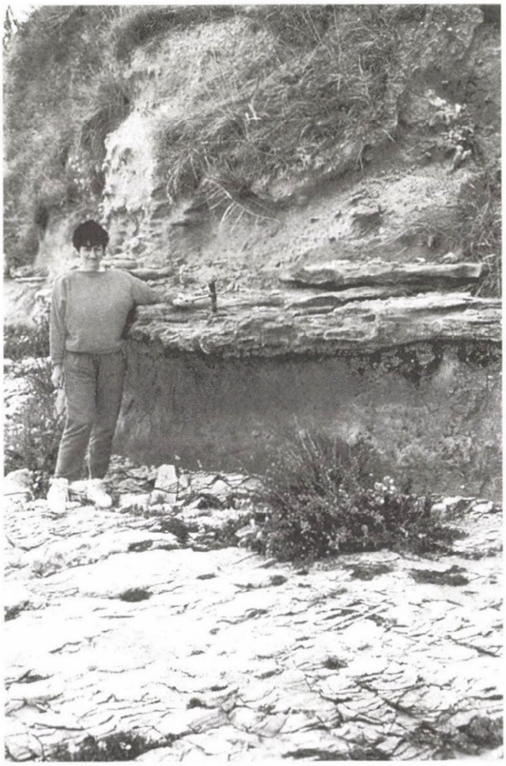

Photo 7. "Tidal" sand layer overlying triple reddish clay

Summary

Based on the asymmetry parameters obtained the uppermost loess with the interbedded middle tephra which overlies the middle paleosol complex appears to represent a reworked deposit, except for the loess layers between 0.00–0.75 and 16.52–17.50 m depth, the paleosols between 11.35–11.70 and 14.00–14.35 m and the middle tephra between 16.50–16.52 m. Below this depth *in situ* sediments are found. A notable case is that of loess-like sediments (24.10–28.70 m) and marine littoral i.e. "tidal" sands (30.10–31.00 m). These have been affected by waves during high tide (12 hours) and by winds (by bora and sirocco during the winter half-year and maestral during the summer one). Based on the variations displayed FG values by the young and old loess pockets and paleosols singled out. In general, over the Carpathian Basin values 60.98–68.38 indicate young loesses, whilst values 65.34–73.59 refer to old loesses. Along the Susak profile loess is represented by a variety of deposits with high sand contents. Values of 55.57–59.47 are typical of young loesses. Below 20.55 m loess becomes increasingly sandy and FG decreases to 52.59 which is almost sand. In the lowermost part of the profile loess-like material prevails (54.73–56.03 and 53.44–56.58) contrasting with loesses of higher parameter values.

Using the method described above information on the granulometry of the Susak profile allows paleogeographic conclusions to be obtained directly from the database, from the summary table containing the parameter values for the individual layers and from the stratigraphic diagrams.

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WATER AND WIND EROSION IN HUNGARY

Ádám Kertész[1]

Introduction

In Hungary the soil is one of the most important natural resources. Soil erosion is one of the most significant *land degradation* processes in agricultural areas. Other land degradation processes, such as acidification and salinisation/ alkalinisation, compaction, destruction of soil structure, surface sealing and other chemical, physical and biological degradation processes (see Várallyay, Gy.–Lesztták, M. 1990; Kertész, Á. 2001) are also important, but are not as extensive as soil erosion.

More than one third of agricultural land (2.3 million hectares) is affected by water erosion (13.2% slightly, 13.6% moderately and 8.5% severely eroded) and 1.5 million hectares suffer from wind erosion (Stefanovits, P.–Várallyay, Gy. 1992, see *Table 1*).

Moderate and strong water and wind erosion extend over 1.7 million hectares.

Table 1. Soil erosion in Hungary

Area, land	Thousand hectares	Percentage total area	Percentage agricultural land	Percentage eroded land
Area of the country	9 303	100.0	–	–
Area of agricultural land	6 484	69.7	100.0	–
Arable land	4 713	50.7	73.0	–
Total eroded land	2 297	24.7	35.3	100.0
strongly	554	6.0	8.5	24.1
moderately	885	9.5	13.6	38.5
weakly	852	9.2	13.2	37.4

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Figure 1 shows the degree of erosion in Hungary.

The first soil erosion map was constructed as early as 1964 by STEFANOVITS, P.–DUCK, T. excluding non-agricultural uses, e.g. forests, urban and industrial areas, roads, etc. The mapping was based upon the analysis of soil profiles. First a soil profile not affected by soil erosion had to be found which was used as a basis for comparison in characterising the soil is profiles of the neighbouring area. Three stages of erosion were defined: the soil slightly eroded if 70% of the basic profile can be detected. The soil is defined as medium eroded in case of 30–70% and strongly eroded if less than 30% of the basic profile is available. Areas affected by wind erosion are also represented on the map.

Most of the soils in Hungary are prone to erosion as about two thirds of the surface area of Hungary is covered by unconsolidated sediments. Loess and loess-like deposits are dominant among them. Mean annual precipitation varies between less then 500 mm and more then 900 mm. Maximum precipitation is typical in June and the second maximum may occur in October as a consequence of the Mediterranean influence. Summer drought is the main problem for agriculture. High intensity rainfall as well as drought is typical during the summer. High intensity rainfalls of relatively short duration cause the most extensive erosion events in the hilly and mountainous areas of the country.

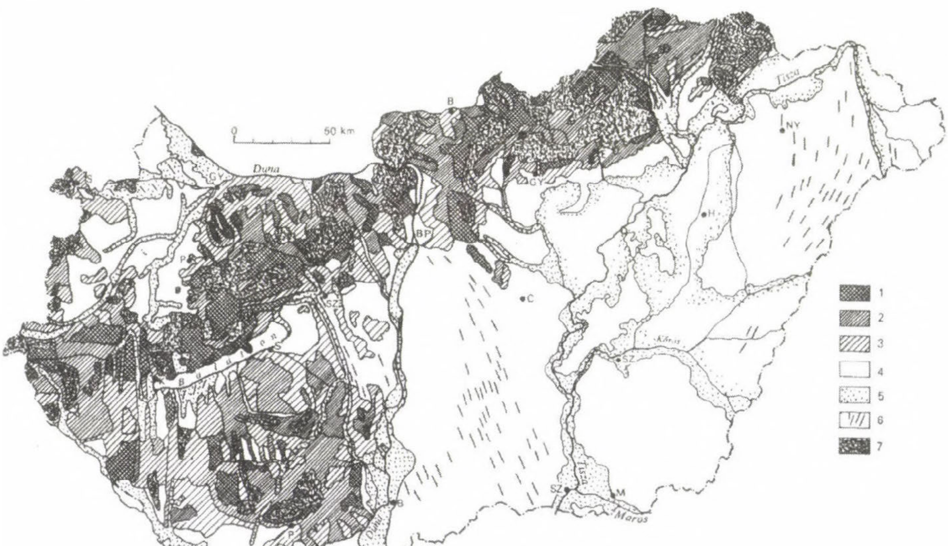

Fig. 1. Soil erosion in Hungary (STEFANOVITS, P. and VÁRALLYAY, GY. 1992). – 1 = strongly eroded; 2 = moderately eroded; 3 = weakly eroded; 4 = areas not affected by water erosion; 5 = sediment area; 6 = areas affected by wind erosion; 7 = forests

Table 2. Changes of agricultural land use in Hungary (% of total area)

Land use	1938	1960	1985	1993	2001
Arable land	60.4	57.1	50.4	50.7	48.5
Gardens/orchards	1.3	2.0	4.8	1.4	2.1
Vineyards	2.2	2.2	1.7	1.4	1.0
Meadows/pastures	17.3	15.4	13.6	12.4	11.4
Agricultural land	*81.2*	*76.7*	*70.5*	*65.9*	*63.0*

The present land use structure is shown in *Table 2*. 77% of the territory of the Great Plain is agricultural land of which 73% is arable. Slopes of highlands and hills give rise to the development of traditional vine-growing and vine producing districts. In the valleys and on the hill ridges, due to their cooler and wetter climate, animal husbandry dominates, based on grazing and fodder production, and is closely associated with forestry.

Urban agglomerations (first of all Budapest) and contiguous recreation areas (Balaton, Danube Bend) are typical places for gardens, which now comprise 2.1% of the total territory of Hungary. The rapid expansion of built-up areas can be observed in urbanised regions, therefore, the area taken out of agricultural use accounts for 17.2% of the territory of the country.

The percentage of forests gradually diminished until the 1950s and was as low as 12% after World War II. The country is situated in the forest-steppe zone and the largest part of hilly regions was forested in the past. A considerable part of this hilly land was deforested in the 18–20th centuries and converted into arable land, increasing erosion hazard; resulting in serious soil losses on the slopes; sedimentation and waterlogging problems in lowland areas. As a result of reforestation now the woodland reaches 19.2% of the country's territory. Grassland was heavily damaged by overgrazing, by natural degradation and owing to poor management. In Hungary grassland occurs in most cases on floodplains and on peatland with a high risk of flooding and waterlogging, and is also common in sandy and salt-affected regions with low fertility and low capacity of biomass production (Stefanovits, P.–Várallyay, Gy. 1992).

Water erosion

Mountain and hill regions of Hungary are severely affected by water-erosion processes (*Photos 1* and 2). Surplus runoff, the loss of soil, nutrients and fertilizers and the accumulation of washed-down material present problems.

Relief conditions favouring erosion are analysed according to the slope gradient categories used in Hungary. On slopes <5% erosion hazard is negligible. As slopes >25% are generally forested they do not give rise to a high risk of erosion (Stefanovits, P.–Várallyay, Gy. 1992). The 17–25% slopes are either under forest or were deforested in the recent past. Most of

Photo 1. Sheet erosion is widespread on hillslopes used for agriculture

Photo 2. Launching gully erosion on arable land

the 5–17% slopes are used for agriculture and degraded by soil erosion to a certain extent (Krisztián, J. 1992).

Erosion-sensitive days characterized by >30 mm daily rainfall are of utmost importance (Stefanovits, P.–Várallyay, Gy. 1992), and they occur 4–12-times per year. Part of atmospheric precipitation falls as intense rain (>30 mm/day) during the vegetation period (March-October). The amount of snow, the snow-cover duration and the rate of snow-melting show an extremely high spatial and time variability. After a cold winter when the soil is deeply frozen the quick snow-melt may result in intense surface runoff and soil erosion.

As mentioned earlier soils are generally highly erodible because the parent material is loose sediment. A great number of investigations were carried out in Hungary to analyse and evaluate the influence of various soil characteristics on the rate, processes and consequences of water- and wind erosion (Karácsony J. 1991; Kertész, Á.–Mezősi, G. 1992; Kerényi A. 1991; Stefanovits, P. 1963, 1964, 1971; Várallyay, Gy. 1986, 1989).

Water erosion processes include sheet-wash, rill and gully erosion. Sheet-wash is an important problem on most of arable land. Most of the crop is harvested by the beginning of June leaving large surfaces without vegetation cover during the most sensitive period, i.e. between July–October. Sheet erosion processes are supported by micro- solifluction and by splash erosion (Kerényi A. 1991). Limited infiltration due to surface compaction, soil surface sealing and crusting and to the plough pan layer near the surface increase the frequency of sheet erosion on large arable plots.

Linear processes of rill and gully erosion are also widespread in hilly areas covered by loose sediments. There is also historical evidence (e.g. Gábris, Gy. *et al.* 2003) that very intensive gully erosion activity took place in the nineteenth century when large areas covered by loose sediments were deforested and opened for arable farming.

Wind erosion

Areas of wind blown sand occupy about 20% of the country's territory. The thickness of sand sediments varies from a few centimetres to 25–30 metres. Soil erosion by wind affects 16% of Hungary's surface. Damage is primarily caused on sandy soils (e.g. on the Danube–Tisza Interfluve, see Mezősi G.–Szatmári J. 1996), where crop yields may be reduced by up to 50%. Improperly cultivated peat soils with decomposed, powdery surfaces also have low resistance to wind erosion.

A method was proposed by Karácsony J. (1991) for the assessment of wind erosion. According to this estimation wind erosion endangers 30–40% of arable land (more than 1.5 million hectares). Wind erosion has been increasing during the last 2–3 decades and it has affected not only the traditionally sensitive sandy soils and peats, but most fertile soils as well (Stefanovits, P.–Várallyay, Gy. 1992).

There is a strong seasonality in deflation with peaks in early spring and in summer. Improper farming practices may lead to a powdering of the soil surface or compaction, and ultimately to deflation.

In Hungary the major factor of wind erosion is the low cohesion of a dry soil surface. The obvious preventive measure is to ensure a proper vegetation cover, which reduces turbulent air motion on the surface. Rye sowing, mulching or green manuring are most often applied (Stefanovits P. 1977). Inorganic materials are also suitable for sealing the soil surface, e.g. clay, bentonite injection, resins or plastic foils (Szabó, J. 1977).

In order to allow mechanisation after the collectivisation of Hungarian agriculture, large arable fields were formed. At the present time, where wind velocity is high and droughts are frequent, small (maximum 25 ha) plots separated by shelterbelts are recommended. Shelterbelts of rapidly growing trees (e.g. poplars and acacia) are preferred. Shelterbelts were introduced in Hungary following Soviet examples. They are now considered necessary on soils with poor water retention and on those liable to drought.

Conclusions

In spite of the fact that water and wind erosion lead to serious problems the perception of erosion is at a very low level among the farmers. Policy makers have been aware of the problem therefore soil conservation became part of the state agricultural policy (Stefanovits P. 1977; Várallyay, Gy.–Dezsény, Z. 1979).

The protection of agricultural land has long been legislated in Hungary (by the 1961/VI Act). The 1987/I Act (popularly called the Land Codex) includes provisions on the soil-conserving cultivation of land, according to the physical endowments and current land use.

The change of regime in 1989 triggered the wave of reprivatisation and the role of state subsidies started to vanish. Chapter VI of Law 55 (1994) regulates soil conservation. It determines the major threats that soil must be protected against water and wind erosion, extreme moisture conditions, salinisation/sodification, acidification, other processes of physical, chemical and biological degradation. According to this law soil conservation is a joint task of the state and the land user.

The Governmental Decree No. 49/2001. (IV. 3.) on the protection of waters against nitrates from agricultural sources describes the rules of right agricultural practice including some measures on erosion control. Application of these measures is obligatory in nitrate vulnerable zones to be checked by the Soil Conservation Service. Farmers may apply for subsidy for deep loosening according to the Ministerial Decree No. 3/2003. (I. 24.) of the Ministry of Agriculture and Rural Development.

The main task of scientists is to use every possible tool to inform farmers and policy makers about the consequences of water and wind erosion by publishing quantitative data on the on site and off site effects of these processes in order to enhance the level of perception among farmers.

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NATURAL HAZARDS IN HUNGARY

József Szabó–József Lóki–Csaba Tóth–Gergely Szabó[1]

Introduction, objectives

The fundamental goal of the paper is to study the territory of Hungary with regard to natural hazards in order to support objective decision making aimed at the implementation of justified measures through a review of the related principal natural processes.

The analysis focuses on the triggers provoking natural disasters and reviews them in terms of micro-regions. This also means that hazard types which occur ever more frequently nowadays and might lead to natural disasters eventually, in the triggering of which the society plays a more or less substantial role (semi-anthropogenic or natural-anthropogenic hazards), are tackled only briefly (Szabó J. *et al.* 2007).

Databases and methods

For the presentation and assessment of the regional factors of natural hazards the physical landscapes of Hungary were chosen as the entities of study. From the present databases reliable analyses and assessments can be performed down to the level of micro-regions. The latter were taken as they are presented in the Inventory of Hungarian Micro-regions of Hungary (Marosi S.–Somogyi S. 1990) widely used nowadays. Therefore the data were applied across the 230 micro-regions found in the Inventory.

Apart from biospheric hazards omitted in the present paper there are 23 hazard types. 16 of them are likely to occur in Hungary. As for the 5 subtypes (falls, landslides, rock and debris avalanches, debris and mudflows, ground sinking) belonging to the group of external forces of lithospheric hazards virtually mean mass movements in the geomorphological sense and data

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available are relevant to this combined subtype, altogether 12 subtypes were phased out, and 7 of them were involved in the investigations. They were chosen because currently they represent the highest risk in Hungary and most of the data available were related to them. The original classification is modified by the separation of *floods* and *waterlogging* and their separate investigation due to the specific natural conditions. Eventually *earthquakes, mass (or surface) movements, wind erosion, downpours, floods, waterlogging* and *droughts* were investigated. The present paper focuses on the analyses of floods, wind erosion and mass movements together with the maps constructed from the results *(Figs 1 through 3)* and the summary maps compiled on the basis of the seven hazard types *(Figs 4 and 5).*

For each of the factors the results of the investigations were plotted on the micro-region map of Hungary. The expectancy of the occurrence of the individual hazard types in the micro-regions (risk) was classified into 4 groups: *negligible (0), slight (1), moderate (2), serious (3).* Since there are numerous micro-regions that cannot be regarded as uniform considering the individual hazard types attempts were made to take this inhomogeneity into account.

Some examples:

– In the lowest lowland sections of micro-regions (e.g. across low floodplains) surfaces elevating from the base level (e.g. levees, high floodplains, terrace islands) are frequent. The high degree of risk of flooding is apparent for the base level, however, the risk for the elevated surfaces is much lesser, it might be negligible. It would be a mistake to extrapolate its significantly high risk of floods over the entire micro-region. In such cases supplementary marks were applied. Over the colour of risk degree characterising the base level of the micro-region another layer of hatching was placed to attract attention. In case the extent of the areas with risk different from the base level is around 25%, dots are used. In the case of 50% lines can be observed while at 75% cross stripes are applied. Thus map representation became more differentiated.

– In the opposite case, in most of the territory of the micro-region no hazards occur or they have only slight effect. However, the micro-region may have parts, sometimes of large extension, where the risk is extremely high. Although its presentation in cartograms is problematic, drawing attention to the local risks is essential. This is achieved by a "**V**" symbol to appear within the micro-region. A typical case is found in a few extensive micro-regions with low relief energy in the Mezőföld where surface movement is not typical at all, except for the narrow bluff zone flanking the Danube, nevertheless mass movement processes pose frequent and serious hazard.

Hungarian landscapes threatened by natural hazards with risk of different degree are characterised more accurately than ever in risk maps for micro-regions constructed on the basis of the above principles. At the end of the investigations an attempt was made to aggregate the different kinds of risk in a summary map. As a result the individual micro-regions received a general risk value. These sum values were determined by two methods. In order to get a closer insight into the general situation the chance for subjective errors was taken deliberately.

Formula of the simple sum:

$$V = A + B + S + T + E + R + F$$

where

V= general risk, further risk of: A = floods, B = waterlogging, S = droughts, T = mass movements, E = wind erosion, R = earthquakes, F = downpours. (Each factor may receive values between 0 and 3 depending on the degree of risk.) In the cases of marks „a", „b" and „c" the risk value of the given landscape was reduced by 0.25, 0.5, 0.75 respective to the letters.

Algorithm of the weighed sum:

$$V_s = 2A + 2B + 2S + T + E + R + F$$

where

V_s = weighed risk, A, B, S, T, E, R, F = same as in the case of simple sum. (Similarly, base values were reduced by 0.25, 0.5 and 0.75 when applying labels of „a", „b", and „c".)

Weighed sum means that three of the natural hazards were selected as considered the most severe ones in Hungary and they were calculated as multiplied by two. It is doubtless that most damage is caused by these factors, but it is arguable whether their impact is exactly the double of those of the rest and whether the latter are equal to each other should be questioned as well. Nevertheless, the authors hold that – based on our present analytic skills and databases – the most important regional differences are manifest despite subjective weighing or even in spite of the lack of weighing at all.

Several factors had to be accounted when determining the degree of the individual risk types:

The potential of the development of *earthquakes, downpours, droughts* and *aeolian* processes was not changed by the society and by the economic development. Their real damage was mitigated as some sort of protective measures were taken (introduction of construction technologies of higher safety, afforestation, irrigation, etc.). Wind erosion is a specific case as besides protection measures which have proven to be more or less successful, the changing of different land use types (deforestation, extensive cultivation) increased the risk of wind erosion even in similar conditions of atmospheric circulation. Therefore in the case of wind erosion the use of the term "potential" is justified and it has to be accounted in the course of the assessment.

In the case of the other hazards studied the triggers can also be impeded successfully, or at least their devastating energy can be reduced. The size of *floods*, the extension and primarily the time period of *waterlogging*, the triggers of *surface movements* can be reduced significantly. Potential catastrophes are not realised in every case. The technique of protection measures have also improved significantly. However, it has to be admitted that the reduction of their risk is far from being unambiguous.

– *On the one hand* the protection itself frequently alters the grade of risk, occasionally increasing it (the level of the flood waves of the rivers forced into embankments has risen due to the limited size of cross-section, the construction of the flood preventing embankments exacerbated the problems associated with waterlogging and with providing water storage of the slopes the threat of mass movements also increased).

– *On the other hand*, the (often irresponsible) actions of the society increased the risk attributed to some of the natural hazards. Deforestation in mountains added to the risk of floods – although to a controversial rate – while the alteration of slopes or their undermining increased the risk of mass movements, etc.

Due to the above facts the maps constructed on the basis of the analyses and the available data

– regarding *floods*, they show the magnitude of hazard expected in the case of the failure of defences,

– considering *mass movements*, they display the degree of hazards deduced from surface conditions and experiences,

– as for *wind erosion*, they indicate the potential hazard.

Results

Table 1 gives an outline on the statistics of the risk degrees of the 7 types of natural hazards studied and estimated according to micro-regions. As there are significant differences in the areal extension of the micro-regions the percentage data of the table for the individual hazard types do not represent the all-national spatial extension of the degrees of the risk posed by the latter. There is only a loose correlation between the two. The description and explanation of the headings of the table is given in the previous (2) chapter on the methods. The description of the individual hazard types is given in the following chapters.

Floods

As it was mentioned above, assessing the risk of flood hazard was based on the effect or potential effect of flooding of the streams in the lack of defence

Table 1. Ratio of natural micro-regions classified into risk degrees as compared to all micro-regions of Hungary (A) and to the total area of the country (B) (%)

Hazard type	Degree									
	Serious (3)		Moderate (2)		Slight (1)		Negligible (0)		Locally serious (V)	Landscape uniformity regarding hazards*
	A	B	A	B	A	B	A	B	A	A
Floods	17	19	6	9	15	22	62	50	11	38
Waterlogging	17	37	5	7	7	10	71	46	6	5
Droughts	21	44	19	18	29	19	31	19	-	>80
Wind erosion	7	17	7	7	49	48	37	28	-	-
Mass (surface) movements	4	2	8	6	27	15	61	77	9	n.d.
Earthquakes	7	5	25	29	67	61	1	5	-	20
Downpours	0	0	14	15	86	85	0	0	-	~ 100

*Numbers show percentage values of micro-regions classed into the group of highest risk degree

constructions or in the case of their damage. The bases for the estimations were the relief and geomorphological conditions of the given micro-region. For this the Topo Explorer maps of Hungary at a scale of 1:50 000 together with several archive maps on floods (primarily the map presenting the Carpathian Basin prior to the river regulation works constructed by A. Rónai in 1938) were applied. To characterise the micro-landscapes the Inventory of Natural Micro-regions of Hungary edited by S. Marosi and S. Somogyi (1990) was used.

Although the four classes in the map of flood hazard (*Fig. 1*) reflect *national* differences the 'serious' degree on the map indicates high risk not only in domestic terms since based on the natural conditions of the flood hazard Hungary is classified among the extremely hazardous areas in international comparison as well. Naturally, defences present a serious retaining force. For example there were only two floods due to dam failures along the Tisza and the Danube during the last century: 1947/1948 and 2001 along the Tisza and in 1954 and 1956 along the Danube. However, the water of flood waves had to be released into temporary storage facilities frequently and the weaker embankments along the tributaries were damaged on several occasions. Furthermore floods often arrived from the neighbouring countries across the 'green border' (to mention inundations of the Szamos and Túr in 1970).

Regarding the abundant property in the protected floodplains of Hungary and the deficiencies of flood prevention revealed occasionally it can

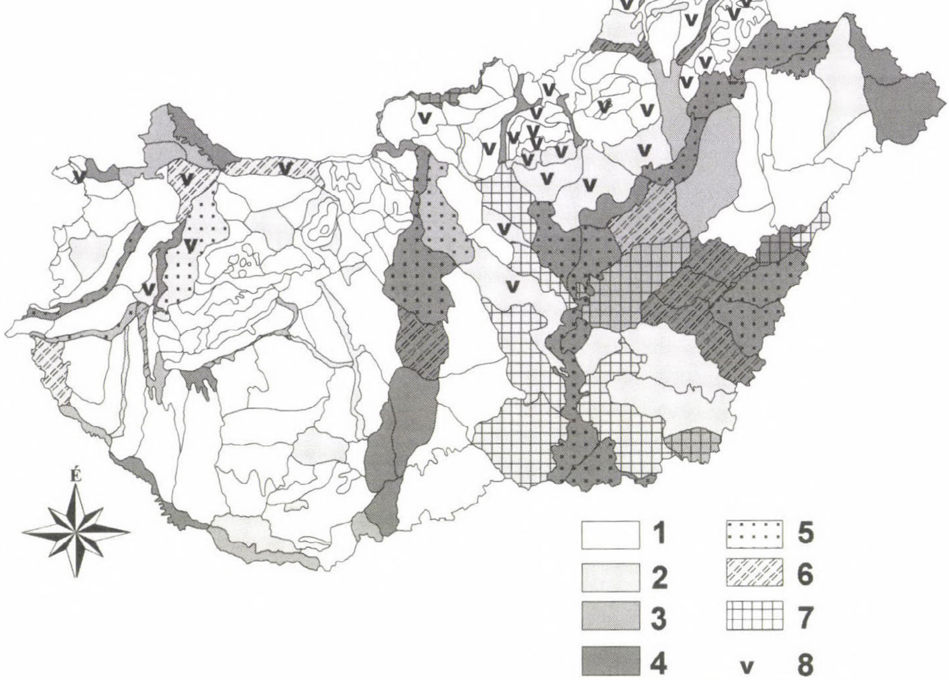

Fig. 1. Flood hazard across landscape microregions of Hungary. – 1 = negligible; 2 = slight; 3 = moderate; 4 = serious. Terrain of slight risk of floods 5 = ca 25%; 6 = ca 50%; 7 = ca 75% within the total area of the microregion. 8 = in some parts of the microregion the risk sub stantially exceeds the average

be stated that potential hazard cannot be ignored in many of the micro-regions within the Great Hungarian Plain and the Little Plain, rather it has to be classified into the 'serious' category of risk. This is justified by the occurrence of major floods on the main rivers during the past ten years or so, which caused significant damage and consumed considerable financial expenditures (Tisza: 1998, 1999, 2000, 2001, 2006; Danube: 2002, 2006; Hernád: 2004, 2006).

Apart from the statistical data visualised in *Fig. 1* and summarised in *Table 1* it has to be emphasized that flood hazard cannot be exposed in total depth even at the micro-region level. Less extensive floods, however serious in damages but lasting for short periods of time may occur locally mostly in the non-lowland areas of the country (e.g. within relatively narrow valleys). Marks of "V" were applied for indicating these sections, however, not all of them. Part of such floods cannot be indicated in maps of micro-region level. Examples of devastating floods developed in the first few years of the 21st century and classified typically into this group are listed in *Table 2*.

Table 2. Some of the major floods in mountains and hills in the first years of the 21st century

- August 9–13, 2002: floods on several streams in Borsod-Abaúj-Zemplén County following heavy rainfalls and damaging 49 properties,
- November 1, 2003: a dam failure on a fishpond on the Bárna stream (500,000 m^3 of water swept across Mátranovák),
- April 18, 2005: flood caused by a downpour at Mátrakeresztes
- May 4, 2005: floods following downpours (at Mád, Bodrogkeresztúr, Bodrogszegi, Szegilong, Tállya)
- May 24, 2005: floods on Vasonca and Fancsali streams (Cserehát),
- July 9, 2005: flood on Ördög stream in Boldva (50 houses were damaged),
- August 15–17, 2005: floods due to a downpour at Szikszó and in 17 neighbouring settlements,
- May 29, 2006: flood at Mátraszele,
- June 23, 2006: floods following downpours in Nógrád County (Sóshartyán–Salgótarján)

Source: Katasztrófavédelem/Disaster Management 2002–2006

In the lowermost portions of micro-regions (e.g. over low floodplain) insular surfaces occur frequently, elevating from the base level. The highest grade of risk of flooding is apparent for the latter.

Wind erosion

Wind erosion occurs where the vegetation cover is not able to protect the surface and wind energy is sufficient to move rock or soil particles over the surface. In such areas different kind of aeolian processes are induced rapidly. Earlier it was believed that aeolian processes are restricted to sand areas and protection (e.g. afforestation) focused on such regions. Today it is well known that wind erosion occurs not only in those areas but it may cause significant damage on the top of bound soils too.

Soil, as one of the most important natural resources, is damaged under the impact of the surface modelling action of wind. Mobilised rock particles, however, make an adverse effect in the biosphere as well, being harmful for the vegetation. In areas of deflation the roots of the plants can be exposed, while in areas of accumulation it is the impacts of the particles and their deposition that might cause problems. Dust as a result of wind erosion is a source of air pollution thus it is detrimental to human health.

Under present-day climatic conditions in Hungary wind erosion endangers only dry areas unprotected by vegetation. The process occurs primarily in spring at the beginning of the growing season when the strength of the wind exceeds the critical threshold velocity near the dry surface. Wind erosion is also active in autumn however its harmful effects are negligible compared to that of spring. In winter, if there is no thick snow cover, wind erosion may be severe on parcels ploughed in autumn (Lóki J. 1985, 2003).

The development of wind erosion and its harmful effect depend on several factors (e.g. soil texture, climate, vegetation, human impacts, etc.). When constructing the potential wind erosion map the critical wind velocity required for the movement of soils with different texture and their erodibility (quantity of transported material in 5 minutes at a wind velocity of 14 m/s) were considered. Based on the average values of the results of wind tunnel experiments, soils were classified into the following risk categories:

– *Negligible (0)* risk occurs in areas with silty, clayey adobe, silty clay and clay soils. To mobilise particles wind velocities over 15 m/s are required and the eroded material is less than 1 kg per 5 minutes.

– *Slight (1)* is the risk when the critical wind velocity is between 8.6 and 10.5 m/s and the quantity of transported material is double the quantity mentioned above. This category includes adobe and silty adobe soils.

– *Moderate (2)* is the risk in the case of sandy adobe soils. In areas with such soils wind erosion starts at wind velocities of 6.5–8.5 m/s and the quantity of transported material is three times that of the first case.

Fig. 2. Wind erosion hazard across landscape microregions of Hungary. – 1 = negligible; 2 = slight; 3 = moderate; 4 = serious. Terrain of slight risk of wind erosion 5 = ca 25%; 6 = ca 50%; 7 = ca 75% within the total area of the microregion 8 = in some parts of the microregion the risk substantially exceeds the average

– *Serious (3)* category involves sand and adobe sand soils together with the kotu and peat containing a high amount of organic matter. These soils can be moved under wind velocities less than 6.5 m/s and the quantity of transported material exceeds that of the first case multiplied by three.

The spatial extension and ratio of the areas threatened by wind erosion with different risks in Hungary estimated on the basis of the above considerations is given in *Table 3* while their spatial distribution is shown in *Fig. 2*.

Table 3. Risk of potential wind erosion in Hungary calculatedon the basis of soil texture (Lóki J. 2003)

Risk category	hectares	%
Negligible (0)	2 804 168	30.2
Slight (1)	4 039 407	43.3
Moderate (2)	873 898	9.4
Serious (3)	1 589 026	17.1
Total:	*9 306 499*	*100.0*

Mass (surface) movements

Natural hazards resulting from mass movements show inverse spatial distribution to that of floods and waterlogging. This general rule that follows from the general principles of geomorphology, was also proved by quantitative data first by the national program of surface movement inventory co-ordinated by the Central Geological Office (KFH) in the mid-1970s. The risk map of these processes by micro-region (*Fig. 3*) was constructed on the basis of the data (Fodor T. 1985; Fodor T.–Kleb B. 1986; Farkas J. 1992; Szabó J. 1995; 1996/a; 1996/b; 2001) collected in the course of the project, which was eventually cancelled prior to completion owing to the lack of financial support and even before continuous monitoring could be started; and on the basis of detailed field experiences conducted by the authors. As far as this contribution describes the *risk* of these processes, the categories shown within the individual micro-regions do not reflect the role of mass movements in the geomorphic evolution and in shaping the present geomorphological aspect of the given landscapes. Therefore numerous micro-regions received strikingly low risk values (especially in mountains of volcanic origin) where mass movements once were fundamental in the formation of the landscape, however, they have a minor influence nowadays (e.g. Dunazug Mountains, Börzsöny, Mátra or regions formerly with typical basalt volcanism). This is one of the reasons why some of the micro-regions marked as having a density different from 0 pieces/km^2 in our previous studies, were classified as negligible in the present

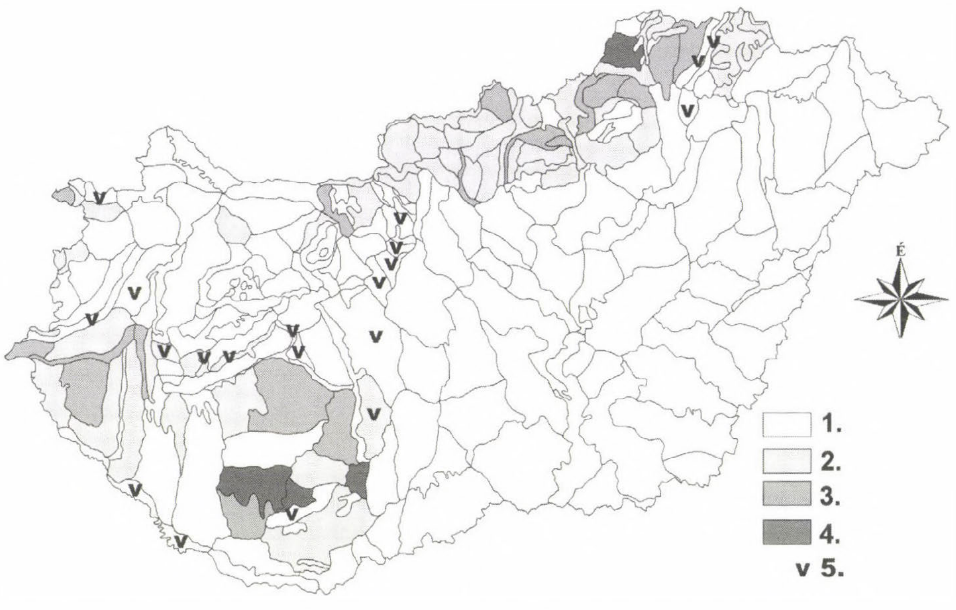

Fig. 3. Mass movement hazard across landscape microregions of Hungary. – 1 = negligible; 2 = slight; 3 = moderate; 4 = serious; 5 = segments of the microregions with grades of risk substantially exceeding the average

map. A further important condition to be taken into account is that map representation of surface movements raises at least two problems.

– On the one hand, it is obvious that in a landscape characterised by relatively low relative relief values where the share of areas with hazardously steep slopes is low, serious risk of mass movements occurs in narrow belts that are of limited, almost negligible in size. In Hungary this is typical of high banks along rivers and lakes. These belts along the Danube and Hernád rivers belong to micro-regions that otherwise display low risk for mass movements, thus most of them were classified into the lowest category. Their risky zones are marked by the "**V**" symbol applied on other maps as well. These marks are especially important in maps of surface movement hazard.

– On the other hand, it is important that mass movements in a landscape (with the exceptions mentioned in the previous chapter) should be regarded as a risk *in general* usually due to the natural conditions (geological structure, slope conditions, water supply). It is difficult (almost impossible on a small-scale map) to show districts of less risk (e.g. valley beds) with a landscape of relatively high risk in the background. Therefore the hatching over the base tones was not applied in *Fig. 3*.

For the sake of a correct interpretation of *Fig. 3* it has to be noted that the majority of surface movements involved in the cadastre of Hungary – 29% in the North Hungarian Mountains – has been triggered by solely social effects. Here movements of miscellaneous origin present 15%. Due to a continuous human impact on surface development in most of the micro-regions of the country it is difficult to determine the exclusive natural potential risk of mass movements. As it is visible on the map, this hazard type is negligible in the majority of the micro-regions of the country. However, where these movements can be registered most of them show some activity today as well according to the surveys. According to the KFH surveys less than 20% of the registered movements belonged to the "finished movement" category in the North Hungarian Mountains. This means that both re-activation of former movements and development of new ones are possible. Therefore it would be a mistake to ignore this type of natural hazards in this country mainly characterised by plains.

Conclusions

As it was indicated in the chapter describing the methods applied, the natural hazard risk map of Hungary at micro-region level was constructed by summarising the values of the spatial characteristics of the seven investigated hazard types. With categorising the values gained by simple and weighed summing the results visualised in *Figs 4* and *5* were obtained.

Some conclusions:

– The following preliminary statements can be made about the risk posed by the investigated seven hazard types according to micro-regions both by simple and weighed summing:

– The country can be divided into south-eastern and north-western parts with higher and lower risk, respectively. The boundary between the two runs along the southern marginal zone of the Hungarian Mountains, thus the spatial distribution is uneven.

– The boundary is not so sharp in Transdanubia. There is an area of lower risk in the southwest (in the belt running between the Zala and Somogy Hills). In contrast, the risk is somewhat higher in North Transdanubia (virtually in the Little Plain).

– More detailed analysis reveals that areas of the highest values of risk are located in the Great Hungarian Plain (except for three regions: Szigetköz, Little Balaton, Nagyberek). According to the simple summing, the greatest risk can be estimated for the deepest situated landscapes and also for the areas of somewhat higher elevation endangered by potential wind erosion. Weighed summing shifts greatest risk to the natural floodplain zone of the Danube and

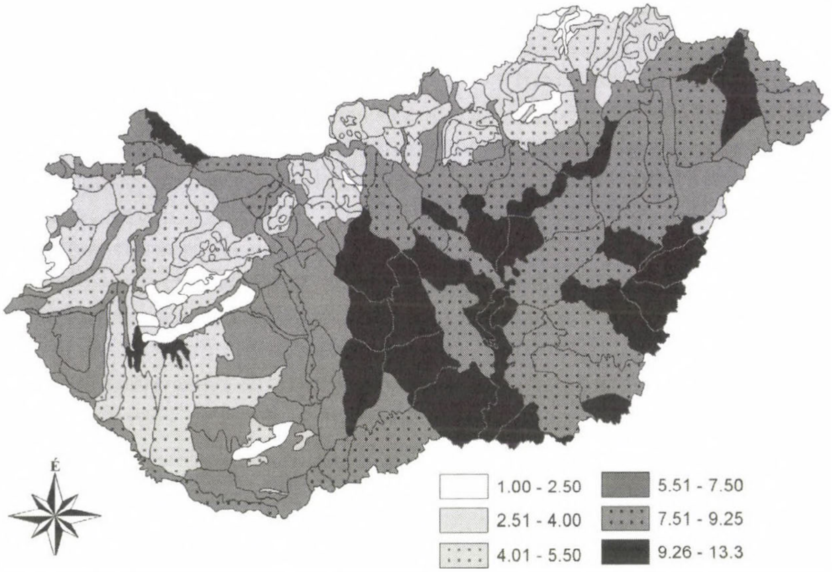

Fig. 4. Natural hazards in Hungary by landscape microregions (obtained by a simple summing up of balls). Possibility of the occurrence of natural disasters from uncommon (white colour) to severe (black colour)

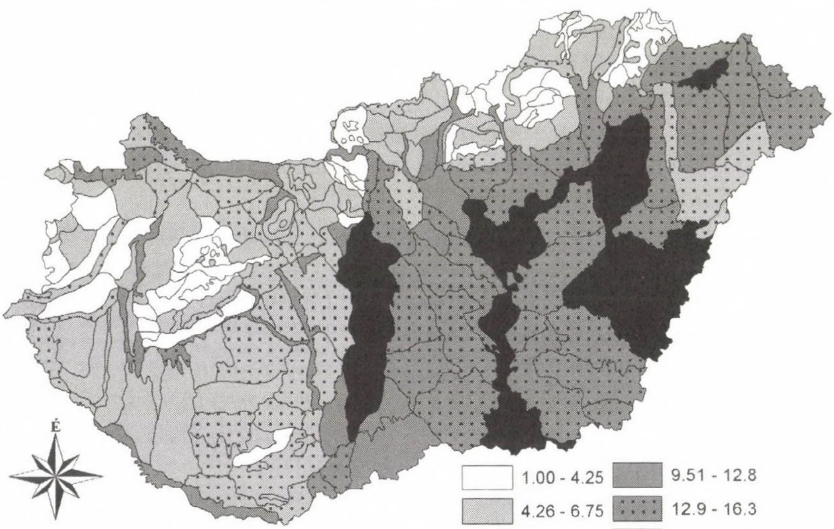

Fig. 5. Natural hazards in Hungary by landscape microregions (obtained by a weighed summing up of balls). Possibility of the occurrence of natural disasters from uncommon (white colour) to severe (black colour)

the Tisza rivers and to the region of the Körös rivers due to the double value of floods, waterlogging and droughts.

– Lowest risk is characteristic primarily for mountain landscapes composed from carbonate rocks, however some volcanic ranges of the North Hungarian Mountains are also classified into this category. Similar low risk is also found for the micro-regions within the Alpine Borderland elevating above the level of floods.

In summary it can be stated that despite the potential subjective errors of summing the resultant data by balls that are enhanced by weighed summing, the fact that the difference between the highest and lowest values in both maps is exactly tenfold, indicates that the variation has an objective basis. In our opinion weighing is necessary, and it does not distort differences but interprets them in a more sophisticated manner. This is also justified by the 23 micro-regions having received the highest and lowest risk values (i.e. by 10% of the 230 micro-regions) essentially coinciding in the two maps. Regarding the highest values 17 micro-regions of the 23 occur on both maps. The difference is explained by the fact that the areas with serious risk of floods and waterlogging together with drought are classified into the category of highest risk due to weighed summing, while the areas less threatened by these hazards are missing from this category.

The authors of this contribution are convinced that this first study about the risk posed by natural hazards at a relatively high spatial resolution in Hungary will be instrumental in the promotion of treating these hazards worthy of their real importance. These facts have to be duly taken into account for the elaboration of prevention strategies, both efficient and economic. Naturally, a more detailed physical planning requires higher resolution and thus investigations providing more exact data. In the opinion of the authors this is to be a primary task in the future.

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COVERED KARSTIFICATION ON THE KARSTS OF HUNGARY

MÁRTON VERESS[1]

Introduction

Covered karst forms can develop, if a permeable non-karstic rock covers the karstifying rock. This is a "hidden" karst. Due to material absence caused by dissolution in the karstified rock, material transport happens in the covering sedimentary. For this reason covered karst forms develop on the surface.

Covered dolines are classified into three types (CVIJIČ, J. 1893; CRAMER, H. 1941; THOMAS, T. M. 1954; JENNINGS, J. N. 1985). Subsidence doline develops, when the depression is formed in non-karstic, unconsolidated sedimentary cover because the matter of the covering is partly transported into the karst. Subjacent dolines develop, when the non-karstic covering rock (e.g. basalt, sandstone) moves into the cavity inside of the limestone which is a fast and periodical process (for example collapse). Alluvial streamsink doline develops when surface waters accumulate the loose covering sedimentary rocks into the pits of the karst. The latter forms develop mostly close to the piesometric surface, for example in poljes. Recently two variations of the subsidence dolines have been distinguished (DRUMM, E. C. *et al.* 1990; THARP, T. M. 1999; WALTHAM, A. C.–FOOKES, P. G. 2003). Dropout doline (cover collapse doline) develops, if part of the covering sedimentary rock collapses into the pit. The process of collapse might occur for different reasons. For example the consiladation of the cover is great, or a cavity develops fastly under the covering. Cause of quickly developing absence of matter can be for example if the lower part of covering moves with solifluction (DRUMM, E. C. *et al.* 1990; THARP, T. M. 1999; WALTHAM, A. C.–FOOKES, P. G. 2003). The slide slopes of the created doline are step-like, discontinuous surfaces. Suffusion doline develops if non-indurated (loose) covering sedimentary rock sinks but it does not collapse (WILLIAMS, P. 2003; WALTHAM, A. C.–FOOKES, P. G. 2003). The process can happen if bigger pieces of the covering sedimentary rock sink, a finer sediment sinks ('cover

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subsidence sinkhole'), or if the grains move with suffusion (DRUMM, E. C. *et al.* 1990; WILLIAMS, P. 2003; VERESS M. 2005, 2006b) if the sediment moves with rill wash (CRAMER, H. 1941; DRUMM, E. C. *et al.* 1990; THARP, T. M. 1999) further probably it can happen with compaction. There are discrabed buried dolines too. This form develops, if in sediment depression of older karst the accumulated infilling can become compact. But this form can also develop if sediment of the fill is washed into the depth (BEZUIDENHOUT, C. A.–ENSLIN, J. F. 1970; BRINK, A. B. A. 1984) or the piezometric surface sinks. The term 'covered karst forms' here is used for dropout doline, suffusion doline, alluvial streamsink doline and buried doline. Depressions of covering sedimentary rock occur on covered karsts (VERESS, M. 2000). These forms develop in the covering sedimentary rock and they are areics closed forms. Their diameter is relatively large (more than 50 metres), while they are shallow (some metres). Several various covered karst forms occur inside of them (dropout doline, suffusion doline, alluvial streamsink doline, buried doline).

According to VERESS M. 2006a and 2006c covered karst forms can develop both during syngenetic and postgenetic karstification. If karstification is of syngenetical character the development age of pit of the limestone floor and that of the covered karst form are identical. Covered karst form develops because pit is created on the limestone floor. If the karstification is postgenetic the pit of limestone floor is older than the covered karst form in the covering sedimentary rock. In case if pit occurs on the limestone floor, the covered karst form is created on the surface of the covering sedimentary rock. The covered karst form accrues, and is covered and buried because of the deposition in the surroundings. Its pit is filled in. Lenticolor intercalation develops in the covering sedimentary rock at the place of the covered karst form. If the pit loses its sediments during accumulation, new forms of covered karst develop on this higher surface which will be younger. The morphology of the pit may refer to postgenetical karstification too. For example if there are forms in the pit, which developed during its being filled in with sediments, then the pit had developed before such an accumulation development which happened earlier than the development of the recently covered karst form.

Methods

Vertical electrical sounding was performed in four karst areas of Hungary *(Fig. 1, Table 1)*. The depth of the limestone floor and the thickness of the covering sediment rocks were determined at different places by VES measurements.

Profiles (i.e. geoelectrical-geological cross-sections) were constructed along transects with assembling beds calculated for these places. The profile of the surface (with covered karst depressions), limestone floor, the bed

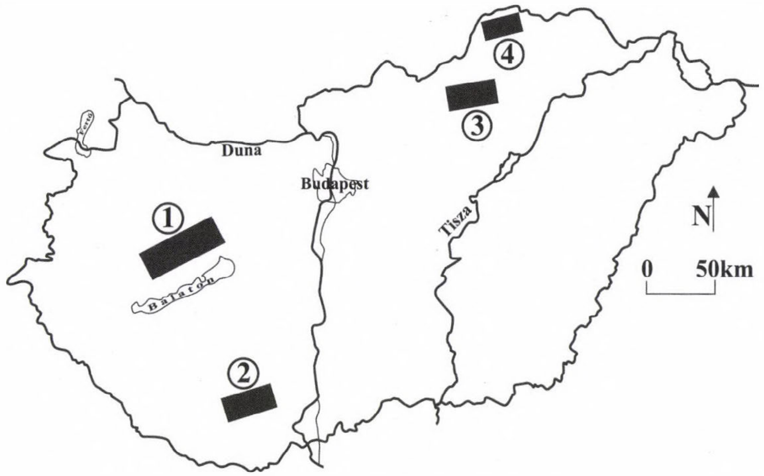


Fig. 1. Karst study areas. – 1 = Bakony Mountains; 2 = Mecsek Mountains; 3 = Bükk Mountains; 4 = Aggtelek Mountains

Table 1. VES measurements in the different karst areas

Karst area	Number of the searching place on the karst area	Number of VES measurements	Number of the geoelectrical-geological profile	Number of cover karst forms crossed by geoelectrical-geological profiles
Bakony Mountain	7	346	71	36
Mecsek Mountain	3	105	12	23
Bükk Mountain	2	64	18	8
Aggtelek Mountain	2	67	14	8

boundaries, (and so the various covering sedimentary rocks), the structure of the covering sedimentary and the resistance value of the various rocks can be shown in the cross-sections. The profile of the surface of the limestone floor can be given more exactly where the limestone occurs on the surface.

Characteristics of the karst regions in Hungary

The Bakony Mountains are part of Transdanubian Mountains. With an area of 2,400 km^2, and elevations between 200–700 metres, they are built of Triassic Dachstein Limestone and dolomite, but Jurassic, Cretaceous and Eocene limestones also occur. Five karstification (paleokarsts) phases could be singled out which are older than the recent karstification (Földváry A. 1933; Végh S.-né 1976). Of them Upper Creataceous karstification was the most important, during which tropical karst developed (Pécsi M. 1980). Traces of ancient karstification may be shown at many places. These karstification processes are proved by bauxite horizon, depressions and elevations found on the limestone flour. At present the mountains are made up of horsts of various altitudes. The surfaces of the horsts are remnants of the Upper Cretaceous peneplain. The mountain was covered by a gravel blanket in the Oligocen-Miocene (Csatka Gravel Formation), patches of which were not destroyed on those horsts whose height is under 500 metres. The covered karst surfaces developed on horsts with heights between 300–600 metres a.s.l. The covering sedimentary rock is loess, and redeposited loess and gravel. Density of the covered karst form is low. These forms are suffusion dolines, dropout dolines, which are termed doline-with-ponor by Veress, M. (2000). Depressions of the superimposing sedimentary rock are repeated on the covered karsts of the Bakony Mountains (Veress, M. 2000, 2006c).

The Mecsek Mountains vary between 250–680 metres in altitudes, with an area of 350 km^2, and they are built of Mesozoic rocks. Their structure is folded, also dissected by horsts, therefore various parts of the peneplain have different altitudes. The area of Northern Mecsek is karstified. The zone of karstification is located in an anticlinal. There are sandstones croppings out (Jakabhegy Sandstone Formation). Water courses of the valleys developed on the sandstone empty into the karst through karst margin sinkhole (Barta K.–Tarnai T. 1987). The sinkholes are in blind valleys. A wave-cut platform of the northern part of the rock stripe which developed in Pannonium age (Lovász Gy. 1971) has undergone karstification since the time of Pliocene (Hevesi A. 1991). Solutional dolines developed during this karstification. This surface is covered with clay, and with loess-sand therefore it is a recently formed covered karst. The bottoms of the bigger solution dolines are covered completely while the smaller dolines are accrued and covered with clay, and with sand-loess. The covered karst forms are mainly suffusion dolines. These forms occur in the area of older solutional dolines.

The area of the Bükk Mountains (or Central Bükk) is 550 km^2, its height is between 275–959 meters. The mountains are built mainly by Ordovician, Devonian, Carboniferous, Permian clay slates, sandstones, limestones (Uppony Mountain), Triassic (Bükk Plateau), and Jurassic (Southern Bükk) limestones. Some parts of the mountain are of folding structure (Uppony Mountain), some parts have nappe structure, other parts have digitation structure which developed by reverse fault (Pelikán P. 2002). The highest area is the Bükk Plateau because during the swelling of the mountain, it had uplifted to the highest elevations. The Bükk Plateau is divided to Great Plateau and Little Plateau. These areas have synclinal structure. Several peneplains occur in the mountains (Bulla B. 1962; Pinczés, Z. 1980). Recent karst of the mountains was formed from covered karst, because the Bükk were mantled with tuffs during Lower Miocene and Upper Miocene and with sea sediments during Karpatian Stage (Varga Gy. 1981; Pentelényi L. 2005; Nagymarossy, A. 1981), but its covered surface has been exhumed since the Sarmatian stage (Sásdi L. 1997). The most mature areas of the Bükk Mountains with regard to karstification are: Little Plateau, Great Plateau, Southern Bükk.

There are autogenic karsts and allogenic karsts in the Bükk Mountains. A series of the blind valleys (karst margin with sinkholes) developed along the rim of the non karstic rocks (along junctions). The non karstic rocks are wedged into the limestone in these places. Dominant forms of karst topography are dry valleys with a row of dolines. There valleys may be separated into areic valley details. A lot of dolines of the rows were sinkholes formerly (internal karst sinkhole). Dolines occur on the mound of the plateaus (hanging doline). These shallow dolines have flat bottom. The neighbouring dolines of the valley bottoms developed into uvalas (Hevesi A. 1977). Some of the hanging dolines, doline rows, uvalas and the former blind valleys are accrued or covered with loess, loess with clay, red clay, aleurite with clay-sand (Jámbor Á. 1959; Pelikán P. 1992), with weathering residual or with their redeposited variations. These accruing patches create the covered karst areas in the mountains.

The area of the Aggtelek Mountains is 185 km^2, their height varies between 150–600 metres. Triassic rocks of the mountain create the nappe system. Folds of the Szilice nappe developed into secondary nappes (Less Gy. 1998). Karst plateaus of the mountain are synclinals of the secondary nappes (Less Gy. 1998). The plateaus are separated by valleys, which developed along the anticlinals of secondary nappes or along strike-slip faults. The southern part of the mountains became covered in Upper Pannonian (Sásdi L. 1990). Karst margin sinkholes (blind valleys) developed along junctions (alugein karst). The epigenetic valleys continued beyond the recent rock border on the autogenetic karst (dry valleys with doline rows).

The dry valley may also be separated into areic valley segments. On the autogenetic karst surfaces of the mountains (Alsó Mound, Haragistya-Nagy oldal) dolines, doline rows, uvalas, erosional-solution dry valleys, karst canyons, erosional structural valleys occur (Zámbó L. 1998), but a few karstic basins occur here (Móga J. 2002) too. On some part of the mountain (for example Teresztenye Plateau, Pitics Mound) the older dolines, and uvalas are accrued with former covering sedimentary rock concerning transporting version of it and with weathering residual (Zámbó L. 1970). Or sinkholes had developed in these places (Zámbó L. 1998) but where covered karstification happened covered karst forms appeared.

Development of covered karst form

Syngenetical covered karst forms develop on covering sedimentary rock surface where impermeable beds wedging in (for example argillaceous layers) occur on the surface or in the covering sedimentary rock, or the latter is thin locally.

Locally thin covering sedimentary rock may develop during accumulation if the limestone floor is dissected by elevations (ridges, mounds, *Figs 2a* and *3*) or if the covering sedimentary is worn down locally. Generally the causes of the thinning of the covering sedimentary rock are the dissected limestone floor and the local denudation of the covering sedimentary rock. Such covered karst forms develop locally in thinned sedimentary basins, in Bakony, Bükk and Aggtelek Mountains. Measurements have shown that in one third of the 21 covered karst forms studied the thickness of the covered sedimentary rock is less than 3.5 metres, in 47.61% of them it is between 3.51–6.0 metres (Veress M. 2005, 2006a, 2006c). This suggests that covered karst forms develop by direct breakdown if the thickness of the covering sedimentary rock is less than 3.5 (covered karst form without burrow). The break down is caused by the collapse of the roof of the blind pit of the limestone floor and furthermore the blind pit is transformed into a pit (Veress, M. 2000). A blind burrow develops in the covering sedimentary rock following the development of a pit, if the overlying sedimentary rock is more than 3.5 metres thick

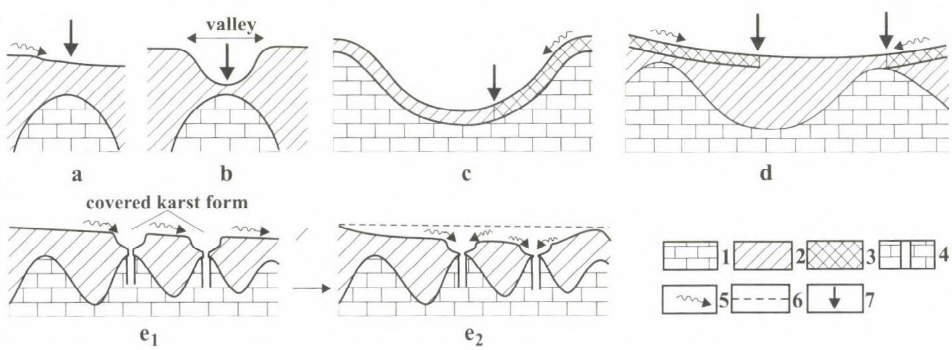


Fig. 2. The places of the covered karstification and development of depression of covering sedimentary rock. – 1 = limestone; 2 = permeable covering sedimentary rock; 3 = clay; 4 = pit; 5 = water flow and sediment transport on the surface; 6 = original surface; 7 = the potential places of the covered karstification: it is where accumulation can be small above the elevation of limestone floor (a) denudation happens locally (b), or impermeable beds wedge (c, d), (e) development of the depression of covering sedimentary rock: covered karst forms develop (e_1) from whose surroundings the covering sedimentary rocks transported trough the covered karst forms it can be transported into the karst, therefore closed depression develops in the covering sedimentary rock (e_2)

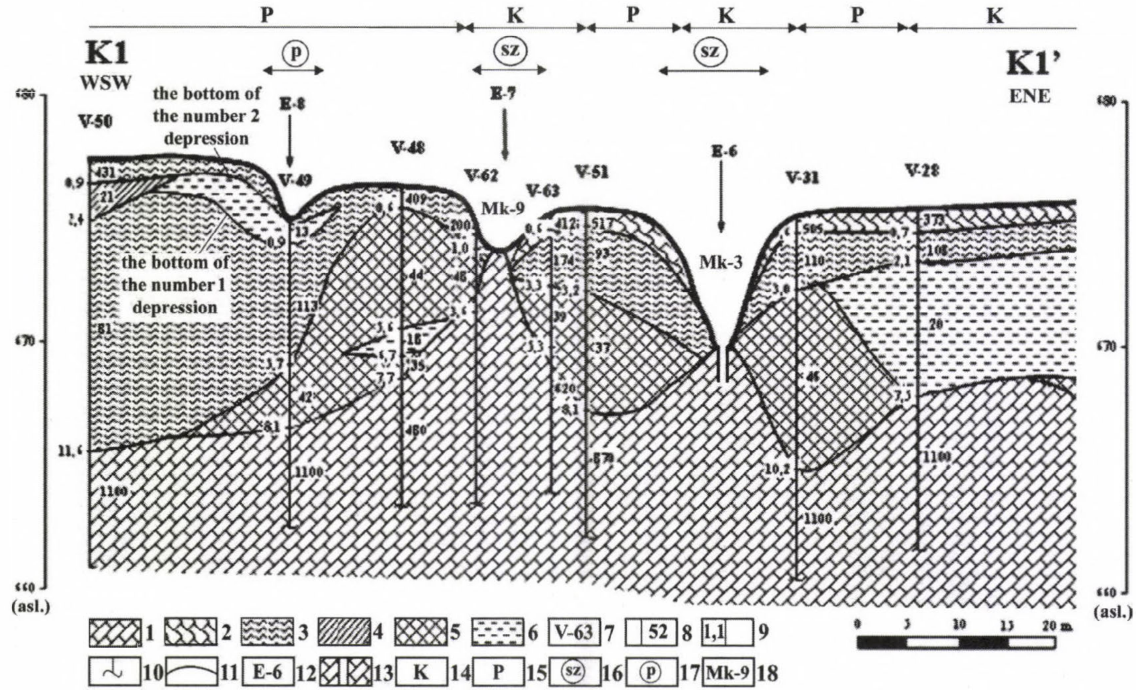


Fig. 3. Covered karst forms which developed above covered up elevations of limestone floor (K1-K1' geoelectrical-geological profile, Eleven-Förtés, Kőris-Mount, Bakony Mountain). – 1 = limestone; 2 = limestone debris; 3 = limestone debris (with clay); 4 = loess (with clay-mud), or clay with limestone debris; 5 = clay (with loess and limestone debris); 6 = clay; 7 = number of VES measuring; 8 = geoelectrical resistance of the beds (Ohm); 9 = depth of bottom of geoelectrical beds (m); 10 = approximate penetration of VES measuring; 11 = border of the geoelectrical beds; 12 = mark of the covered karst form; 13 = pit; 14 = elevation; 15 = paleokarst depression; 16 = syngenetical covered karst form having developed above elevation; 17 = postgenetical covered karst form, which developed above elevation; 18 = limestone outcrop and its number

(VERESS M. 2005, 2006a, 2006c). Covered karst form develops where the covering sedimentary rock subsides, or sinks above a blind burrow (covered karst form with a burrow).

As it was established by measurement, postgenetical covered karst forms developed where the thickness of the covering sedimentary rock is over 6.01 metres. 56.25% of postgenetical covered karst forms are found in the Bakony, where the thickness of covering sedimentary rock is more than 6.01 metres.

Covered karst forms having developed at wedging in of impermeable beds, occur in the Mecsek Mountain (*Figs 2c, 2d,* and *4*).

The depressions of covering sedimentary rock may develop, if the covering sedimentary rocks are removed locally. The process may happen if the covering sedimentary rock is transported through the covered karst forms into the karst *(Fig. 2c)*.

Development of covered karst surfaces on Hungarian karsts

Karstification may take place during accumulation and later during denudation. The covering sedimentary rock may develop where the limestone floor is dominated by mounds or depressions. The depressions can appear in the form of dolines, uvalas, sinkholes, blind valleys and segments of doline rows of dry valleys. Allogenic karst develops if the covering sedimentary rock is impermeable (JAKUCS L. 1971). Allogenic karst is like a patch, if the covering sedimentary rock fills in the depressions of the limestone floor. Karst margin sinkholes develop at the margin of the allogenic karst *(Fig. 5.Ia, Fig. 5.Ib$_1$)*. However the allogenic karst may also develop in different ways. It can also occur that it is not the mounds of the depression system that are covered, but their surroundings. Sinkholes develop where the limestone crops out like a window in the patch. Therefore a sinkhole may occur inside of the impermeable sediment surface too *(Fig. 5.Ib$_2$)*. Allogenic karst is buried during covering up *(Fig. 5.Ic$_1$)*. New allogenic karst appears when the covering sediment becomes removed. Gullies lead to the sinkholes if denudation is the result of sheet wash *(Fig. 5.Id$_1$)*. Such sinkholes may develop in Aggtelek Mountains where the older dolines, uvalas are accrued by impermeable covering sedimentary rock. Blind valleys with sinkholes develop if valleys are formed on the surface of the covering sedimentary rock *(Fig. 5.Id$_2$)*. We can mention the blind valley of the Dász doline (Aggtelek Mountains). The water of the sinkhole shaped the Szabadság Cave. The allogenic karst is changed into covered karst, if the impermeable covering sedimentary rock of the allogenic karst is removed and permeable sediment crops out on the surface. Depressions of the covering sedimentary rock may develop on the allogenic karst too. For

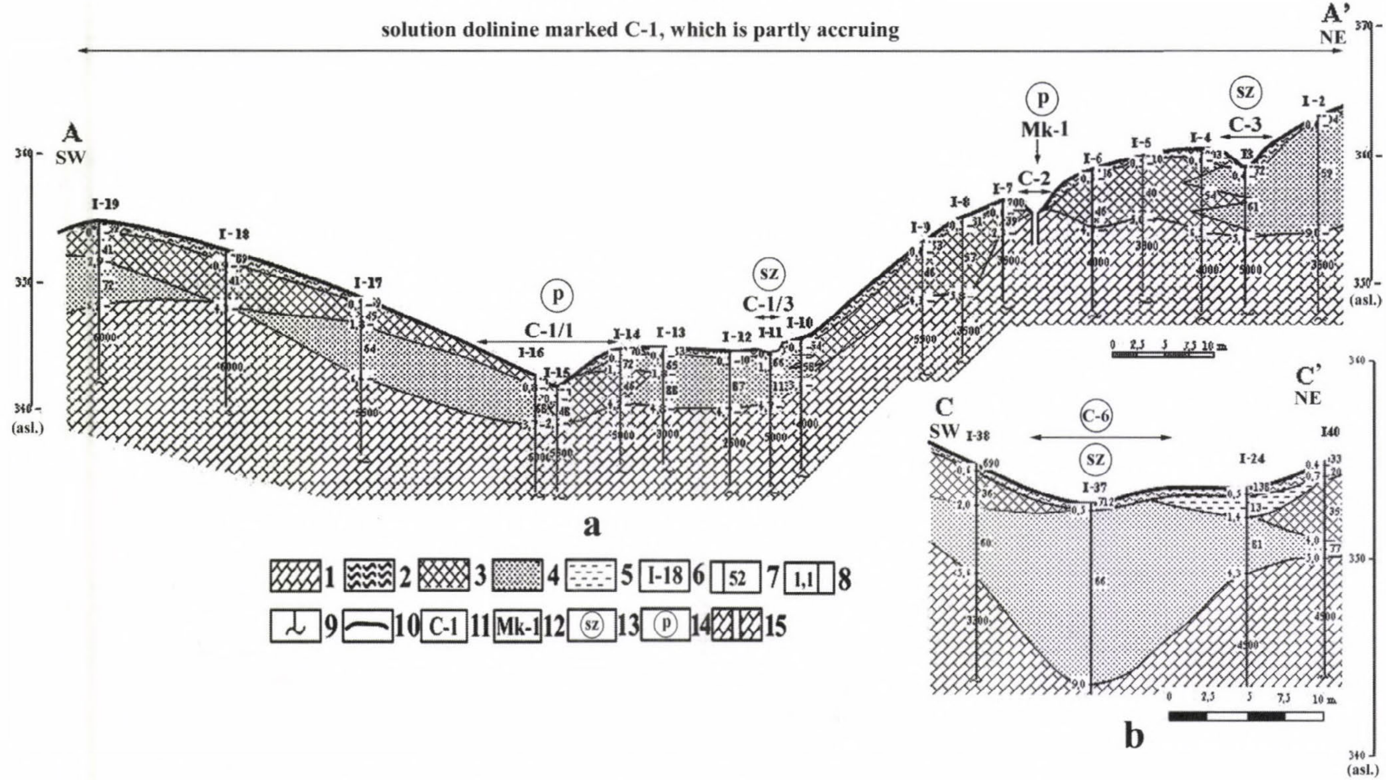
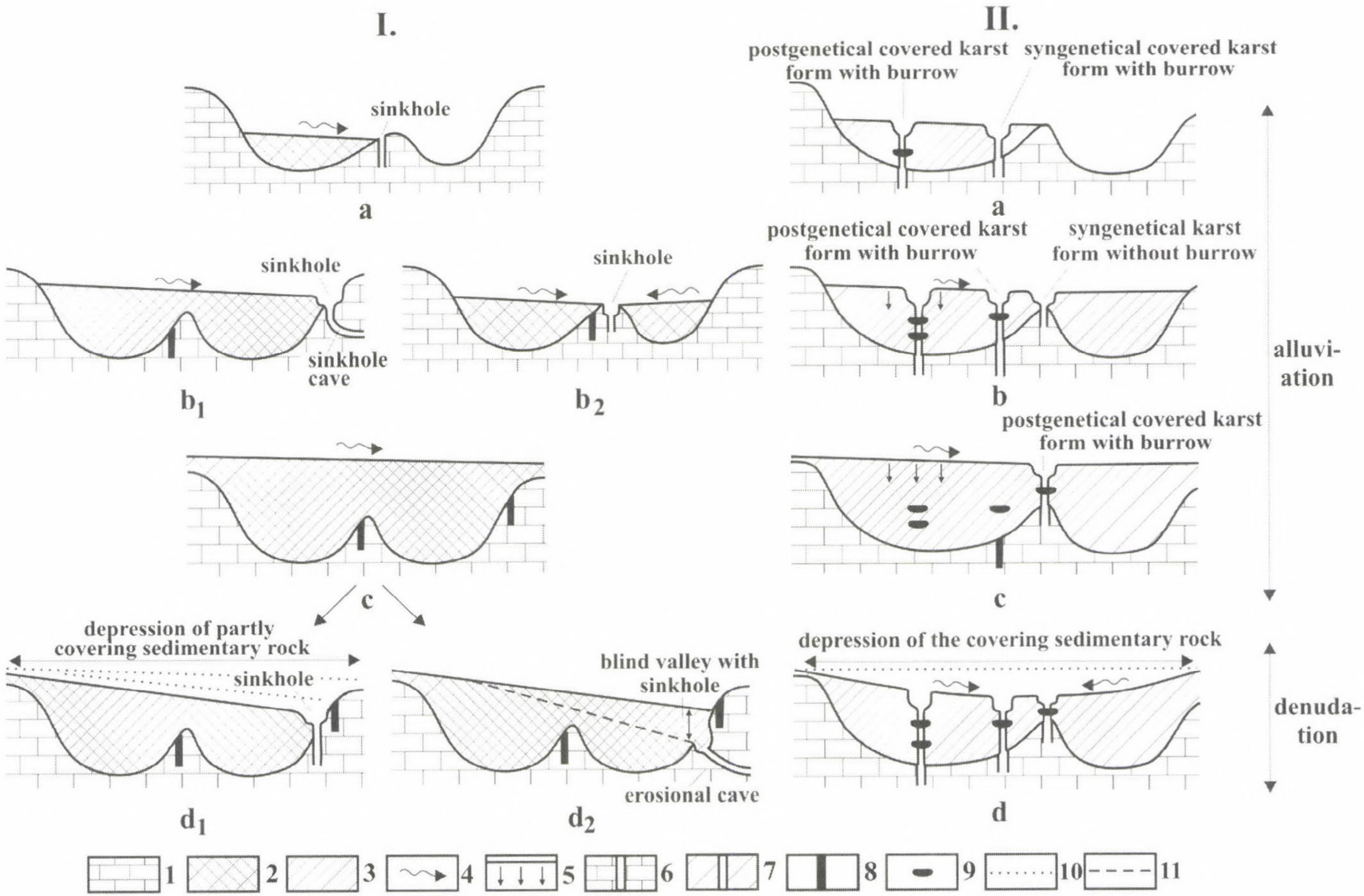


Fig. 4. Partly accrued (a) and covered up dolines (b) of Mecsek Mountain and their covered kast forms. – 1 = limestone; 2 = soil, sand, aleurit; 3 = limestone debris (with clay, and with sand); 4 = sand-loess (with limestone debris); 5 = clay; 6 = number of VES measuring; 7 = geoelectrical resistance of the beds (Ohm); 8 = depth of bottom of the geoelectrical beds (m); 9 = approximate penetration of VES measuring; 10 = border of the geoelectrical beds; 11 = mark of the covered the karst form; 12 = ouctcrop of the limestone; 13 = syngenetical covered karst form, which developed at the wedging of the clay; 14 = postgenetical covered karst form; 15 = pit


I.
II.
sinkhole
a
sinkhole
sinkhole
cave
b1
sinkhole
b2
c
depression of partly
covering sedimentary rock
sinkhole
d1
blind valley with
sinkhole
erosional cave
d2
postgenetical covered karst
form with burrow
syngenetical covered karst
form with burrow
a
postgenetical covered karst
form with burrow
syngenetical karst
form without burrow
b
postgenetical covered karst
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depression of the covering sedimentary rock
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ation
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1 2 3 4 5 6 7 8 9 10 11

example if the sinkhole is to be found inside of the allogenic karst, or if the covering sedimentary rock of the allogenic karst is denuded by sheet wash. The depression of the limestone floor is exhumed partly. (Depressions of the partly covered sedimentary rock develop.) Such depressions occur in Aggtelek Mountains.

Covered karstification happens if the covering sedimentary rock is permeable *(Fig. 5II)*. Covered karst expands with accumulation. The character of the covered karstification may be modified with the changing thickness of the covering sedimentary rock. (Covered karstification may happen when the accumulation is not too fast, or it is interrupted by periods without accumulations.) The elevations (mounds, ridges) are buried gradually during accumulation.

Covered karst forms (karst forms without burrow) may develop inside of the depressions of the limestone floor at the initial stage of the accumulation when the thickness of the covering sedimentary rock is less than 3.5 metres. In the case of the former sinkhole pits may cause material absence which creates the conditions of the development of the covered karst forms, if the covered karst can develop with accruing sinkholes or blind valleys. If the accumulation continues postgenetical covered karst forms with burrows develop in the depressions of the limestone floor where the thickness of the covering sedimentary rock is between 3.5–6.0 metres, while covered karst forms with burrow develop on the slide slopes of the elevations *(Fig. 5.IIa)*. Covered karst forms without burrow develop if the thickness of the covering sedimentary rock is smaller than 3.5 metres. This development phase is represented by the covered dolines of the Mecsek Mountains *(Fig. 4)*. When the elevations are buried, covered karst forms without burrow develop above the elevations of the limestone floor, where the thickness of covering sedimentary rock is less than 3.5 metres, but syngenetical or postgenetical covered karsts forms with burrow develop on the slide slopes where the thickness of the covering sedimentary rock is below 3.5 metres. Postgenetical covered karst forms with

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Fig. 5. Allogenic karstification (I) and covered karstification (II) of the sizeable karst depression and karst system depression (uvalas). – 1 = limestone; 2 = impermeable covering sedimentary rock; 3 = partly permeable covering sedimentary rock; 4 = water flow and transportation of the sediment on the surface; 5 = percolating water; 6 = limestone????; 7 = pit; 8 = burrow infilled pit; 9 = lenticular structural sediment; 10 = former surface; 11 = bottom of the valley. a = partial accumulation; b = full accumulation, I.b_1 junction is at the margin of the depression system, I.b_2 limestone crops out of the covering sedimentary rock like a window; c = covering up; d = denudation, I.d_1 sinkhole and partly depression of the covering sedimentary rock develop at the junction of the denudation of the covering sedimentary rock because of sheet wash on the allogenic karst, I.d_2 sinkhole develops at the junction in the blind valley when the development of the valley happens on the allogenic karst, II.d depression of the covering sedimentary rock develops

burrow develop in the depressions of the limestone floor where the covering sedimentary rock is thicker than 6 metres *(Fig. 5.IIb)*. The area of the Nagy Mező has such a development phase. A blind valley is accrued partly here *(Fig. 6, 7a)*. Syngenetical covered karst form without burrow developed on a ridge which is between two sinkholes of the blind valley *(Fig. 7a)*, while paleokarst covered karst forms occur which have various ages above each other in the infilling of one of the sinkholes. Lenticular intercalations in the sediment superimposing each other prove the existence of former covered karst forms *(Fig. 7b)*. If the accumulation continues the thickness of the covering sedimentary will be so great that covered karst foms with burrow may develop only on the elevations *(Fig. 5.IIc)*. Namely covered karst forms do not occur along such lines with a permeable covering sedimentary rock, but its thickness is more than 20 metres *(Fig. 8)*. Covered karstification does not develop further if accumulation continues *(Table 2)*.

Denudation follows accumulation. The extension of the covered karst surface decreases during denudation. The denudation happens on the surface at the beginning, later it proceed into the karst. It means that any former covered karst form may be activated because of the thinning of the covering sedimentary rock (postgenetical karstification). Syngenetical covered karst forms with burrow may develop on elevations with greater altitude and covered karst forms without burrow are created when the covering sedimentary rock becomes thin further. The depressions of the covering sedimentary rock develop because of the local denudation of the covering sedimentary rock. Two kinds of depression of the covered sedimentary rock may develop. The depression of the covering sedimentary rock develops in the covering sedimentary rock only if the density of elevations of the limestone floor is sizeable *(Fig. 2e)*. Such depressions of the covering sedimentary rock are typical of Bakony Mountains (Tés Plateau). With the deepening of the valleys the covering sedimentary rock has thinned on the Tés Plateau. For this reason covered karst forms developed above the elevations. The covering sedimentary rock was transported through these forms into the karst. In this manner the depressions of the covering sedimentary rock develop on the bottom of the valleys *(Fig. 8)*. The depression of the covering sedimentary rock develops in the accruing of the depression or in the depression it self, if the depressions of the limestone floor are greater. In that case the depression of the partly covered sedimentary rock develops too like an allogen karst. Such depressions developed in the extensive old dolines and uvalas of the Teresztenye Plateau (Aggtelek Mountains, *Fig. 9, 10*), farther more on the areic part of the doline line valleys for example on the Aggteleki karst or in the Bükk Mountains *(Fig. 6, 7)*. Such depressions may occur where the cave system of the karst is well developed. Therefore a great amount of covering sedimentary rock could be transported into the karst.

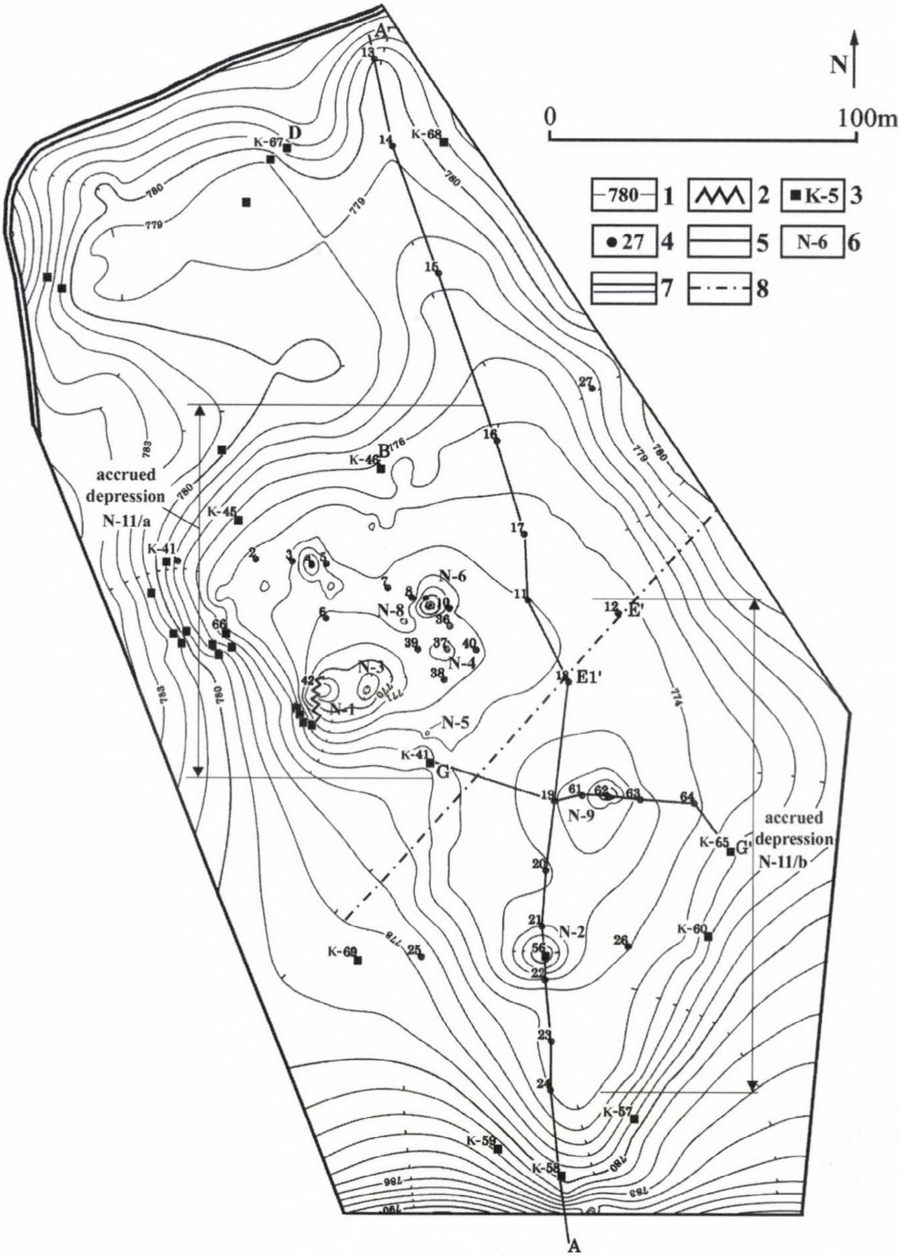

Fig. 6. The map of the area of the partly covered blind valley from Nagy Mező (Bükk Mountains). – 1 = contour line; 2 = rock wall; 3 = limestone outcrop and its number; 4 = number and place of the VES measuring; 5 = the line of profile; 6 = mark of karst form; 7 = road; 8 = fence

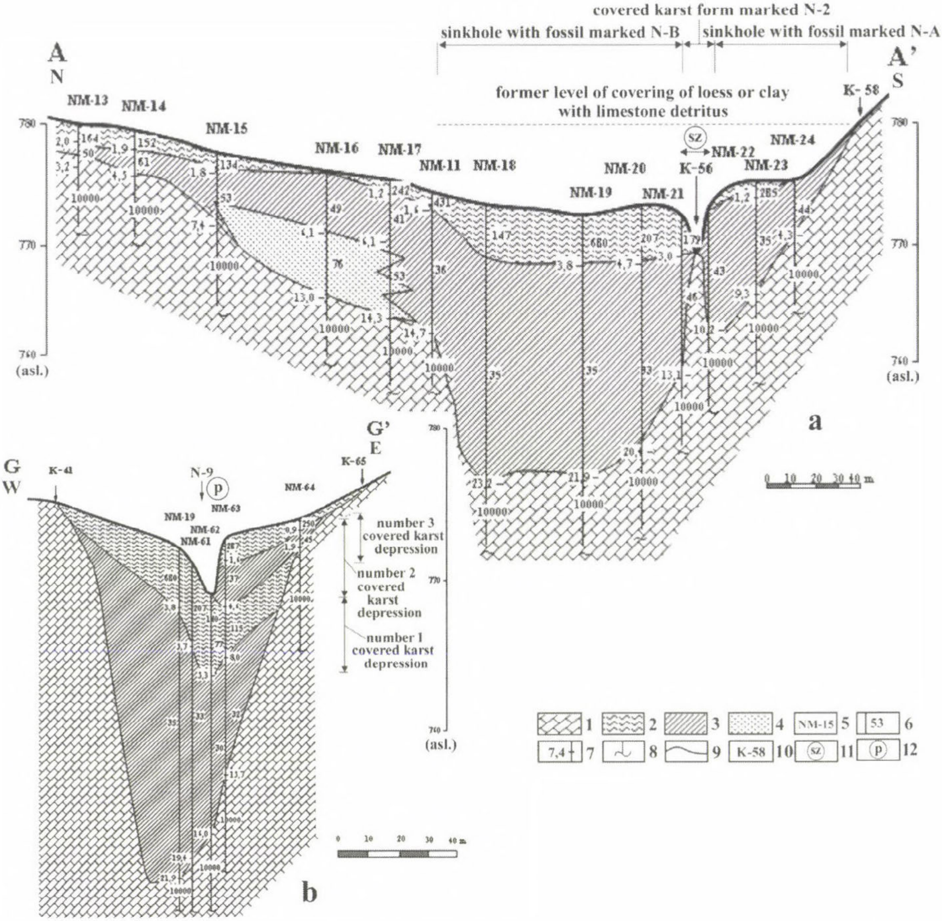

Fig. 7. Covered karst surface which is created by partial accumulation (Nagy Mező). – a = profile marked A–A'; b = profile marked G–G'. – 1 = limestone; 2 = limestone debris (with clay); 3 = loess (with clay-mud) or clay with limestone debris; 4 = loess (with sand, or with limestone debris); 5 = number and place of VES measuring; 6 = the geoelectrical resistance of the beds (Ohm); 7 = depth of bottom of the geoelectrical beds (m); 8 = approximate penetration of the VES measuring; 9 = the border of the geoelectrical beds; 10 = the place of limestone outcrop and its number, 11 = syngenetical covered karst form having developed above elevation; 12 = postgenetical covered karst form having developed above accrued sinkhole

Impermeable sediment infilling may develop on the area of the covered karst forms of the depressions of the covering sedimentary rock. The water does not filter but it flows on the surface from these sediment patches. The decantation water empties into the active covered karst forms. Thus covered karst forms expand their catchment areas if there are forms of fossil covered

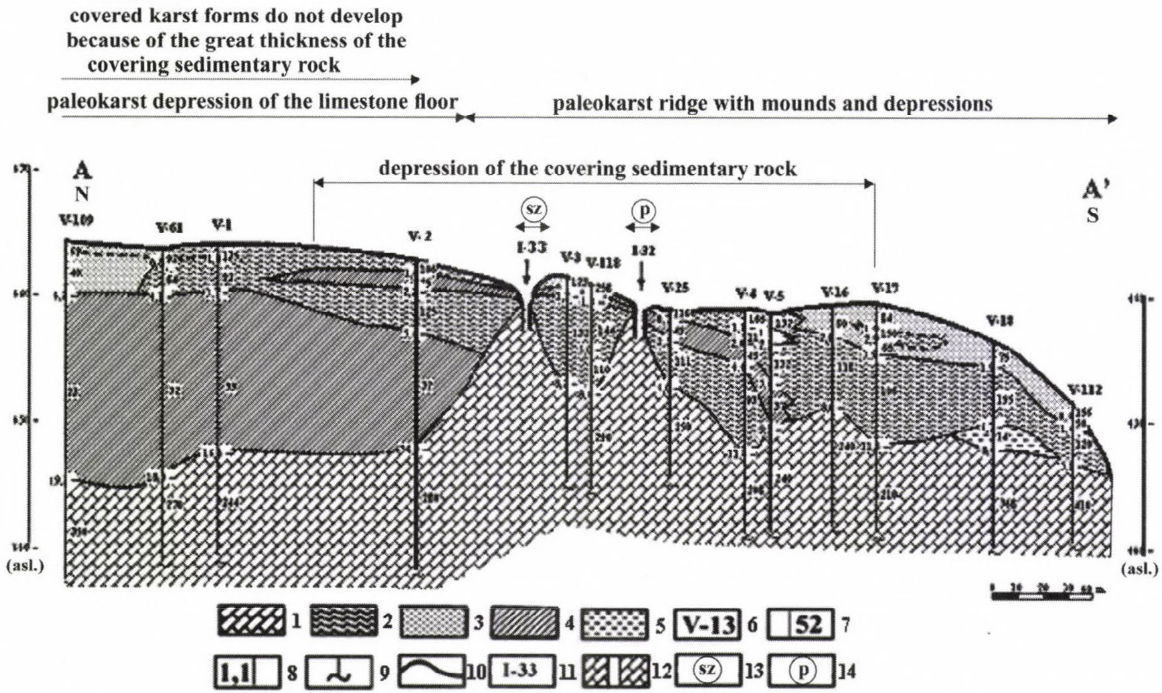

Fig. 8. Depression of the covering sedimentary rock which developed in the covering sedimentary rock of the denuded paleokarst surface (geoelectrical-geological profile marked A–A' Tés-1 area, Tés Plateau, Bakony Mountains; the profile is on the bottom of the Tábla Valley, its direction is the same as that of the bottom of the Tábla Valley, therefore the covering sedimentary rock suffered thinning along the profile because of denudation). – 1 = limestone; 2 = limestone debris (with clay); 3 = loess (with sand, or with limestone debris); 4 = loess (with clay-mud) or clay with limestone debris; 5 = clay; 6 = number and place of VES measuring; 7 = geoelectrical resistance of the beds (Ohm); 8 = depth of bottom of the geoelectrical beds (m); 9 = approximate penetration of VES measuring; 10 = the border of the geoelectrical beds; 11 = mark of covered karst form; 12 = pit; 13 = syngenetical covered karst form, which developed above elevation; 14 = postgenetical covered karst form, which developed above elevation

Table 2. Relationship between covered karst forms of different types and the thickness of the covering sedimentary rock

The greatest thickness of the covering sedimentary rock [m]	Place of development of covered karst forms			Classification of the covered karst surface	Process
	At depression of limestone floor	On side slope of elevation	On the elevation		
< 3.5	without burrow s.c.k.f.	there is not covering sedimentary rock	there is not covering sedimentary rock	the depression of the limestone floor is partly accruating	accumulation
3.51–6.0	s.c.k.f. with burrow	s.c.k.f. without burrow	there is not covering sedimentary rock		
6.01–20.0	p.c.k.f. with burrow	s.c.k.f. with burrow	s.c.k.f. without burrow	the limestone floor	
>20.01 (?)	covered karst form does not develop	p.c.k.f. with burrow	s.c.k.f. with burrow or/ and p.c.k.f. with burrow	covered up, the covering sedimentary rock is planar or it is dissected by gullies or valleys	
6.01–20.0	p.c.k.f. with burrow (?)	p.d.k.f. with burrow	s.c.k.f. with burrow or/ and p.c.k.f. with burrow	depression on the covered karst of the covering sedimentary rock, or depression of the partly covering sedimentary rock	denudation
3.51–6.0	c.k.f. with fossil	c.k.f. with fossil, p.c.k.f. with burrow and s.c.k.f. with burrow	the elevations which are the highest, are exhumated, s.f.k.f. without burrow and s.f.k.f. with burrow can develop on those elevations, (which are of medium height) s.c.k.f. with a burrow and p.c.k.f. with burrow develop (on those elevations which have small height)		

Note: c.k.f.: covered karst form, s.: syngenetic, p.: postgenetic

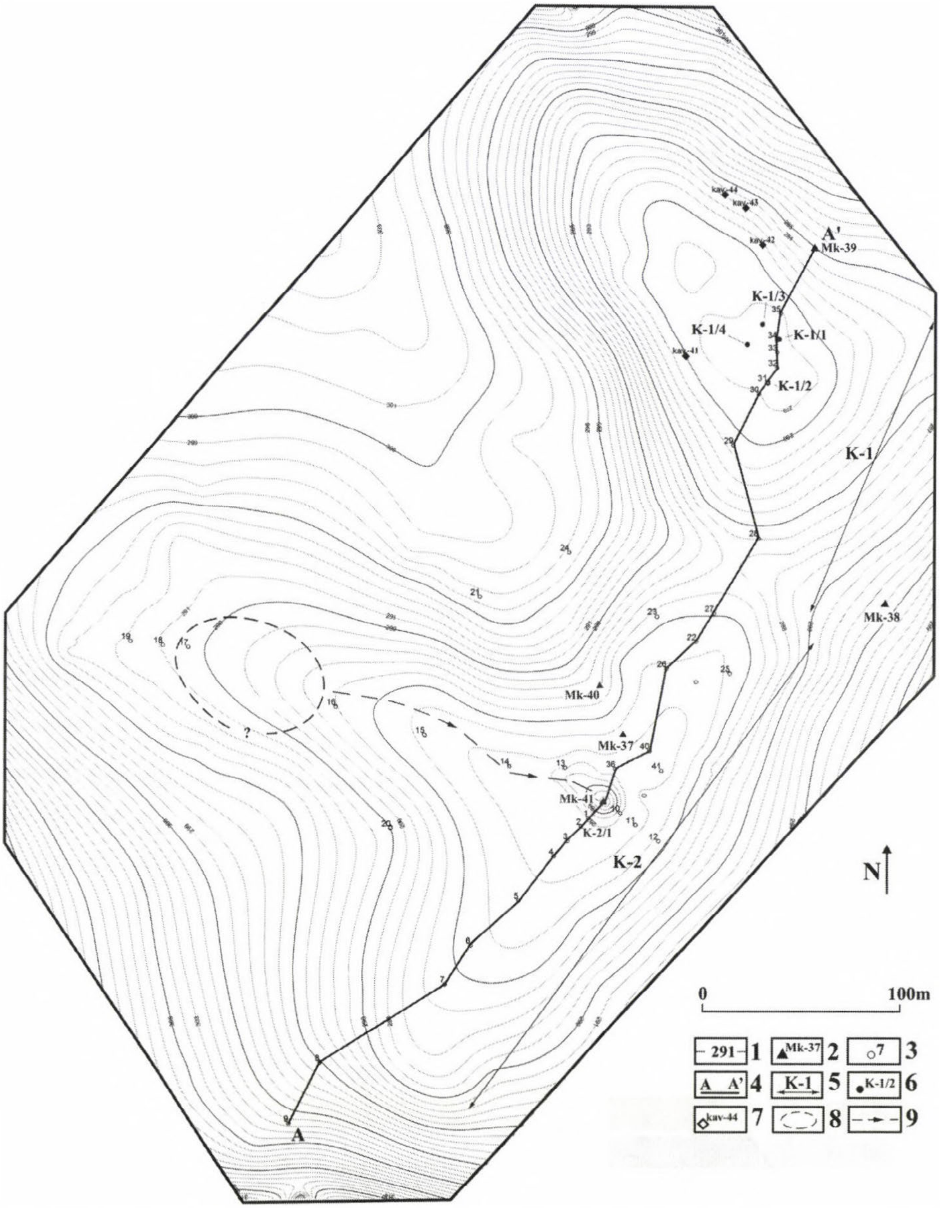

Fig. 9. The map of partly covered depression of the sedimentary rock (Teresztenye Plateau, Aggtelek Mountains). – 1 = contour line; 2 = limestone outcrop and its number; 3 = number and place of VES measuring; 4 = line of the profile; 5 = partly exhumed depression of covering sedimentary rock; 6 = mark of the covered karst form; 7 = limestone gravel outcrop and its number; 8 = covered up sinkhole; 9 = gully

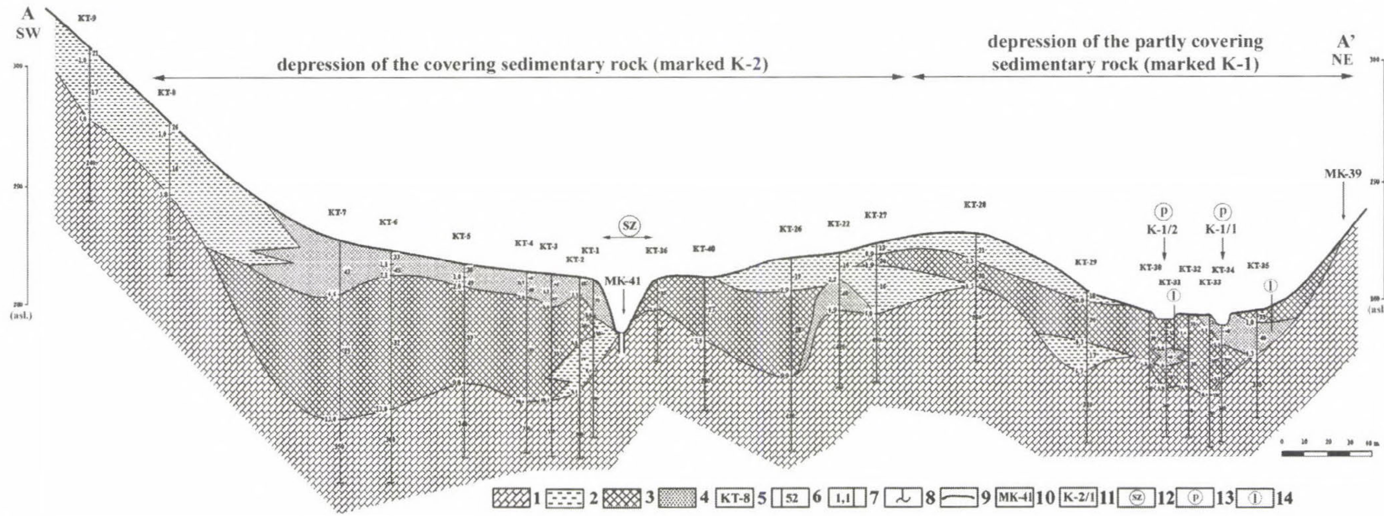

Fig. 10. The depression of covered sedimentary rock (K-2). The depression of the partly covered sedimentary rock (K-1) geoelectrical-geological profile marked A–A′ (Teresztenye Plateau). – 1 = limestone; 2 = clay; 3 = clay (with limestone debris-sand); 4 = sandy-gravelly-loess (with limestone debris); 5 = number and place of VES measuring; 6 = the geoelectrical resistance of the beds (Ohm); 7 = depth of bottom of the geoelectrical beds (m); 8 = approximate penetration of VES measuring; 9 = border of the geoelectrical beds; 10 = place of limestone outcrop and its number; 11 = mark of karst depression; 12 = syngenetical covered karst form having developed above elevation; 13 = postgenetical covered karst form having developed above depression; 14 = lenticular sediment structure. Note: The surface of the coving sedimentary rock of the depression is a transition between the allogenic karst (because of the clay beds) and the covered karst (because there not are valleys or a gully in its internal, concerning the fact that limestone does not crop out at the bottom of the covered karsts)

karst in their surroundings to which impermeable sediments have been added. These phenomena contribute to a more intense deepening of the depressions of the covered sedimentary rock. More and more covered karst forms may be accrued and so impermeable sediment patch develops within their area. Therefore impermeable character in the depressions of the covering sedimentary rock develops increasingly. Hereby the depressions of the covering sedimentary rock may develop gradually to allogenic karst.

Conclusions

– Allogenic karstification happens along junction if the covering sedimentary rock is impermeable. In contrast, covered karstification occurs at places where the permeable covering sedimentary rock is thinned or permeable beds wedge out.

– Forms having emeged during uncovered karstification or permeable sediment patches of the covering sedimentary rock determine the development of covered karst within the Hungarian karsts.

– The places of karstification of the limestone floor might be reactivated during accumulation. The covered karst will be the result of postgenetical karstification overlying these areas.

– The karstification place may be drifted in case of accumulation but during denudation too, if the karstification is allogenic. The direction of the drifting is the same as the direction of the junction migration. If sinkhole develops inside of the allogenic karst and the sinkhole accrues because of the accumulation another sinkholes do not develop in its surroundings. At such places the junction does not drift.

– Covered karstification may happen on the same place but the characteristic of it may change. The development of syngenetical covered karst form with burrow attends the existence of the syngenetical covered karst form without burrow, later the existence of the previous is followed by the development of postgenetical covered karst form with burrow on the karstification places. The places of covered karstification may be drifted too. Drifting happens to the direction of places which have smaller covering sedimentary rock thickness. The direction and degree of the drifting depend on the development of the surface (whether there is denudation, or accumulation) or on the morphology of the limestone floor. If the karstification happens at the same place, syngenetical karstification is attended by postgenetical karstification. If the karstification drifts, the characteristic of the covered karstification does not change with certainty.

– The forms of the limestone floor are buried during accumulation, while they are to be exhumed by denudation.

– Such surface develops which dips into the direction of the junction on allogenic karst. Sinkhole develops (in case when denudation is generated by sheet wash) or blind valley is created (when denudation is generated by channel erosion) at the margin of the allogenic karst. Depression of partly covering sedimentary rock develops if the denudation is generated by sheet water. Depression of the covering sedimentary rock develops on the covered karst too, and covered karst forms are created inside of it. The bottom of the depression of the covering sedimentary rock may dip into various directions.

– Depressions of the covering sedimentary rock, or depression of partly covered sedimentary rock develop too. The nature of development depends on the morphology of the limestone floor.

– Allogenic karsts and covered karsts may change into one another.

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QUANTITATIVE ANALYSIS OF DERIVATIVE LAND MOSAICS

GÁBOR MEZŐSI[1]–BURGHARD MEYER[2]

Introduction

Every landscape has its own potential, which has to be determined in case of any kind of spatial planning meant to be environmentally friendly. Knowing the potential is also important during the evaluation of the effective or optimal land use. Any other way, planning and research will not produce realistic results. Numerous methods and tools can be applied for the evaluation of landscape structure and processes, though basically two approaches are accepted. On the one hand researchers might concentrate on spatial relationships and refer to the potentials of the landscape (BASTIAN, O.–SCHREIBER, K. F. 1999). On the other hand, if the operation and use of a given spatial unit are considered, one might end up in a functional landscape analysis. The functions are not only physical and natural categories, but they are also able to signify a certain type of potential.

Most frequently landscape functions are defined as the pendants of landscape structure and landscape potential with an emphasis on functional and social relationships. To be aware of the landscape functions is an imperative necessity during management, thus planners must reveal these relationships for a well based project Besides, landscape functions play an essential part in determining environmental risk, too.

The methods used for the spatial analysis of the landscape are well documented; the question of scale and structure is broadly discussed. Nevertheless, the spatial extension and hierarchy of landscape functions is somehow neglected in the literature. This is understandable, since the evalua-

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tion of functions as spatial mosaics raises a number of theoretical and practical questions. Some of them are the following. How can be an integrated/aggregate value understood from the aspect of the basic functions? What are the limits of the theorem claiming that the analysis of functional mosaics must provide additional information on landscape quality and interactions?

The main goal of this paper is to explore the integrated value of functional mosaics; to evaluate their suitability for determining risk; and to assess the applicability of landscape metrics in the description of landscape functional mosaics.

Landscape functional mosaics

Functions in the landscape

Most of the interpretations agree that landscape functions can be divided into three thematic groups (deGroot, R. 1992; Bastian, O.–Schreiber, K. F. 1999; Bastian, O.–Steinhard, U. 2002). These are: economic (e.g. renewable resources), ecological (e.g. resistance to soil erosion) and social (e.g. recreation). The quantitative description of the nearly three dozen of known landscape functions is not at all precise.

During research, most of the problems are caused by the scale. Landscape functions can be grouped at least into two classes of scale, thus if the above mentioned thematic groups are considered too, then after all 1st order, 2nd order, 3rd order, main and subfunctions can be distinguished. If more functions are analysed during a research project, it is an essential requirement that they are studied at the same hierarchical level. A further problem is that functions, having already an aggregate character (e.g. the erosional and recreational functions are determined by numerous factors), might show multiple combinations within almost each spatial units, and might mobilise various relationships and interferences.

Analysis of landscape mosaics

The major concepts of landscape ecology are based on the assumption that the patterns perceived in the landscape are in close relationship with ecological processes (Turner, M. G. 1989). The mosaic character of the landscape and its features are well studied. It is also broadly accepted that the mosaic pattern is apparent regardless of scale (Forman, R. T. T. 1995). Heterogeneity in the landscape appears in a double way. The first is the gradient change of an attribute in space.

Gradients do not have borders and no patches can be realised in them, still they represent certain heterogeneity (e.g. tropical rainforests, where changes can be considered continuous). Landscapes of this type are quite rare. The second form of spatial heterogeneity is represented by mosaic patterns. In this case attributes are spatially organised, they form aggregates, which can be delineated. Landscape mosaics may contain patches and corridors. This concept had set the base of the widely known patch-corridor-matrix model (Forman, R. T. T.–Godron, M. 1986) and lead to numerical description of patterns with the help of index-lists. Patches can be influenced by the heterogeneity of substrates, natural disturbances and anthropogenic effects. Landscape components and attributes can be arranged into a patch-corridor-matrix configuration.

The evaluation of the landscape, including statistical analyses, is highly dependent on scale. Landscape patterns are studied at three levels: patch-level, class-level (patch type level) and landscape-level. Landscape indices are derived from the parameters defined for patches and patch types. Parameters are usually summed or averaged, though the algorhythm is frequently modified by different authors. Landscape indices can be interpreted not only as simple heterogeneity indicators, and class indices also represent more than just the fragmentation of the landscape. They are the measures of landscape pattern as a whole.

The model of landscape functional mosaics

If landscape mosaics are defined as the aggregation of spatial patterns, landscape functional mosaics are then the aggregation of functional patterns, arranged in integrated spatial units. Different landscape functional mosaics can be created by focusing on different landscape functions during modeling. In contrast to most approaches during the last decade, the term 'landscape metrics' will be used in this study not only for land use or land cover. They were applied for the description of spatial data and for mapping/assessing landscape functions. This has resulted in different levels of landscape metrics over the same cultural landscape.

The application of landscape metrics raises three major problems. The first is the integrated manner of functions and, as a consequence, of their interdependency. The second is the differences in scale. The content and extension of a so called main function, such as the pedological one, is very different from that of a subfunction, e.g. resistance to erosion. The third problem is the transfer of results (derived from the patch analyses of functional mosaics) into the practise of planning and management, and thus the way how functional values can be fitted to the existing landscape categories.

Methods

Landscape functions are scale dependent. The functional difference at the existing hierarchical levels can be determined, however, in order to exclude the serious problems originating from interdependency homogeneous categories were applied. For the analysis the following landscape functions, representing the third hierarchical level, were selected: recreation, resistance to erosion, resistance to underground water and biomass production. The selection was made on the basis that these functions are the most important in determining environmental risk over the study areas.

Landscape functional mosaics were studied on a class-level. In this respect a major problem was the interpretation of the smallest geometry where landscape functional elements could be investigated (minimum element size was 500 m^2 and defined at a scale of 1:10 000). The methodological analysis was tested on two study sites, each with an area of 50–100 km^2, situated in Germany and Hungary. The German site, Jesewitz, is characterized by a moraine landscape, and located north of Leipzig/Saxony. The Hungarian site is a part of the Lake Velence catchment and includes the lake itself. The surroundings of Jesewitz are characterised primarily by agricultural land use with arable land considered as the main land cover category. On the other hand, the Hungarian test site is characterised by mixed land use and land cover (vineyard, recreation, agriculture).

Landscape metrics were applied on the patches of the above determined four landscape functions. Landscape potentials, described by Marks, R.–Müllers, M. (1992) provided the structural base of functions. In this way spatial units were shaped, fitting to the existing geotypes. For example the resistance to erosion function is based on the resistance potential, which depends on the following factors:

– relief (the energy of overland flow is determined by slope length and angle),

– soil (physical soil type, humus content, gravel content),

– land use.

When calculating erosion probability, Marks, R.–Müllers, M. (1992) considered the same factors, and used a table form evaluation. In our study maps of physical soil types (9 categories), slope angle (11 categories) and landuse (15 categories) were superimposed and intersected, in order to determine the basic units (approximately 800, representing nearly 70 classes) for which the likelihood of soil erosion was calculated. The EPIC method was used for this purpose, though Erosion 3D or any other Wischmeier-Smith based method could also be suitable. Units were evaluated one by one, and e.g. where erosion probability proved to be very slight the soil resistance function was considered unimportant. Patches were classified into 3 categories, and the spatial pattern of e.g. the soil resistance function was determined this way. Then the patterns were analysed on a patch-level, too, with the following metrics: Shape Index, Perimeter-Area Ratio, Aggregation Index, Core Area Index, Proximity Index *(Table 1)*.

Table 1a. Calculated data for determining the functional pattern of the study area

Landscape Totals				
	Function	Biom	Soil	Retention
Area	Number of Parcels	1260	1407	6326
	Area (Class)	66,461,099.97	61,149,497.14	61,270,744.02
	Mean Patch Size	251,327.68	409,011.74	100,858.37
	Patch Size standard deviation	310,474.94	988,204.26	341,957.71
Edge	Total Edge	1,013,427.23	1,596,793.27	2,519,756.9
	Mean Patch Edge	4,900.62	10,485.47	3,919.37
Diversity	Richness:	8	10	11
	Relative Richness (%)	100	100	100
	Shannon's Diversity:	0.683	1.72	1.721
	Shannon's Evenness:	0.328	0.747	0.718
	Dominance:	1.397	0.583	0.677
	Number of classes (actual):	8	10	11
	Number of classes (potential):	8	10	11

Table 1b. Calculated data for determining the functional pattern of the study area

Type	AREA	AREA_ CPS	PERIM	PERIM_ CPS	PARA	PARA_CPS
1.	61.0000	91.3043	8200.0000	91.3043	134.4262	4.3478
1.	94.0000	95.6522	13800.0000	100.0000	146.8085	8.6957
1.	146.0000	100.0000	13400.0000	95.6522	91.7808	0.0000
2.	377.0000	97.6190	31600.0000	100.0000	83.8196	2.3810
2.	433.0000	100.0000	21600.0000	97.6190	49.8845	0.0000
3.	3277.0000	100.0000	142200.0000	100.0000	43.3933	0.0000

Table 1b. (continuation)

Type	SHAPE	SHAPE_ CPS	CORE	CORE_CPS	PROX	PROX_CPS
1.	2.5625	91.3043	0.0000	0.0000	2.8889	52.1739
1.	3.4500	100.0000	0.0000	0.0000	1.7510	43.4783
1.	2.6800	95.6522	0.0000	0.0000	1.5192	39.1304
2.	4.0513	100.0000	0.0000	0.0000	2.1134	26.1905
2.	2.5714	97.6190	0.0000	0.0000	2.5989	33.3333
3.	6.1826	100.0000	0.0000	0.0000	15.8738	17.3913

However, several problems have turned up during the aggregation at this hierarchy level; namely the number of functions was highly influenced by the geometry of the patches. Thus landscape metrics were made only in case of the main landscape functions, otherwise several other functions should have been mathematically introduced and statistically involved. Another major question, worthwhile for further analysis, is how the interdependence between functions could be assessed and characterised.

First results

The data gained from the three base maps (*Figs 1, 2* and *3*) were organized in a database with a 160 row x 180 column setup. After overlaying the cell values of the different maps the functional characteristics were calculated (e.g. likelihood for erosion), which may support decision making in the future. The patch values show that usually functions are of low spatial complexity (low perimeter-area ratio), they are diverse (low Shannon's Index) and fragmented.

It is hard to realise a direct or discernible relationship if the received metric values are compared with the patch-level values of ecological factors (e.g. with the physical characteristics of soils). Nevertheless, the amount of available data is not sufficient for a statistical evaluation. Thus, for further analyses a larger pool of data would be necessary.

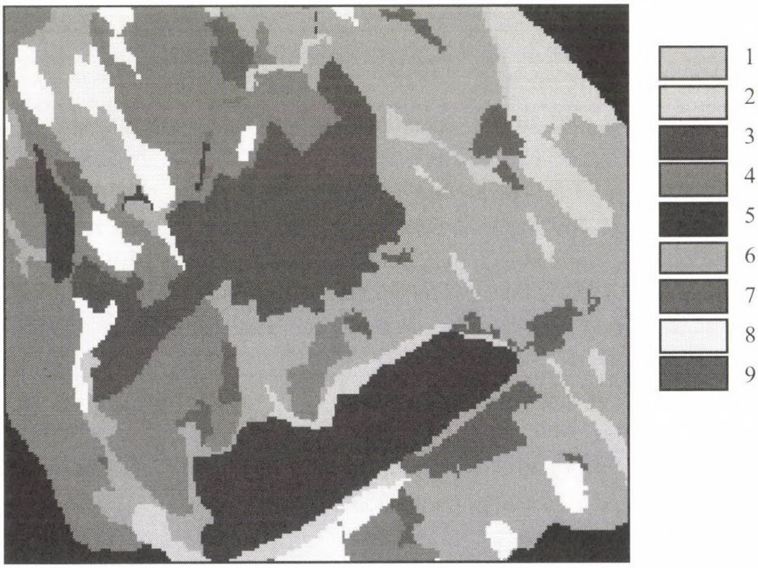


Fig.1. Land cover with physical soil types (test area B). – 1 = clay; 2 = clayey loam; 3 =forest; 4 = sandy loam; 5 =open water surface; 6 =loam; 7 =wetland; 8 =sand; 9 =built-up area

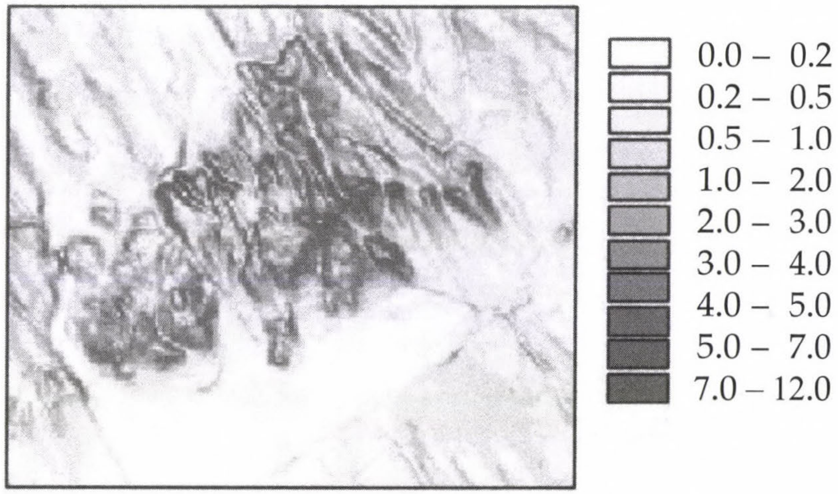


Fig. 2. Slope angle categories within the test area B

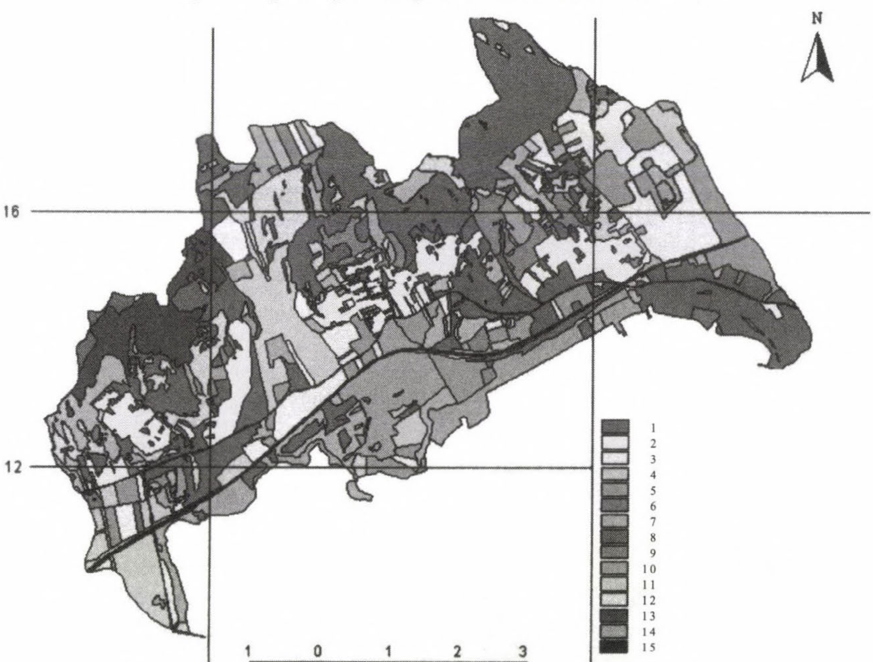
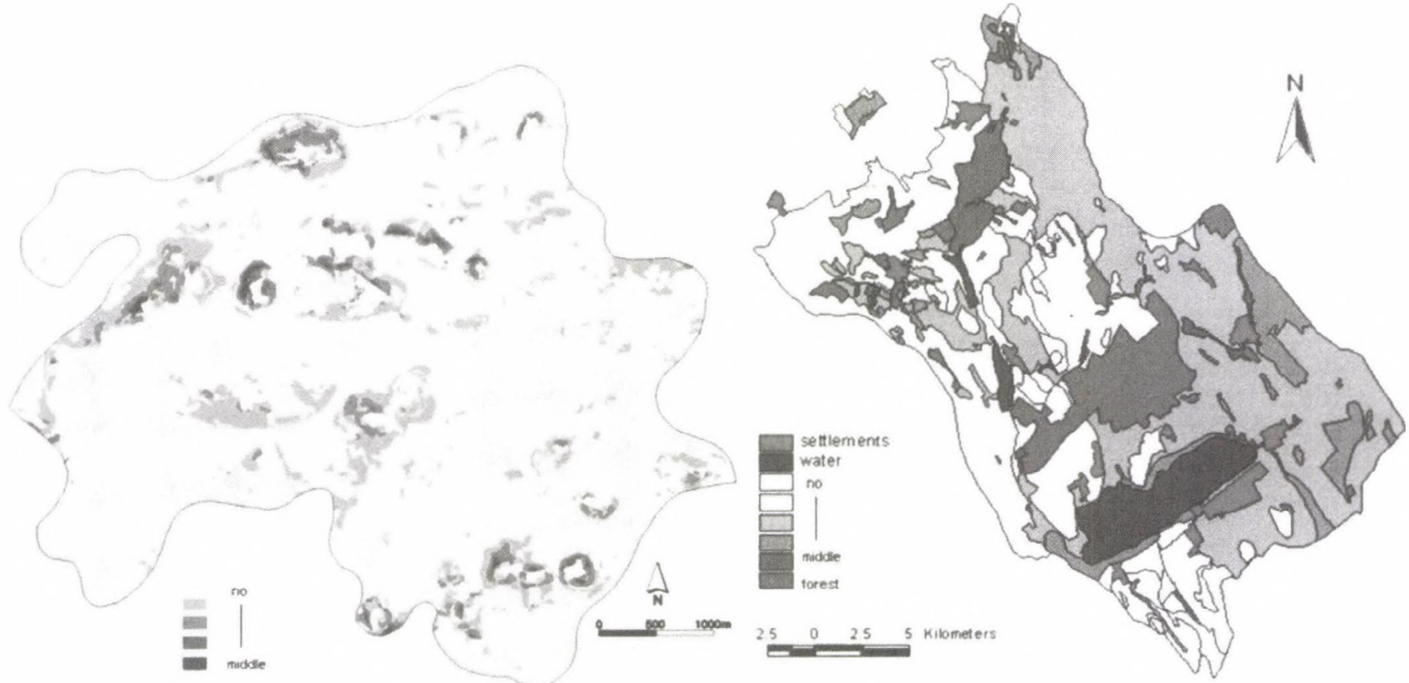


Fig. 3. Land use (1999). – 1 = built-up area; 2 = vineyard, orchard; 3= arable land (cereals); 4 = arable land (fodder crops); 5 = arable land (root crops); 6 = fallow; 7 = medow and pasture; 8 = broad-leaved forest; 9 = coniferous forest; 10 = mixed forest (broad-leaved/coniferous); 11 = gallery forest; 12 = forest under planting, renewal and timbering; 13 = natural vegetation; 14 = wetland (reed, meadow, fens); 15 = public road, motorway



A B

Fig. 4. Resistance to erosion on the study site. **A** = Test Area Jesewitz, Germany; **B** = Test Area Lake Velence, Hungary

The final question is: what additional means can landscape metrics provide for determining landscape functions and landscape potential, and how can changes be predicted in a cultural landscape? This predominantly depends on the possibility of projecting functional changes to the future. Regarding the Hungarian study area the expansion of the nature conversation function can be expected, which will decrease the weight of other functions (e.g. soil resistance), in the long run however it may lead to an increase in the value of the soil productivity function. This may also mean that e.g. in the case of the soil resistance function the measured Shannon Index or the Perimeter–Area Ratio can decrease, referring to an increasing ecological stability.

Acknowledgements – The study was supported by the OTKA, grant number T46558

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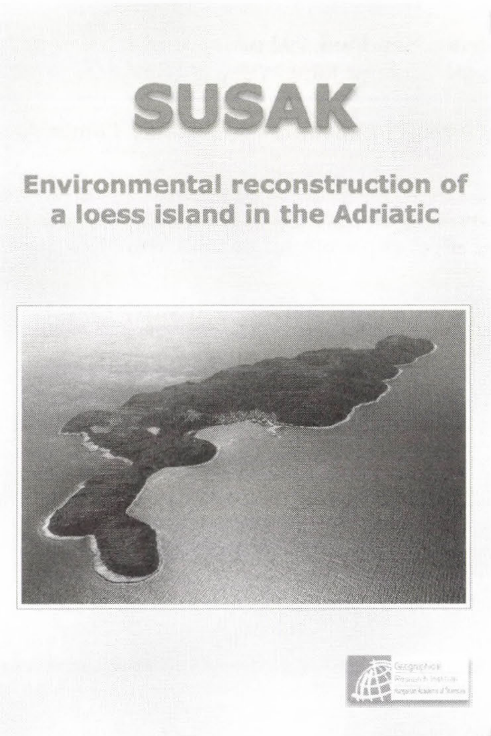

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Studies in Geography in Hungary 33, Geographical Research Inst. HAS, Budapest 2008, pp. 101–109.

FLUVIAL LANDSCAPE PATTERN IN AN AGRICULTURAL DANUBIAN FLOODPLAIN

DÉNES LÓCZY[1]

Introduction

Floodplains along the Hungarian Danube River have long been disconnected from the main river channel through channelization and fluvial landforms, which largely determine the ecology of the landscape, are strongly modified by human action (first of all, by tillage). Based on satellite image interpretation the paper investigates floodplain morphological systems in two approaches. In one approach the density of fluvial features (primarily ridge-and-swale systems) are surveyed and analysed for distribution according to alignment. In the second step geomorphological units are identified and their pattern confronted with usual tillage directions in the individual agricultural fields. It is claimed that the angle between tillage direction and the axis of the point-bar system is a meaningful parameter in the prediction of the loss of river deposition features from the surface.

Floodplains and riparian zones are areas of amphibian nature, where fluvial and „dryland" (e.g. desiccation) processes are equally efficient controls of geomorphic evolution and vegetation growth. The dynamics of the floodplain environment (including geographical processes like the passage of flood waves, soil formation and erosion as well as biological ones like vegetation growth and fish reproduction) are influenced by the natural pattern of landforms (bar-and-swale terrains, natural levees, backswamps). Before river channelization and land drainage measures more than half of Hungary, a lowland country in the centre of the Carpathian Basin, was regularly inundated. Human interventions in the 19th century reduced the area of floodplains: today along major rivers they cover 23% and along minor water-courses 10% of their total area. The extent of reduction of floodplain width varied but along all major rivers geomorphic evolution took different paths on the active and the protected floodplain.

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Floodplain evolution and sedimentation also varies with the various rivers. For instance, oxbows along the Dráva River show much lower infilling rates than those along the Danube River (Erdősi F. 1977). The broad Dráva floodplain had received a relatively low amount of specific suspension load during floods and, thus, the infilling rates were low – even for the meanders naturally cut off before channelization began in the 1850s (Somogyi S. 2000). With efficient flood control, however, the survival of fluvial pattern on the surface of protected floodplains under agricultural use largely depends on the tillage techniques applied.

Challenges in floodplain geomorphology

A recently renewed academic interest in floodplain research in Hungary can be explained by several circumstances:

– national programme for flood control planning (establishing emergency reservoirs over protected floodplains primarily in the Tisza River system to 'cap' flood wave peaks);

– inventory of natural monuments at national, regional and local scales (including spectacular fluvial landforms – Szabó J. *et al.* 2004);

– development of ecotourism based on natural monuments (facilities to be located in both active and protected floodplain, like in the Gemenc Forest belonging to the Danube-Dráva National Park and in the Ormánság region along the Dráva River);

– implementation of other Water Directive tasks (eg. conservation of seminatural wetlands).

In spite of the above motivations geomorphological and geoecological investigations in Hungary hardly extend over floodplain areas. Protected floodplains, where the highest quality agricultural lands are concentrated, deserve more attention in geomorphological research.

In general the elements of floodplain topography (Lóczy D. 2005) can be summarized in the following *(Table 1)*.

Table 1. Natural and man-made features along Hungarian rivers

Natural features	Man-made features
bar-and-swale series	drainage ditches
natural levees with crevasses	flood-cotrol dykes
oxbow lakes and filled cutoff meanders	accentuated field boundaries
enclosed backswamps	built-up areas, paved and dirt roads
	navvy pits

The distinction between natural and man-made features may seem somewhat artificial in some cases (Nagy A.–Lóczy D. 2004) but their combination is certainly decisive in landscape pattern. Bar-and-swale systems seem to occupy the largest areas and, therefore, dominate floodplain pattern.

Objectives

The paper presents research aimed at revealing the texture of physical landscape pattern in a floodplain and comparing it with the pattern resulting from long-term cultivation (tillage direction, road network and field boundaries). The seminatural landscape pattern is of great landscape ecological significance since it controls the functioning of the floodplain landscape (for instance, through the distribution of groundwater and soil moisture). The opportunities for the preservation of fluvial features depend on the adjustment of land use to this pattern. In this flat and open landscape large-scale farming is typical and long-term tillage highly influences the chances for the survival of fluvial features. Naturally, point-bar systems are three-dimensional sediment sequences and ploughing only affects the very surface but topographic changes may involve the transformation of the entire landscape pattern. Parameters were sought to represent the density of features, their alignment and to describe how human action accelerate the process of obliteration for fluvial features. Over most of the floodplain dissection is mostly determined by the density of alternating coarser grained point-bars and inter-bar swales of finer fill. The variations in grain size make the identification of landforms are reflected in grayscale tones on satellite images and that makes identification relatively easy. The structure of point-bar systems towards depth is disclosed by auger holes deepened along transects.

Study area

For the landscape pattern survey a typical floodplain test area along the left bank of the Danube in Mohács Island was selected *(Fig. 1)*. The surveyed area is found in the vicinity of the villages Dunafalva, Sárhát and Homorúd (46°N; 18°48′E) and its size is 6.48 km x 3.55 km. It is a perfectly flat, low-lying floodplain of 84–88 m elevation. Maximum relative relief does not reach 2 m km^{-1}. Its surface was affected by the accumulation of Danubian deposits as late as Neolithic times (Erdősi F.–Lehmann A. 1974). Consequently, the network of traces of fluvial features is still relatively dense – in spite of intensive agricultural use made possible by efficient river regulation and land drainage beginning with the 1890s.

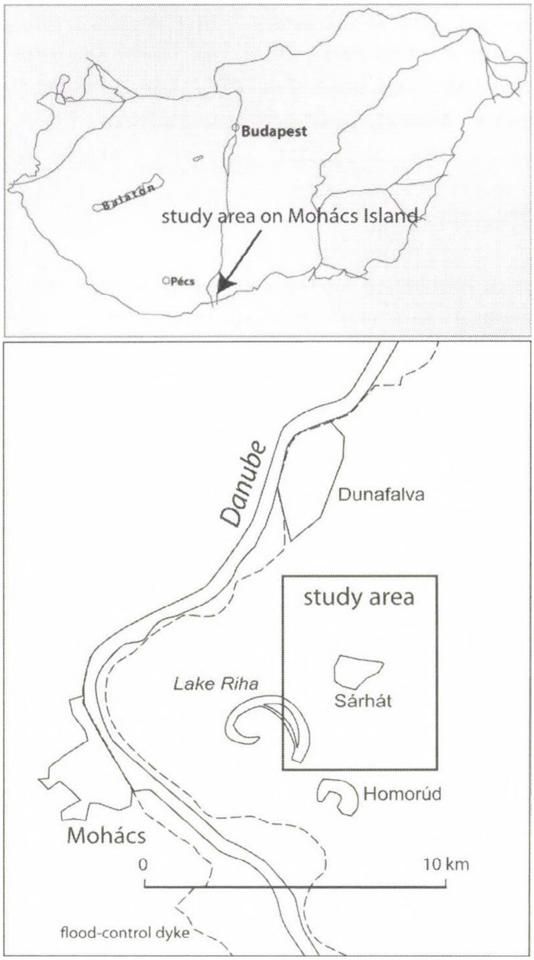

Fig. 1 Location of test area on Mohács Island

Although in the first stages of land drainage predominant floodplain forests were cleared to gain wet meadows for grazing, both study areas are now under intensive arable use (70–80%). The predominant crops are maize, winter wheat, soy and fodder crops (Lóczy D. 2004). The environmental conditions are quite favourable for the cultivation of the listed crops (Lóczy, D.–Szalai, L. 1999).

Methods and findings

Particularly when long inactive, deprived of natural vegetation well adjusted to natural pattern, and, at the same time, truncated by tillage activities, floodplain landforms generally show a rather subdued relief. Even detailed (1:10 000 scale) topographic maps are hardly suitable for realistically presenting their spatial distribution. Combined with satellite images taken at proper dates, however, the variations in the grain size and moisture content of infillings reveal the distribution pattern of (mostly) fluvial landforms. For some sections of the Danubian floodplain the georeferenced GoogleEarth® mosaic compiled of images taken in recent years have appropriate resolution for the interpetation of fluvial landforms.

In order to characterise landscape pattern, a simple distribution map of landforms is not sufficient since the alignment of features is also of significance in the studied floodplain of the Danube. Therefore, the geometry of landscape pattern is illustrated by directional diagrams which show the average intervals between drainage elements or their remnants in north-to-south and west-to-east directions of the geographical grid (*Figs 2* and *3*). The intervals

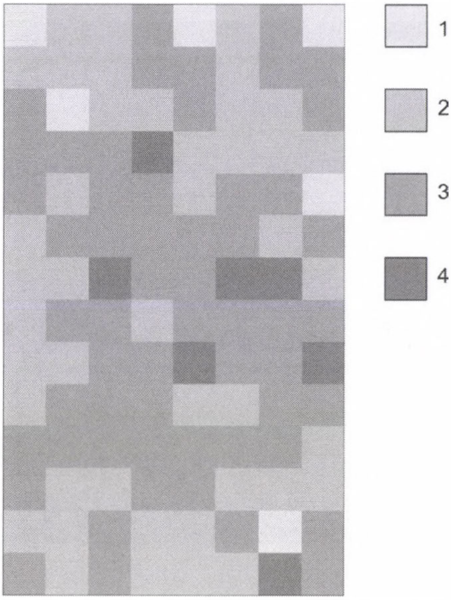

Fig. 2. Density of fluvial and anthropogenic features counted along latitudes. 1 = 10 or less; 2 = 11–20; 3 = 21–30; 4 = more than 31

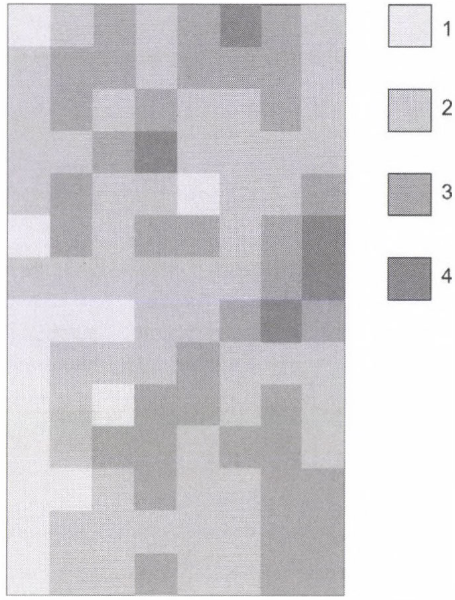

Fig. 3 Density of fluvial and anthropogenic features counted along meridians. 1 = 10 or less; 2 = 11–20; 3 = 21–30; 4 = more than 31

of the grid are 15″ along longitudes and 21″ along latitudes, both equalling ca 450 m. Information from 1:10 000 scale topographic maps was supplemented with surface features depicted on the GoogleEarth® satellite mosaic of the area. The features taken into consideration include natural elements of surface dissection like oxbows, meander traces, swales and man-made canals as well as man-made features like roads, canals, permanent field boundaries. Thus, the frequency of distribution for fluvial and anthropogenic feature density is separately represented for latitudes and longitudes. In order to combine both figures, a difference grid map *(Fig. 4)* was produced by subtracting the results of W to E counts from those of N to S counts for each grid cell. This can be meaningful for the true spatial distribution of fluvial features.

Relying on remotely-sensed images and detailed topographic maps, a map of fluvial landscape units can be drawn (boundaries depicted in gray tone in *Fig. 5)*. Altogether 30 more or less natural units (various generations of point-bar systems) are delimited. Further subdivisions of such a set of units are made by field boundaries. Thus, the number of units rose to 68 (although not all of them are suitable for analysis). For each unit of uniform pattern (where it was possible) an axis was established along which the point-bar system extended from the „root area" towards the tip reached at its ultimate develop-

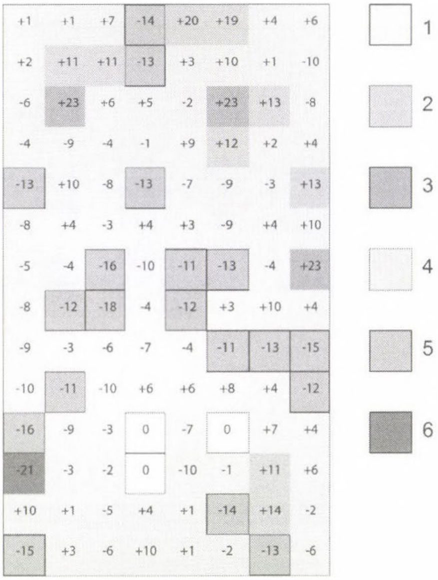

Fig. 4. Difference between the number of feature boundaries counted in both directions. Positive values refer to the case when features counted in N to S direction outnumber those counted in W to E direction. 1 = +10 or less; 2 = +11–20; 3 = +21–30; 4 = -10 or more; 5 = -11– -20; 6 = -21– -30

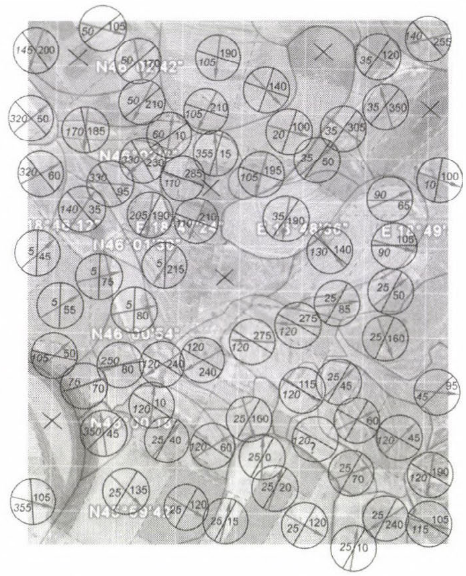

Fig. 5. Map of fluvial geomorphological units (continuous thick lines) and field boundaries (dashed lines) with circular diagrams showing directions (N = 0 degree; E = 90 degrees; S = 180 degrees; W = 270 degrees) of the axes of bart-and-swale systems by agricultural fields (arrows) and of usual tillage (continuous thin line) and average interval between fluvial features (in metres)

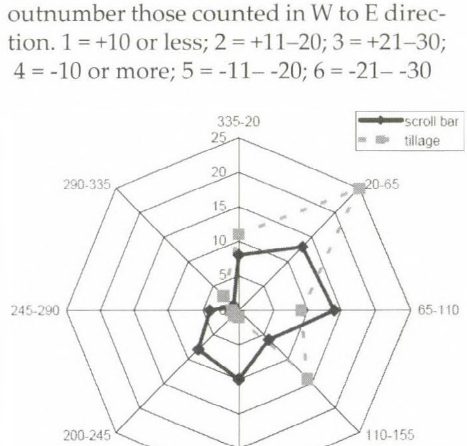

Fig. 6. Frequency distributions of variation between longitudinally and latitudinally estimated feature density (A) compared to the distribution of axis directions of bar-swale systems (B)

ment stage before cutoff. Each axis is represented in *Fig. 5* within a circle by an arrow rectangular to the most frequent alignment point-bars. In addition the usual long-term direction of tillage was also determined and represented within the same circle. The approximate angles of both directions to N are also shown in angles (0 degree is N, 90 degrees is E etc.). The frequency distribution of point-bar system axes is compared to that of tillage directions in *Fig. 6*.

The identification of fluvial landform traces is confirmed by grain

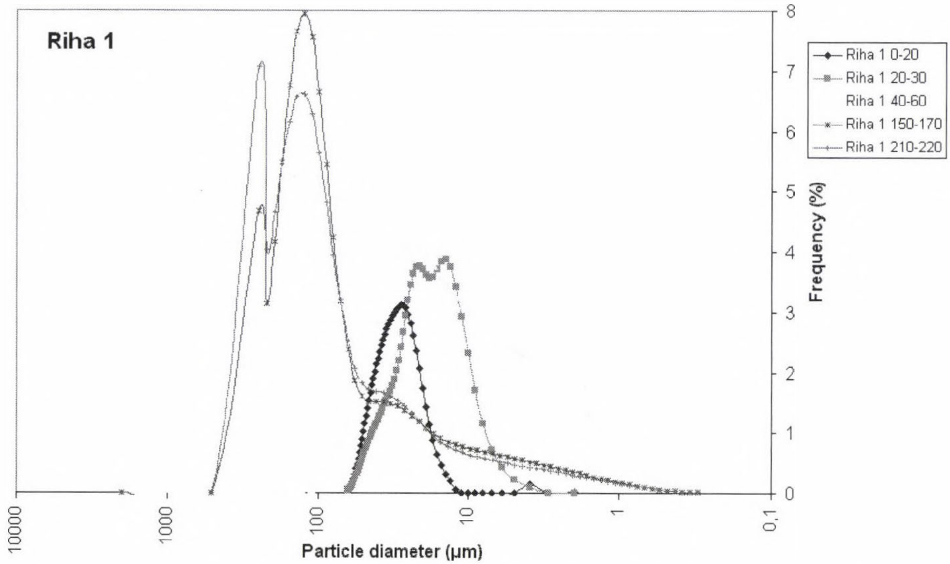

Fig. 7. Grain size distributions for exposed point bar deposits (layers nos 1–3) and swale accumulations at depth (nos 4–5)

size analyses along randomly selected transects. The superposition of point-bar and swale deposits is clear from the profiles (for instance, from the profile shown in *Fig. 7)*. The analyses were performed by a Fritsch Analysette A22–32 type instrument, capable of grain size identification over the 0.3 to 300 micrometer range.

Discussion

As expected, the study revealed a relatively high density of fluvial features in this floodplain section of the Danube. In the overwhelming majority of grid cells the number of man-made features crossed by surveying lines was much lower than the number of fluvial features (mostly point bars and swales). On the grid map of difference between N to S and W to E alignment countings positive and negative values are almost equally distributed. At the selected grid scale of ca 450 x 450 m this means that point-bar systems are equally developed in N to S as well as W to E directions. The frequency distribution of point-bar system axes has to confirm this statement.

Across the floodplain under study being adjusted to a NE to SW section of the Danube on the left bank between the village of Dunaszekcső and the town of Mohács, meanders shifted and point-bar systems mostly developed in

NE to E and subordinately S to SW directions. This is clearly reflected in the frequency distribution of bar-and-swale system axes *(Fig. 6).* Units with axes all other directions do not constitute more than 20% of all units represented with a circle.

The relatively high density of clearly identifiable features indicates that all point-bar system generations took shape in historical times. Most of the now cut-off meanders could be active channels in the centuries after the Hungarian Conquest of the Carpathian Basin (896 AD).

Intensive farming beginning with channelisation and land drainage from the 1850s could not obliterate fluvial features – although where the direction of tillage is approximately at right angles to the axis of bar-and-swale systems, the destruction of the physical pattern is clearly visible. Tillage directions show maxima in the N to NE segment and, naturally, a secondary peak in a rectangular direction, in the E to SE segment.

The identification of fluvial geomorphological units of different feature density and arrangement may help land use planners to allocate land strips for cultivation by smallholders in the floodplain landscape generally suitable for large-scale farming.

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Quaternary vegetation history in Hungary

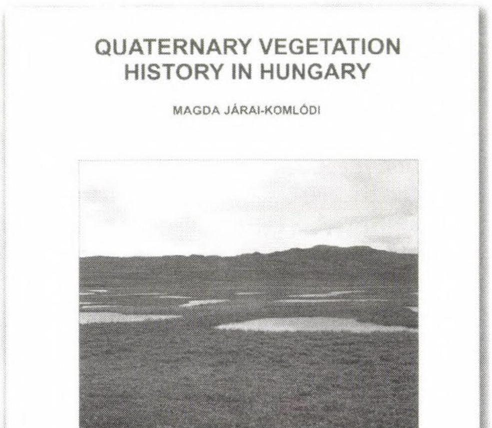
by Magda Járai-Komlódi

Járainé Komlódi Magda: **Quaternary vegetation history in Hungary.** *Budapest. 2003. Geographical Research Institute HAS. 76 p. (Theory-methodology-practice 59)*

The accumulation of knowledge of Quaternary vegetation history in Hungary started in the mid-20th century, primarily with palynological studies on Holocene forest development by Bálint Zólyomi.

Based on these initial results, using sophisticated methods and in co-operation with the related scientific disciplines, the vegetation history of Hungary could be extended back to the Lower Pleistocene, with a special reference to reconstructions for the Late Pleistocene (Weichsel). With the involvement of archeological investigations, several aspects of human impacts during the last thousands of years have become identified as well.

The present publication is aimed at a summary of results achieved over the past fifty years.



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Studies in Geography in Hungary 33, Geographical Research Inst. HAS, Budapest 2008, pp. 111–123.

IMMIGRATION, RECEPTION AND INTEGRATION IN HUNGARY

ZOLTÁN DÖVÉNYI[1]–PÁL PÉTER TÓTH[2]

Raising the issue

During the history of Hungary of more than one thousand years the country became participant of the international migrations repeatedly, even though she did not always benefit from this part of the "highway of nations". Hungary and the Carpathian Basin had been forced to play this role, stemming from their geographical position, all that could be done was to attempt to make use of these migration processes. This effort was successful for centuries, as the population of Hungary had increased significantly due to the inflow of immigrants.

The population supplying role of immigration ceased in the last decades of the 19th century, replaced by the population-decreasing process of emigration. This turn was also the end of a historical period: from this time on Hungary has been both a destination of immigrants and a country releasing emigrants at different times *(Fig. 1)*.

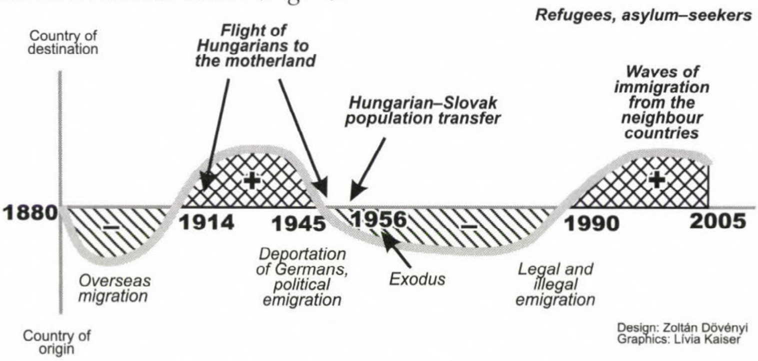

Fig. 1. Phases of international migration in Hungary (1880–2005)

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The present phase of receiving immigrants started about two decades ago. This period, which started in the late 1980s – i.e. during the final years of the state socialist period – bears the following major characteristics:

– The number of immigrants remains above that of emigrants year by year, thus the number of foreign citizens legally staying in Hungary is continuously increasing.

– Despite the process mentioned above, the share of foreigners among the total population is still low, constituting some 1.5% of the inhabitants of Hungary.

– The immigrants can be classified into several migration types, the separation of which sometimes is hardly possible.

– Among the immigrants both voluntary and involuntary migrants can be found.

– Hungary is basically a destination of immigration for the Hungarian population of the neighbouring countries.

– Immigrants live in Hungary in a rather concentrated spatial pattern, more than half of them having chosen the capital city and its surroundings as their new home.

– The majority of the Hungarians coming from the neighbouring countries arrived with the intention of settling down in Hungary, which is indicated by the high share of those who have actually gained Hungarian citizenship.

The statements above also reveal that the relationship of the immigrants, belonging to the different types of migrations, to the receiving country can be very different. One extreme is the group of transit-migrants whose main intention is to reach the selected country, accordingly the countries in between are "obstacles to overcome" for them (Juhász, J. 2000). The majority of the involuntary migrants (refugees and asylum seekers) do not wish to integrate either, they are waiting for the opportunity to return home. This category, however, contains special groups willing to integrate into the Hungarian society, as it is shown by examples.

The other extreme is those migrants whose primary objective is the eventual settling down in the receiving country. Between the two extremes there is a wide "blank spot", where it is hard to forecast the integration of the immigrants.

Starting from the above statements, the authors make an attempt to present an overview of the past two decades of international migrations having affected Hungary, using the categories of immigration, reception and integration. Given the limited size of the paper two basic aspects will be emphasized:

– quantitative and structural features of immigration to Hungary, migration types and groups;

– characteristics of reception and integration, with special regard to the migrants of Hungarian ethnicity from the neighbouring countries.

The characteristic features of immigration

In the late 1980s – in the last phase of the state-socialist system – the hitherto rather lukewarm processes of international migration changed very rapidly and basically unexpectedly, which concerned both the migrations of voluntary and involuntary character.

Waves of refugees and the refugee issue as a new problem

The Hungarian citizens had not encountered the refugee issue as a striking mass phenomenon since the exodus in 1956, so meeting this issue again came as quite a surprise at the end of 1987 (Rédei M. 2007). What was especially striking is that this time people seeking refuge fled to Hungary, and did not escape from there.

Although two decades are not a very long time, the waves of refugees affecting Hungary can still be divided into markedly different phases on the basis of the origin of asylum seekers (Dövényi, Z. 2006).

– The Romanian phase lasted from late 1987 to the summer of 1991. The number of asylum seekers coming from Romania – whose majority was of Hungarian nationality – was mostly determined by the political events that took place in Romania. The final phase of the rule of Ceauşescu, and the period of uncertainty after the fall of the dictatorship, finally the ethnic riots made more than fifty thousand Romanian citizens move to Hungary.

– The Yugoslav phase started in the summer of 1991, after the civil war broke out, and was mostly related to the conflict between Serbia and Croatia. Due to the geographical proximity, citizens of both countries have sought asylum in Hungary in large numbers, but the exact figures are unknown, as several asylum seekers did not register at the refugee authorities. What can be said with certainty, however, is that this phase was far more intensive than the previous one: from (the former) Yugoslavia – within that especially Croatia – more refugees arrived to Hungary within seven months than from Romania in three years. Obviously, the ethnic composition was also different; Croats were the majority in the latter case. The situation is different if we look at the refugees who fled to Hungary from the Voivodina region belonging to Serbia: possibly tens of thousands of young Hungarian men fled from Voivodina to Hungary to escape the pointless military service. By reasonable estimations, at the end of 1991 some 75 thousand people who had fled from their homes stayed in Hungary.

– The Bosnian and Herzegovinan phase started when the main actions of the Yugoslav civil war moved to that region. Mostly because of the larger geographical distance, asylum seekers from this area only came to Hungary in smaller numbers. This phase was concluded by a small peak induced by the ethnic cleansing of 1995 *(Fig. 2).*

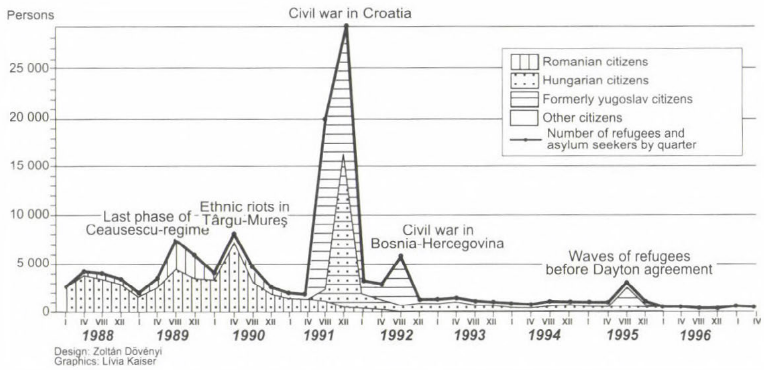

Fig. 2. Waves of refugee migration affecting Hungary (1987–1997)

– If we make the balance of the first three phases, we can see that more than 130 thousand people sought asylum in Hungary from the beginning of 1988 to the middle of 1995. This significant mass of people, however, has dissolved since then; the majority of these people have already left Hungary. The largest group remaining in Hungary is the group of those Transylvanian Hungarians (from Romania) who received Hungarian citizenship. From the aspect of integration practically this is the only group of the involuntary migrants who are worth attention from these phases.

– This was more or less the end of that phase of involuntary migrations to Hungary where the asylum seekers came from the neighbouring countries. The refugee issue did not cease exist, however, as in 1997 a very much different wave of refugees coming from outside Europe started, and this phase is still going on today. This basic shift of direction was caused by the fact that in that year Hungary annihilated the territorial restriction of the accession to the Geneva Refugee Convention, which meant that from 1997 onwards Hungary received refugees not only from Europe but from all over the world. This rapidly induced another peak in the influx of refugees, to be followed by a decline in their numbers again *(Fig. 3).*

Only a very small part (3%) of the asylum seekers coming from overseas remote places (e.g. Bangladesh, Iraq, Afghanistan) are given the refugee status, another 12% is to be received, the overwhelming majority had to leave Hungary, or should leave the country in the future. This way the issue of reception and integration only concerns a smaller group of migrants.

Foreign citizens in Hungary

Within the international migrations fundamentally changing in the late 1980s, not only involuntary but also voluntary immigrations to Hungary increased

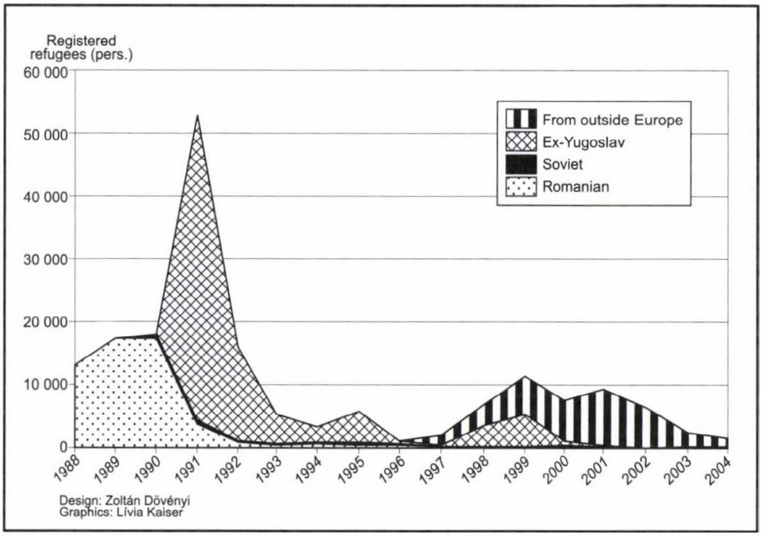

Fig. 3. Refugees and asylum seekers by citizenship in Hungary (1988–2004)

by leaps. The volume of this is demonstrated by the 410 thousand legal immigrants having moved to Hungary in the period between 1985 and 2005, of whom almost 330 thousand arrived after 1989.

Similar to the asylum seekers, the number of voluntary immigrants showed considerable fluctuations over the period in question. The deliberately restricted immigration of the socialist era was replaced by an intensive immigration, culminating in 1990. The majority of the immigrants – just like in the case of asylum seekers – were Romanian citizens with Hungarian nationality. This was followed by a decrease, which had evidently a lot to do with the transformation crisis appearing in Hungary too, which did not make Hungary an attractive destination of migrations. Parallel to the improvement of the economic situation, the number of immigrants started to rise again, stabilising at approximately 20 thousand per year *(Fig. 4.)*.

The composition of the immigrants by citizenship clearly reveals that Hungary is a destination of migration for the citizens of a few neighbouring countries only (mostly for native Hungarian speakers). This is clearly demonstrated by the fact that 70–80% of all immigrants arrived from Romania, Ukraine, Yugoslavia (Serbia and Montenegro), and the remaining part is shared by the rest of the world.

The foreign citizens do not only immigrate to Hungary; part of them leaves the country after a while. The balance is nevertheless definitely positive, thus the number of foreigners living in Hungary is increasing year by year. The volume of this growth is shown by the fact that in 1980 the number of foreigners living in Hungary was just over 12 thousand and did not reach 20 thousand by

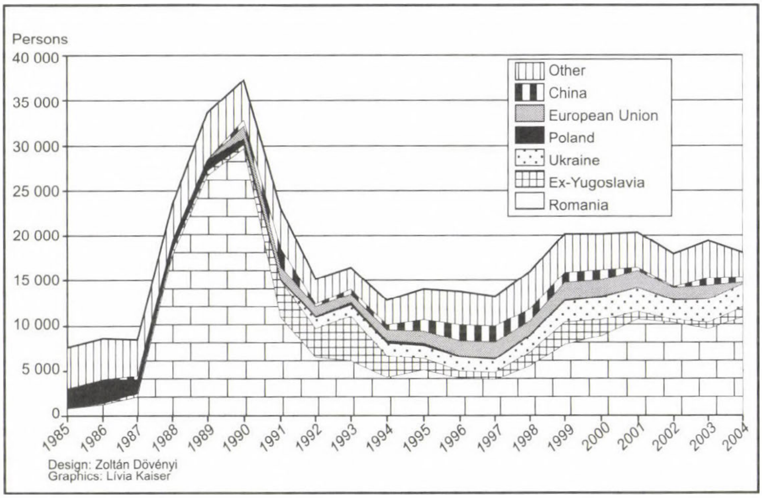

Fig. 4. Migration to Hungary by country of origin (1985–2004)

1987 (HÁRS Á. 2001). As a result of the subsequent mass influx of immigrants, by early 1993 the number of foreign citizens who lived permanently and legally in Hungary was over 123 thousand; at the beginning of 2006 their number reached 154 thousand, i.e. they made up 1.5% of the total population of Hungary.

Almost 85% of the foreigners living in Hungary are from European countries, as for the rest of the world it is only the Chinese that are worth attention (their number was 8,584 in 2006). As regards the countries of origin, Romania has a dominant share (with approximately 43%). On the whole, some two thirds of all foreign citizens arrived from one of the neighbouring countries (GÁRDOS, É.–SÁROSI, A. 2006).

The foreigners settling down in Hungary for a longer time show considerable concentration from other aspects too. Some of these are summarised below:

– More than half of the immigrants live in Budapest and its surroundings, other significant concentrations could be found along the Serbian and the Ukrainian border, which indicates the major directions of immigration as well.

– Looking at the place of residence of the foreigners, a high level of urbanisation can be seen, i.e. they are usually urban dwellers, just over one-fifth of them live in villages.

– The overwhelming majority of the foreigners, i.e. almost four fifths of them, belong to the working age category, i.e. they are a basically labour-oriented group. Parallel to the strengthening of secondary migration, however, an ageing process started among them too.

– The majority (almost 80%) of the foreign citizens contacted and replying at the census of 2001 declared Hungarian as their native language.

The new citizens of Hungary

One of the important consequences of international migration concerning Hungary is that approximately 115 thousand persons were awarded Hungarian citizenship in the period of 1990–2004. This is almost eight thousand new citizens per year on average, while significantly less, only a total of 15 thousand people abandoned their Hungarian citizenship in the same period. The balance thus is a gain of approximately one hundred thousand people.

Looking at the previous affiliation of the new Hungarian citizens we can see that this game has very few players. Hungary is only interesting in this respect for a few neighbouring countries where a significant number of Hungarians live. This is clearly demonstrated by the fact that almost two thirds of the people awarded the Hungarian citizenship had abandoned Romanian citizenship, some 12% of them had Yugoslav, 8% Ukrainian and almost 5% Russian (Soviet) citizenship formerly. Accordingly, the four countries above provided almost 90% of the new Hungarian citizens.

The spatial location of the new citizens is practically the same as that of the foreign citizens residing for a long time in Hungary. Their main place of residence is the capital city and its surroundings, a secondary concentration can be found along the border with Serbia. A high urbanisation level of the new citizens is also typical, as is a slight surplus of women and a relatively favourable age composition.

Typical features of immigration and integration

In order to analyse the issues of immigration and integration, it is actually enough to concentrate on the group of Hungarians from the neighbouring countries.* Several surveys have been conducted with this purpose, the most useful is the one made in 2002, focusing on the persons aged 18 or over, migrating to Hungary from the neighbouring countries and receiving the immigrant status in 1991. The database of this survey contained a total of 5,763 people, whose detailed analysis gave us a comprehensive picture of the groups of immigrants from the neighbouring counties (Gödri I.–Tóth P. P. 2005). This paper is primarily based on this survey, too.

The background of immigration: migration purposes, motivations and decisions

The movement of the overwhelming majority of the immigrants to Hungary shows basic difference from the other cases of the international migrations. Its special feature is due to the fact that the new borders drawn after

World War I deprived the Kingdom of Hungary of almost two thirds of its territory and almost 60% of its population. Perhaps the most serious element of the loss of population was that almost 3.2 million persons of Hungarian nationality became then citizens of other countries. For different reasons, their number has decreased by approximately a million since then; but still it reached almost 2.2 million in 2001. This is a significant number, especially when compared to the total population of Hungary which is around ten million.

With some simplification it can be said that the immigration to Hungary equals the migration of Hungarians to Hungary. This does not only mean the decrease of the number of Hungarians living in the neighbouring countries but also the shrinking of their area of settlement.

Those who move to Hungary, irrespective of their subjective intentions, instead of having an ethnic "gain" deriving from their situation, promote the decrease of the proportion of those still residing in the country of origin, and accelerate the assimilation to the majority nation of the Hungarians already living in minority.

The characteristic features, peculiarities – different from the other cases of the international migrations – of the immigrations to Hungary, featured above, determine the motivations, compositions, family and friendly relations of those arriving in Hungary, together with the long-term consequences of the migrations at individual (family) level, the dynamism of integration, and the impact on the demographic processes of the original and receiving communities.

The majority of the immigrants from the neighbouring countries (74% of them) have moved to Hungary with a definite intention of settling down permanently. As regards the original place of residence, two thirds of them were urban residents, so it is not surprising that they were looking for their new homes in an urban environment too. More than three quarters of them came from regions where over half of the population was Hungarian. Their departure thus did not only decrease the number of the Hungarian communities in their old homes but also loosened the Hungarian ethnic blocks. It is a gain for the receiving country but a loss for the country of origin that the majority of the migrants are highly educated: almost 20% has university degrees, 10% finished a college or a technical school, and another almost 40% passed the final exams of a secondary school. It is worth noting that in the 1990s the level of education among the immigrants was even higher.

For the majority of the immigrants, one of the main motivations, even if not in a direct form – in accordance with the special features of the migration processes concerning Hungary – is the feeling of belonging to the same nation, the inner force of trying to eliminate the isolation from the mother nation. This motivation is present in most cases even if the move itself is actually motivated – like in the recent years – by financial, economic reasons, or by the intention to unite families. In the migration processes then it is the ethnicity for the Hungarians arriving to the mother country that determines the content and extent of the relationships, the cultural and the symbolic capital. This does not only mean for them that they speak the language of the receiving country as their native tongue; it also means the feeling of being home that comes from belonging to the same nation.

The positive impact of the "background" introduced above, playing a dominant role in the motivation of the actual migrations, and of the networks of relationships built on this background can be seen in many forms. One of the manifestations of these impacts is that the community of origin, which plays an important role in the actual realisation of the planned intention to resettle, does not reject the relocation of their members, in fact, they have a definitely positive attitude to those wishing to move, which indicates that the thought and act of emigration to Hungary is an accepted and supported way of behaviour in the community. On the part of the receivers, even if the immigration of their fellow Hungarians is not always evidently welcome, it is well known that the acceptance of the Hungarian ethnic citizens from the neighbouring countries is the highest among all immigrating foreigners.

In the mediation of the migration pattern, in addition to the determinations by the "background" described above, of course the personal relations – direct family, relatives and friends – have played an important role. Beyond the general fact that masses of people with background of Transylvania (Romania), former "Upper Hungary" (Slovakia), former "Southern" Hungary (Serbia), Transcarpathia (Ukraine) live in Hungary, approximately half of those who came after the year 2000 had family members who had formerly moved to Hungary. These persons did only mediate the migration pattern in most of the cases; they also acted as a link for the migration of the newcomers. In this case then the migration pattern is not simply a chain migration as the dominant patterns of the long-term migrations; it is a system of relationships much deeper than the chain migration, involving not only family and relatives but also general relationships between the receivers and the received persons.

There was a significant change in the motivations triggering migrations in the years after 2000. In the new millennium, the political situation of the neighbouring countries was not a push factor to the extent that it had been in the early or mid-1990s. Parallel to this, among the migrations coming from the ethnic identity – with the exception of those coming from Yugoslavia – the fears of ethnic tensions, of human rights violations and the lack of the Hungarian speaking educational institutions became less important.

The major group of immigrants, if we classify them by the motivation of migration, is those who emigrated from their old homes for economic reasons. Parallel to the lessening importance of migrations due to ethnic identity reasons, motivations of economic origin became the major factor of migration.

When making the decision on migration, the hard economic situation of the neighbouring countries, the higher living standards and the better conditions of living in Hungary increased in importance. It is impossible to tell now, however, how the accession of Romania to the European Union and the improvement of the economic situation of Romania will impact the intentions of the Hungarians living in Romania to migrate.

The second largest group after those who migrated for economic reasons are those whose motivations were family unification or ethnic reasons. As regards those in the latter group it should be noted that within the changed circumstances the migration-spurring role of ethnic belonging gained a new meaning, now it is mostly the rejection of the minority status that plays a dominant role, and not so much the ethnic conflicts and discriminations.

The changes in the second half of the 1990s compared to the beginning of the decade suggest that one of the main motivations of migration in the future will be the so-called secondary migrations implemented for the unification of families. The main participants of these movements are the pensioner parents, aged 60 or more, of the children who already moved to Hungary in the former years. The appearance of the elderly immigrants is reflected in the age composition of the immigrants, although the majority of the movers are still in the 25–34 years category. The composition by gender showed a slight male surplus in the late 1980s and the first half of the 1990s, to give way to a surplus of female movers (14.8%) from the second half of the 1990s.

Nowadays final relocations (or the acquisition of the immigrant status) are often preceded by previous temporary, transitory migrations, especially in the case of the younger generations – with working or educational purposes. This often becomes the preparatory phase of the final immigration. The reasons behind this phenomenon – not neglecting the presence of national feelings in the background – are the allegedly better professional, career opportunities in Hungary, the higher living standards, and also the friendly and professional relations (often marriages) made meanwhile.

The economic, social and identification features of integration

The integration of the immigrants to Hungary from the neighbouring countries is significantly different from the typical ways of integration, as their ethnicity, native language, and also their historical and cultural traditions are identical with those of the receiving community. These circumstances determine to a large extent the success of integration. The immigrants of Hungarian ethnicity and native language, moving to Hungary from the neighbouring countries, reach a community not foreign for them with regards language and culture; in fact, they migrate to their mother country, where they find themselves in a medium much closer to their own cultural patterns and traditions than the circumstances of the majority societies surrounding them in the countries of origin. Accordingly, the integration of the immigrants can and should be looked at from economic, social, psychological and identification dimensions.

The integration of the immigrants arriving to Hungary from the neighbouring countries into the labour market can be called successful. On the labour market the immigrants arriving to Hungary after 2000 were not in a marginal position either as regards economic activity or their position in the employment structure. This was influenced, in addition to their age and education, by the relationship capital that most of them possessed already on their arrival in Hungary, and the symbolic capital that most of them had due to belonging to the same ethnic group as the receiving community.

In the circle of the immigrants, the migration resulted in shifts with regards the economic activity status and also led to significant employment mobility at the level of the individuals. The former positions were kept by most of those who found jobs matching their education, who had been intellectuals in leading positions before their migration. Unemployment or getting into a lower employment status was more frequent in the circle of those who had white-collar jobs but no diploma. The majority of those having arrived in Hungary as skilled workers were able to find a job, but many of them were employed as semi-skilled or unskilled workers in their new workplaces.

On the whole we can conclude that males, the younger generation, those with diploma of higher education and those who lived in Budapest or in other cities and towns were more successful in finding employment matching their qualifications. This had an influence on the spatial location of the immigrants, as almost 30% of them chose Budapest as their new place of residence. This does not necessarily correlate, however, with the previous urban background of the immigrants; it comes much more from the attraction of the Hungarian capital city due to its functions as economic, cultural, administrative, political etc. centre. As opposed to the group described above, the majority of those who were in a disadvantaged position on the labour market were women, the elder generations, those with lower educational qualification, or those who lived in villages or smaller towns. Unemployment mostly affected immigrants who fell into the age group of 40–49. Those who could not find jobs matching their qualifications were also mostly from the 40–49 years age group, together with those who only had skilled worker certificates and secondary school exams.

The social integration of the immigrants is also relatively good. The composition of the relationship networks more extended than those of the receiving community suggests that the immigrating group integrated into the Hungarian society with the "collaboration" of the relationship-mobilising effect of migrations, i.e. the so-called social solidarity. Among the elderly persons or those with lower school education the family and relatives – mostly with the assistance of other immigrants –, among the younger ones, and those with higher education the friendships and the members of the receiving community are the dominant channel of integration. An important element of successful integration is the fact that in the period right after the immigration it was the formerly immigrated persons who helped the new immigrants, while later the role of the members of the receiving society increased in importance.

In general we can say that the success of the integration into the labour market is of dominant importance for the life of immigrants in the receiving country. This is also true for those who have migrated to Hungary. Coming from the special character of the migrations concerning Hungary, however, irrespective of the labour market situation, the group whose integration was the most successful by subjective indices is the group of pensioners. We assume that this is probably due to the fact that the phenomena belonging to the set of symbolic capital, playing an indirectly dominant role in their migrations, were the most "evidently functioning" in their case. This is supplemented by the fact that their migration is also considered successful in as much as they are most effectively able to help their formerly immigrating children both psychically and financially. An important element of the general satisfaction is that they did not have to break away from the land of their birth; their ties to the place of origin are still strong, due primarily to the family and relatives, and also the friendships allowed by the spatial proximity. The feeling of successful integration was also promoted by the fact that the communities releasing their migrants did not have any negative judgement of the emigrants any longer, and also that within the changed political circumstances they can visit the native land "left behind" at any time, since relatives and friends are living there. The facts listed above do not only determine the different elements of the psychological adaptation but also play an important role in the preservation of their own identity and the subjective judgement of the success of their integration, what is more, they make the feeling at home even more evident. As a result of all these they do not only judge their situation better than the Hungarian population does but the proportion of those who are more satisfied with their present situation is also much higher than the share of those who had been more content before their migration.

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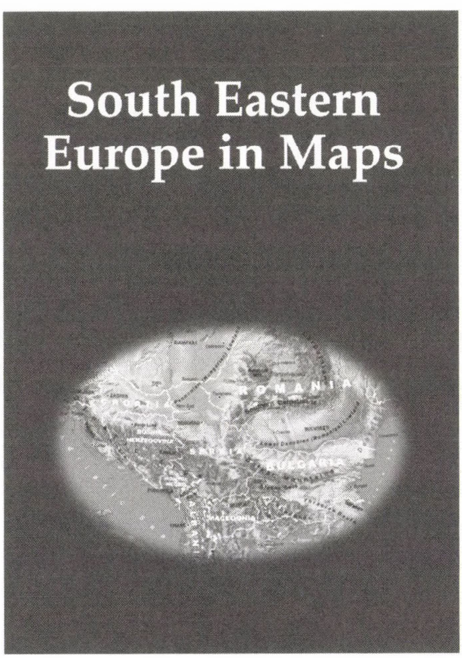

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REGIONAL CHANGES IN THE HUNGARIAN URBAN SYSTEM

GYÖRGY ENYEDI[1]

Introduction

The paper gives a short synthesis on the nature of regional changes in the Hungarian urban system over the past two decades and the mechanism of the processes responsible for them. These changes in urban system are caused by a combination of three factors. The first is the *globalisation* process which influences urban economy, social structure, and spatial linkage network in every big region worldwide. In Europe, comprising small countries, globalisation internationalizes the urban system, creating a continental network, while weakening former national urban system. Although EU regulations impact on the system of urban governance, basically, it remains within the bounds of the nation-state framework and shows a much greater geographical diversity than urban development.

The second factor is *post-socialist transition.* Although sufficient time has passed since the onset of the systemic change – allowing us to view this as a historical period, comparable to the interval between two world wars – and the democratic institutions and the market economy have been rapidly introduced, the impact of 45 years of state socialism lingers, for instance, in the slow development of real estate market, the strong centralisation of municipal finances, or in weak civic participation. In 1990, the local government system had to be changed radically an without delay – while the pace of transforming the urban system could be gradual and continuous – since this was one of the fundamental conditions of the democratic transformation of the political regime. The Act on Local Governments (1990) was approved by a newly elected parliament, whose members – with a few exceptions – lacked experience concerning the methods and operational forms of democratic governments. The act is outdated, dysfunctional in a number of aspects and chances for substan-

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tive amendment are nil.[2] The institutions of government were radically transformed in 1990, but the mentality of civil servants operating these institutions and the relationship between citizens to their elected local governments retain many old reflexes. This is exemplified by the constant attempts at centralisation on the part of the government or the relationship of citizens to their own elected self-government bodies sometimes by opposition and in other cases by paternalism. Thirdly, we must consider that Hungary – along with all Central European countries – follows a special *urban development path,* which differs historically from that of other European regions. Changing the urban system is a long process. The characteristics of modern (post-industrial) urbanisation did not disappear, but either influenced the ongoing urbanisation process of the state-socialist period or were "deep-frozen", only to become reactivated at once in 1990 and try to rapidly make up for the 45-year long paralysis. A few of the said qualities of state socialism, for example, governmental centralisation, ambivalent relationship between citizens and governance, had also characterised Central Europe before World War II (Enyedi, Gy. 1992; Kovács, Z. 1999). Evidently, the three factors act simultaneously, and we have no intention of analysing them separately, but we must be aware of the various influences when judging the changes in urban system.

Regional Changes in the Urban System

Development of the Budapest Metropolitan Region (BMR)

Over the past quarter of a century, the Budapest agglomeration – whose spatial development dates back to the 1870s – turned into a polycentric metropolitan region. After 1990, suburbanisation accelerated remarkably – while the capital's population declined by a quarter of a million over the past 15 years. On the one hand, it has changed the blue-collar character of the suburbs, which remained almost general during the state socialist system; and on the other hand, the suburban zone has become more diversified by the location of industrial firms, shopping malls and logistic centers. Some suburbs have become small urban centers, their job opportunities have increased. Daily commuting to workplace is manifold and there is also a process of out-commuting from Budapest. All these correspond to metropolitan development in advanced countries.

By tradition, the Hungarian urban system is single centered. In 1910, when the country's total area was threefold its present size, Budapest's population of 1 million (7th largest city in Europe at the time) was tenfold that of the

[2] Amendment of the Act requires a two-third majority vote in the House of Representatives which makes it unlikely in the near future.

second largest city (Szeged). Today, its population of 1,7 million is "only" 7.5-fold that of Debrecen occupying second place but the area of the metropolitan region has increased and the number of its inhabitants is 2.5 million, a quarter of the country's population.

International functions, the concentration of capital and the R&D sector lend the Budapest metropolitan region its outstanding importance. In this respect, contradictory processes are taking place in the Hungarian urban/regional policy. Reducing Budapest's economic and demographic predominance has been the fundamental aim of regional policy for decades. This has been attempted in many ways: Budapest's industrial predominance has ceased, the role played by universities and R&D has diminished, etc. But two factors support the metropolitan region's rise to prominence anew, that is, to growing inequality within the urban system. The first is the rapid and radical transformation of the Hungarian economic structure, which has been comparable to that of advanced countries. Just as global metropolitan regions have become the engine of global economy (its causes are widely discussed in professional literature), so Hungarian economic development cannot dispense with the pull of Budapest. The second factor is the globalising impact. Budapest is Hungary's *only* global city which has been incorporated into the European metropolitan system, and the strengthening of its competitive positions within Europe serves national interests. The Vienna–Bratislava–Budapest triangle is the "golden triangle" of Central European economic development; the regional levelling policy within the country should not aim to weaken Budapest's position. No other city in the country could become the "economic driver", as none has reached the critical size necessary for the general boosting of a knowledge-based economy (Horváth Gy. 2006).

The Budapest metropolitan region differs in size and structure from the rest of the country to such an extent that its governance requires special procedures (metropolitan governments are unique everywhere). Compared to its economic importance the region has a conspicuously underdeveloped infrastructure. Private investments in infrastructural development – e.g., transportation – are minimal, thus it requires government investment. Although cooperation among the settlements to operate the infrastructural network in the metropolitan regions is indispensable, it is very weak in the Budapest region.

Split in the urban system

In accordance with the increased economic role of the cities and the network-like economic development, regional disparities may be explained basically as inequalities within the urban system. However, regional and urban inequalities assume different geographical-spatial forms. Qualifying a region as underdeveloped or advanced gives an average value of the aggregate economic, social etc. indices of the settlements comprising the region. This covers up internal inequalities of regions. There may be advanced, dynamic cities in underdeveloped regions, too. They can grow apart from their region by joining the national/international network of advanced cities. Debrecen and Nyíregyháza, located in the less developed North-east Hungary are good examples for booming cities within a less developed region. The research of inequalities in the urban network deals with every city individually and not dissolved in an average value of a settlement group.

It is an important characteristic of the transformation of the urban system that the main distinction is made between cities that participate in network development and those that do not. Neo-liberal economic policy puts international competitiveness of cities in the focus of urban policy (Lorrain, D. 2005), whereby inequalities within urban network increased and some cities, having lost their earlier functions and left with hardly any competitive opportunities, were plunged into lasting decline like depressed rural areas. The strong aspiration of Central European countries to catch up with the West increases the allure of competitiveness, which in public opinion means attaining the Western European standard. The political left offers only weak criticism of this neo-liberal policy, for any programme of social solidarity and equality could be easily identified with the slogans of the condemned state-socialist system.

Current regional policy is two-faced. On the one hand, it continues to proclaim the conventional aim of helping underdeveloped regions to close the gap; this would emphasize rural development. On the other, the macro-economic aim of supporting the country's catching up (with the European average) is gaining strength. In current regional policy this means a return – after nearly three decades – to the growth pole concept. The national development plan for 2007–2013 focuses on the pole program which concentrates central budget (Treasury) supported development in seven regional centers (city regions). However, we should point out the uncertainty concerning the actual implementation of this conceptual shift, since the distribution mechanism of the structural funds does not guarantee the growth poles any share. While European urban policy is paying increasing attention to the metropolis problem (Priemus, H. *et al.* 1997), in Hungary the actual practice of allocation of development resources has not made a definite move in this direction.

The Hungarian urban system itself is three-tiered. Within the network, we can distinguish the already mentioned global role of the BMR; the second group contains medium-sized (in some cases even small) cities/towns that form part of transnational networks linking Hungarian regions to regions of the neighbouring countries. Cross-border ties are widespread within the

Carpathian basin. Hungary has international borders with seven countries[3]; of its 19 counties (sub-national regional administrative level) 14 are contiguous with the national boundary. National urban policy has but weak impact on cross-border relations.

There is also a rather large group of small towns that are actually excluded from the transnational or from the dynamic national network – they form the third tier. These have partly lost their earlier urban functions, agglomerative pull, suffer from high unemployment rates and a steep demographic decline. This group includes mainly the traditional rural market towns in Eastern Hungary, whose main function was the trading of agricultural products and the provision of their rural attraction zone with basic services. This sinking category came to include the mining and industrial cities hit by the deep structural changes of the first half of the 1990s, though most were capable of modernising their economic structure. However, replacing the lost functions of the sinking rural market towns, e.g. by developing eco-tourism, depends on chance. They lack suitable, skilled labour force even for carrying out economic activities using medium-grade technology. Although these settlements have urban status, they have lost – temporarily or lastingly? – urban functions. However, not once during the past 135 years has a town suffered the demotion to rural commune. Behind the general integration processes, the Hungarian settlement system is characterised by a double dichotomy: the dichotomy of the rising urban network and the declining towns on the one hand and the still surviving traditional rural–urban dichotomy on the other.

The rural–urban dichotomy survived under the state socialist system. Notwithstanding egalitarian slogans, rural living conditions were far less favourable than the urban ones. Rural settlements were at a considerable disadvantage not only in respect of incomes, but also of the availability of public services (Enyedi, Gy.–Lonsdale, R. E. 1984). Funds for development of settlement infrastructure were distributed by the central budget among settlements, which meant almost exclusively those with urban administration. The inefficient operation of the state-owned economy required continuous budgetary support; therefore, the funds allocated for infrastructural development were only the bare minimum. The road, public utilities and telecommunication networks suffered the most from this, falling behind Western Europe by several decades. Dividing the settlements into rural communes and towns/cities meant not merely a public administrative or functional distinction, but also a different growth trajectory. For this reason, a complicated application process preceded the granting of city status to rural communes, moreover, in the interest of regulate budget expenditure, the number of settlements with city administration was limited.

[3] In Europe, only Germany has more (nine) neighbours.

After the systemic change, the 1990 Act on Local Governments annulled the privileges of cities, declaring all local governments equal. Nevertheless, there is still a strong competition for winning the "city administration" title. It is hard to convince the population that cities are not superior settlements, that urban status in itself does not make life better.

The complicated procedure of granting city status and the centralised financing of local governments (according to their public services) remained, but the central government does not really limit the number of entitlements, since it does not burden the budget, and is suited eminently for political patronage.

Thus, the number of settlements with city administration rose from 166 in 1990 to 298 by 2007, when four towns had less than 2,000 inhabitants *(Table 1).*

Table 1. Number of urban settlements and the ratio of urban population in Hungary (1950–2006)

Year	Number of urban settlements	Growth in numbers	Ratio of urban population (%)
1950	54	–	36
1960	63	9	40
1970	73	10	45
1980	96	23	53
1988	125	29	58
1990	166	70	62
1995	194	28	63
2000	222	56	64
2006	289	67	67

Source: Beluszky P.–Győri R. (2006).

Evidently, no economic or social change could justify such an extremely rapid growth in the number of urban centers. Many of the above mentioned declining settlements just dropping out of urban network were granted city status during the past 15 years.

Functionally they were not urban at all, they were only hoping – in vain – that by attaining the status they could stop their decline. Beluszky P.–Győri R. (2006) stated that – according to their statistical analysis of the location of urban functions – about 100 cities, i.e. one third of the settlements with urban status had no real urban functions.

Current administrative differentiation between rural communes and urban centers, as well as the procedure to acquire urban status would require thorough revision *(Fig. 1).*

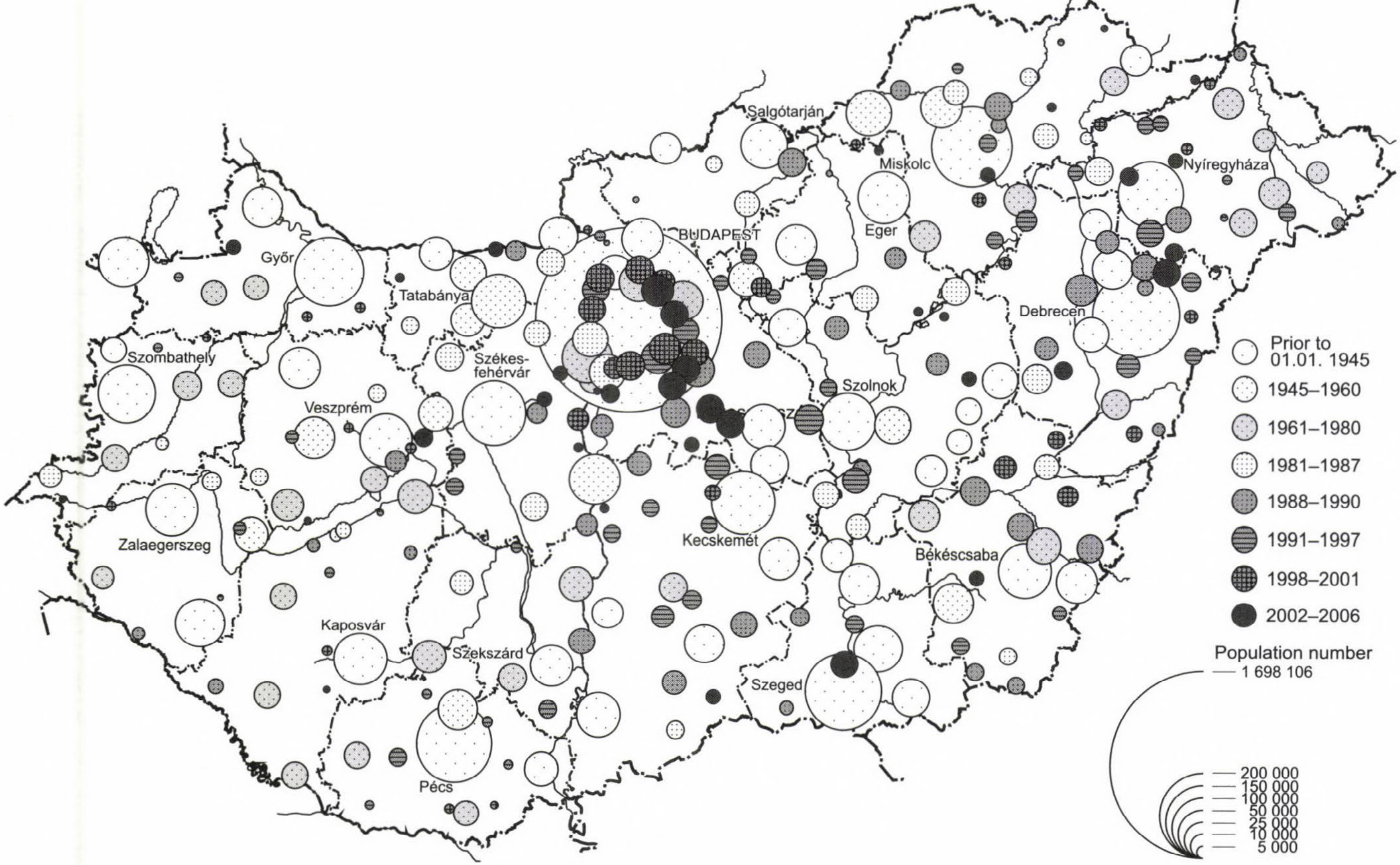

Fig. 1. Dates of granting urban status to settlements. *Source:* Beluszky P.–Győri R. (2006)

Population changes in the settlement system

The fundamental economic restructuring, the re-establishment of market economy, the demographic trends of the past three decades have substantially modified the distribution of the population within the settlement system, and the direction and mechanism of migrations.

The main characteristics are as follows:

The country's population has been steadily declining for some time due to the demographic trends: death rates have outnumbered birth rates since decades. Since 1990, the number of immigrants has surpassed that of emigrants by approximately 200,000, thus the positive migration balance is curbing the population decline.

The population of urban settlements has declined since the last census. Growth was registered only in a few rural settlements. Between 2000 and 2005, the number of inhabitants of cities decreased by 2.4 percent, while that of rural communes grew by 1.1 percent. The traditional centuries-old village-to-city migration reversed to city-to-village movement. The fundamental cause lies in the acceleration of suburbanisation, particularly in the 1990s. Concomitant with the development of urban regions, new residential belts and employment centers appeared in the suburbs, which led to constant migration flows out of cities and increased daily commuting. This pattern followed the urbanisation model of the advanced countries. Out-migration from cities also had a special, Central European motivation, namely, the sudden collapse of the traditional industry and the social welfare ambition of full employment. Masses of semi- and unskilled workers performing simple physical labour became redundant. Most of them were first generation rural immigrants living in workers' hostels in the cities in the period of state socialism. Many of them returned to their rural homes, where, in the absence of job opportunities, they tried their hand at some form of subsistence farming, while living on pension received after early retirement and/or on social assistance. Finally, in backward regions the Roma population became the majority in a group of villages. Natural increase among Roma is rather high, hence came the population growth in certain rural areas.

The map of daily commuting flows had to be redrawn. Sixty percent of the rural employees work away from home in nearby small towns or at jobs in small and medium-size enterprises in other villages. (The ratio of farming population declined to 5.5% in 2005, and even in villages their ratio is only 15%).[4] The new inter-settlement economic ties within a rural region (of which daily commuting is one expression) create a new type of small scale integration among rural communes and small towns, which may call for a new form of regional governance (administration of statistical micro-region).

[4] Part-time and hobby farmers are not included.

Conclusions

We may conclude that in Hungary – as in all Central European countries – the settlement system has undergone rapid changes over the past two decades. Some of the changes conformed to general European trends, for instance, accession to the global metropolitan system or the development of transnational urban networks. It was typical of the Central European region as a whole that, after the 45 year-long detour, the development path of the urban network returned to its long-term trends. This return – i.e. that path dependence still makes its way – is not a simple process, since both urban functions and the structure and operational mode of urban society changed greatly under state socialism.

The large scale – functionally unjustified – expansion of the urban network is a specific feature of Hungary. The already mentioned survival of the rural–urban dichotomy has made the acquisition of the urban legal status the main objective of a number of large rural communes. Generally, these newborn towns – with urban administration but lacking many of the urban functions – have been unable to join the urban network and mostly represent the group of dropout, declining cities.

New integrations are emerging in rural–small town areas. The Hungarian local government structure is very fragmented, and a part of the rural communes are unable to provide their inhabitants even with basic municipal services (Pálné Kovács, I. 2007). Notwithstanding the low-level cooperativeness, local alliances for operating the various public services are spreading, but the big question is whether these micro-regional integrations should be organised into an autonomous territorial administration level.

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TRANSFORMATION OF THE SETTLEMENT SYSTEM IN POST-SOCIALIST HUNGARY

PÉTER BAJMÓCY[1]–GÁBOR HEGEDŰS[2]

Introduction

During the last centuries the Hungarian settlement system went through essential changes several times. Two of them had been associated with the adoption of the system of state socialism and the following era of transition after the power shift in 1990.

Before analysing the transformation of the settlement system in post-socialist Hungary, it is necessary to outline its characteristics during the socialist era (after the review of BELUSZKY, P.–GYŐRI, R. 2005). The major forces influencing the development of the urban stock and network prior to 1990 were subject to central control, homogenisation, concentration, hierarchisation, and settlement network planning. Central control meant e.g. industrialisation, policies on business premises, settlement financing and institutions dictated by large state-owned companies. Homogenisation was generated by the monopolistic position of social and economic control and a network of organisations serving them and in addition by the nationally standardised, model-based distribution of centralised institutions. The first stage of the Central European (and Hungarian) urbanisation began at the turn of the 19th and 20th centuries (ENYEDI GY. 1988). The second stage (the phase of the so-called relative deconcentration) started only in the mid-1980s. Despite the very rapid growth of certain cities and the large-scale concentration of the population, Hungary remained underurbanised (in terms of volumes of urban industry and central functions), and this state of underurbanisation caused significant mass commuting. Relative concentration was equivalent to hierarchisation as well: since county seats became centres of political power, institutions proliferated

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in them. Before the mid-1980s, settlement network development was centrally planned and controlled. As a consequence, a hierarchical chain emerged, with the capital city on the top of it, and villages at the bottom; in the latter no local administrative offices operated. Urban development was controlled by settlement network planning. These features affected the smaller settlements as well (G. FEKETE, É. 2005).

Conditions of the transformation of settlement system after 1990

After 1990 fundamental changes took place in the Hungarian settlement network. The transition to market economy has brought about increasing socio-economic polarisation and residential segregation within the settlement network, both among and inside the settlements (the internal shifts being typical in the larger cities). Transformation of the labour and housing market generated commercialisation and a rapid functional conversion from residential to business use in the inner parts of the post-socialist cities; new forms of migration including suburbanisation and ghettoisation (KOVÁCS, Z. 1999), and new handicapped social groups evolved (e.g. BOROS, L. 2007). Most of the settlements have attempted to follow neo-liberal municipal policies concentrating on their economic efficiency in various fields: attracting investors, increasing tourist functions, or privatising the former public services, like medical services (PÁL, V. 2004). Novel global pattern of consuming and housing (e.g. shopping malls, gated communities) appeared, specially adapted and spread hierarchically (e. g. BOROS L.–HEGEDŰS G.–PÁL V. 2006).

Under the conditions of market economy, the role of industry and agriculture in the employment and in GDP decreased. The services became much more important both in the economy of Hungary and in the settlements. The economy of the central part (especially Budapest) and western regions of Hungary underwent a very rapid growth. Foreign investors preferred these areas to the south-western, eastern, and northern regions of the country. The former industrial zones suffered from a serious crisis. Cities of the crisis ridden areas possessing more diversified industry and located closer to the western border of Hungary managed to escape from this unfavourable situation, but cities with a non-diversified (heavy) industry remained in a very difficult position, and extensive crisis regions emerged (especially in North Hungary). The regional disparities (e.g. in terms of GDP, employment and unemployment rates, average life expectancy, degree of modernisation) increased heavily, in a way that did not exist in the former state socialist regime *(Fig. 1).*

After 1990 there were important changes in the Hungarian public administration as well. The number of cities intensely increased, because of the liberalisation of granting an urban status to settlements. In 1990 there were

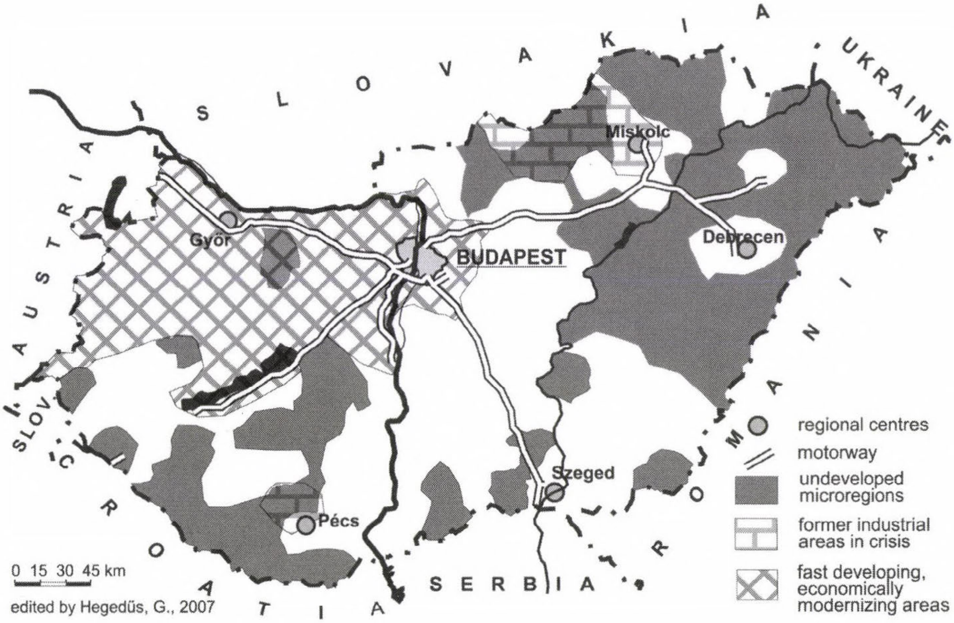

Fig. 1. Spatial structure of Hungary in the transition era

only 166 cities/towns in Hungary in contrast to 289 in 2007. Yet the number of functional cities/towns and that of the settlements with urban status was more or less equivalent in 1990 (Beluszky P. 1999). After 1990, many bigger rural settlements having no urban functions got the city-status mainly due to political reasons, therefore these settlements are often called 'ceremonial towns' (after Hajdú Z.). In 2007 the rate of urban population was 67.0% in Hungary, with considerable regional differences.

Another tendency of the transition era is the slightly growing number of administratively autonomous settlements. During the state socialist period, many small settlements were by force united with larger ones (often with a city or town), thus losing their public administrative autonomy. After 1990 some of the mentioned settlements regained independence e.g. for economic reasons (Hajdú Z. 2001). Therefore, while in 1990 there were 3070 public administration units (NUTS 5 level), in 2007 there were already 3152 (288 cities/towns and 2863 villages). Nevertheless, both from a social geographical and a public administration point of view, the Hungarian settlement network still remained rather fragmented. *Table 1* shows the composition of Hungarian settlement system by population size categories in 2004.

Though the ratio of the more populous settlements (settlements with 10,000 inhabitants or more) is relatively not very high (4.5%), most of the

Table 1. The distribution of Hungarian settlement network by population size groups

Number of settlements by population size group (2004)			Population of settlements by population size group (2004)		
Population size group	Number of settlements	Ratio (%)	Population of settlements	Ratio (%)	Difference between the rate of population and that of the number of settlements (%)
0-499	1027	32.7	277 923	2.7	-30.0
500-999	690	21.9	503 234	5.0	-16.9
1000-1999	644	20.5	928 189	9.2	-11.3
2000-4999	503	16.0	1 508 982	14.9	-1.1
5000-9999	138	4.4	958 162	9.5	5.1
10000-49999	122	3.9	2 315 962	22.9	19.0
50000-99999	12	0.4	761 651	7.5	7.1
100000-	9	0.3	2 862 639	28.3	28.0
Total:	3145	100.0	10 116 742	100.0	0.0

Source: Hegedűs, G., 2007, Hungarian Central Statistical Office, 2004.

Hungarian population (54.2%) is concentrated in them (which are – with few exceptions only – urban settlements with regard to public administrative status). Thus, it is worth analysing the Hungarian urban network separately.

Transformation of the urban system

According to a classification of the Hungarian cities based on their urban character (urban functions and institutes), there is a strikingly high significance of Budapest within the Hungarian urban network (Beluszky, P.–Győri, R. 2005).

The position of Budapest in the settlement hierarchy has remained stable, or even strengthened since 1990. The capital is the only city of a European scale in Hungary. In spite of the loss of its population due primarily to suburbanisation and to ageing, Budapest continues to play an increasingly important economic, social, cultural and administrative role in the country after the change of political system. Anyway, the population of nearly all of the Hungarian cities/towns has dwindled due to the general trend of population loss in the country as a whole and to other factors (e.g. suburbanisation), as well. Amongst the regional centres, Győr has strengthened its positions (increasing higher education and financial functions). Similarly to some smaller (socialist) industrial cities (like the medium-sized town Ózd), the situation of Miskolc worsened because the crisis of its heavy industry resulted in a relatively intense population outflow during the transition period. Generally, the economic position of most of the settlements at the lower levels of the urban hierarchy declined. The only exceptions are those located in the Budapest agglomeration or in North-western Hungary. The population of the medium-sized and smaller towns decreased primarily due to their negative natural increase. There are two main types of medium-sized and smaller towns in Hungary. One of them, the unique Hungarian market town supplemented with "tanyas" (see *Table 2*) is typical of the Great Hungarian Plain. These market towns had a very strong agricultural character in the past and they still consist of an inner, more urban-like core and of village-like outskirts, sometimes surrounded by "tanyas" (scattered farmsteads). The other, more urban- and less village-type of urban settlements are most frequent in Transdanubia (west of the Danube) featuring a more important service or industrial and a less important agricultural function.

Though the transformation of Hungarian urban network is an important process, the change of Hungarian village system seems to be even more

Table 2. Some relevant figures on the urban settlements in Hungary

Hierarchical level	Number of settlements(2002)	Total number of residents (2001)	Average number of population (2001)	Average number of population as a % of the preceding level
Capital city	1	1777921	1777921	–
Regional centres	5	855342	171068	9.6
County seats	13	976816	75319	43.9
Medium-sized cities	25	808807	32352	43.1
Small towns	79	1284390	16258	50.3
Quasi-towns	82	702910	8572	52.7
Settlements with urban status but without urban functions	51	290942	5704	66.5
Total number of settlements with urban status	256	6697128	26160	–

Source: Beluszky, P.–Győri, R. 2005, modified by Hegedűs, G.

significant, which can be attributed to its intensive regional differentiation and the process of suburbanisation. Suburbanisation has been one of the most spectacular regional processes in Hungary in the 1990s and in the first years of the new millennium. There are a lot of new houses, new streets in an increasing number of settlements near the largest towns of Hungary. A lot of settlements located close to the largest towns have migration gain, while the largest towns have migration loss. It is an absolutely new phenomenon; before the mid-1980s a massive concentration (i.e. urbanisation) was the main trend of migration in Hungary.

Undoubtedly the suburbanisation process is the strongest near Budapest; it is much weaker around the provincial towns. For this reason most of the Hungarian references regarding suburbanisation deal with the processes in the metropolitan region of the capital (Dövényi Z.–Kovács Z. 1999). The processes in the provincial cities/towns have been less documented yet (Bajmócy, P. 2000; Bajmócy, P. 2007; Hardi T. 2002; Timár J. 1993).

In our opinion the suburbanisation is the deconcentration of the urban population and functions. It is deconcentration, because the urban population and functions are not concentrated exclusively in the cities any more, but in the nearby areas, and it is deconcentration because a real out-migration of people and their activities are taking place. This process is deconcentration in the urban areas, but it is concentration with regard to the development of a whole region or a country. In accordance with the previous definition the *suburban settlement* is a dynamic settlement near the cities and its dynamism derives mainly from the out-migration of people and shift of their activities and urban functions from the cities towards suburban settlements.

There are no data about the direction of the migration in Hungary, so no quantified measures of suburbanisation are at our disposal. Indirect indices have to be used to measure and specify this process. Looking at some relevant statistical data about suburbanisation (rates of population growth and of migration) almost all of the settlements near the towns show quite high values of these indices, but a lot of other settlements do as well *(Fig. 2).* For example there are settlements with an abundance of tourist facilities around the Lake Balaton and the major spas on the one hand, or village clusters with large Roma/Gypsy population of north-eastern and south-western Hungary on the other hand. Both of these settlement-groups retain population growth. Some settlements with increasing population can be found in the western and north-eastern parts of Hungary. The western region is the most affluent and dynamic part of the country, while the north-eastern is the poorest periphery with massive in-migration of the poor people. This re-migration of the poor from the urban centres to the peripheries was really strong in the first years of the 1990s, in the years of the economic recession, and it has smaller importance now.

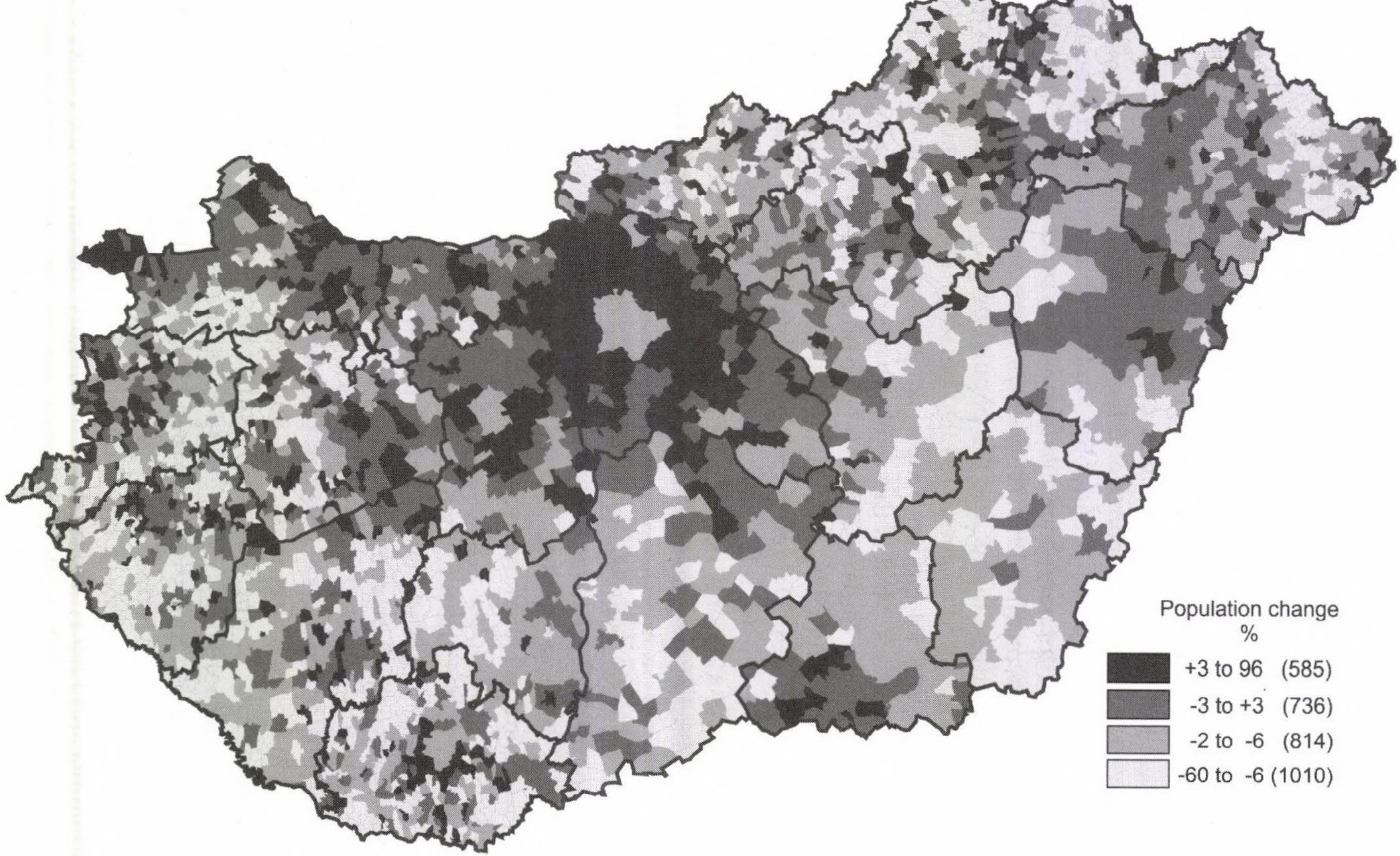

Fig. 2. Population change of the Hungarian settlements between 2001 and 2007. Source: Hungarian Statistical Office.

These indices are unfortunately not adequate to measure suburbanisation and to specify those settlements where suburbanisation is important. Other statistical data are necessary to find out the source settlements of the migration. For this purpose an empirical survey was carried out. The local governments of the villages that are close to the largest Hungarian towns and have migration gain were asked to fill out questionnaires. Are the villages whose local governments claimed that there is in-migration from the nearby town to their village the potential venues of suburbanisation? From the results of the local government questionnaires and the statistical data it was possible to specify the settlements which are involved in the suburbanisation process.

According to our survey the suburbanisation process started around 30 Hungarian cities/towns after 1990. Nowadays, there are almost 370 dynamic settlements around these towns, and the population growth of them between 2001 and 2006 amounted to about 104,000 persons. The total population of these settlements was 1.4 million people, so the population growth reached 7.5% in the last six years. Most of these suburban settlements (150) are located around the capital city, Budapest. Also a large number of similar settlements is to be found near Győr (26), Miskolc, Pécs, Székesfehérvár, Szombathely and Veszprém (15–20), Debrecen, Szeged, Tatabánya and Zalaegerszeg (10–12). There is a considerable difference between the population growth of the suburban settlements near Budapest and in the vicinity of the other towns. The suburban settlements around Budapest grew by 77,000 persons between 2001–2006, while the growth around Győr was 4,300, around Pécs: 3,300, Debrecen: 3,000, Székesfehérvár: 2,400, then come Szeged, Szombathely, Miskolc, Veszprém, Dunaújváros and Tatabánya (1,000–2,000). In this case the importance of Budapest is clear, and the suburban growth around Budapest is 20–50 times greater than the growth around the rest of the large towns of Hungary.

Almost half of the suburban settlements subsidize in-migration in one way or another, but on the Transdanubian part of the country they do it even more intensively. The most common form of attracting people is offering cheap building plots supplied with public utilities or supporting housing construction. Only half a dozen of local governments prevent in-migration; all of them are situated in a very nice environment and accommodate a large number of national minorities (Germans, Slovaks, and Croats). According to the data of the local governments the largest group of migrants was the families with children, however, in the most developed Middle- and West Transdanubian regions the intellectuals formed the largest group. The entrepreneurs were also an important group, mainly in West Hungary, whilst the pensioners in South Transdanubia and East Hungary. In West Hungary the ratio of the richer out-migrants (the rich, intellectuals, entrepreneurs) is much larger than the poorer ones (the poor, Roma, pensioners), whereas in East- and South Hungary the poorer out-migrants are in majority. So in this case the urbanisation process of East Hungary in the 1990s is similar to East Europe, and in West Hungary is similar to West Europe. Most of those people who moved out from the towns to the nearest village go back to the town to work or for some services, so the link between the town and the suburban settlement is very strong.

Apart from residential suburbanisation around the large cities of Hungary, there is also industrial, commercial and recreational suburbanisation. But the gap between the agglomeration of Budapest and other towns is even wider in these processes than in the case of the residential suburbanisation. While in the agglomeration of Budapest there are new hypermarkets, outlet-centres, and logistic centres, factories, new educational and medical centres in the suburban villages, around the other larger towns there are only some discos, petrol stations, restaurants, and small factories. In contrast to it, the recreational suburbanisation is quite common in the provincial part of Hungary as well.

In our opinion the main (but not the only) reason is the need of the costumers, where do they choose to live. We interviewed almost 1500 households in 24 different urban areas of Hungary with the help of geography students of the University of Szeged. The questionnaire was aimed at the households who moved out from the towns to the nearby villages over the last decade. We asked questions about the date of migration, the amenities and facilities in the previous and the actual place of residence, the reasons for migration and for the choice of the new settlement. We selected the households with random sampling according to the data of the local governments. Finally, we received 1226 filled questionnaires from the out-migrant families. Most of the questionnaires are from the nearby villages of the 24 biggest Hungarian towns, but some of them are from settlements within the administrative area of the towns, because of the special feature of Hungarian urbanisation (suburbanisation also affected the administrative areas of the towns). Most of the out-migrants are with secondary-school certificate or diploma. So it is true even in the provincial part of Hungary that most of the out-migrants are from the higher strata of the society or at least they have higher degree of education. On the other hand, most of the out-migrants came from blocks of flats and now they live in a detached (single-family) house with garden, so the living conditions of these families have changed thoroughly by the migration.

Why do people move out from the large towns to the villages (and small towns) nearby? The main reasons are economic. The price of the building plots is very high in the towns and much lower in the villages. It is very important, that people move out from the towns to the villages, but the working places are still in the towns, mainly in the town centres. The transport facilities are in key position. The other forces are in relation with the quality of life and environment. The time of the suburbanisation process is the time for "rural renaissance" as well. The advantages of the villages and the disadvantages of the cities can be listed at great length. But the „rural renaissance" is not such an important reason in Hungary than it is in Western-Europe. Another major reason was that people wanted to have private houses (probably with garden) and they could buy or built it easier in the suburban villages than in the towns. In the towns there is little new place for building plots especially for large ones, so building a new house is easier in the villages than in the large towns. The out-migrant people said that the main difference is in the environmental position of the villages and the towns, but the service facilities were much better in the towns. The main difference is not at the view of the different towns, but at the view of the towns in contrast to the villages.

The process of suburbanisation will continue in the future. More and more settlements will be embraced by this phenomenon. It will be a long-lasting process in Hungary, which need to be taken into consideration when plans for the development of the larger towns and the nearby settlements are formulated in the near and distant future.

Transformation of the rural system

The social and economic changes in the last fifteen years made a deep impact on the rural system in Hungary. It is well known that the situation of the villages was relatively bad during the communist regime. It was not just because of their size (mass-urbanisation, migration from the villages to towns), but also because of the wish of the central government. The villages had a lack of infrastructure, poor services, low living standard, lack of workplaces, etc. Because of the mass out-migration the population of the villages was ageing and low educational level prevailed. Most of the villages had these problems, but not in the same way. The most serious problems occurred in the small villages, while the larger rural settlements and the ones in special geographical setting (Budapest agglomeration, mining and industrial villages, important agricultural centres, tourism destinations) were in a much better position.

After the change of political regime the social and economic conditions changed dramatically. On one hand, there are much better economic conditions (new investments, factories, service facilities), but on the other hand serious social problems also turned up (unemployment, decreasing number of employees). The most important consequence of these circumstances is the increasing regional disparities. The regions near the Austrian border and around Budapest are in the best position, but the regions around other larger towns and also the main tourist attractions (Lake Balaton, major spas) are also in a favourable position. On the other hand, the eastern, north-eastern and south-western regions and some inner peripheries are the losers. The differentiation is not only in regional scale, but also goes according to the size of the settlements. One more general condition has to be mentioned which is important in the life of the villages nowadays. The demographic situation is very bad in Hungary, there has been natural decrease since 1981, and the age structure of the population is becoming older and older. This ageing process is advanced in the villages, especially in the small ones.

The effects of the political change served for the benefit of the rural system of Hungary. All the villages have independent local governments, they can choose their own way of economy. Renewal of private farms and rural tourism give new impetus to some villages. But nowadays the most important process in the Hungarian countryside is the strong differentiation of villages. Instead of the differentiation by the number of the population the most important factor is the geographic location of the villages. In addition the size of the settlement is also important (age structure, natural decrease, services). The third important factor of the differentiation is the social structure of the villages, which had a minor importance earlier. There are special rural settlements where affluent people are concentrated. These are first of all villages in the vicinity of the large urban centres. In contrast there are villages with poor, marginalised, unemployed people with low educational and qualification level.

While in the last decades the villages of Hungary were relatively similar to each other and their development pathway was absolutely different from the towns in terms of service facilities, demographic trends, living standard etc., in the last years a strong differentiation process started among the villages. On the other hand, the gap between the towns and villages has been decreasing.

By the classification of all the 2,875 villages of Hungary (Beluszky P.–Sikos T. T. 2007) and also by the findings of the authors of the present study there are different types of villages in Hungary by the living conditions (demography, population change, service facilities, accessibility, agricultural endowments, personal income, tourist facilities, etc.). Within the main groups of villages a lot of smaller sub-types can be distinguished as well. In the last fifteen years or so new village types appeared (poor villages with ligh unemployment and favourable demographic characteristics, small villages in fair economic situation, very old villages with elderly people as residents). Some groups of villages have grown in economic importance (suburban villages, small villages with touristic function), whereas others disappeared (industrial villages, agrarian large villages, villages with some urban functions). The first type disappeared due to restructuring of the industrial pattern in Hungary, and the second two groups did it because most of them obtained urban administrative status. On the other hand some groups retained their previous characteristics (small villages, so called „tanya"-villages) (Beluszky P.–Sikos T. T. 1982; Beluszky P.–Sikos T. T. 2007).

One of the most characteristic and dynamic groups of villages consists of about 300 members. These are the suburban or peri-urban villages with best conditions with regards to their demographic pattern, transport position and living standards. There are some sub-groups incorporated, with the differentiating factors being the size of the settlements, and their distance from the nearby large towns. Nowadays the most dynamic villages of Hungary belong to this type, especially the ones located very close to the capital city, Budapest. All the villages of this group have higher indicator values than the rural average, but this advantage is smaller at villages to be found at the edge of the urban agglomerations. As regards population size, this is the largest group of the Hungarian villages, comprising almost 30% of the rural population of the country.

Another, but smaller group of dynamic rural settlements consists of only 40 villages with significant tourist importance. Their dynamism and the economic and social circumstances are among the best. The largest concentration of these rural settlements is located near the Lake Balaton.

The third largest group is formed by the „average villages" with more or less adequate conditions, especially with better job opportunities (300 villages scattered all over in Hungary, mainly micro-centres in the Western and Northern part). This group is in permanent change, some villages can shift upwards, others downwards.

The next group of villages is the medium-sized villages in relatively bad conditions. There are different subgroups of it; the first is with almost 600 villages mainly from the north-eastern side of Hungary. Poor job opportunities, low living standards, and widespread unemployment are the most important characteristics of these villages. Sometimes the conditions for farming activities are good, they are traditional agrarian villages, but because of the decline of agriculture in Hungary after 1990 most of them are in crisis now. The other sub-group is the so called „tanya-villages". The population of outskirts is traditionally very high in the agrarian regions of the Great Hungarian Plain. A high percentage of the agrarian population, a poor provision of public services, but relatively large personal incomes are the main characteristics here. The causes of differentiation of the "tanyas" (scattered farmsteads) are the same that we could see for the villages. There was a huge population loss in the previous decades, but by now the population figure of outskirts where "tanya" settlements are located seems to have become stabilised. But while the population of outskirts is growing near the larger towns, along the major public roads, it is further declining in the most remote areas (i.e. far from the villages, without electricity and paved roads) at a rate as before.

The former homogeneous group of the small villages (where population is usually under 1,000, sometimes 500) can be divided into at least two large groups and several sub-groups (Bajmócy P.–Balogh A. 2002; G. Fekete, É. 2005;

Józsa, K. 2007). There are almost 1,600 small villages in Hungary (more than 55% of the total number of villages), with more than 1,000 dwarf villages included (with less than 500 inhabitants). The first large new group of small villages, consisting of two sub-groups is those in relatively good conditions. The first sub-group is the largest, with more than 600 villages. These villages are in good position concerning employment opportunities, where unemployment rate is the lowest among all the types, and they are to be found mainly in the western part of Hungary. The other sub-group benefits from the tourist importance of the settlements. It is less numerous, and includes 40–50 villages only.

The largest group of the small villages has poor, sometimes very bad conditions (900 villages). Anyway this group is also differentiated, there are some sub-groups here. Almost one third of the villages belong here but only 11% of the rural population lives in these settlements. All the villages have bad traffic and service facilities, and they lost 30–50% of their population in the last decades. The first sub-group is the industrial commuting subtype, with relatively low unemployment. This is the group with the smallest settlements, so there is an urge to commute for local people who can hardly find any workplace in these villages. The second sub-group is the agrarian one, mainly very far from the commuting centres. There is a high percentage of the agrarian population, and the ratio of commuters is very low, some kind of subsistent villages occur. The third group is a new and very special one. Almost 200 villages belong to this type with the worst economic and social situation (gravest unemployment, very low number of employees, obsolete housing conditions), but the demographic situation is the best among all types, this is the only village type with natural increase. In these villages a considerable part (or sometimes the majority) of the residents is Roma. These villages are in the poorest peripheries of the country (north-eastern, south-western part) and have very few prospects for the future. The last sub-group is composed by small villages with overwhelmingly ageing population. Because of the out-migration of the previous decades the population is very old here (more than one third of it is over 60) with a low rate of employment. Similarly to the previous type these villages are dominated by inactive population, but in contrast to the extremely young age structure of those villages in this case by the elderly (Beluszky P.–Sikos T. T. 2007). Sometimes the establishment of a home for elderly people and substantial in-migration can also change the demographic character of the small villages, originally with a very high death rate.

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THE CREATIVE KNOWLEDGE SECTOR IN THE BUDAPEST METROPOLITAN REGION

Tamás Egedy[1]–Zoltán Kovács[2]

Introduction

As a consequence of the shift from the Fordist production system to the post-Fordist economic structures the metropolitan regions have acquired an ever growing importance and became the centres of economic and social development of countries and regions. Thus the economic progress and urban development are in a permanent and advancing interrelationship (Scott, A. J. 2006). From this perspective big cities and metropolitan regions play a prominent role; in addition due to their size and population number they represent a considerable material, spiritual and intellectual "mass" (Malecki, E. J. 1987). Naturally, parallel with the metropolitan development trends new research topics have appeared in the sphere of social sciences with an aim to reveal the motivations behind this rapidly changing and intricate progress. International experience shows that in economic competition – along with information and its flow – an increasing role is played by creativity (and particularly by culture), invention and innovation (Hall, P. 1998; Lambooy, J. G. 1998). Concerning further development of the European metropolitan regions it might be decisive how these city-regions will be able to attract and integrate firms in the sphere of the creative knowledge sector and their manpower (Glaeser, E. L. 2005).

For better understanding of creative knowledge sector and the role of socio-economic location factors in the metropolitan regions across Europe the ACRE project[3] was launched in October 2006. In this project researchers

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[3] ACRE project (Accommodating Creative Knowledge – Competitiveness of European Metropolitan Regions within the Enlarged Union, Contract no.: 028270) is financed by the 6th Framework Programme, Priority 7: 'Citizens and governance in a knowledge-based society'.

aim to assess the impact of the emerging 'creative class' and the rise of the 'creative industries' on the competitiveness of EU metropolitan regions. The central research questions of the project are: What are the conditions for creating or stimulating 'creative knowledge regions' in the context of the extended European Union? More particularly, what is the role of the so-called 'soft' factors in creating and stimulating 'creative knowledge regions'? The most important topic to consider is which metropolitan regions might develop as 'creative knowledge regions', and which regions might not.

Budapest is one of the 13 major cities taking part in the international research project. The Budapest Metropolitan Region (BMR) as the biggest metropolitan region of East Central Europe could provide relevant information about the development trends of creative knowledge sector taking place currently in transitional economies. The present paper summarises the first results of our research carried out in the initial phase of ACRE project. After a short theoretical overview our study summarises the current situation of creative knowledge sector of BMR together with socio-economic background information[4].

A short theoretical overview

Since the 1990s, the importance of geographical location and context has enjoyed a revival in economic and economic-geographic theories. The traditional agglomeration concept in the late 19th century used to explain the rise of new urban-economic clusters and centres no longer applies in its original sense. Instead, we should speak of new types of agglomeration economies in the current 'post-industrial' or 'post-Fordist' era. Phelps, N. A.–Ozawa, T. (2003) have highlighted the main shifts in agglomeration factors from the late industrial to the post-industrial or post-Fordist era (e.g. shift from town-with-suburbs to the global city-region, from hierarchically organised monocentric structures to polycentric structures, from manufacturing to services etc.). The increasing coming together and co-mingling of technological innovation, cultural creativity and governance are the driving forces of urban development in the 21st century.

In this new economic context creativity as such seems to have gained status and be required to attain success in the economy and in urban and regional development. Only metropolitan regions that are creative all round will survive global competition (Andersson, A. 1985; Hall, P. 1998; Törnqvist, G.

[4] For detailed information about the state of creative knowledge sector in Hungary and Budapest see Kovács, Z. *et al.* (2007). Budapest: From state socialism to global capitalism.

1983). Knowledge, rooted in regional and local cultures is also fundamental to understanding both the agglomeration and clustering of economic activity and the ability of cities and regions to increase their competitiveness. Cities with strong creative sectors – especially new-economy industries, such as high technology production, business and financial services, media and cultural-products industries, and neo-artisanal manufacturing – are in the vanguard of this trend. Through the worldwide networks of these global cities, a globalised lifestyle is promoted which is largely determined by the dominant lifestyles of these cities (Scott, A. J. 2006).

Creative and knowledge intensive industries

The rise of the 'creative industries' is an important element of urban and regional economic growth in the developed world. This process has been attributed to the demise of the Fordist mode of production, which was based on cost imperatives and secured through a national, Keynesian regulatory regime. With integrated global markets and the advent of new technologies there has been a search for new sources of competitive advantage (Rantisi, N. M. 2006). Empirical studies have highlighted the character of creative industries, being generally small, agile firms that operate within a networked chain of interrelated activities. In addition to creation and production, marketing and distribution are also key aspects of this chain, critical to commodities that rely on capturing (and manipulating) consumer sensibilities (Hirsch, P. 1972). Researchers including Zukin, S. (1995) have also stressed that the symbolic value of products has become at least as important as their practical uses (also Lash, S.–Urry, J. 1994). The 'hard core' of these creative industries, consisting of the economic branches mentioned above, is most often labelled 'cultural industries'. However, these cultural industries have intensive links with several other creative economic branches, as well as with creative departments of various production activities. The wide array of creative activities developed around the cultural industries is most often called 'creative industries' *(Table 1).*

A large share of these creative industries is highly interrelated with knowledge intensive activities. In this sense creativity and knowledge are strongly interwoven. When we discuss the relevance of location factors or the cluster theories for the attraction of new economic activities in the creative and knowledge intensive industries it makes sense to expand the focus of attention to sectors such as ICT in general (other software companies), the financial sector, law and other knowledge intensive business services, as well as the research and development and higher education sectors.

Table 1 Creative industries – Different definitions

Creative industries	Copyright industries	Content industries	Cultural industries	Digital content
Largely characterised by nature of labour inputs: 'creative individual'	Defined by nature of asset and industry output	Defined by focus of industry production	Defined by public policy function and funding	Defined by combination of technology and focus of industry production
Advertising Architecture Design Interactive Software Film and TV Music Publishing Performing arts	Commercial art Creative arts Film and Video Music Publishing Recorded media Data-processing Software	Pre-recorded music Recorder music Music retailing Broadcasting and film Software Multimedia services	Museums and galleries Visual arts and crafts Arts education Broadcasting and film Music Performing arts Literature Libraries	Commercial arts Film and video Photography Electronic games Recorded media Sound recording Information storage and retrieval

Source: Hartley, J. (2005).

The 'creative class'

Another concept rapidly gaining popularity amongst urban researchers is the 'creative class' of Richard Florida (Florida, R. 2002). Analysing the role of creativity in economic development and urban and regional success Florida, R. came to the conclusion that Talent, Technology and Tolerance (3Ts) are important conditions. In his 3T model he argued that growth is powered by creative people (Talent), who prefer places that are culturally diverse and open to new ideas (Tolerant), and the concentration of 'cultural capital' wedded to new products (Technology). All these together result in 'business formation, job generation and economic growth'. Florida, R. claims that we are entering the 'creative age', in which people with original ideas of all sorts will play a central role. According to Florida, R. (2002) "The creative class is comprised of a 'super creative core', which consists of a new class of scientists and engineers, university professors, poets, actors, novelists, entertainers, artists, architects and designers, cultural worthies, think-tank researchers, analysts and opinion formers, whose economic function is to create new ideas, new technology, and/or new creative content". Beyond this core group, the creative class also includes a wider circle of talent working in knowledge-intensive industries. The latter industries include high-technology sectors, financial sector and juridical services.

It is important to stress that a creative knowledge economy offers chances to people of all socio-economic and educational strata to profit from their talents. Of course, not all people are equally creative or talented, but in principle, everyone has a certain talent that could contribute to urban or regional innovation and economic development. An economy focusing on creativity does not need to be an elitist economy. It can also offer new chances to marginal groups that have been unable to participate in urban and regional economic progress.

Introduction to the Budapest Metropolitan Region (BMR)

Geographical context

The BMR is located in the official EU-region of Central Hungary, which is one of Hungary's seven NUTS-II regions. The settlement system of the Central Hungary Region can be subdivided into three segments: i.) Budapest, the capital city of Hungary; ii.) the agglomeration zone of Budapest, including officially 80 settlements, and iii.) the rest of Pest county – excluding Budapest and its metropolitan region – with 106 settlements (i.e. municipalities). Budapest currently has a population of 1.7 million inhabitants, which has been continuously decreasing since the mid-1980s when the peak was 2.1 million. Administratively the city is subdivided into 23 districts, 6 on the Buda side, 16 in Pest and 1 on Csepel Island between them. Each district can be associated with one or more city parts named after former towns within Budapest and they serve as independent municipalities (Tasan-Kok, T. 2004).

The zone of agglomeration comprises the suburban settlements around Budapest which maintain strong ties with the city, lying in its daily commuting zone. Through the development of the metropolitan transport network the city expanded its zone of influence dynamically during the last decades (*Fig. 1*). Today the agglomeration of Budapest officially consists of 80 settlements, some of them have urban status, the others are villages. Budapest and its agglomeration have altogether 2.44 million inhabitants and with this figure it is the largest metropolitan region in East Central Europe (Földi, Zs. 2006).

Demographic context

Demographic trends of the 1990s basically proceeded after 2001 with slight micro-level changes. However, social polarisation and the consequent spatial segregation enhanced compared to the 1990s. Another important feature of recent demographic trends is that the increasing economic prosperity

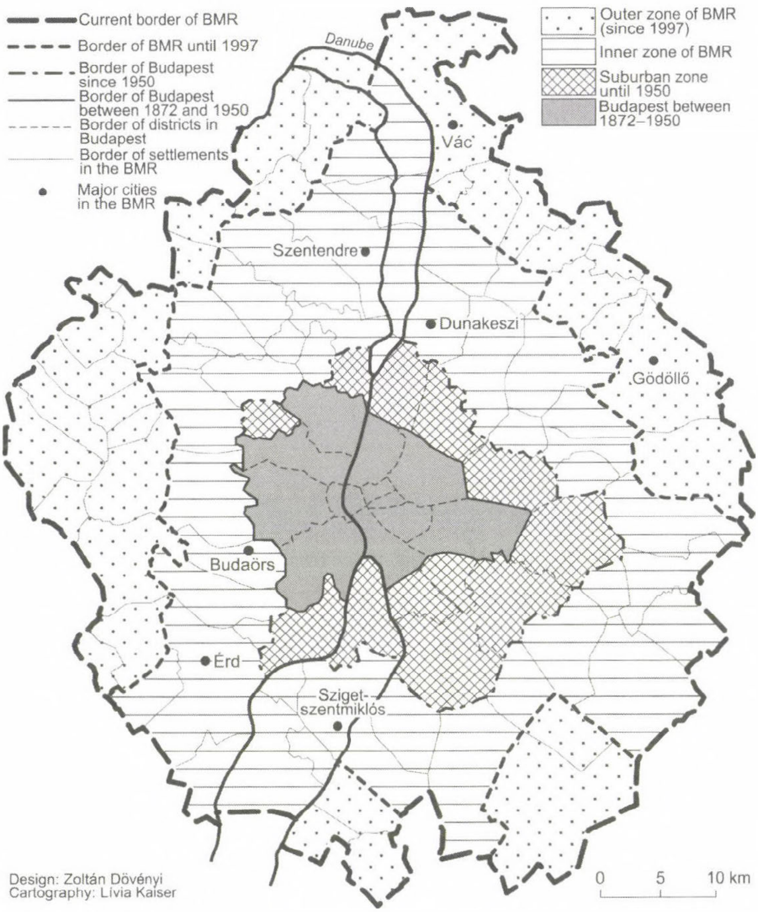

Fig. 1. Budapest Metropolitan Region

and functional specialisation in the BMR has caused a marked increase in the rate of people commuting.

According to the Hungarian micro-census held in 2005 the number of population in Budapest is 1.696 million. As a result of suburbanisation and ageing the population figure of Budapest decreased by 321 thousand between 1990 and 2005, at the same time the number of population in the agglomeration zone grew by 25% and reached 719 thousand by 2005 *(Table 2)*. The 80 settlements belonging to the officially recognised agglomeration zone around Budapest contain nearly two thirds of the population of Pest County.

Similar to the whole country Budapest and its surroundings can be characterised by a marked ageing process. Central Hungary (i.e. Budapest and Pest County) has the highest value of ageing index among the seven Hungarian

EU regions with 112.3% (for Budapest it is 145.5%). On the other hand, the average life expectancy is much above the national average in Budapest: it is 70.5 years for men, and 77.4 years for women, in Pest County it is 69.1 and 77.05 years respectively.

Since 1998 the level of employment has been continuously increasing in the BMR. In 2005 63.3% of the age group between 15 and 64 was actively employed (65.4% in Budapest), and both figures are well above the national average (56.9%). The ratio of white-collar employees is very high (56.7%), just like the proportion of people working for the public sector (37%). In terms of wages, the level in Budapest is 27% above the national average.

Until 2002, unemployment had decreased considerably when it was 4% in the BMR as compared to the national figure of 5.8%. Since then the ratio of unemployment has been slightly increasing in accordance with the national trends. Latest figures from 2004 are 4.4% for Budapest, and 4.7% for Pest County, in the latter seasonal fluctuations and regional differences being relatively strong.

Due to Budapest, the general level of educational attainment in the BMR is much higher than the national average. In the adult age group (18+) 54.1% of the population holds secondary education (national figure is 38.4%), whereas the ratio of people with higher education is 13.6%, nearly double the national average.

Table 2. Natural increase and migration (1990–2004)

City, region	Number of births	Number of deaths	Natural increase	Immigration	Out-migration	Balance of migration	Population change
Budapest	244 459	405 160	-160 701	810 183	915 408	-105 225	-265 926
Agglomeration	103 923	110 988	-7 065	595 286	442 326	152 960	145 895
Rest of Pest county	64 911	86 171	-21 260	254 148	215 535	38 613	17 353
Central-Hungary	413 293	602 319	-189 026	1 659 617	1 573 269	86 348	-102 678

Source: Central Statistical Office (CSO), Budapest

Economic characteristics

The economic output of the BMR has always been dominant within Hungary. This was further strengthened by economic restructuring after the change of regime in 1989–90. This was earmarked by the explosion of service sector and development of high-tech industry. Due to the spectacular growth in commerce, business and financial activities the change was especially far-reaching in Budapest, where the weight of services on the labour market increased from 62.5% to 78% between 1990 and 2006. The rapid transformation of the economy was also fostered by foreign capital investments mainly in the fields of logistics, transportation, telecommunication, retailing and high-tech industry.

The BMR is the economically most advanced area of the country. In 2004 44.5% of the national GDP was produced in the Central Hungary Region, 35% in Budapest itself. The per capita GDP produced in the Central Hungary Region was 159%, in Budapest 205% and in Pest county 89% of the national average (*Fig. 2*).

In 2005 the number of registered enterprises in Budapest was 354,000, which meant a 7% growth compared to 1995. The number of enterprises per 1,000 inhabitants in Budapest was double the national average. The entrepreneurship based in the capital city represented 29% of the national figure. It is typical of Central Hungary that the number of medium-sized enterprises is below the national average. Thus, the majority of the enterprises are small enterprises with 0–9 employees.

After 2000 the BMR managed to keep its leading position in the economic development and modernisation of the country in most respects. Within the local economy industry is still important but in a transformed manner and with a gradually reducing share. In terms of output and employment the five most important branches are: chemical industry, machinery, food processing, woodworking and publishing. Within services the financial sector has been developing most intensely, other innovative economic branches in Budapest are info-communication technologies, logistics, life-sciences (medicine production, bio- and nanotechnology), creative industries and cultural economy.

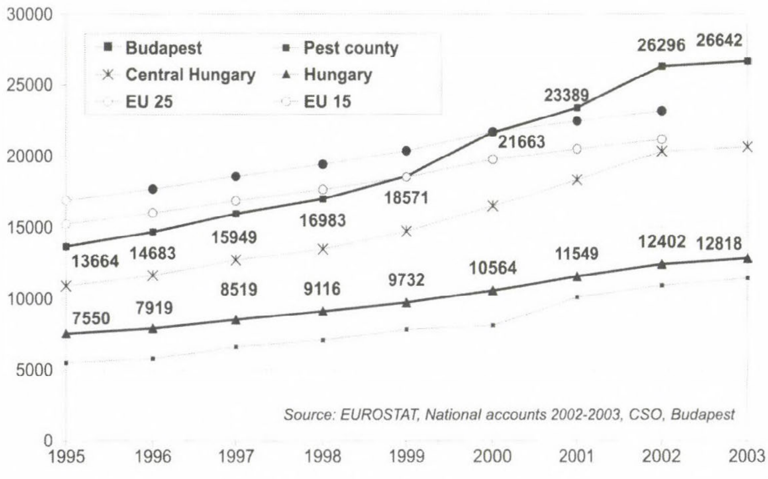

Fig. 2. The per capita GDP (EUR, in Purchasing Power Parity)

The economic and spatial changes of the BMR were at their most intense on the metropolitan periphery. According to empirical evidences three new economic poles arose as a result of the restructuring process: i) Gödöllő town and its surroundings (long-term objective is the formation of a "Technopolis" through synergies of knowledge-oriented industries, and private and academic research); ii) Szigetszentmiklós–Dunaharaszti–Soroksár (due to massive investments it is the biggest logistics centre of Eastern and Central Europe and an important commercial transport hub between the Balkan/Western Asia and West Europe); iii) Budaörs and Törökbálint (multi-functional business zone with a mixture of modern industrial and office complexes as well as retail and recreation facilities) (*Fig. 3*).

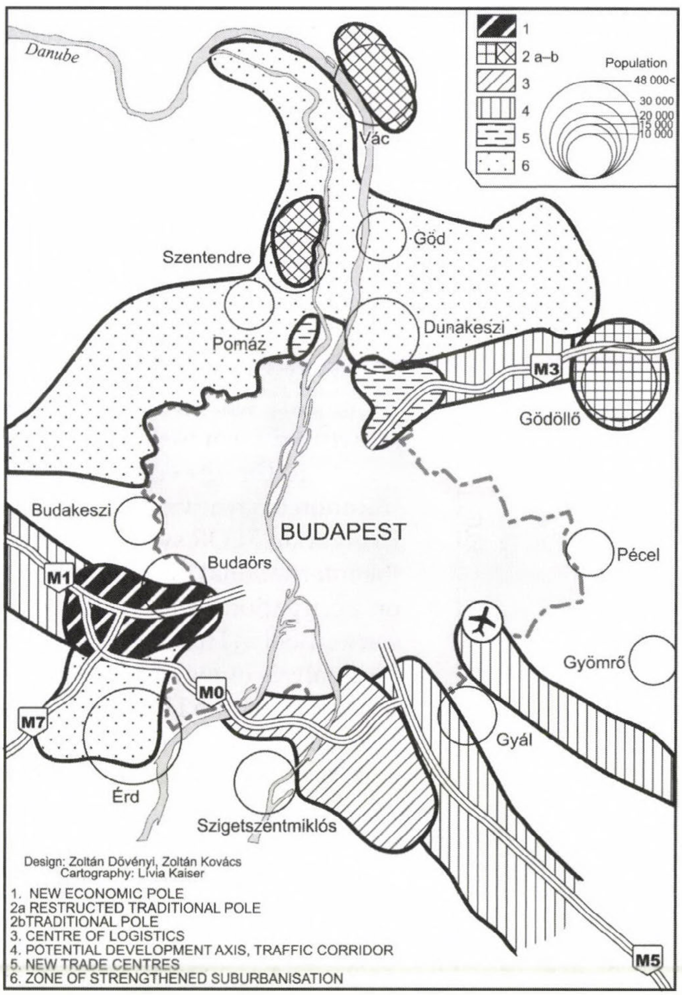

Fig. 3. Development poles in the Budapest Metropolitan Region

Table 3. The importance of BMR in the creative knowledge sector in Hungary (%)

Sectors	Enterprises			Employees			Revenues		
	1999	2004	Change	1999	2004	Change	1999	2004	Change
Creative industries	42.0	43.3	**1.2**	40.5	44.8	**4.3**	58.3	62.3	**4.1**
ICT	55.8	53.6	**-2.2**	49.8	46.7	**-3.2**	42.4	43.1	**0.7**
Finances	28.2	27.4	**-0.8**	75.5	66.5	**-9.0**	89.7	91.2	**1.5**
Law and business	42.3	41.9	**-0.4**	52.7	53.0	**0.3**	80.4	66.6	**-13.7**
R&D, higher education	65.6	52.4	**-13.2**	48.1	48.7	**0.7**	77.5	77.5	**0.0**
Creative knowledge sector	42.1	42.3	**0.2**	47.4	49.0	**1.6**	58.5	58.4	**0.0**
Total:	*34.5*	*35.0*	*0.5*	*37.8*	*39.1*	*1.3*	*51.3*	*53.2*	*1.9*

Source: CSO Hungary; 1999, 2004

The current situation of creative knowledge sector in the BMR

Data sources

In the beginning of ACRE project on the basis of the international literature the consortium defined those *economic activities* and *occupations* that can be classified as part of the creative industries (see Annex I). For the analysis of the current situation of creative industries in the BMR two sets of data have been used:

i) *Creative industries* – For the identification of creative knowledge sector the international NACE codes were used, which are identical with the TEAOR'03 codes applied by the Central Statistical Office (CSO) of Hungary. Data about the number of enterprises (divided by companies, sole proprietors, government institutions), their number of employees and annual revenues (in 1,000 EUR) were supplied by CSO Hungary. This set of data was available in a cleaned and structured form for 1999 and 2004;

ii) *Creative occupations* – For the identification of creative occupations we used the Hungarian FEOR system, which is similar to the international ISCO88 system. Latest data on occupation were available from the last census held in Hungary in February 2001. For the analysis of regional variations of creative industries within Hungary we used data aggregated for the entire country, for regions and counties, and for the BMR, respectively.

The state of creative knowledge sector in the BMR

At the end of 2004 there were 264 thousand active economic organisations in Hungary operating in the field of *creative industries* and *knowledge intensive industries* (together the 'creative knowledge sector'), which made up 36.4% of the active economic organisations registered in the country. Within the creative knowledge sector the proportion of creative industries was 57% with 150,331 organisations, whereas the knowledge intensive industries represented 43% (Kovacs *et al.* 2007).

Within the creative knowledge sector the weight of BMR is especially outstanding in the fields of ICT (53,6%), R&D and higher education (52,4%). In terms of revenues the share of BMR is also decisive in the field of R&D and higher education (77,5%) and in law and business services (66,6%).

BMR has a favourable position also with regards the creative industries, concentrating 43,4% of these firms *(Table 3)*. In all the branches of creative knowledge sector the role of Budapest is predominant within the BMR. If we look at the composition of the creative knowledge sector in the BMR the relative weight of creative industries and law and other business services is extreme, with 65,071 and 29,396 organisations respectively, comprising 84.7% of the firms active within this sector.

It is also important to analyse the relative weight of economic organisations of the creative knowledge sector within the local economy. Firms in the creative knowledge sector make up 44% of the active economic organisations registered in the BMR and 46.1% in Budapest proper *(Table 4)*.

Table 4. Ratio of creative and knowledge intensive enterprises (%)

Sectors	Budapest	Agglomeration	BMR	Country
Creative industries	26.8	22.1	25.7	20.8
ICT	3.6	3.0	3.4	2.2
Finances	2.4	2.8	2.5	3.1
Law and business	12.4	9.1	11.6	9.7
R&D, higher education	1.0	0.6	0.9	0.6
Creative knowledge sectors	46.1	37.6	44.0	36.4
Total:	*100.0*	*100.0*	*100.0*	*100.0*

Source: CSO Hungary, 2004

Within the agglomeration the relative weight of firms operating in the creative knowledge sector is the highest in the north-western sector of Buda (41.8%), and lowest in the south-eastern sector of Pest (30.2%). In this respect we can also observe substantial differences among the settlements (*Fig. 4*). Highest proportions of creative firms are registered in the settlements of the north-western sector (Csobánka 52.1%, Nagykovácsi 49.9%, Telki 48.1% and Budakeszi 47.9%), on the other hand lowest figures can be found in the south, south-east (Alsónémedi 23.3%, Ócsa 23.4%).

Equally marked geographical differences can be detected within Budapest. Districts of the Buda side show up higher proportions with regards the relative share of creative firms (12th District 55.3%, 1st District 54.2%, 2nd

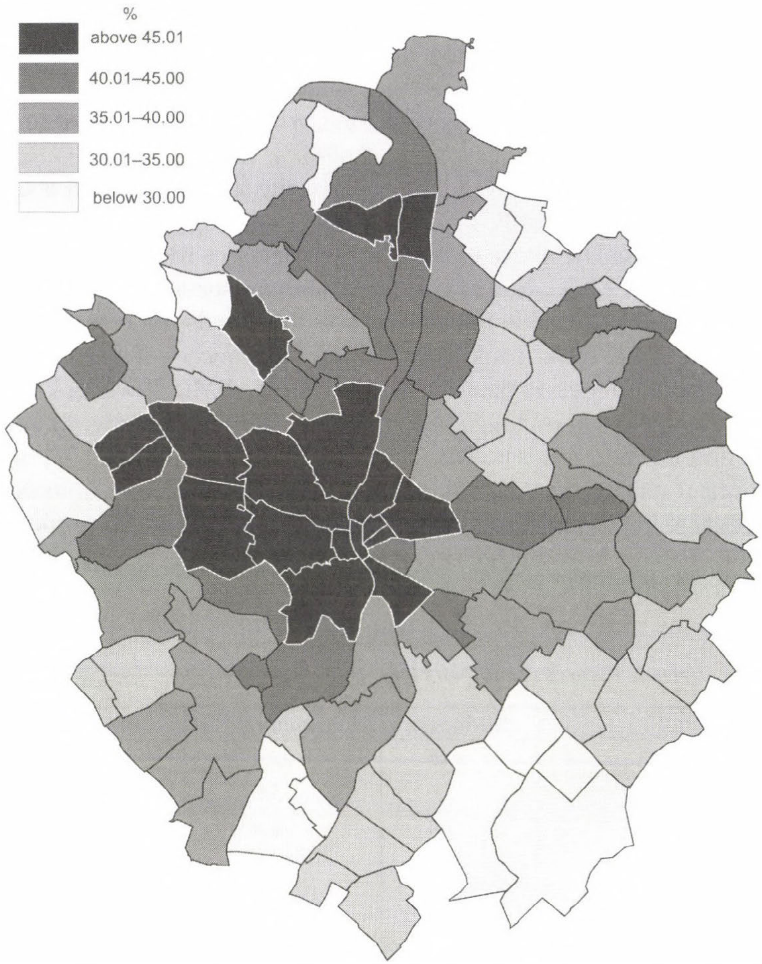

Fig. 4. The ratio of creative and knowledge intensive enterprises in the BMR.
Source: CSO Hungary, Census 2001

District 54.0% whereas the number and share of creative knowledge sector is generally lower in the south-eastern districts of the Pest side.

The position of creative knowledge sector can be further refined if we analyse its relative weight in employment and the annual revenues of firms. According census data both with respect employment and revenues BMR and Budapest play outstanding role in Hungary: 39.1% of all employees worked here and 53.2% of revenues were realised here in 2004. As a general trend it can be stated that the weight of BMR in the creative knowledge sector is even higher. Greatest extreme can be found in finances, only 27.4% of firms in this branch are located in the BMR, nevertheless 66.5% of employees are working here, and 91%

(!) of total revenues are realised here. In terms of revenues the share of BMR is also decisive in the field of R&D and higher education (77.5%) and in law and business services (66.6%). Only revenues realised by companies in the ICT sector (43.1%) are significantly below that average weight of BMR.

In 2004 in the BMR highest revenues per firm and per employee were registered in the ICT sector, with 971.5 thousand and 149.2 thousand EUR respectively. National figures in the same sector were 448.4 thousand EUR per firm and 76.6 thousand EUR per employee in that year. Lowest figures of revenues per firm and/or employee were registered in the R&D and higher education sector *(Table 5)*.

Table 5. Revenues per enterprise and per employee in the BMR (1000 EUR)

Sectors	Revenues/ enterprise	Revenues/ employee
Creative industries	167.3	56.1
ICT	971.5	149.2
Finances	856.7	98.9
Law and business	106.8	35.0
R&D, higher education	78.6	5.3
Creative knowledge sector	*250.9*	*65.6*
Total:	*448.4*	*76.6*

Source: CSO Hungary, 2004

With regards to the number of enterprises, their employees and the quantity of revenues the following branches have leading position in the BMR:

- legal accounting, book-keeping and auditing activities, tax consultancy, market research and public opinion polling, business and management consultancy (NACE:741);
- other retail sale of new goods in specialised stores (NACE:524);
- miscellaneous business activities (NACE:748);
- architectural and engineering activities and related technical consultancy (NACE:742)
- software consultancy and supply (NACE:722).

At national level, 81.8% of the enterprises in 'motion pictures and video activities' and 71.9% of 'publishing' are located in the territory of BMR. With regards productivity the 'insurance and pension funding' branch has a leading role with 40.27 million EUR revenues per organisation. Second in the row with regards productivity the 'telecommunications' branch, where the annual amount of revenues per firm reached 12.34 million EUR in 2004 *(Table 6)*. This was 2.5 times higher the national average. Interestingly, in the field of 'telecommunications' the difference between Budapest and the agglomeration

Table 6. Creative knowledge branches with highest revenues per enterprise (1000 EUR)

Branches	Budapest	Agglomeration	BMR	Country
Insurance and pension funding	47,493.7	23.7	40,270.0	24,722.7
Telecommunications	12,597.5	11,512.0	12,339.2	5,069.5
Financial intermediation	10,959.7	956.2	9,605.4	5,063.3
Manufacture of television and radio receivers etc.	6,838.6	5,084.9	6,474,4	18,329.6
Manufacture of electronic valves and tubes etc.	2,988.8	4,827.3	3,657.4	4,693.9
Manufacture of office machinery and computers	690.7	13,255.3	3,615.8	6,623.6

Source: CSO Hungary, 2004.

zone is negligible. 'Financial intermediation' takes the third place according to the average revenues per firm (10.9 million EUR). The only branch where the productivity of firms located in the agglomeration zone is higher than that operating in Budapest is 'manufacture of office machinery and computers'.

With respect the average revenue per employee the highest figures are recorded in the fields of 'telecommunications' and 'insurance and pension funding', with 239 thousand and 177 thousand EUR respectively. There is a significant difference between Budapest and its agglomeration zone. In the branch of telecommunications the firms located in the agglomeration have significantly higher revenues per employee (346 thousand EUR) than the firms with similar profile in Budapest (211 thousand EUR).

BMR as a living space for creative employees

Data of the 2001 national census revealed the main features of spatial distribution of labour force in the creative knowledge sector in Hungary and in the Budapest Metropolitan Region[5]. First we investigate in which segments of occupation has the BMR an outstanding role within the country. Taking into account the weight of BMR measured by its average economic performance the occupations were categorised into three groups: 1st group: outstanding role (with 60–100% of employees); 2nd group: average role, corresponding to the average weight of BMR (with 30–60% of employees); 3rd group: negligible role,

[5] Though there has been a massive growth in the employment of the creative knowledge sector since 2001, we assume that the main geographic and sectoral dimensions have not changed significantly.

below the national weight of BMR (with 0–30% of employees). In the analysis we also took into consideration the size of the different occupation sectors *(Fig. 5)*. According to *Figure 5* the weight of BMR is most outstanding among patent attorneys, 90% of them live in the BMR where the Hungarian Patent Office is located. Their total number however is only 160 persons.

'Market research, advertising and marketing' belong to the first major group of occupations, where the role of BMR is outstanding. Two thirds of the 14 thousand employees working in this field in Hungary live in the BMR and 73% of them work here.

BMR has equally high shares in art (9,000 employees) and performing arts (6,000 employees), 72% and 68% of people active in these sectors in Hungary live and work in the BMR *(Fig. 6)*. There were 3,000 journalists and editors in the publishing sector in Hungary in 2001, 74% of them lived in the BMR. In addition to these occupations the share of BMR is also high in the electronic media (Radio and TV). We should also note that in all sectors of the creative industries a major part (from 57% to 68%) of the high rank managers and professionals live and work in the BMR.

In the second category (where BMR concentrates 30–60% of total employees) the 'IT sector' is the most prominent. In 2001 more than half of the

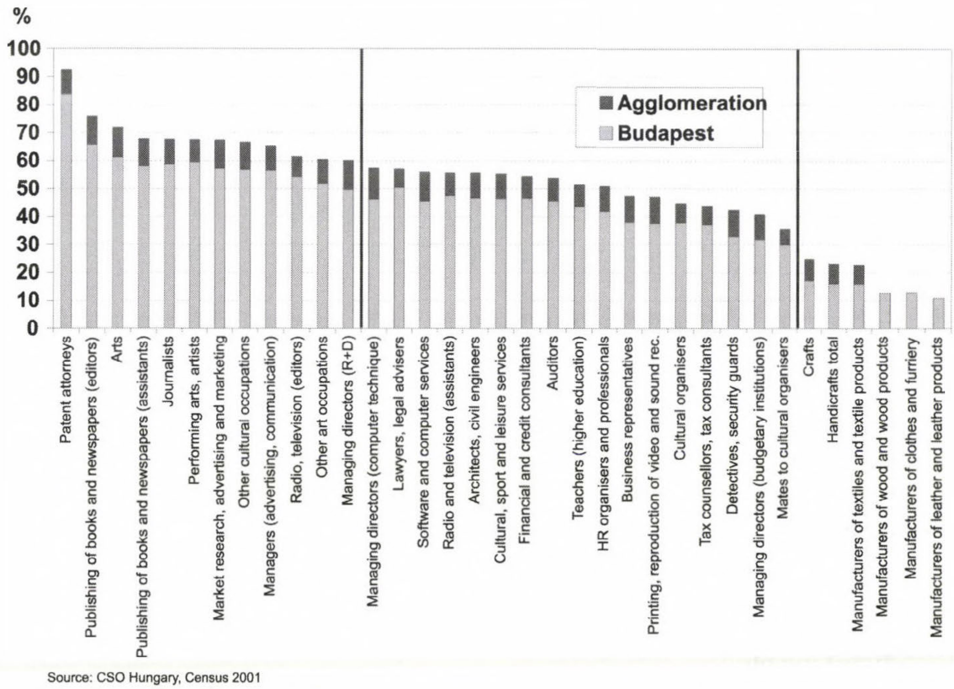

Fig. 5. Ratio of creative employees living in the BMR. Source: CSO Hungary, Census 2001

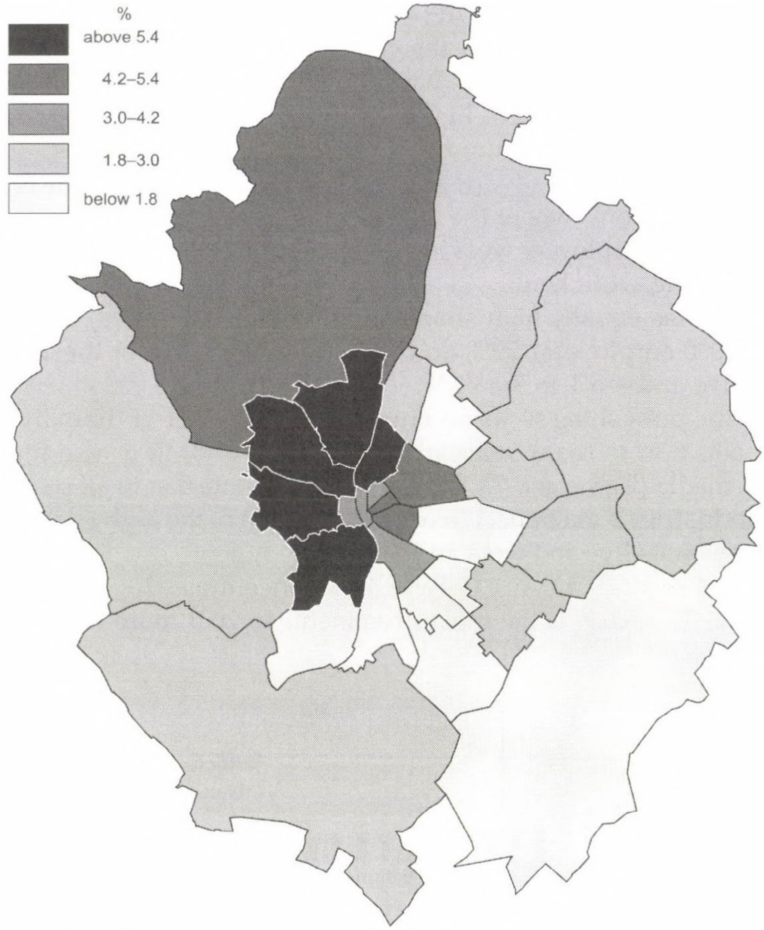

Fig. 6. The ratio of employees of arts in the BMR. Source: CSO Hungary, 2004. Design: SZABÓ, B.

42,000 employees working in the IT sector in Hungary lived in the BMR, predominantly in Budapest. To this category belong also occupations in 'law and other business services', 'R&D and higher education', and 'architecture and town planning'.

In the third category (where BMR is underrepresented) those occupations can be found, which play traditionally more important role in the countryside, among them folk-art and handicrafts (e.g. pottery, textile, leather, woodworking etc.).

The national census of 2001 contains also data on the demographic profile and educational attainment of employees working in different creative occupations. In the analysis we focus on the proportion of young age groups and people with higher education. The proportion of employees with university and college degree is extremely high (above 75%) in the fields of 'R&D and higher education', 'finances' (accounting, book-keeping and auditing activities) and 'law' (legal services). The ratio of people with higher education is also relatively high in occupations of the IT sector (software consultancy, analysts etc.). To sum up it can be stated that in occupations within the 'knowledge intensive industries' (ICT, Finances, Law, R&D and higher education) the share of highly educated employees tend to be generally high. Within the 'creative industries' the proportion of employees with higher education is somewhat lower, highest ratios can be found in the field of 'architecture', 'electronic media' (Radio and TV), and 'performing art'.

Creative occupations where the young age group (18–29 years) is overrepresented can be easily separated from the rest. The ratio of young age group is above 25% in the IT sector. This age group is especially dominant among IT professionals, software managers, computer network managers. Young people are also overrepresented in the field of 'market research, advertising and marketing'. The proportion of young professionals has increased in 'finances' and 'law' (accounting, book-keeping, auditing activities, legal services). Older age groups have higher shares in occupations related to higher education, R&D and other government institutions, and also in the field of 'architecture'.

Conclusions

The Budapest Metropolitan Region is the economically most advanced area of the country and since the change of the political regime BMR managed to keep its leading position in the economic development and modernisation of the country in most respects. The economic output of the BMR has always been dominant within Hungary. In 2004 44.5% of the GDP was produced in the Central Hungarian Region and 35% in Budapest itself.

The economic restructuring has made it obvious that Hungary and BMR – based on its skilled workforce – could be competitive in the knowledge based industries within the European economic area. Accordingly, the national, regional and local strategies in Hungary have focused on the development of creative and knowledge intensive branches since 2000. The weight of BMR is significant and favours the progress of these industries; up to now the Central Hungary Region (and within that BMR and Budapest) attracts most of foreign and domestic investments and innovations, and BMR plays a prominent part in financial, legal, commercial and logistic services. It serves as gateway for innovation and modern technologies, and national centre of most creative activities (education, R&D, media, finances etc.). This is confirmed by statistical data: its share in the creative knowledge sector in Hungary was 42.3% in 2004 (ca. 112,000 companies and sole proprietors) employing 427,000 people.

BMR is over-represented in terms of the number and ratio of creative and knowledge intensive firms, as well as the employees in firms of these industries and the revenues generated by this sector. With regard to the individual branches it is the creative industries, legal and business services, ICT, R&D and higher education where BMR is an indisputable leader. Culture and cultural industries are also worth mentioning as Budapest is the prominent cultural hub of Hungary, and South Eastern Europe in many respects. The development of creative and knowledge intensive industries in provincial cities is now somewhat lagging behind that of the capital but their gradual close up – especially in financial services – is indicative of positive shifts and promising for the future.

At the end of 2004 there were 264 thousand active economic organisations in Hungary operating in the field of *creative industries* and *knowledge intensive industries*, which made up 36,4% of the active economic organisations registered in the country. Within the creative knowledge sector the weight of BMR is especially outstanding in the fields of ICT, R&D and higher education. With respect employment and revenues BMR and Budapest play an outstanding role in Hungary: 39.1% of all employees worked here and 53.2% of revenues were realised here in 2004. In terms of revenues the share of BMR is decisive in the field of R&D and higher education and in law and business services. In 2004 in the BMR highest revenues per firm and per employee were registered in the ICT sector. With regards the number of enterprises, their employees and the quantity of revenues legal accounting, book-keeping and auditing activities, tax consultancy, market research and public opinion polling have the leading position in the BMR. Regarding creative occupations the role of BMR is outstanding in market research, advertising and marketing, art and performing arts, journalists and editors in the publishing sector and people working in the electronic media. In all sectors of the creative industries the majority of high rank managers and professionals live and work in the BMR.

Due to the economic development of the past fifteen years BMR has been integrated successfully into the European metropolitan network, even if economic difficulties occurred in the years after 2002. Although at present the emergence of the creative knowledge sector is in an incipient stage, the position of Hungary, including BMR, is advantageous and competitive. If BMR is able to use its options stemming from geographical setting and economic endowments, it could be effective in playing gateway position in the development of creative and knowledge intensive industries in this part of Europe.

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GEOPOLITICS OF ENERGY AND THE EAST CENTRAL EUROPEAN COUNTRIES

KÁROLY KOCSIS[1]–TIBOR TINER[2]

Introduction

Since the end of the 20th century the global energy sector has been under a continuous pressure resulting from the rapid growth of global energy consumption, the skyrocketing of energy prices and the strong competition for the energy resources. So it is understandable, that the security of energy supply, being the engine of economic development, is an extremely important issue, first of all for the importing countries. This is especially true for the EU-member East Central European or Visegrád countries[3], which are only able to cover a minor part of their energy consumption by own production (e.g. 9% of crude oil, 17.3% of natural gas consumption in 2005) (*Table 1*). The present-day tension results from the risks of great imbalances between energy demand and supply. Additional problems are the territorial concentration of the major hydrocarbon reserves and the political uncertainty in some of these energy producing regions (*Figs 1 and 2*). The Gulf States and Russia possess 60.7% of the proved oil and 68.7% of the proved natural gas reserves of the world (*Table 2*). At the same time the bulk of the energy import concentrates to Europe and North America (e.g. 59% of the crude oil import, 85.5% of the natural gas import in 2005). The largest European oil and gas consumers (and importers) are in the west (Germany, France, United Kingdom, Italy, Spain,

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[3] Visegrád countries or Visegrád Group ('V4') is a formation of East Central European countries (Czechia, Hungary, Poland, Slovakia), with the efforts to work together in a number of fields of common interest within the EU. The creation of V4 in 1991 was motivated by several extremely impotant factors: e.g. elimination the remnants of the communist bloc in Central Europe, overcoming historic animosities, joint accomplishment of the socio-economic transformation and joint accession to EU. (See www.visegradgroup.eu)

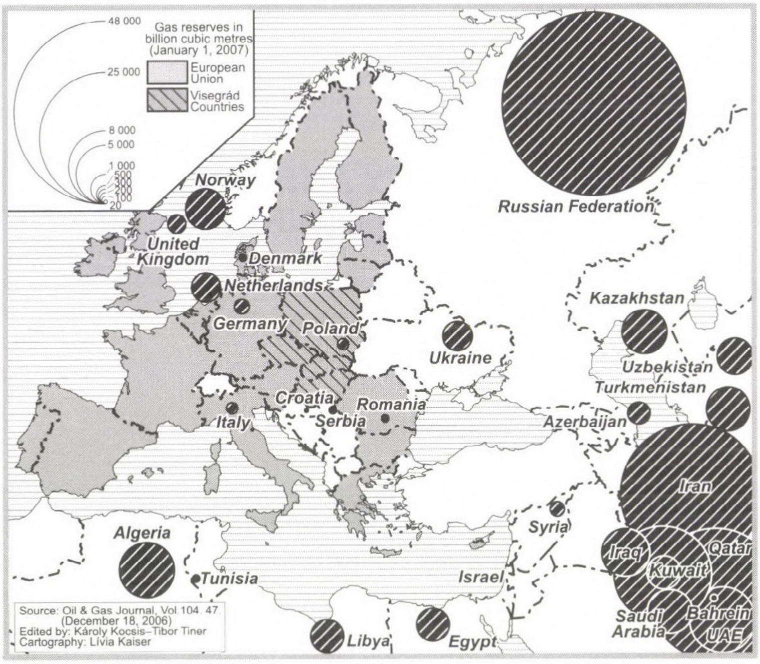

Fig. 1. Major proved gas reserves (January 1, 2007)

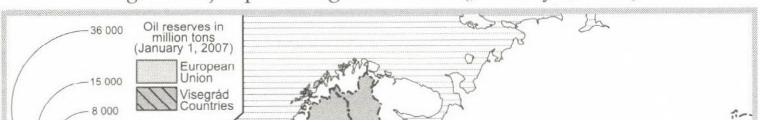

Fig. 2. Major proved oil reserves (January 1, 2007)

Table 1. World crude oil and natural gas production and consumption (2005)

Continents, regions	Crude oil Million tons		Natural gas Billion cubic metres	
	Production	Consumption	Production	Consumption
North America	454.8	1,061.4	696.2	725.4
Central & South America	532.2	361.4	187.6	181.0
Europe	274.1	770.1	315.2	554.3
Former USSR	585.9	192.1	813.9	679.8
Middle East	1,259.6	315.1	323.8	309.1
Africa	497.8	141.5	182.8	87.1
Asia & Oceania	393.7	1.158.4	376.2	421.6
World Total	*3,998.1*	*4,000.0*	*2,895.7*	*2,958.4*
EU-27	131.1	732.6	222.6	539.4
Visegrád Group	3.9	43.5	7.8	45.2

Source: Energy Information Administration, Report June-October 2007, International Energy Annual 2005 (www.eia.doe.gov)

Table 2. World proved crude oil and natural gas reserves (January 1, 2007)

Continents, regions, countries	Crude oil		Natural gas	
	Billion barrels	Million tons	Trillion cubic feet	Billion cubic metres
North America	200.967	27,529.7	262.331	7,428.2
Central & South America	115.150	15,774.0	255.302	7,229.1
Europe	15.512	2,125.0	180.001	5,096.9
Former USSR	98.874	13,544.4	2,014.800	57,051.1
Middle East	739.505	101,302.0	2,565.738	72,651.4
Africa	114.073	15,626.5	484.433	13,717.2
Asia & Oceania	33.366	4,570.7	419.487	11,878.2
World Total	1,317.447	180,472.2	6,182.692	175,069.1
EU-27	7.313	1,001.8	94.899	2,687.2
Visegrád Group	0.141	19.3	6.746	191.0
Norway	7.849	1,075.2	82.320	2,331.0
Russian Federation	60.000	8,219.2	1,680.000	47,570.9
Kazakhstan	30.000	4,109.6	100.000	2,831.6
Azerbaijan	7.000	958.9	30.000	849.5
Turkmenistan	0.600	82.2	100.000	2,831.6
Iran	136.270	18,667.1	974.000	27,579.8
Iraq	115.000	15,753.4	112.000	3,171.4
Kuwait	101.500	13,904.1	55.000	1,557.4
Qatar	15.207	2,083.2	910.500	25,781.7
Saudi Arabia	262.300	35,931.5	240.000	6,795.8
United Arab Emirates	97.800	13,397.3	214.400	6,071.0
Algeria	12.270	1,680.8	161.740	4,579.8

Source: Oil & Gas Journal, Vol. 104. 47. (December 18, 2006)

Benelux states) surrounded from afar by their largest suppliers (Russia, Norway, Algeria, Lybia, Gulf States) (*Table 3, Figs 3 and 4*). The territorial imbalance between the energy exporters and importers upgraded the role of the transit countries, who during the last years, the time of the inflating energy prices, often came into conflicts (price-disputes) with the producers (e.g. Russia's 'gas war' with Ukraine in 2006, with Belarus in 2007). These conflicts resulting temporary breakdown in the energy supply drew the attention to the importance of the security of energy supply and of the energy markets and the need of the diversification of supply routes. In this Eurasian geopolitical context of the energetic issue the Visegrád Group plays a special role as part of the EU, the largest global energy importer and as an important transit area between Russia, Middle East and Western Europe.

Table 3. Origin of crude oil and natural gas import of EU-27 (2005, in %)

Continents, regions	Crude Oil	Natural Gas
Russian Federation	29.9	45.1
Africa	18.1	28.3
Norway	15.5	24.1
Middle East	20.1	2.5
Caspian	6.8	0.0
Other regions	9.6	0.0
Total:	*100.0*	*100.0*

Source: http://ec.europa.eu/dgs/energy

Some geopolitical characteristics of the energy supply in Europe

During the last quarter of a century the production and consumption of crude oil and the production of natural gas nearly stabilised, in parallel with the sharp decline of the coal production and consumption (*Fig. 5*). Due to the fact, that natural gas is the cleanest, most nature-friendly energy source (similar to the nuclear energy) and its application does not accumulate social problems, its share in the European energy balance increased continuously. Between 1980 and 2005 the gas consumption of the EU-27 increased by 88.4% and for the period of 2005–2030 a growth of 24% (from 537 bcm to 666 bcm) is forecasted. At the same time the EU's gas production will decrease by 30% until 2030 (Esnault, B. *et al.* 2007). These facts underline the dynamically increasing import dependency of the EU-27 (52.3%), which in the case of coal is 39.6%, of crude oil 82.2%, and of natural gas 57.7% (2005) (*Table 4*). This external dependency of the EU is expected to reach 66% (coal), 90% (oil) and 80% (gas) by 2030 (Geopolitics…2007). The dependency of import of hydrocarbons is especially

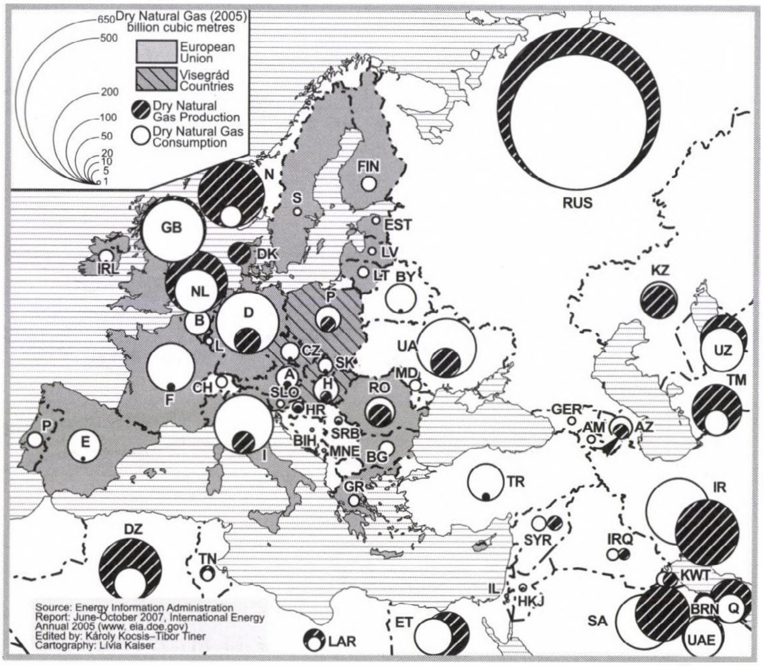

Fig. 3. Natural gas production and consumption (2005)

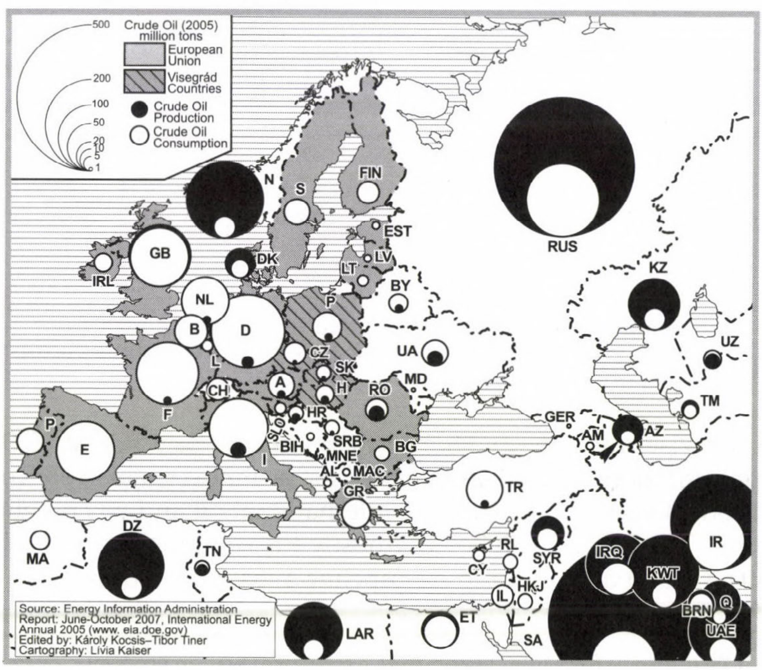

Fig. 4. Crude oil production and consumption (2005)

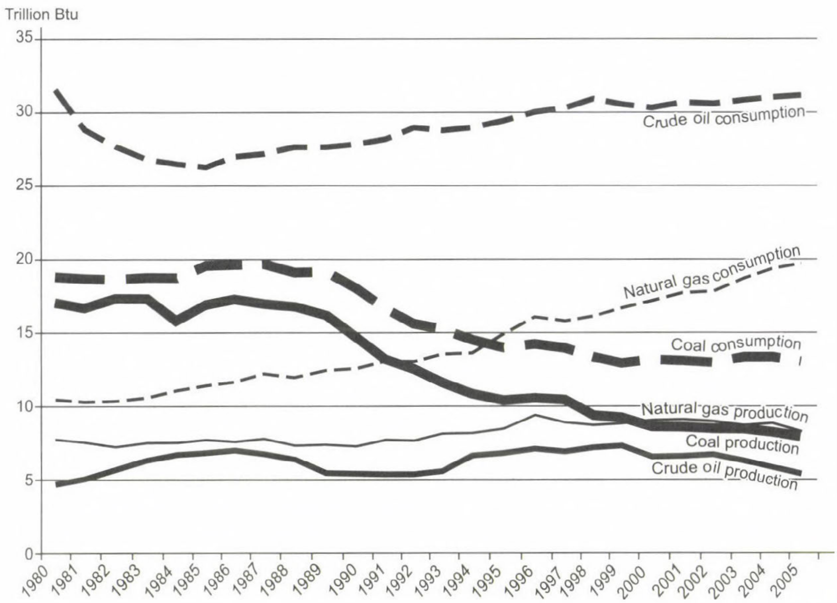

Fig. 5. Energy production and consumption of the EU-27 (1980–2005)

Table 4. Fuel import dependency of EU-27 and of the Visegrád Group (2005, 2030 in %)

	All fuels		Coal	Oil	Gas
	2005	2030	2005	2005	2005
EU-27	52.3	64.2	39.6	82.2	57.7
Czechia	27.4	50.3	-17.4	97.4	97.8
Hungary	62.9	63.9	43.4	79.2	81.1
Poland	18.0	44.7	-22.6	96.0	69.7
Slovakia	64.6	69.6	88.5	81.9	97.2

Remark: Negative numbers indicate that the country is a net exporter.
Source: EU Energy in Figures, Pocket Book 2007 (http://ec.europa.eu/dgs/energy), Mantzos, L.–Capros, P. 2006.

high in the Visegrád Group. Due to their historic past (COMECON[4]) and geographic location their oil and gas import is almost exclusively controlled by the Russian Federation. The first international oil and gas pipelines supplying the V4 countries with Soviet (mostly Russian) fuels were built during the 1960s (Druzhba-Friendship oil pipeline 1964, Brotherhood gas pipeline 1967) (*Fig. 6*).

[4] COMECON (Council for Mutual Economic Assistance) was an economic organisation of the socialist states led (and controlled) by the USSR, between 1949 and 1991.

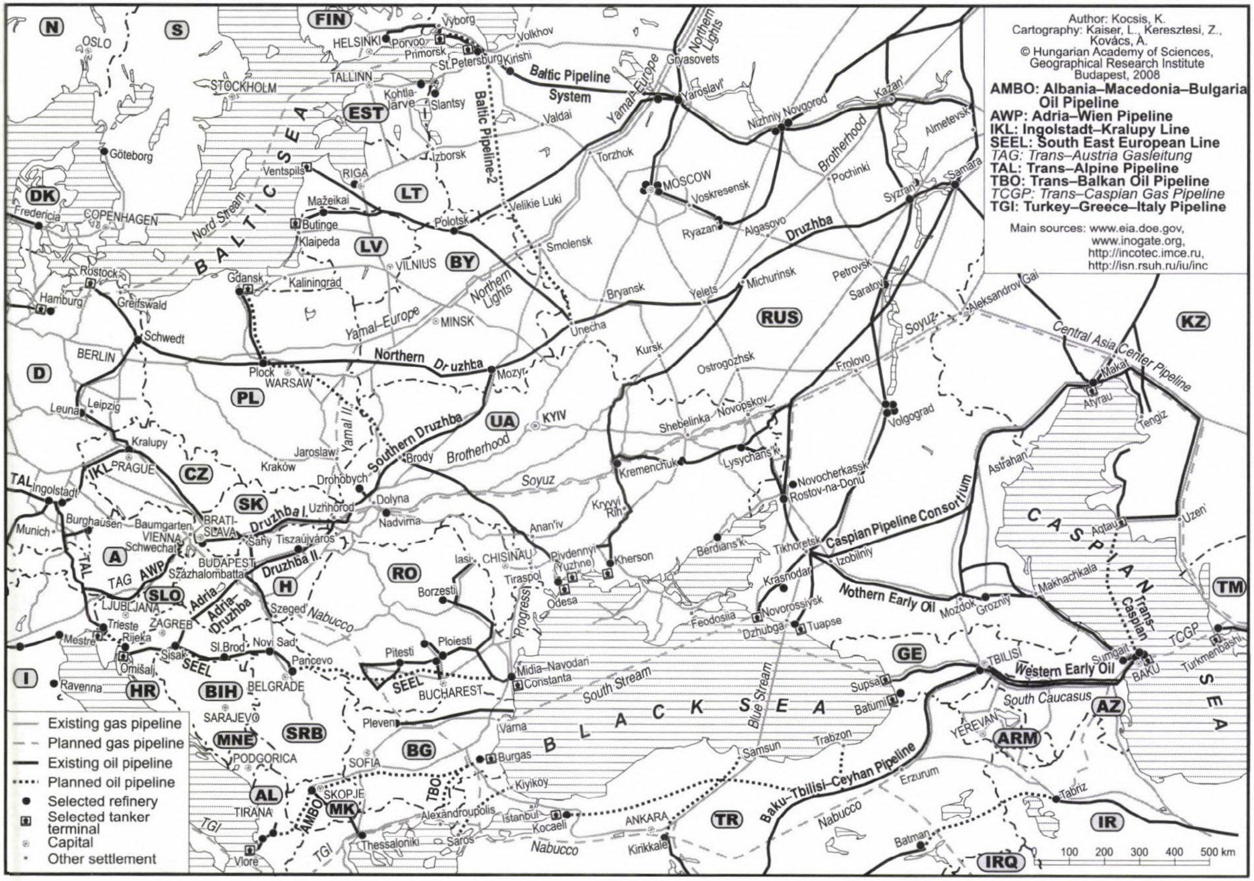

Fig. 6. Major gas and oil pipelines

During the Socialist-Soviet period the oil and gas supply was reliable and based on long term agreements, also with Western Europe (since 1968!) in spite of political conflicts. Following the collapse of the communist alliance system and disintegration of the USSR – in spite of the surviving energy interdependencies – the previous stability of international energy supply in the post-communist countries gradually came to an end. The dramatic changes in international situation over the eastern half of Europe (enlargement of the EU, establishment of pro-Western and pro-Russian economic organisations[5] in the former Soviet space) heavily transformed the economic equilibrium of international energy (export-import) systems and increased the importance of their geopolitical influence. During the second half of the 1990s efforts were made at diversifying of energy supply routes and bypassing of transit states with new pipeline construction projects.

The dominant actors of the recent west Eurasian geopolitical games on energetics, of the new pipeline projects are the Russian Federation and the EU (in addition to the USA). The EU-27 largely depends on Russian gas and oil imports (45.1% and 29.9% in 2005), so does Russia depend on European markets. The European oil and gas exports represent about two thirds of total Russian exports (Esnault, B. *et al.* 2007). Accordingly, the main economic goal of Russia to remain reliable energy supplier for Europe, to decrease dependence from the traditional transit countries (first of all from Ukraine and Belarus) and to preserve its dominant position on EU's gas and oil markets. The latter is related to the reviving ambitions of the Kremlin to restore past international political position of Russia using energy supply as a geopolitical weapon.

Pipeline projects to reduce Russian dependence

Since the second half of the 1990s USA pushed for construction of several pipelines (e.g. ***TCGP**: **Trans Caspian Gas Pipeline***, from 1996 onward, or ***Trans Caspian*** oil pipeline) that would carry Caspian energy westward without transiting Russia. It would have broken Russia's monopoly on the region's energy transportation system. Moscow reacted fast to construct its own Blue Stream

[5] GUAM (Organisation for Democracy and Economic Development, 1997) established by Georgia, Ukraine, Azerbaijan and Moldova to counterbalance Russian influence. A common interest in efforts to resolve "frozen conflicts" in their territory (Abkhazia and South Ossetia in Georgia, Nagorno-Karabakh in Azerbaijan, Transnistria in Moldova) also unite these GUAM countries located in the buffer zone between Russia, the EU and NATO and blaming problems for the presence of Russian military forces. EURASEC (Eurasian Economic Community) proclaimed on October 10, 2000 by Russia, Belarus, Kazakhstan, Kyrgyzstan (and with the accession of Uzbekistan in 2006) was the union of customs and tariffs within CIS (Commonwealth of Independent States).

submarine gas pipeline (2001–2005) from Russia to Turkey, which killed the USA and EU backed TCGP project (Geropoulos, K. 2007). At the same time with strong USA support the ***South Caucasus Pipeline*** (SCP) project (between Baku and Erzerum) was realised (2006), which allowed Azerbaijan and Georgia to resist Russian political and economic pressure (*Table 5*). This gas pipeline with the potential of being connected to the Turkmen and Kazakh producers via the planned TCGP would be in the future the supplier of the EU backed Nabucco and TGI pipelines. The Ukrainian project of ***Supsa–Feodosiia*** submarine pipeline between Georgia and Ukraine (bypassing Russia), which could supply Caspian and Iranian gas to Ukraine and other European countries, is based on the SCP and the Baku–Supsa, Tbilisi–Yerevan–Tabriz gas pipelines.

The ***Baku–Tbilisi–Ceyhan oil pipeline*** (BTC) was built in the period 2002–2006 between the Azerbaijani capital Baku and the Turkish Mediterranean port, Ceyhan and represents the second longest oil pipeline of the world (1,768 km). The establishment of the pipeline route was geopolitically and ecologically motivated (bypassing Russia, Iran, the unstable Middle East and the overcrowded Turkish straits, Bosphorus and Dardanelles) and served the increase of the economic independence of the GUAM-member Azerbaijan from Russia.

For December 2002 a new plan had been worked out regarding the ***extension*** of the Ukrainian ***Odesa–Brody oil pipeline*** (built 2001) to the Polish port of ***Gdańsk***. This would be the only route for transporting Caspian oil to Central Europe i.e. to the Visegrád countries – bypassing Russia via the GUAM states: Azerbaijan, Georgia, Ukraine (through Baku–Batumi–Odesa/Pivdennyi terminals). Although it is supported by the EU, this pipeline has only 9 million tons annual capacity, which is very modest comparing to larger projects in terms of commercial attractiveness. Moreover, Russia has successfully blocked oil transport from Kazakhstan to Ukrainian seaport Odesa. Kazakhstan declined to join this project, unless it is transformed to include Russia and committed additional massive oil volumes for export via Russia. On 10 October 2007 an agreement to form this pipeline consortium was signed by Poland, Lithuania, Ukraine, Georgia and Azerbaijan in Vilnius. Finally, in accordance with Russia's will the Kazakh oil (from the giant Tengiz field) started to supply the Odesa-Brody pipeline via the CPC (Caspian Pipeline Consortium) in Russia. This project is highly important to make safe oil supply for East Central Europe, first of all for Poland and Lithuania.

On April 3, 2007 Romania, Serbia, Croatia, Slovenia and Italy signed an agreement about the construction of a 1,400 km long oil pipeline (***South East European Line***, SEEL) from the Romanian port ***Constanța*** to the Italian ***Trieste***. This EU backed pipeline with a planned capacity up to 90 million tons annually would reduce tanker transportation in the Turkish straits and Adriatic Sea and would be a competitor to the Russian dominated Burgas–

Table 5. Major East European pipelines (existing and planned)

Pipeline name	Fuel	From – to	Capacity (bcm gas or mt oil/year)	Start date	Existing or planned
Brotherhood	gas	Russia – Slovakia, Hungary	104.0	1967, 1978, 1984, 1989	Existing
–	gas	Russia – Finland	5.8	1973	Existing
Soyuz	gas	Russia – Ukraine		1978, 1983	Existing
–	gas	Russia – Romania	14.3	1987	Existing
Yamal – Europe	gas	Russia – Poland, Germany	33.0	1999	Existing
Blue Stream	gas	Russia – Turkey (Izobilniy – Durusu)	16.0	2003	Existing
South Caucasus Pipeline	gas	Azerbaijan – Turkey (Baku – Erzurum)	16.0	2006	Existing
Nord Stream	gas	Russia – Germany (Vyborg – Greifswald)	2 x 27.5	2010	Planned
Nabucco	gas	Turkey – Austria (Erzurum – Baumgarten)	4.5–31.0	2012	Planned
TGI	gas	Turkey – Greece – Italy	11.5	2012	Planned
South Stream	gas	Russia – Bulgaria – Italy (Novorossiysk – Varna)	30.0	?	Planned
Trans-Caspian Gas Pipeline	gas	Turkmenistan – Azerbaijan (Turkmenbashi – Baku)	30.0	?	Planned
Druzhba	oil	Russia (Samara) – Poland, Germany, Slovakia, Czechia, Hungary	70.0	1964	Existing
Northern Early Oil	oil	Azerbaijan – Russia (Baku – Novorossiysk)	5.8	1997	Existing
Western Early Oil	oil	Azerbaijan – Georgia (Baku – Supsa)	5.8	1999	Existing
Baltic Pipeline System	oil	Russia (– Primorsk)	75.0	2001	Existing
Caspian Pipeline Consortium	oil	Kazakhstan – Russia (Tengiz – Novorossiysk)	28.2	2001	Existing
Odesa – Brody	oil	Ukraine (Pivdennyi – Brody)	9.0	2001	Existing
Baku – Tbilisi – Ceyhan	oil	Azerbaijan – Turkey (Baku – Ceyhan)	50.0	2005, 2006	Existing
Trans-Balkan Oil Pipeline	oil	Bulgaria – Greece (Burgas – Alexadroupolis)	15–23.0	2011	Planned
South East European Line	oil	Romania – Serbia – Italy (Constanța – Trieste)	40–60.0	2012	Planned
Baltic Pipeline System-2	oil	Russia (Unecha – Primorsk)	50–75.0	?	Planned

Remark: bcm= billion cubic metres, mt= million tons. *Source:* Esnault, B. *et al.* 2007.

Alexandroupolis pipeline transporting oil from the Black Sea, Caspian area to the largest markets of the EU. Most likely source of the oil could be the large Kazakh fields, from where the main transit routes (CPC) are under Russian control (Socor, V. 2006).

Since the 'Orange Revolution' in Ukraine (2005), the changed, pro-Western (EU and NATO) attitudes of Ukrainian foreign policy resulted in the increase of Russian natural gas and crude oil prices up to the international level. In January 2006 a 'gas war' burst out because after the negotiations between the two countries for the gas prices proved unsuccessful, the Ukrainian Naftohaz company siphoned the main transit gas pipelines running via Ukraine from Russia to Central and Western Europe, which resulted in shutdown of gas supply by Russia. This was not a unique phenomenon, Russia often shut down pipelines supplies during the time of political disputes (e.g. 2003 Latvia; 2006 Ukraine, Lithuania, Georgia, 2007 Azerbaijan), which enabled by the very close relationship between the Russian energy industry and the Kremlin.

Following the gas crisis the EU expressly endeavours to decrease strategic dependence (EU-25 43% in 2005) on Russian (Gazprom's) gas and to diversify energy supply (Hafner, M. 2006). The first step of this was to realise alternative, non-Russian controlled gas corridors to EU: the Nabucco and Turkey–Greece–Italy (TGI), for further diversification of export possibilities to the European markets, bypassing Russia and Ukraine. Construction of the 3,300 km long ***Nabucco*** gas pipeline is expected to begin in 2009 and is planned to be finished in 2012. It would connect Baumgarten an der March, the largest natural gas hub in Austria with Erzerum in Turkey, the end of South Caucasus Pipeline. Once completed, it would allow transportation of natural gas from producers in the Caspian region such as Azerbaijan, Turkmenistan and Iran to EU and to the countries (Turkey, Bulgaria, Romania, Hungary) along its path. The recently announced ***TGI*** pipe would transfer Caspian gas from Turkey through Greece to Italy with an annual capacity of 11.5 bcm and completion date of 2012.

Though it was an original Austrian conception to carry Iranian gas to Europe, the Nabucco project was delayed for years by USA opposition to development of Iran's gas fields. Western failure to engage with Turkmenistan deprived Nabucco of that possible source of gas for Europe. Washington had to insist that Azerbaijani gas alone (expected to flow in coming years to eastern Turkey) could support both Nabucco and the planned TGI pipeline simultaneously, an argument that led to more questions. Turkey's government, driven by short-term tactical and political considerations (often unrelated to energy policy as such), never came fully on board the Nabucco project. As a result of existing and planned „pro-Russian" and „pro-Western" energetic corridors Turkey became a natural hub for Caspian and Iranian gas destined for Europe and the arena of rivalry between EU/US and Russia. Similar to Ukraine this transit country of strategic importance increasingly depends on Russian energetic supplies (60% of natural gas and 20% of oil imports). Due to the Russian influence, Turkey has already demonstrated cool attitude towards Ukraine's and Georgia's NATO aspiration and openly opposed NATO's naval deployments in Black Sea area (Tsereteli, M. 2005).

Pipeline projects to secure Russia's market positions

The 4,196 km long ***Yamal–Europe pipeline*** was built between 1994 and 1999 (since 2005 with a capacity of 33 billion cbm) to supply Russian gas from the Yamal Peninsula to the North Central European market via Belarus, Poland and Germany.

The ***Baltic Pipeline System*** (BPS) transports Russian oil from the Timan–Pechora area, West Siberia and the Volga–Ural region to the oil terminal Primorsk at the Gulf of Finland. The pipeline built between 1997 and 2001 aims to bypass the continental transit countries (e.g. Belarus, Ukraine, V4) and supply Western Europe by tankers via the Baltic Sea.

The ***Nord Stream*** (former names: North Transgas, North European Gas Pipeline prompted by similar Russian geopolitical motivations) was planned from 1997 and under construction since 2005 with a 1,196 km long Baltic Sea offshore section between the Russian Vyborg and the German Greifswald. The Nord Stream submarine pipeline as an alternative route of the Russian gas to West-Central Europe beside of the existing Yamal–Europe pipeline have seen by opponents as geopolitical weapon against the continental energy transit countries (Belarus, Ukraine and V4 countries). The Nord Stream pipeline expected to start transporting gas in 2010 with an annual capacity of 55 billion cbm seems to be a tool to exert Russian political influence on transit countries by jeopardizing their gas supply without affecting gas exports to Western Europe (Baran, Z. 2007).

The disagreement over oil tariffs between Belarus and Russia at the beginning of January 2007 led to a disruption of oil supplies via Druzhba pipeline to Central Europe between January 8 and 11, 2007. Following this event the Russian government decided to construct an oil pipeline (***Baltic Pipeline System-2, BPS-2***) from the Druzhba pipe (from Unecha near the Belarus border) to the Baltic Sea port Primorsk, which annual throughout capacity is expected to increase up to 150 million tons. The BPS-2 reducing Russia's reliance from the transit state Belarus will redirect about half of the capacity of the Druzhba, the oldest and largest oil pipeline transporting Russian and Kazakh oil across Europe. This project will cause Belarus a possible loss of revenue of 300–400 million EUR annually (Resnicoff, M. 2007).

The ***Northern Early Oil*** (NEO) pipeline transports oil from the large Azeri-Chirag-Gunashli (ACG) fields in the Caspian Sea near Baku via Grozny to the Russian port Novorossiysk since 1997 and following a break since 2005. With the launch of the EU/US backed BTC oil pipeline in 2005–2006 the utilisation of NEO's capacity is reduced considerably (Zaslavsky, I. 2006).

It was a strategic mistake for the West and a big success for Russia, that the 1,510 km long ***Caspian Pipeline Consortium***'s (CPC) oil pipeline, planned to export annually 65 million tons of oil from Kazakhstan to Russia (Tengiz–Novorossiysk), was built also by American companies (e.g. Chevron) with government approval from the late 1990s to 2001. Currently operating at some 28.2 million tons of oil annually, this Russian controlled pipeline direct the majority of Kazakhstan's growing oil output and export to Russia, which fact ruined the Western-backed Trans Caspian oil pipeline project (Aqtau–Baku) and seriously damage the interests of the BTC pipeline backed by the US government.

On May 25, 2007 Russia, Bulgaria and Greece signed a basic treaty to implement the project ***Burgas–Alexandroupolis*** oil (previous name: Trans-Balkan Oil, TBO) pipeline between 2008 and 2011. This 279 km long pipe is the first on the territory of EU to be 51% owned by Russian firms and aims to supply the western markets with Russian–Kazakh oil bypassing the overcrowded Turkish straits.

The Russian geopolitical goals with the construction of the 1,213 km long trans-Black Sea gas pipeline, ***Blue Stream*** (2005) were to block the plans (TCGP and Nabucco) of the EU to use the territory of Turkey to bring gas from the Caspian region and the Middle East to Europe bypassing Russia. The absence of a common western energy strategy in Western-Central Asian region was demonstrated by the ENI, Italy's state-controlled energy holding company, which is actually a partner of the Russian Gazprom in the construction of Blue Stream, loaning the technology and financing for the submarine pipeline (Socor, V. 2007).

Evidently Russia makes efforts to preempt Nabucco and TGI pipelines to preserve its European market dominance. Following the western opposition to Gazprom's involvement in Nabucco, the Russian-Italian project ***South Stream*** was announced in June 2007 (900 km long submarine pipeline from Russian Novorossiysk to Bulgarian Varna) bypassing both the Caucasian countries and Ukraine. From Varna the south-western branch of the South Stream would run through Greece to South Italy, and its north-western branch would continue via Romania, Hungary and Slovenia to North Italy.

In the midst of its anti-Nabucco campaign in May–June 2007 Russia signed agreements with ***Kazakhstan, Turkmenistan and Uzbekistan*** (with the main gas supplier of the planned Nabucco) to construct new Russia-bound gas export pipelines, which seriously damage the EU-plans about non-Russian controlled pipelines from the Caspian region. According to these plans vital for the Gazprom and Russia among others a gas pipeline would lead from the Russian Aleksandrov Gai (crossing of Soyuz and ***Central Asia–Centre*** pipelines) to Ukrainian Novopskov, in the same corridor, which is used for the Soyuz (1983) gas pipeline. With an annual 28 bcm capacity, this gas pipeline could serve as a link in the system through which gas is transported from Central Asia to Europe. The pipeline expansion between Uzhhorod and Novopskov would strengthen the role of Ukraine as transit country for natural gas to Central and Western Europe.

Due to these agreements Kazakhstan, Turkmenistan and Uzbekistan would almost completely be dependent on Russian-controlled export pipelines. This situation made possible for the Russian Gazprom to purchase gas at a rate of about 45–65 USD/1,000 cubic metres (December 2006) from these Central Asian countries and sell that gas to Western Europe for around 230 USD (Baran, Z. 2007). To keep out Turkmenistan from the West (and to retain as a reliable gas supplier) Gazprom agreed to rise the price of Turkmen gas from 100 USD/1,000 cubic metres in December 2007 to 130–150 USD in 2008, which could result the increase in gas prices also in Ukraine and in V4.

In the year 2007 Russia's strategy in terms of Caspian energy resources and related transport routes was successful. The main items of this strategy were the following: encircling the EU by gas pipelines (Nord Stream, South Stream) bypassing problematic transit countries; buying the bulk of the East Caspian gas as cheap and selling it as expensive as possible; bringing Kazakh oil and Turkmen gas to the West through Russian controlled pipes; making Russia's ties with the Caspian as strong as possible; discouraging or killing competing EU/US backed projects (e.g. TCGP, Nabucco, TGI) and persuading the West that Russia is a reliable energy supplier (Karbuz, S. 2007).

The position of the Visegrad countries

The 'Visegrad countries' consisting of Czechia, Hungary, Poland and Slovakia are in a special geopolitical position in Europe. They get most of the crude oil and natural gas supplies from Russia. Exceptions are Poland and Hungary, these countries meeting about 19–30% of their natural gas demand from domestic sources. This dependence is a permanent problem for these countries when working out their actual energy strategy. It is because they privatised their energy markets still in the process of preparation for EU accession. During the 1990s these countries made attempts to diversify their energy supplies in order to diminish their dependence on Russian gas and oil resources. The strategic importance of this region, however, lies largely in the crude oil and natural gas pipelines which transit these four countries on their way to Western Europe.

The most important pipeline ***Druzhba*** which provides these countries with Russian oil is divided into northern and southern branches of different carrying capacity on the territory of Belarus. *Northern Druzhba* (1 million barrel per day) transfers oil to Poland and Germany, *Southern Druzhba* (1.2 million barrel per day) crosses Ukraine, where it is divided into two additional branches. *Druzhba I* runs the Czech Republic via Slovakia, and the *Druzhba II* turns south to reach Százhalombatta (the largest refinery in Hungary). Here this section of Druzhba is linked to the Adria pipeline which in turn delivers crude oil to Serbia and to Croatia.

In December 2002 two members of Visegrad countries (Hungary, Slovakia) joined Russia, Ukraine, Belarus and Croatia to sign an agreement aimed to integrate and expand the capacities of the *Druzhba–Adria* pipeline system. The aim was to facilitate the transportation of Russian crude oil to Croatian port of Omišalj. This would allow direct shipment of Russian oil to North America, planned by Russia's oil company Yukos at that time.

The territory of the V4 appears as a key transit region for Russian natural gas exports to Western Europe for a long time. The ***Yamal-Europe*** pipeline running through Belarus and Poland to Germany is currently Russia's only gas export pipeline to Europe that does not cross the territory of Ukraine. Most of the natural gas of this pipeline is destined to Germany.

Yamal-II pipeline (Poland–Slovakia) exists as a plan, although it has not been approved yet. Further pipelines, as ***Brotherhood*** and ***Soyuz*** passing through Ukraine deliver gas to Slovakia, Hungary and Czechia and altogether carry about 25% of the natural gas consumed in Western Europe and about 70% of the Russian natural gas exported to West (North Central… 2003).

The energy strategy of Slovakia

An increasing share of nuclear energy and the involvement of more renewable resources are the pillars of Slovakia's long term energy security strategy. Major energy actors agree with the government's plans until it respects the EU liberalisation policies and guarantees stability on the energy market, while environmentalists are eager to stress there are certain parts in the new Slovak energy strategy that must be specified further.

Slovakia would have to draw out an enormous sum (SK 460 billion) from the state budget, as the new energy security strategy calls for the building of new power production facilities (Balogová, B. 2007). Considerable part of this money would be invested into production of renewable resources, which are set to make up nearly 25% of total electricity production of Slovakia and the rest into nuclear power plants and thermal water. According to the Ministry of Economy the new energy strategy would require both state funds and private investors.

The investment plans of major power utility Slovenské Elektrárne and its Italian investor (Enel), are already in line with the state strategy. The planned huge amount of financial investment is consistent with the Energy Strategy of the Slovak Republic and the power output projections. About SK 110 billion envisaged for the next five years will cover the completion of the new units of nuclear power plant in Mochovce. The Slovak state has to guarantee a stable and transparent legislative and regulatory framework that would motivate investors to introduce new power generation capacities in Slovakia. Nuclear power stations provide 68% of the energy produced in Slovakia (2005).

Greenpeace activists have an opposite opinion, claiming that expanding the country's nuclear energy output is not a proper way to reach energy security. They state that current reactors in Jaslovské Bohunice and Mochovce can only be supplied by the Russians, the builders of these power plants. Even in the future it is not likely that Slovakia will enrich uranium or produce nuclear fuel. The previous government considered wind or solar power to be an option in its energy plans. But the current state administration is not proposing major construction of these utilities because they do not contribute enough to the stability of the supply system. Instead, the strategy recommends more focus on thermal power plants, hydropower plants and similar technologies.

According to the principles of the new energy strategy the role of fossil fuels will decrease in the future. The country's number one oil refinery, Slovnaft declared that Slovakia must continue to follow the EU's principles of liberalising its energy market. But until then the proposed strategy is acknowledged. Slovakia's dependence on Russian oil supplies has caused troubles for energy experts. The new energy strategy calls for alternative oil pipeline routes and diversification of energy supplies. Slovnaft supports the idea of diversification for Slovakia and other European countries. The oil firm as a part of the international MOL group headed by the Hungarian oil company, also supports making the oil pipeline routes more interconnected among EU members, and building strategic oil supplies in accordance with the EU directive on assisting neighbouring countries in need.

Now that the Adria pipeline from Croatia has resumed operation, Slovnaft can secure its oil supply by drawing on two sources: the *Druzhba-I* pipeline from Russia, and Adria. In case of need, Slovakia can secure 3.0 to 3.5 million tonnes of oil annually. Another option for diversification is the possible reserve route of the Czech branch of Druzhba-I. This could be filled through the *IKL* (*Ingolstadt–Kralupy Line*) connected to *TAL (Trans-Alpine Pipeline*) near Ingolstadt. Eventual interlinking of Bratislava and Schwechat refinery in Austria might not be able to considerably help the diversification. The oil for Austria flows to the country through TAL pipeline, which on the Austrian–Italian border connects to the *APW* (*Adria–Wien Pipeline*) with 10 million tons annual capacity supplying oil to Schwechat.

There are some hopes relying on the Nabucco pipeline, which will be completed by 2012. It will be built by a consortium of five energy companies, including MOL. However, the project has already caused tensions between the USA and the EU, because the infrastructure would be plugged into gas resources in Iran.

Greenpeace maintains that the Slovak government does not pay enough attention to increasing energy effectiveness. There are only two tools that can boost energy security: minimising energy wasting and concomitantly maximising the use of domestic sources. Current technologies make it possible to reduce energy consumption in housing estates and commercial buildings to one third of their current levels. The strategy does all it can to diversify energy resources. Unfortunately, considering the limited amount of available resources, it must be reckoned with the challenge that if there is an increasing interest from a larger number of clients, Russia and Azerbaijan might sell oil to some of them. The strategy should focus on how Slovakia can handle the situation with a limited amount of oil.

The Polish and Czech ways

The relevant energy strategy of ***Poland*** is based upon government documents (Guidelines for Poland's Energy Policy until 2020) which have been worked out in 2000. The document formulated the strategic directions of the state activities. Its central elements are the safety of energy supply of the country and the improvement of energy efficiency. In 2002 a short-term forecast was outlined for the development of fuel and energy sector until 2005 which was adopted by the Council of Ministers. According to its content, it is the government's task to seek options for the diversification of oil and natural gas supplies including alternative gas imports from Norway and the Middle East.

The country has a low production of oil which covers only 20% of its primary energy demand. Consequently approximately 50% of Poland's oil imports come from Russia, while the rest of crude oil arrives from the United Kingdom, Iran and Norway. It's a well known fact that Poland's economy is largely dependent on oil import running from Russia through the Druzhba I pipeline transiting Asian oil to Poland. The country has 7 oil refineries, with a total capacity of 380,000 barrel per day, including two large refineries in Plock which produces 60% of the gasoline of the country and this refinery industry is dependent on Russian oil. In 2006 the total oil consumption of Poland was nearly 490,000 barrel per day, and ca 40% of this quantity came through the *Northern Druzhba* pipeline (Oil Consumption 2006). In addition to the natural gas resources of Poland, the Upper Silesian hard coal fields contain over 90 billion cubic metres of coalbed methane. The domestic production of natural gas covers ca 35% of the demands. Supplies come primary from Russia on the Yamal–Europe pipeline via Belarus with a very low share of those from Germany. Besides, Poland is considering the import of liquified natural gas (LNG) by shipment from Qatar, Nigeria and Norway.

Opposite to Hungary Poland has certainly not kept a low profile in political contacts with Russia. Poland desires a commercial relationship with Russian energy suppliers that are free of monopolies, price-fixing and blackmail. The origin of this official statement came from a contract signed between Russia and Germany in 2005. That time Russia signed a deal with Germany to build the *North Stream*, a gas pipeline under the Baltic Sea bypassing Poland. Gazprom will own 51% of the pipeline with E.ON and BASF (Germany) taking each 24.5–24.5%.

Though Russia would welcome Polish investors to join this project, Poland is not interested in investing in North Stream. The Polish government has criticised the project claiming it would be more expensive than the alternative of going through the territory of the country. That is correct: the submarine pipeline will cost at least three times more than an overland route through Lithuania and Poland (Baran, Z. 2007). So Poland is worried that the new pipeline – which would also bypass EU member Baltic states – could be used to cut off energy from Poland for political purpose without affecting supplies to Germany. In exchange for the much higher construction price, Ukraine, Belarus and Poland will no longer be the exclusive operators of gas transit and will not be able to transit blackmail Russia. Polish politicians accused Germany of halting plans fore more integrated EU cooperation on foreign and security affairs, including energy security.

The energy strategy of the ***Czech Republic*** is mainly based on the oil import arriving through the Southern Druzhba pipeline. The Czech refinery industry is relatively heavily dependent on supplies of Russian oil from this pipeline, even though not so much as Slovakia is. In 2006 the total import of 7.7 million tons was the greatest amount since the proclamation of the independent state in 1993. Nearly 67% of this quantity was transported through the *Druzhba-I* pipeline, and the rest 33% came through the *IKL* (Ingolstadt–Kralupy Pipeline). It runs from the German Ingolstadt and linked up to the high capacity TAL (Transalpine Oil Pipeline). TAL is a 753 km long pipeline running from Trieste (Italy) across the Alps to Ingolstadt and Karlsruhe (Germany). TAL as the artery of south-western part of Central Europe is the most important oil pipeline for Austria and Germany. Bavaria receives 100%, Austria 75%, Baden-Württemberg 50% of its supplies from this pipeline of strategic importance.

Supplies of oil from Russia apply to refineries in Litvinov and Pardubice, the refinery in Kralupy processes light oils supplied to the Czech Republic through the pipeline IKL. Except the short time crises in 2006 and 2007 the supplies of oil to Czechia via the Druzhba pipeline have been secure and reliable in recent years and Czech politicians are not worrying about an additional gas war in the future.

If some time in the future Druzhba were to be closed down, different solutions could be sought to supply Czech refineries. There are several versions: a) shift of technology in the refineries of Litvinov and Pardubice to technologies which would allow them to process light oils; b) the shipment of Russian oil to Czech refineries through German seaports by rail; c) transfer of oil with similar parameters via the pipeline IKL. Alternative routes are worked out with regard to the possibility of their utilisation in crisis situation.

A more intensive use of IKL–TAL pipeline network may be solution in the future, but TAL Company, operating the pipeline of the same name has 8 shareholders and these also have their shareholders. Each decision on strategic matters must be approved by statutory bodies. The situation is roughly the same in most of the affected refineries. Consequently there is no chance that an agreement could be achieved in a short period of time between Czechia and TAL Company.

It may be a technical problem that Druzhba pipeline could be shut down. It is old, and in the case if no investment in modernisation is made it could break down. To avoid this unfavourable situation Czechia has signed an agreement with Russia in the early 1990s. It contains the joint implementation by Czech and Russian firms of projects for the construction of new and reconstruction of existing infrastrukture of the gas, oil and refinery industry in both countries. This agreement reflects a general interest of Czech companies to participate in any reconstruction of the Druzhba pipeline on the territory of Russia (Hüner, T. 2007).

Hungary: stability desire in energy import

As the above title reflects it is a real dilemma for Hungary, whether the country can pursue its own energy security interests or simply must follow decisions made by Russia, USA or the European Union. Due to the ongoing negotiations about whether Hungary would support the Russian or EU proposals regarding pipeline construction Budapest has recently become frequented hot spot by Russian and US politicians.

Whilst the US is eager to increase its involvement in East Central European energy policy, Germany is playing its own game putting pressure on the new EU member states. In recent years German transnational company E.ON AG (Düsseldorf) has acquired strategic stakes in East Central Europe and mainly in Hungary getting majorities of the shares in several Hungarian regional electric and gas companies. Nowadays the company has considerable market share, typically E.ON supplies 2.4 million Hungarian costumers in electricity and nearly 0.6 million in gas markets. The Russian Gazprom has expressed its interest in buying the wholesale division of MOL (Hungarian National Oil Company), but it was refused and now E.ON is supposed to be the new buyer. As E.ON has recently acquired the gas division of MOL as well, this could also easily become part of the deal for the access to the Russian market.

The most acute problem of Hungary has long been the lack of a transparent and coherent energy policy (Bősze, B. 2006). Because of the problems deriving from the complex situation it is still difficult to see the efforts made by the government to shape a strategy in order to secure domestic energy supply. It was expected that after 2006 the newly elected government's programme would contain some hints in this direction but as its stands the recently launched National Development Programme is too broad and too vague in relation to energy security. The new National Energy Strategy for 2006–2030 contains some relevant points, but there is a definite lack of visionary ideas for the near future (Az új Magyar..., 2006). There is no answer to the question: What stance should Hungary take with respect to Russia and how the diversification of energy supply can be achieved in the international context? Though the Strategy states that its targets are only feasible in the context of EU external energy relations' policy, it does not contain any view on external energy relations' policy at all.

Only the Minister for Economy and Transport spoke about the importance of Central European cooperation, the alignment of energy security policies by the new member states, and Hungary's interest in building the Nabucco pipeline. These announcements do not, however, change the fact that there is a vacuum in official policy development, which reveals that the government's energy strategy is keeping a low profile and reacting only to emergency situations. (The only initiative where Hungary has managed to successfully advance among the new EU member states is the location of the proposed Energy Supply Observatory in Budapest.)

Concerning renewable energy utilisation Hungary is at the bottom among the EU member states. The country has made the lowest offer of national target-percentage of domestic renewable energy production with a mere 3.6% until 2010, compared to Slovakian or Slovenian targets (31 and 34% respectively) for the same year. While the 2006 National Development Programme indicates that the Hungarian target will be increased (4.2% at present) nevertheless it is still very low. The National Energy Strategy for 2006–2030 predicts that renewable energy production could be increased to 7% (2010) or 9% (2025) within a foreseeable future.

According to some experts old power plants can be technically transformed and enabled for biomass production, so that old industries can be reconstructed for renewable energy production. The Hungarian Energy Office has declared that the electricity network is technically not prepared to take in more capacity generated by wind farms and this situation will not change in the foreseeable future. It does not take any further energy network development for an undefined time period.

In terms of energy efficiency Hungary is even below half of the EU average. This result comes despite the fact that problems were acknowledged long time ago. In 1999 a government decision regarding the national strategy for energy efficiency already aimed at introducing various measures, institutions and subsidies. But there have been no results as yet. A recent positive development is that the New Energy Policy Strategy for 2006–2030 picks up and proposes many of the former initiatives. However, beyond the development of objectives no serious results can be expected without money allocated to the issue. In the current financial conditions of the country, however, it is unlikely that the government would devote resources to long-term economic objectives, such as better efficiency of energy utilisation by 2030.

Conclusions

The global increase of hydrocarbon energy demand resulted in the sustained growth of energy prices since 1999 and pushed the energy (especially the gas) supply security as a dominant global geopolitical issue to the fore. There is an energy interdependency between the suppliers and consumers, which underlines the need of security of supply and of markets. Although the fair relationship between the exporters, importers and the transit countries should be the priority of energy policy, due to the increasing competition for energy resources and markets, beside the economic factors geopolitical motivations also play an important role. As a result of the weak cohesion among the energy policies of the EU-member states Russia often took advantage of the situation. Due to the lack of unity the Kremlin can "preemptively block European attempts to construct transport routes for Caspian and Central Asian oil and gas that do not involve Russia" (Baran, Z. 2007). The countries, and the large European energy companies (e.g. ENI, BASF, Ruhrgas, Gaz de France, Gasunie) are turned against each other by Moscow in order to secure more favourable (often dominant) market position for Russia. Sometimes Russia seems to strive after driving wedge between the eastern (former Soviet Block) and western member states of the EU.

With regards the energy strategy of East Central European countries that joined the EU in 2004 it can be stated that the majority of these countries have already prepared energy policy and strategy to secure their own energy supply. All of them have been making continuous efforts to be independent from considerable Russian oil and gas import for a while. To avoid negative effects of the future's unforeseen gas wars and conflicts between Russia and Ukraine, the new member states of the European Union have worked out more scenarios and projects for the future. Additionally, they have also declared targets to increase the rate of renewable energy in their domestic energy production.

As an exception Hungary is still stuck into powerful energy economies that drive to international energy-security politics. The country has changed its strategy when turned off US initiatives and gave preference to Russian connections. Furthermore there is no visible indication of a coherent national energy security strategy. It is not surprising that the interests of the country are not taken into account when decisions are made, therefore national energy security strategy need to be elaborated.

The lobbying techniques of Hungary within EU should also be enhanced. However, without clear political intentions and decisions it is difficult to lobby for anything. Technically and financially the country is not prepared to provide a substantial portion of national energy production from renewable energy sources. It is very unlikely that long term objectives will be integrated into effective government actions. The European Union is also putting the requirement of sound economic management over savings energy and Hungary should take into consideration all these initiatives.

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Ukraine in Maps

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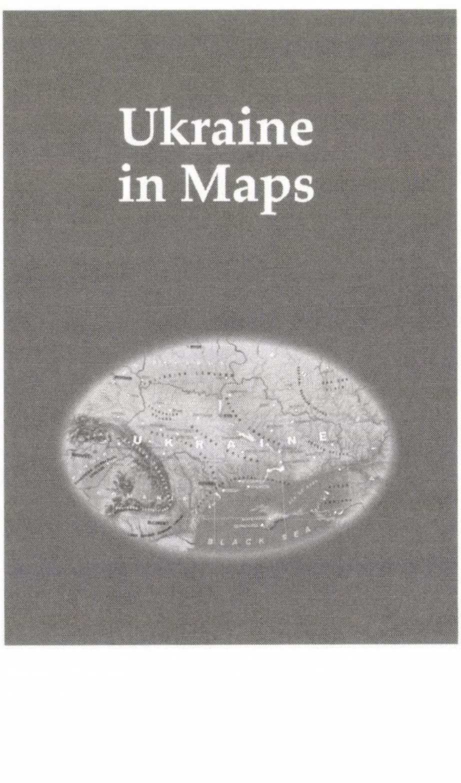
KOCSIS, K.–RUDENKO, L.–SCHWEITZER, F.

Institute of Geography National Academy of Sciences of Ukraine 148 p.
Geographical Research Institute Hungarian Academy of Sciences. Budapest, 148 old.

Kyiv–Budapest, 2008

Since the disintegration of the USSR, the Western world has shown an ever-growing interest in Ukraine, its people and its economy. As the second-largest country in Europe, Ukraine has a strategic geographical position at the crossroads between Europe and Asia. It is a key country for the transit of energy resources from Russia and Central Asia to the European Union, which is one reason why Ukraine has become a priority partner in the neighbourhood policy of the EU. Ukraine has pursued a path towards the democratic consolidation of statehood, which encompasses vigorous economic changes, the development of institutions and integration into European and global political and economic structures. In a complex and controversial world, Ukraine is building collaboration with other countries upon the principles of mutual understanding and trust, and is establishing initiatives aimed at the creation of a system that bestows international security.

This recognition has prompted the Institute of Geography of the National Academy of Sciences of Ukraine (Kyiv) and the Geographical Research Institute of the Hungarian Academy of Sciences (Budapest) to initiate cooperation, and the volume entitled "Ukraine in Maps" is the outcome of their joint effort. The intention of this publication is to make available the results of research conducted by Ukrainian and Hungarian geographers, to the English-speaking public. This atlas follows in the footsteps of previous publications from the Geographical Research Institute of the Hungarian Academy of Sciences. Similar to the work entitled South Eastern Europe in Maps (2005, 2007), it includes 64 maps, dozens of figures and tables accompanied by an explanatory text, written in a popular, scientific manner. The book is an attempt to outline the geographical setting and geopolitical context of Ukraine, as well as its history, natural environment, population, settlements and economy. The authors greatly hope that this joint venture will bring Ukraine closer to the reader and make this neighbouring country to the European Union more familiar, and consequently, more appealing.



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HUNGARIAN INDUSTRY AFTER 1989 – WITH SPECIAL ATTENTION TO INDUSTRIAL ESTATES

Éva Kiss[1]

Introduction

After 1989 a new era started in the development of Hungarian industry. Radical changes have taken place in its organisation, structure and ownership pattern. (Industry is subdivided into three sub-sectors: mining, manufacturing, and electricity, gas, steam and water supply. Of them manufacturing is the most important with more than 90% of industrial employees and enterprises.) The spatial pattern of Hungarian industry has also transformed, and in this process industrial parks or better to say industrial estates played a relevant role (Kiss É. 2001). Industrial estates denote areas prepared for industrial activities. In Hungary the majority of industrial parks are industrial estates in reality, therefore this concept is used. The notion of industrial estate is related to structural change of traditional industrial areas in international context and, to a certain degree in Hungary too (Lengyel I. et al. 2002). Industrial estates emerged as a new phenomenon in post-socialist countries, and they also represented the new scenes of industrial production at the beginning of the 1990s.

The main purposes of the present study are, on the one hand, to give a brief overview on the major changes in the Hungarian industry having taken place since 1989, and on the other hand to demonstrate the most important characteristics of Hungarian industrial estates and to reveal the role they play in shaping the Hungarian industrial space. The study is partly based on a survey carried out in 2006. The management of 181 industrial estates have been invited to fill out a questionnaire, but only 77 (43%) of them responded. In spite of the relatively low rate of response, the survey is adequate to indicate the major characteristics of industrial estates and their role in the industrial space. The rate is much higher if we take into consideration that about 10–15% of the concerning industrial estates do not operate yet.

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The present study consists of two main sections. After the introduction, the major trends in the Hungarian industry since 1989 are outlined then the most important features of industrial estates and their impact on the spatial pattern of industry are demonstrated.

Major changes in the industry after 1989

Since 1989 the industrial sector of the Hungarian economy has been transformed radically. The former socialist industry has been succeeded by capitalist industry. As a consequence, the Hungarian industry is very similar to the industry of developed western countries in many respects. In spite of the changes taken place during the last decades the position of industry within the economy has not changed considerably *(Tables 1* and *2)*.

Table 1. Major changes in Hungarian industry, 1990–2005

Denomination	1990	2005
Number of enterprises with legal entity	14105*	31093
of which: limited liability company	11329	29568
of which: joint stock company	578	902
Number of enterprises with foreign interest	4066**	3387
Share (%) of foreign direct investment invested in industry of all FDI	47.9	46.1
Share (%) of industrial investments of all investments	28.7	33.1
Number of industrial firms with less than 50 employees	11240	68722***
Number of industrial firms with more than 300 employees	872	2643****
Number of all employees in industry	1282185	750635
of which: in machinery industry	421554	246211
of which: in light industry	283246	133194
of which: in food industry	198890	110824

* Data from 1992., ** Data from 1994., *** All enterprises without sole proprietors., **** Number of enterprises with 250 and more employees. Source: Hungarian Statistical Yearbook, 1990, 1992, 1994, 2005. Regional Statistical Yearbook, 1990, 2005.

Table 2. The importance of industry in Hungarian economy, 1990–2005

Share (%) of industry	1990	2005
of all limited liability companies	19.8*	13.2
of all employees	30.7	27.5
of all enterprises with foreign interest	17.2**	13.7
of all investments	37.4	35.3
of gross domestic product	32.3	39.6
of export	83.2	55.1

* Data from 1992., ** Data from 1994., *Source:* Regional Statistical Yearbook, 1990, 1992, 2005.

Of the changes having taken place since the beginning of the 1990s, the organisational renewal was the first, most rapid and spectacular process (Kiss É. 1993). Owing to it, traditional organisational forms (state companies, co-operatives) have disappeared or have been reorganised. Almost from the beginning of the transition period new organisational forms such as limited liability companies (Ltd.) prevailed. The most popular organisational forms are Ltd. and limited partnership, which together accounted for 94% of all enterprises in industry in 2005.

During the last 17 years the industrial firms have increased in number. They especially mushroomed at the beginning of the 1990s, when many new enterprises were established. In 2005 more than 52,000 enterprises operated in industry. Compared to other sectors their share (11%) is very low, which means that in other sectors of the economy lot more firms have been founded after 1990.

With the progress of the organisational renewal the size structure of industrial firms has also changed. Since 1989 the number of industrial firms with less than 20 employees has increased at a fastest pace. A spectacular shift took place in favour of small and medium-sized firms, because the majority of the newly founded firms were such ventures. The number of firms which came about from the decomposition of the former huge state companies has also increased the category of enterprises with less than 50 employees. At the same time the number of firms with more than 250 employees decreased radically, and now their share is only a couple of percents. As a consequence of these processes the size structure of industrial firms has become more balanced and proportionate in Hungary.

The firms with several branch plants used to be typical of the Hungarian industry, especially during the socialist period. However, after 1989 several less efficient plants were closed down and a lot of plants became independent. Thus, the number of branch plants has decreased considerably, e.g. in 1990 5,500 industrial plants operated in Budapest, but by 1997 their number has dropped to 1,463, and in 2007 their number did not reach one thousand. During the last decades the profile of plants shifted towards non-producing activities (repairing, marketing, storage etc.). Usually these plants are bound to move closer to the consumers, while those pursuing production activities are often located in traditional industrial districts.

Whilst the number of industrial enterprises has been on the increase that of the employees decreased considerably: from 1.3 million to 751 thousand between 1990 and 2005. The drop was especially dramatic in the first half of the 1990s, in the north–north-eastern part of the country and within some branches. For example mining has lost 88% of its employees, and there was a drop by 56% in engineering, 43% in light industry and 40% in food industry. These figures also reflect the change in the structure of industry. Extracting industries and production of raw materials became overshadowed by manufacturing, and knowledge-based branches have risen to prominence. Engineering (telecommunications, computer electronics, electronics, and car industry) and chemical industry (manufacturing of plastics, rubber and pharmaceuticals) developed at the fastest pace. Industrial restructuring has been going on at a different pace in various parts of the country. Generally, in the traditional industrial districts (e.g. in the northern part of Hungary) it was a much slower process.

Reorganisation of ownership is one of the most essential outcomes of the change of the political system. Compared to other East Central European countries privatisation started earlier in Hungary. The initial "spontaneous" process was soon replaced by a state controlled procedure of privatisation (VOSZKA É. 1998). Privatisation was a differentiated process both spatially and in time (CSÉFALVAY Z. 1996).

Besides Hungarian investors the foreign ones have also played an important role in the privatisation of Hungarian industry. Nowadays in certain branches the share of foreign ownership is very high. For example in the car industry 95% of all enterprises are in foreign property, this share is 66% in chemical industry, 62% in food industry and 61% in textile and leather industry.

Since 1972 it has been possible to establish joint ventures in Hungary, but their number started to increase only after 1989. In 1985 there were 21 joint ventures in industry, and twenty years later their number almost reached 3,400. They make up 14% of all enterprises with foreign participation, indicating that industry is not the most attractive sector for foreign investors. Nevertheless, in each year about 40–50% of all invested foreign capital is attracted by industry. (Until 2005 a total of USD 61 billions have been invested into the Hungarian economy.) Germans, Austrians, Dutch, Americans, French, Finns, Japanese and Swedes are the most important foreign investors in industry. They have chosen a Hungarian site for the following reasons: cheap, but relatively skilled labour, developed infrastructure, favourable geographical location etc.

Since the beginning of the 1990s foreign investors have sought for having an exclusive ownership in an enterprise. In 2005 about 60% of the enterprises with foreign interest were fully in foreign ownership (ten years earlier their share was only 28%).

Foreign direct investment (FDI) has played a relevant role in the renewal of Hungarian industry, in its modernisation and integration into the global economy. FDI had a great role in the transformation of the spatial pattern of Hungarian industry as well. The other changes taken place in industry have also affected the industrial space however their impact was not so intense as that of foreign direct investment.

By the mid-1990s the spatial pattern of Hungarian industry has transformed. The former north-east–south-west orientation of the industrial axis

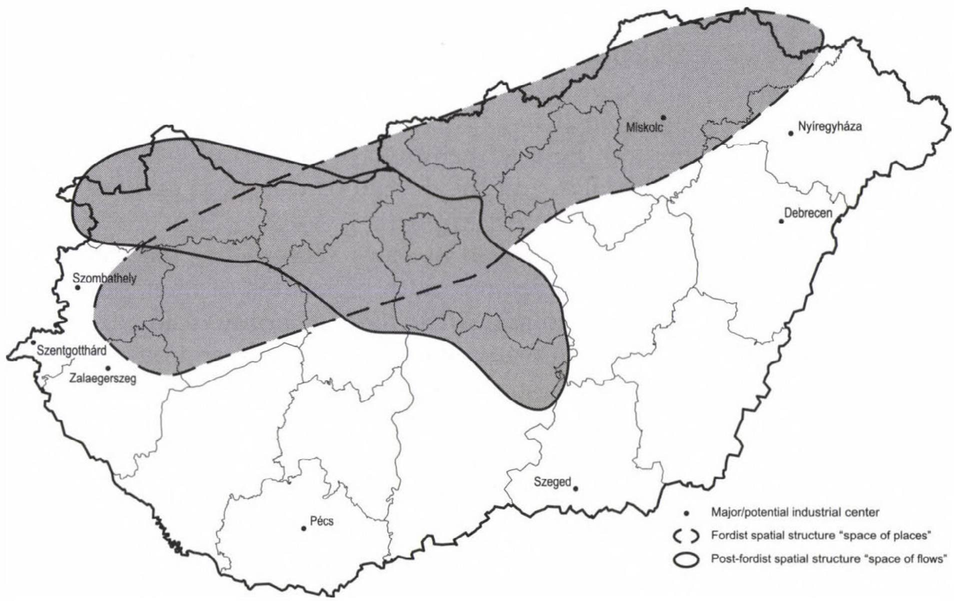

Fig. 1. Transformation of the spatial structure of Hungarian industry by the mid-1990s

which had followed the occurrence of natural (e.g. mineral) resources has been replaced by a north-west–south-east industrial axis including the northern half of Transdanubia (Győr–Moson–Sopron, Fejér, Vas, Komárom–Esztergom counties) and Central Hungary Region (Budapest and Pest county) *(Fig. 1).*

Some characteristics of industrial estates

In highly developed countries industrial estates go back to the remote past, but in the post-socialist countries they appeared only after the change in the political system. In East Central Europe the first industrial estate was established in the town of Győr in Hungary in 1991. But officially, "industrial parks" exist only since 1997, when the government decided about the introduction of a special development program for industrial estates. Then, the establishment of industrial estates has been accelerated, and a real boom took plce. In a certain sense this can be considered as the third wave of industrialisation in the history of Hungary. A probable stimulating factor was that the industrial estate as a concept and potential means of regional development has become known only by that time. In addition, many settlements began to seek the way out of the economic crisis in the second half of 1990s, and many of them found that establishing an industrial estate would be an efficient solution for the local economic problems. This was the reason why the industrial estates were spreading very fast, especially before the millennium. Between 1997 and 2007 their number grew from 28 to 192 *(Fig. 2)*.

The reasons behind the establishment of industrial estates in various places were largely similar, and they could be classified into four main groups basically. The first and most important objective was to create job opportunities and to ensure livelihood in many settlements, particularly in declining and underdeveloped regions with high rates of unemployment. The second major trigger was to renew the local economy or to attract new branches. Reutilisation of old, already existing industrial and other (e.g. redundant military) facilities was also an important driving force. Intentions for the transformation of local spatial structure of industry constituted the fourth group of reasons. In addition, some other, very special causes have also been mentioned in the course of the survey, for instance, the special options deriving from geographical setting and from the location along state border; use of agricultural land of poor quality; easier access to different concessions and grants by gaining the status of industrial estate.

Industrial estates, primarily greenfield investments as new industrial establishments differ from old traditional industrial sites in many aspects (e.g. in size, ownership). The latter were owned by the state, while the former may have different proprietors. Local authorities or their economic ventures are the owners of the major portions of industrial estates. Sometimes there are industrial estates owned by Hungarian or foreign legal entities or individuals *(Table 3)*.

In the beginning industrial estates were established mainly in the northern part of Transdanubia, because of its favourable geographical location, closeness to the western border, relatively more developed infrastructure, openness, flexibility and innovation orientation and because of its generally higher levels of social and economic development. After 2000, however, they extended beyond "the line of River Danube", as industrial estates spread in the eastern part of the country in an increasing number. By now, their spatial distribution has become more balanced, even though there are much less of them in the southern half of the country. Industrial estates are primarily urban phenomena, because urban settlements are populous, their infrastructure is more developed, and usually they have industrial traditions. The share of industrial estates located in rural settlements did not reach 10% in 2005.

Even nowadays a considerable part (42%) of industrial estates is greenfield investment. Since the turn of millennium, however, the share of mixed (brown- and greenfield) type industrial estates has increased, because many brownfield industrial estates have outgrown their area and greenfield areas had to be added. The main reasons why investors prefer greenfield industrial

Fig. 2. Industrial estates by the year of foundation in Hungary, 1997–2007

Table 3. Differences between traditional industrial areas and industrial estates

Denomination	Traditional industrial areas	Industrial estates
Occurrence in time	before 1989, during the socialist era	only after 1989
Designation (or choice) of location	centrally decided by the state-socialist government (spontaneously in a certain sense)	designated by local authorities (mostly in a regulated way)
Size of area	usually small, less than a few hectares	usually large, several tens of hectares
Location within a settlement	usually within the administrative boundary of a settlement concerned, scattered	usually at the periphery of a settlement in a designated area, concentrated
Appearance of the establishment	generally sites are dirty with high smoky chimney-stacks, disordered	clean sites embedded into green environment, large halls without high, smoky chimney-stacks, orderly
Impact on environment	polluting the environment	environment friendly, less polluting
Type of activity of the firms settled down	only one kind of activity, basically production	usually different kinds of activities, production and services
Type of services on the site	no special firm providing services for the whole area	generally there is a special firm providing services for the whole estate
Number of firms settled down	generally one or very few	generally many
Owners of firms settled down	exclusively the Hungarian state	private Hungarian and foreign owners prevail

Source: compiled by the author.

estates are the following: they are cheaper and can be established within a shorter time than brownfield industrial estates. They are also popular, partly because a site with whatever size can be required, partly because they ensure larger flexibility and freedom in land use and because they can be extended in the future. They offer better possibilities for radical structural shifts in the economy than brownfield investments (Cselényi, J. et al. 1999). Greenfield industrial estates were also established in some places to create sizeable manufacturing. Their popularity has not decreased by the fact that they are much more risky investments as their future is very uncertain. No one knows whether they will have enough investors and by what time or if at all the expenses of an enterprise would be returned *(Fig. 3).*

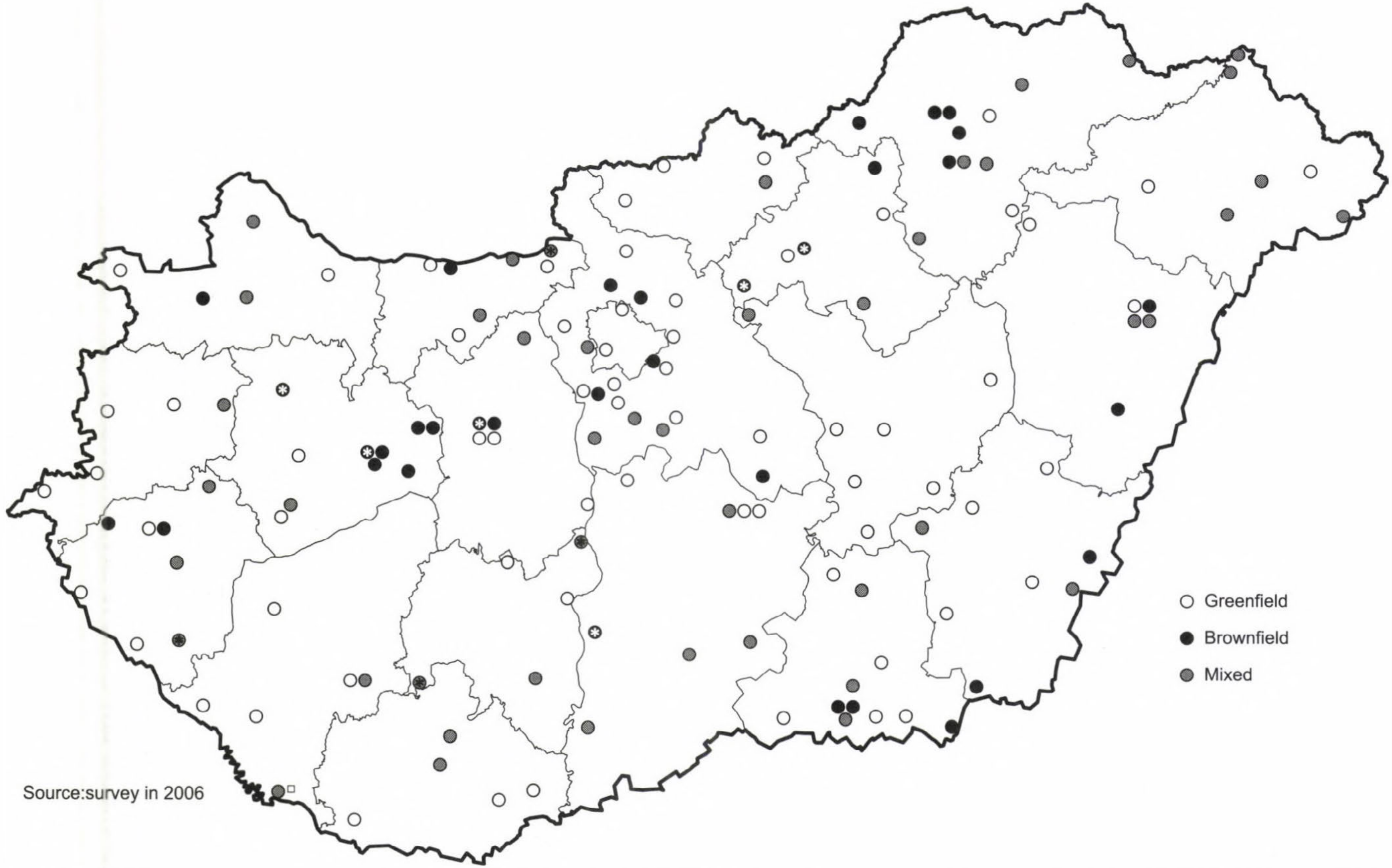

Fig. 3. Industrial estates by the type of investment according to the survey in Hungary, 2006. (* Industrial estate established on the site of former military base)

During the last decades the share of brownfield industrial estates has decreased because of the reasons mentioned above. In many cases brownfield industrial estates originally were socialist industrial firms or military bases, but in the 1990s it was realised that these existing industrial or military establishments can also operate as „quasi" industrial estates. They have been or are considered as an opportunity for reutilisation. The occurrence of brownfield industrial estates is closely related to the former north-east–south-west industrial axis of the country, where Hungarian industrial production was concentrated during the state-socialist era. The spatial distribution of greenfield industrial estates has become more balanced by now.

To prevent environmental pollution or to pursue environment friendly activities is the most often emphasized expectation from the industrial firms showing intention to settle down. Apart from this, investors to establish any kind of activities are welcome at industrial estates. In principle most industrial estates give preference to some kind of branches. This intention, namely to prefer a profile, is generally in accordance with geographical location of the settlement concerned, its natural endowments, the past and present structure of its industry, the quality of local labour force and infrastructure. The sharpening competition or the worsening situation is well indicated by the fact that in 2001 three quarters of industrial estates insisted on some particular kind of profile in principle, but in 2006 only half of them did. Indeed, most settlements are not in a bargaining position with regards to various options. On the other hand, selecting a specific profile for an industrial estate can be an advantage too, because it makes the industrial estate very particular, a unique location.

Besides industrial activity other kinds of activities are also pursued in industrial estates. About three quarters of them are involved in production reflected also in their name. Only about one quarter of the industrial estates give place to non-productive branches. Of the latter logistics and innovation centre functions are the widest spread. Industrial estates for logistics try to take an advantage of their favourable transport position and/or of their geographical location along the state border. Industrial estates in large urban settlements are purposed to fulfil innovation centre functions, since industrial traditions and skilled labour force can promote their development. Industrial estates with non-industrial functions are concentrated in the central part of the country, in Budapest and in other major cities.

In 2005 there were 17 enterprises per one industrial estate on the average. Most of these enterprises are Hungarian owned and small enterprises. According to the survey carried out in 2006 there were 27 out of 77 industrial estates without any enterprises with foreign interest. Their spatial distribution well outlined the area in the country almost neglected by foreign investors. The share of enterprises with foreign interest was much higher in the industrial estates located in the northern part of Transdanubia. These are also industrial estates with high land utilisation. Here the density almost reached 100%, which means they are occupied by enterprises almost fully. These are the most matured industrial estates. According to the surveys, between 2001 and 2006 the number of industrial estates with the rate of occupied sites exceeding 70% of the total area has increased from 12 to 33. Most of these industrial estates can be found around the capital city and in the northern part of Transdanubia. They form the new industrial axis, where industry, primarily manufacturing develops most rapidly *(Fig. 4).*

In Hungary an industrial establishment can get the industrial estate status if it meets the basic requirements, such as to have at least ten enterprises with a total of 500 employees within five years. In many cases industrial estates operate as only „quasi" industrial estates, because they do not meet these requirements. According to the survey in 2006 39% of industrial estates accommodated less than ten enterprises, and 47% of industrial estates have failed to have at least 500 employees. At the same time 43% of the industrial estates have met both criteria. Each industrial estate (except Infopark in Budapest) met the third requirement, namely to occupy a minimum area of 10 hectares. Even nowadays the majority of Hungarian industrial estates extend to an area between 20–50 hectares. Compared to other parts of the world there are relatively more numerous but smaller industrial estates in Hungary.

Generally, the maturity of industrial estates is closely related to the year of foundation (i.e. of gaining industrial estate status) and to the type of investment. The most developed (matured) of them are mainly greenfield sites having acquired industrial estate status before 2000. It has also become obvious that the level of maturity of industrial estates primarily depends on the quality of human resources responsible for their operation or/and the maintenance of the site (Gergely S. 2006).

Some of the major indicators of industrial estates also demonstrate that industrial estates play a very important role in the Hungarian industry and in a broader sense in the whole economy. Only a few percents of enterprises are concentrated in industrial estates, nevertheless they employ about one fifth of all industrial employees and they produce the bulk of Hungarian industrial export. The decrease of the share of export from industrial estates was considerable during the last ten years, because the number of small and medium-sized Hungarian enterprises incorporated producing mainly for internal market increased, while in the beginning the number of enterprises with foreign interest usually producing for foreign market was higher *(Table 4).*

The role of industrial estates in shaping the industrial space is different on macro (regional) and micro (local, settlement) levels. On regional level primarily greenfield industrial estates have played a prominent role in the transformation of the spatial pattern of industry, because most of the enterprises with foreign participation can be found in these industrial estates, and

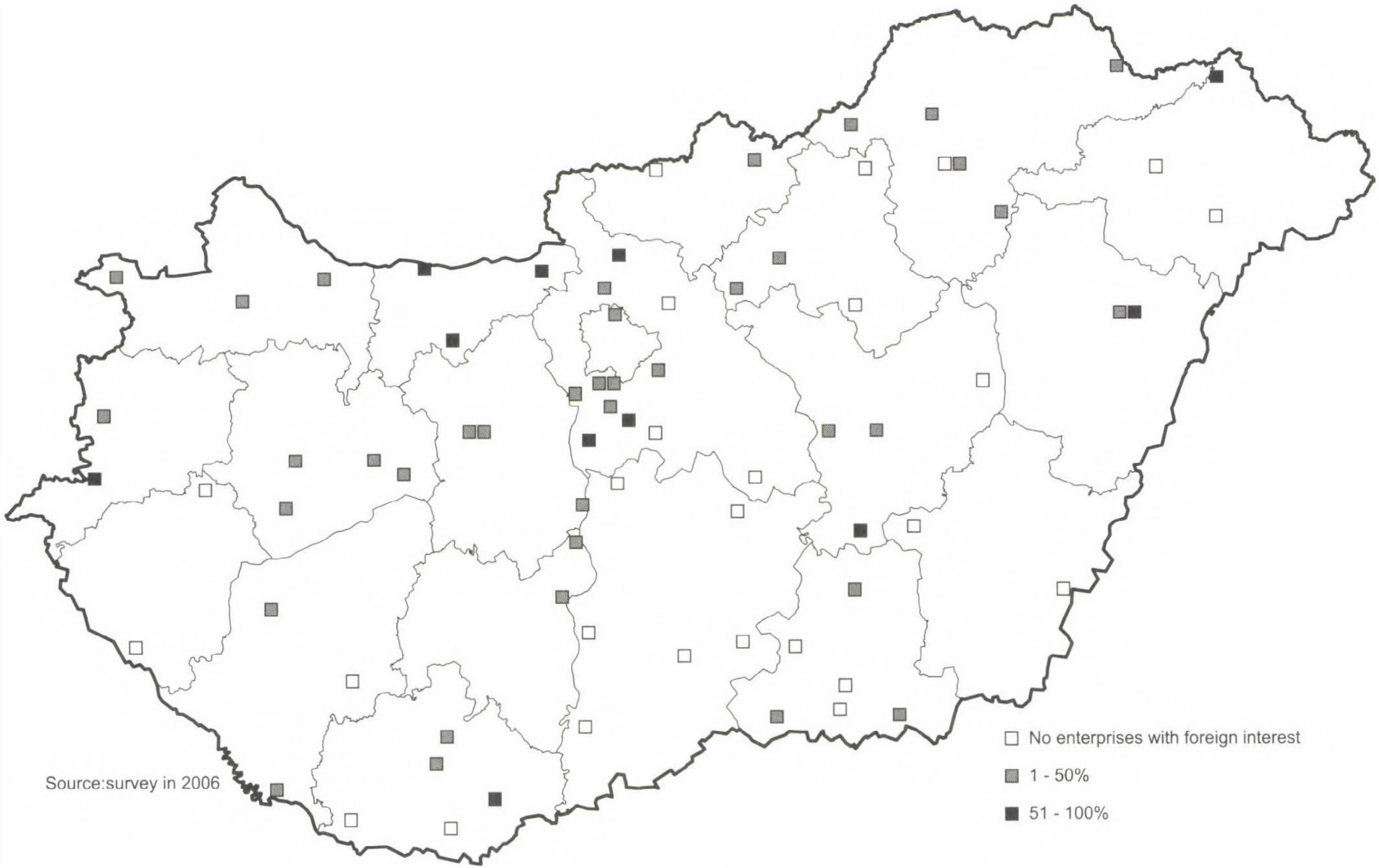

Fig. 4. Share of enterprises with foreign interest in the industrial estates surveyed in Hungary, 2006

Table 4. Major indicators of Hungarian industrial estates, 1997–2005

Denomination	1997	1998	1999	2000	2001	2002	2003	2004	2005
Number of industrial estates	28	75	112	133	146	160	165	165	181
Total area of industrial estates (in hectare)	2500	4472	6700	7400	8100	8800	9050	9098	9847
Number of enterprises settled down in industrial estates	450	566	980	1495	1760	2152	2450	2571	2989
Size of the area within the total occupied by enterprises (in %)	18	23	27	32	38	40	43	47	49
Ratio of export income (in %)	70	70	80	85	78	75	66	72	64
Number of employees in industrial estates (in thousand)	26	50	82	105	115	128	139	145	171

Source: Ministry for Economics, 2006.

they have considerably contributed to the development of the new industrial spatial structure. On the local level neither greenfield, nor brownfield industrial estates play relevant role in shaping the local industrial spatial structure. In the case of greenfield industrial estates this is because they require large areas and for this reason they are usually located on the periphery of the settlements as new industrial areas. In case of brownfield industrial estates it is because they occupy already existing industrial areas and thus they do not have any special effect on the original spatial pattern of industry. Their impact is much stronger on the local atmosphere and on their surroundings if the old industrial establishments are renovated or rehabilitated.

Conclusions

In the last decade of the 20th century radical changes started in the Hungarian industry, and by now they have already been finished. The transition period has come to its end, and at the beginning of the 21st century Hungarian industry has to face new challenges. Its future depends to a large extent on the influx of foreign direct investment, intensity of relocation in international scales and on global economic conditions. Naturally, the future of Hungarian industry also depends on industrial estates, because they concentrate the most important enterprises with foreign interest. Industrial estates have played a very important role in the renewal of the Hungarian industry and they are considered 'the islands of modernisation'. They became the new scenes of industrial production. By now a dense network of the estates has been developed, and their further expansion is expected. However, it is also obvious that the future of each of them depends on plenty of factors and probably not all of them will be able to survive. Undoubtedly, industrial estates will keep on playing a key role in the local and regional economic development and in shaping the spatial structure of Hungarian industry.

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FROM TOURISM TO MIGRATION: SPATIAL INEQUALITY OF FOREIGN PROPERTY OWNERS IN HUNGARY

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Introduction

One of the important elements of the processes of territorial mobility is migration which can be interpreted as spatial movement. The causes, phases and consequences of this phenomenon are comparable with one of the most profitable 'industries' of our age, which also provides a great development potential, that of tourism. While migration is motivated by the hope of improvement in life conditions, tourism is moved by the drive to acquire experiences (BERÉNYI I. *et al.* 2003). Although connections between tourism and migration are obvious, these have not been explored in a scholarly fashion. It is a serious challenge for the researcher to try to distinguish and identify the characteristic features, similarities of and differences between these two phenomena. As a consequence of globalisation both tourism and migration have become such complex phenomena that in order to understand their interrelationship it is inevitable to use an interdisciplinary approach (BELL, M.–WARD, G. 2000; KOVÁCS, Z. 2000; WILLIAMS, A. M.–HALL, M. C. 2002; TIMÁR J. 2007; MÉSZÁROS R. 2007). From the angle of tourism, the main question is whether the migration can be interpreted as the continuation of previous tourist experiences. From the angle of sending areas the question is whether migrants make trips to previous places of residence, as visiting friends and relatives (VFR tourism). On the other hand, from the angle of receiving areas VFR tourism can also be interpreted when migrants are visited by their friends and relatives. A further issue to be studied is whether participation in tourism as it is interpreted within the modern way of life can be a rival (a motivating or hindering factor) to making

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a decision to migrate from the country of origin (Niedomysl, T. 2005; Rédei M. 2007). Experts in migration try to clarify the role of the touristic experience on subsequent migration. They hope to find out whether the place of migration occurs as a target area of tourism or whether the persons joining the migrants may experience a touristic type attraction towards the place of immigration. Both phenomena represent a question to be answered – particularly, where the dividing zone can be drawn between the two phenomena.

There exist a number of migrational and touristic forms of behaviour the common point of which is still need to be explored. International migration includes cases when a citizen who has decided to relocate arrives as a tourist, then stays at the place of visit, and subsequently applies for a work permit or a residence permit. It is also a common situation when the intent of relocation is motivated by the economic growth generated by the boosting tourism of a place and by the emerging jobs and hope of employment (Snepenger, D.–Johnson, J.–Rasker, R. 1995; Williams, A. M.–Baláz, V.–Wallace, C. 2004). The reverse case is when the strengthening of the touristic role of a place leads to an escape reaction from potential negative consequences among the local population. It is also possible for the massive appearance of tourists to cause a large-scale relocation of local inhabitants and the utilisation of their property as tourist accommodation (Rátz, T.–Puczkó, L. 2002). Pensioners also occasionally choose places of residence which have an environment also attractive to tourists and which provide a peaceful natural ambiance, hoping that such an environment would positively influence their life expectancy, or places where the purchasing power of their pension is higher. Thus, they are hoping to maintain or even improve their living standard. A further possible interrelationship between tourism and migration can be identified in cases when owners first build a small week-end bungalow within the vicinity of a resort place or in a suburban settlement and later the zone is re-classified as a residential belt and the bungalows can be replaced by detached houses for permanent use (Kovács Z. 2002; Williams, A. M.–Hall, M. C. 2002; Hall, M. C.–Müller, D. K. 2004).

Since the political transition an average of 30 million foreigners cross the borders of Hungary each year, which is significant both when compared to the area or population of the country and in a European or even world-wide comparison. There is a scarcity of information available as to how the behaviour of entering foreigners relates to the phenomena of tourism and migration. Hungary is part of an important transit route connecting the Balkans with Western Europe (Dövényi, Z. 2006). On the other hand, from the direction of Romania and the Ukraine the lower living standard of the population generates migratory processes. Thus, the participation of these countries in legal or illegal migration is almost inevitable. As a consequence of the Trianon treaties the possible intention of ethnic Hungarians in Romania (Kocsis, K.–Kocsis-

Hódosi, E. 1995) to settle in today's Hungary is to be taken into account which is further inspired by visits paid to friends and/or relatives living in this country (Kocsis K. *et al.* 2006). On the other hand, Hungary acts as an attraction in the eyes of foreign persons with no Hungarian background arriving from the European Union or from overseas. The same is true for ex-Hungarian emigrants and their offspring who came to explore the attractions of the country during tourist trips and subsequently decided to settle here. Internal migration related to tourism may be motivated by the seasonal employment, and by the fact that places which are too heavily visited by tourists become aversive to local inhabitants or by the reclassification of former resort zones to residential belts.

If a concept of tourism as an intersectoral phenomenon is accepted which has at its core a change of environment aimed at acquiring new experiences and using related services, the relationship between tourism and migration and the points of interaction between these two major phenomena can only be explored when the spatial forces are understood (Nemes Nagy J. 1998), and the demography of movers and their motivations are studied (Casado-Diaz, M. A. *et al.* 2004).

Focal points in the connection between tourism and migration

Tourism and migration are increasingly important elements of human mobility. Nevertheless surprisingly little effort has been made so far to investigate the interrelationship between them in Hungary. The development phases, causes and consequences of migration are not independent from tourism as a more recent form of mobility, and vice versa. Changes in the volumes and directions of tourism and migration often complement and substitute each other. In this paper property acquisition by foreigners is examined from a macro perspective, using secondary, register-based data. The main emphasis will be placed on analysing the spatial patterns of the phenomenon.

Tourism and labour migration

Tourism has a strong influence on labour migration: where the labour force is not yet inclined to be mobile it may induce the process (Szivás, E.–Riley, M. 2002). In places where there are few people who could be or wish to be employed in tourism industry or the wages on offer are not satisfactory for the local labour force, foreign labour supply is bound to appear sooner or later. This process is very typical nowadays in developing countries where the persons in the management of hotels and catering units usually come from foreign countries (Hall, M. C. 2005). On the contrary in globalised cities with strong economic potential and a high concentration of skilled workforce there might be a significant demand on manual personnel in the tourist trade (gatemen, waiters). Tourist attractions can be called relatively permanent in a place, as opposed to manpower, which may change depending on the demand (Rátz, T. 2004; Baláz, V.–Williams, A. M. 2005), e.g. in areas where mass tourism is declining and individual destinations are coming to the fore (Butler, R. 2004).

In connection with production-oriented migration, Aitken, C.– Hall, M. C. (2000) point out that the models of international migration are certainly closely related to the flow of technology and information. Immigrants bring along intellectual capital of their own, which manifests itself in the form of know-how, practical knowledge and marketing skills. Working experience, the enterprising spirit, capital and the business network are all positive assets brought along by immigrants. Their contacts have an invigorating effect on imports at their place of usual residence in the course of which they give preference to products of their country of origin. Immigrants also play an important role in small-scale retailing, once they are acquainted with the language and culture of the target area which allows for easier sales of the products.

Bianchi, R. V. (2000) approaches the question from the angle of 'holiday workers' (personnel who serve tourists, but themselves also being in a tourist status officially). This new type of worker is neither a tourist nor an employee in the classic sense. The novelty is that the life-style chosen is very likely to be only temporary within their own life cycle. This new type of nomadism is a metaphor for physical, intellectual and sexual freedom in which work goes hand in hand with a tourist's experience. The boundaries between tourism and work-oriented migration are not impenetrable, however. The interaction between tourism and migration cannot be understood without the transformation of post-industrial societies duly taken into account. Our point of departure has to be the fact that relationships between work and leisure time become blurred in the post-industrial world. The social characteristics of holiday workers are no longer as clearly marked as they used to be – they include the new middle classes as well as the less educated, marginalised strata. Holiday workers also include graduates who do not wish to enter the local formal and strictly regulated labour market. Working while a tourist means that the person acquires social experience, and there is an attempt to strengthen relations with the local society. For many northern people this type of work means a glimpse beyond their own culture. Especially for people from Great Britain, Germany, the Benelux states and Scandinavia the Mediterranean world has become a standard escape route from the cold, chilly, damp climate, stressful work places and polluted industrial belts. Tourist enclaves and yacht marinas form social and economic centres which attract holiday workers. Where the local labour force is not very well trained or the criteria for employment are difficult to comply with, foreign people are in a more favourable position owing to their training and cultural capital within the labour market of tourism. The local labour force want social security and registered employment, while the people coming from the other countries can afford to neglect these aspects for a period of time, thus they can be employed for lower wages and their employment costs less altogether.

Studies made in foreign countries also contain relevant comment on the topic of labour migration (Rédei M. 2006). In the course of student mobility, for training purposes, potential human capital is relocated in another country where it causes an increase in potential. The place where it migrates from suffers a loss. The continually spreading attitude of lifelong learning contributes to confirming the long stays abroad entailed by studying – during these periods working as a part-time worker or holiday worker can serve as a source of (extra) income. These forms, however, are relatively hard to register. (Lukács É. 2002).

Tourist aspects of elderly migration

One of the illustrative examples of the connection between tourism and migration is the phenomenon of retired people changing their place of residence after the active phase of their life is over. Retirement migration is life-style oriented, and its participants often become motors of the dezurbanisation process. The causes for retirement migration are to be sought in the increasing numbers of the elderly population, people's ever longer and increasingly active old age, the changing pension patterns, guaranteed incomes and increasing knowledge about free time (Attias-Donfut, C. *et al.* 2005). Describing the migration of American pensioners to Mexico, Truly, D. (2002); Borbély A.–Lukács É. (2001) points out that earlier travels play a crucial role in decisions regarding elderly migration. After examining the problem, King, R. *et al.* (2000) came to the conclusion that beside a life long career several other factors have a strong influence on international elderly migration – the boundaries between home and holiday home, work and free time are becoming blurred and the need to visit friends and relatives also comes to play its part when making travel decisions. Migrants looking for a 'good place' do not move anywhere unless they used to visit the location regularly beforehand, and what is more, they interpret their earlier holidays as the most vital source of that decision. Thus researchers are not fully in accord regarding the primacy of the role played by tourism (O'Reilly, K. 2003). Experiences gained from holidays or other channels influence the migration decision to varying extents. A summer holiday or a visit to a relative provides a different perspective from doing seasonal work in a place. There is a great difference in the depth of information gained.

A holiday can serve as a springboard within this process, e.g. through buying a second home. In making this decision, owning the second home can be seen as an important connection offering a gradual transition between a short summer holiday with seasonal stay and permanent residence (Flognfeldt, T. 2002; Timothy, D. 2004; Szőke, A. 2006).

Tourism and social relationships overarching national borders (diasporas and ethno-tourism)

The geographical expansion of family and friendship ties is an inspiring factor to international migration world wide. Owing to their different life-styles, people become ever further removed from each other, but maintaining contact remains possible through tourism. The spreading of various ethnic minorities is becoming a growing motivating factor of tourism aimed at visiting friends and relatives (Duval, D. T. 2004; Fox, J. E. 2003).

Cluzeau, O. C. (2001) also points out that the history of Corsica, Spain and Madagascar has produced diaspora groups which were forced to flee their place of birth or chose to settle in some other place out of their own accord. The presence of diasporas plays an important role in tourism, too. Some sources call this ethno-tourism or community tourism. Tourism is a social factor which revives and strengthens the relationships of people living in diaspora with the mother country. When returning for an extended period of time, emigrants do not make use of commercial accommodation but prefer to buy property – indeed, there are property agents working to evaluate the commercial demand represented by people living in emigration. For instance, in the year 2000 of the 4.37 million tourists who visited Morocco 1.65 million were Moroccans living abroad.

Beer's study (2000) sheds light on a unique element within the influence on migration exercised by tourism and social relations. He claims that a great number of marriages are contracted between Philippine women and visiting, mainly German, males. In the 1990s the mediators of these German-Philippine marriages were kinship networks and friendships, but today the women who live in Germany but are originally Philippine help make the matches for others who are still living at home. For this it is necessary to get the men to travel to the Philippine Islands as it was very difficult to acquire tourist visas for women. German men frequently travelled to the distant islands in the certain knowledge that once there, they would walk down the aisle with the chosen woman. The chief motivation of the journey is that Philippine women are known to make exemplary wives – a belief that even guidebooks make the effort to point out, but there are agencies working in this segment of the market through marriage safaris or offers advertised in newspapers, too.

The dream wedding is held on the Philippines according to the appropriate rituals, while the registration is done in Germany. The relatives and friends of the German men can meet eligible Philippine young ladies at the wedding itself, which further enlivens 'marriage tourism.'

Holidays, country life-style, dezurbanisation

In the case of the owners of second homes, international and internal migrations become blurred. Summer holidays represent a change in life-style but this may also be motivated by the onset of particular phases of the individual life course. Country areas which are suitable for starting a home, as well as suburban belts which had originally been agricultural areas, regularly become the target of the desires of second home owners (WILLIAMS, A. M.–HALL, M. C. 2002). The change of function, which takes place in a former agricultural region (the land is divided into plots and is built upon) leads to the disappearance of fertile land, which could be profitably exploited, while rural gentrification can start as soon as the new owners settle into already inhabited rural areas. This latter may lead to the re-invigoration of areas, which had once been dominantly agricultural in character.

Non-economic factors are gaining an increasing role in migration-related decisions (BÖRÖCZ, J. 1996; KRAKOVER, S.–KARPLUS, Y. 2002). The most common non-economic factor is the weather linked with attractive environment and life-style, but the quality and quantity of services available is also an important aspect. Non-economic factors make it difficult to model the migratory processes, as they provide an almost endless variety of variables. The characteristics that make a place unique are not provided by the market; a clean environment, free space, wildlife, good schools and friendly neighbours are not typical market factors or at least have not been considered as such thus far (CLARKE, N. 2004; KAUFMANN, V. *et al.* 2004).

In their work on migration between the provinces of Spain, STILLWELL, J.–COLL, A. G. (2000) point out that each of the economic and social changes taking place independently had a totally individual effect on the behaviour of the migrants, which are almost impossible to explain using the existing theoretical frameworks.

The rate of migration to nearby areas is increasing, while migration between provinces has been declining, as has the tendency to move out of Madrid and Barcelona. The inclination to migrate away from these centres is characteristic of the older generation. Immigrations are no longer focused on industrial regions. The main directions are the axis between the Ebro and the Mediterranean coast – the economy of the latter, including the Balearic Islands, being based on the service sector and tourism.

Literature review on second homes

Investigations into tourism and migration tended to develop independently of one another in the second half of twentieth century (Bell, M.–Ward, G. 2000). Some types of the growth of tourism activity are increasingly considered to be a sub-type of migration in some areas of migration research. This is against a background of an overall increase in the numbers, formats, and spatial distribution of tourism. The energy of tourism researchers has been devoted to investigating the new flows, and the causes and consequences of the emerging phenomena (McKercher, B.–Lew, A. A. 2004). A systematic exploration of the interrelationship between tourism and migration started from the 1990s.

The continuum metaphor has become very popular in the literature, which deals with the tourism–migration nexus. Vacationers anchored one end of the continuum of tourism-migration, while permanent migrants anchored the other end. Warnes, T. (1994) studying the displacement of Northern Europeans to Spain, combined the analysis of mobility forms with an assessment of the tourist background and different types of housing ownership and use. This resulted in a number of forms, ranging from the one-week hotel holiday to the stay at permanent residence. O'Reilly, K. (2003) distinguished migrants from tourists in terms of orientation to home, and identified four main groups: full residents, returning residents, seasonal visitors, and peripatetic visitors. These two kinds of typologies, produced by the same author researching a single area, reflect the fluidity of tourism–migration in reality.

King, R. *et al.* (2000) created a provisional continuum where international retirement migration ranged from permanent legally registered residents, through non registered seasonal migrants, owners of second home staying for short period, to long-term tourists. Bell, M.–Ward, G. (2000) stated that tourism, as temporary movements, and permanent migration formed part of the same continuum of population mobility and proposed a unified classificatory framework, with time and space dimensions. Rodríguez, V. (2001) stated that, in practice, there was a continuum of situations, which were difficult to assess quantitatively, but did not generate new categories of international retirement migration. Krakover, S.–Karplus, Y. (2002) argued those potential immigrants represented a special case whereby their status on the tourist migrant continuum was not fixed but, rather, was changeable and conditional. King, R. *et al.* (2002) also placed tourism-led migration and migration-led tourism at two ends of the continuum of personal mobility. After a decade of research, it seems that a general consensus has emerged as to the existence of blurred or grey zones between permanent migration and tourism, involving complex forms of mobility.

There are a large amount of questions to be addressed concerning the relationships between migration and tourism, particularly relating to where the dividing line or zone can be drawn between the two phenomena (Bianchi,

R. V. 2000; WILLIAMS, A. M. *et al.* 2004). This zone of overlapping has tended to grow due to a process of convergence between work and leisure time activities (CLARKE, N. 2004), the increasingly changeable labour markets, and rapid ageing in the developed societies, combined with changing income streams, the development of transport and telecommunication facilities and globalisation tendencies (DIJST, M. *et al.* 2005; HALL, M. C. 2005).

Additionally, connections between tourism and migration have been examined in relation to Hungary's geographical position, historical heritage and resulting geopolitical relations, together with the natural resources to be exploited by the tourism industry (BORA GY.–KOROMPAI A. 2001). There are however major gaps in our knowledge, which demand further research into a number of specific topics (CSORDÁS, L. 1999; CSORDÁS L.–JURAY T. 2007).

Foreign real estate owners in Hungary

From the start of the state socialist epoch until 1974 (when Law I on the foreign currencies was passed), non-Hungarian real estate ownership was prohibited in Hungary. Gaining convertible foreign exchange was the driving force in this opening which, to some extent, paralleled the aforementioned development of international tourism. During the first phase of transformation, the 171/1991 Government Decree introduced liberalisation measures, but many restrictions and time-consuming bureaucratic measures remained in force. Foreign citizens did not like this fluid situation. A broad liberalisation took place in 1996 and this measure has induced growing foreign interest in the Hungarian real estate market (BERÉNYI I. *et al.* 2003).

From 1998 onwards, during the accession negotiations to the European Union, the acquisition of real estates by non-Hungarian citizens, considered as the flow of capital (direct foreign investment), was not completely free. During each of the earlier enlargements of the EU, similar sets of issues were discussed amongst the current member states and the candidates (SZIVÁS, E. 2005). One of the key themes was the free movement of people. However, a close interrelationship exists between the free movement of capital and free movement of people, as two principles. The EU insisted on the right of individual member states to impose restrictions on international migration from the new member states, and a 2+3+2 years derogation period was introduced as a potential barrier to labour migration (LUKÁCS É. 2002); initially only the UK, Ireland, and Sweden did not insist on imposing these restrictions. As a direct consequence of this, the Hungarian government postponed the complete liberalisation of the domestic property market. Five years after the accession (1 May 2009), the market conditions for real estate will be revised in view of progress in relation to the free movement of people.

According to current regulations (7/1996 Government Decree), property purchases by foreigners are subject to the approval of the home county (19 territorial units of Hungary at former NUTS 3 level) or Budapest Municipality public administration. The aim of this section of the paper is to give an overview of national scale about the type of properties purchased by foreigners and the spatial distribution of their new owners, according to nationality. The quality of the data available is relatively poor, being partial and inconsistent, until 2001, which means that is was not possible to carry out a longitudinal national-level analysis. This is due to the fact that, until 2001, the public administration offices of the counties and capital were not obliged to create a formally unified database; thus every office collected and summarised the data regarding property purchases by foreigners as they deemed most appropriate and taking into account their IT resources. This means that a coherent national database was only available between 2001 and 2006.

The data on foreign property purchases originated from the legal registry of the Ministry of Local Government and Regional Development. The original data files were selected, checked and harmonised by the authors. The core of our analysis was based on the number of foreign real estate purchasers and their national distribution. Nevertheless, the number of foreigners does not coincide with the number of purchased real estates because one property may belong to several owners. Moreover there are cases when the co-owners are citizens of different countries *(Fig. 1)*.

Between 2001 and 2006, approximately 36,000 foreign citizens purchased real estate in Hungary. The majority of foreign purchases (21%) were registered by local administration offices in Budapest (also the number one international tourist destination) together with the three counties around Lake Balaton (29%), the most popular summer resort. It is assumed that foreign citizens purchase real estate in settlements that they had visited before or where friends and relatives live. The distribution according to the nationality of purchasers for the six years under study shows that the majority of estates in foreign property (33.1%) belong to Germans, while further significant participants are the Austrians (14.7%), Romanians (9.6%) and Dutch (8.6%). Examination of the national groups, which dominate the various counties of Hungary, has led to interesting results. Germans represent the majority of foreign property owners in 12 counties. In Somogy county their rate among foreign citizens is 64.1 percent, which means the highest one in contrast to Borsod county, where Germans (although also the leading buyers) only accounted for 22.9 percent of foreign owners. Austrians dominate in Győr–Moson–Sopron and Vas counties in the common borderland. In the first they make up 60.8 percent, in the latter they represent 50.8 percent. Romanians are in a majority in two counties (Hajdú-Bihar: 58.1%, Békés: 63.0%) in the south-eastern part of Hungary, but they are dominant (24.8%) owners in Pest County too. Ukrainians are the leaders in Szabolcs–Szatmár–Bereg County (34.4%).

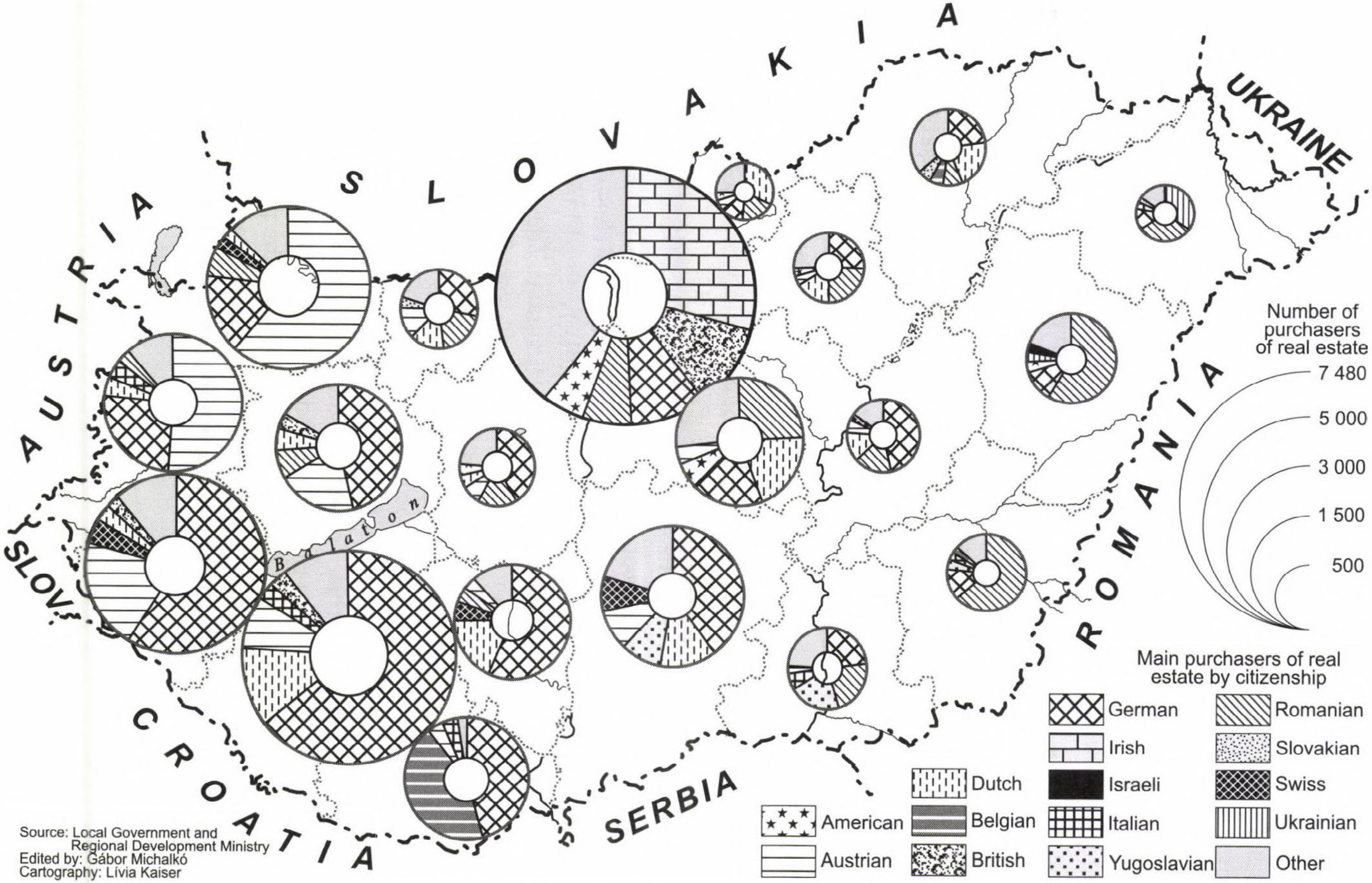

Fig. 1. Spatial distribution of foreign purchasers of real estate in Hungary, 2001–2006

These indicators allow us to conclude that Germans can be considered potential buyers in the whole of the country, and do not display particular territorial preferences (except for Tolna and Baranya counties, which contain a considerable ethnic German minority). One of the factors explaining the dominance of German purchasers, and their spatial distribution, is likely to be the presence of other buyers of German origin in Hungary. As an example of the role of ethnic networks, they recruited new investors from their circle of friends and relatives due to their positive experiences of property ownership in Hungary. A similar trend also seems to have occurred in Sweden (Müller, D. K.–Hall, M. C. 2004), although that derived from a substantially different set of circumstances. Other citizens, mainly those from the surrounding countries, prefer to buy estates in the counties near the border with their own country, which is probably motivated by accessibility considerations, combined with different attractions. Moreover, the possibility of circular movement between the countries would play an important role.

It is interesting that Romanian citizens dominate in Pest County, surrounding Budapest, relatively far from the Hungarian–Romanian boundary. This can be explained by commuting to Budapest, where they are employed dominantly. Another motivation is the low prices of real estate in rural areas. Additional explanatory factors include the network of mainly ethnic Hungarians, who immigrated in this county earlier (Gödri I.–Tóth, P. P. 2005) and provided reliable information for the newcomers. Ethnic networks could play an important role in most of the neighbouring countries, where ca 3.5 million ethnic Hungarians live. Naturally, if foreign purchasers find a desirable environment near the border, they are unlikely to add to their expenses by travelling to more distant areas within Hungary. These facts show the strong distance dependency, which characterises purchases by foreigners. There is one characteristic exception, namely Slovakia. Despite the long common boundary and the substantial ethnic Hungarian community, there is no Hungarian county where Slovakian citizens would be the dominant buyers. The level of international immigration to Hungary is very low compared with Romania, Ukraine and Serbia. These facts could reflect the influence of mobility experiences upon foreign property purchases. The distance dependency is high (for similar findings see Müller, D. K. 2004), but the purchasing power and ethnic network of buyers – together with the uneven economic and social spaces in the receiving country – could modify the quasi-linear relationship.

Conclusions

The purchase of real estate by foreign citizens is a phenomenon relating to international tourism and migration. Processes of the EU integration contribute to the acceleration of international mobility. This is manifested in a free flow of manpower, migration of retired people or in various sort of leisure time spending. All the above processes might be instrumental in inducing purchase of real estate abroad. A long-term stay in or repeated visits to a foreign country might eventually lead to buying real estate of own property. In Hungary a close relationship could be observed between the different forms of international mobility and real estate purchases by foreign citizens. The most massive tourist and migrant flows from West Europe to Hungary are emitted by Germany. From this it follows that the greatest number of property customers comes from this country. It is very probable that behind the purchases by German and Austrian citizens are tourism related activities whilst in the case of Romanian citizens the primary trigger is seeking for jobs. Germans intending to obtain real estate are attracted by the counties around Lake Balaton. Austrians as a rule buy estates in areas close to the common state border. On the other hand, Romanians display the highest demand in the border zone plus in Budapest and its metropolitan area with an abundance of job opportunities.

The accession of Hungary to the Schengen Agreement generates a series of issues in the processes of international mobility. On the one hand this mobility might be curbed at the external borders. On the other hand, a free travel across internal borders is expected to increase foreign tourist turnover. Stemming from the principle of reciprocity a gradual abolition of derogations hampering the migration of workforce is to lead towards a further liberalisation of the Hungarian real estate market. The latter together with the elimination of internal borders might give an impetus to purchases by citizens arriving from the EU countries.

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EFFECTS OF UNIFYING ECONOMIC SPACE ON THE BORDER AREAS OF HUNGARY

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Introduction

Hungary is located in East Central Europe and the country is specific among the European states, as there are seven neighbouring countries beyond its boundaries. Hungary is bordered by Austria on the west, by Slovakia on the north, by Ukraine on the north-east, by Romania on the east and south-east, by Serbia, Croatia and Slovenia on the south. The neighbouring countries – except for Austria – are post-socialist states struggling for the solution of similar problems of transition after the political changes in 1989–1990, when communism collapsed. Hungary is situated in the central part of the Carpathian Basin, therefore most of the state borders are not natural barriers – except the Danube River on the north-west and the rivers on the south-west.

Presently Austria, Hungary, Slovakia, Slovenia are members of the European Union, since 2007 Romania has also been a member of the community and Croatia has an associate member status. Accordingly, most sections of the Hungarian state border are internal borders within the EU (after the end of 2007 – besides Austria – Hungary, Slovakia and Slovenia will be members of the Schengen Agreement, so the traffic at border crossing points might become freer).

The development level of the infrastructure that creates the background of the cross-border co-operations is characterised by significant regional disparities as a result of different natural, political, social and economic conditions.

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In order to describe the situation of the border areas of Hungary, it is necessary to introduce the changes in the spatial pattern of the country. The most important dimensions are the following:

– Since the beginning of the industrial modernisation in Hungary i.e. the mid-19th century the role of Budapest has become a decisive factor in the spatial pattern. The dichotomy between Budapest and the countryside became enhanced during the recent economic and political transition.

– Macro-regional disparity has appeared between the western and eastern parts of Hungary, which can be modelled like a west-to-east slope.

– Partly as a result of the development policy of the communist era that focused on the towns and major settlements, the urban–rural dichotomy according to the hierarchy and size of the settlements has become a characteristic feature of the Hungarian spatial pattern (Nemes Nagy, J. 1994).

The development levels of the western and eastern border areas differ significantly, as an outcome of the communist era and of the new processes after the political changes.

The first aim of the current study is to present and calculate the economic effect of the neighbouring participants of the economy along the border area of Hungary. The second one is to demonstrate the transformation of the border areas since the political changes and to explore the different characteristics of the sections along the Hungarian state border.

Effects of European integration and the national borders

An integration process should be a win-win game basically (Breuss, F. 2001). As a matter of fact however gains and losses are not balanced in many cases; some have to pay most of the costs of the enlargement whereas others enjoy the benefits of it. This might vary not just by different countries, but also over different regions within a state. In this context border regions are one of the most important types of areas.

Border regions are frequently described as underdeveloped areas, and it often can be confirmed empirically (Petrakos, G.–Topaloglou, L. 2006), especially in Central and Eastern Europe (Erkut, G.–Özgen, C. 2003). However, typically not just the formation of present borders effected the less favourable situation of these regions, as the settlement structure had formed and many characteristics of the economic and social activities developed much earlier. Borders of the countries in Central and Eastern Europe changed many times in the course of the past centuries, and had broken the natural run of development. The 'melting' of national borders can help to re-establish former spatial relations as their barrier function decreases; in this manner their role as contact zones can grow stronger (Erkut, G.–Özgen, C. 2003). Besides, the opening of national borders also helps social cohesion by increasing the mobility of people or encouraging it. Consequently, border regions may be put in a state of flux by their changing economic role through the reallocation of activities and options (Topaloglou, L. *et al.* 2005).

Nevertheless, the effects of European integration on border regions are hard to judge unanimously. Some authors (e.g. HUBER, P. 2004) claim that the influence of the enlargement of the European Union in the past twenty years has been mainly neutral on borderlands both with a few positive and negative consequences. The latest integration leap of the EU – the Eastern Enlargement – however seemed as an important and very effective act with respect to the border regions.

In this process border areas located near a prospering market or an economic centre of a neighbouring country can take advantage of the integration. The increase in cross-border trade, the change in wage rates, the growth of employment related to gain in labour supply affect mainly the newly joined and transitional countries (NIEBUHR, A. 2004; PFAFFERMAYR, M. *et al.* 2004). The border regions of neighbouring countries hitherto often suffered a decline in wages and increase in unemployment stemming from their marginal location. This evidence was also investigated through the impacts of German re-unification (BUETTNER, T.–RINCKE, J. 2007).

The situation of the border regions is a critical aspect, since they can gain extra benefits by it (NIEBUHR, A. 2004, 2005). Border areas with favourable location make profit from their attractiveness and better accessibility conditions in many respects, relative to other non-border regions and along the external borders of the integration areas (KOZMA, G. 2006). While borders are 'melting' in the EU internal space, they are 'freezing' in the external spaces (TOPALOGLOU, L. *et al.* 2005). Consequently, these areas are facing many problems, and serious difficulties might emerge due to their low economic performance and unfavourable access to European markets (NIEBUHR, A. 2004).

Techniques to measure integration benefits and border effects

The methods of describing the impact of an integration process cover a wide array of techniques of spatial analysis. Benefits can be measured simply by statistical enumeration or typifying regions through their characteristics, supported by factor and cluster analyses (TOPALOGLOU, L. *et al.* 2005). Measuring the change of economic specialisation and spatial concentration relating to integration can also be useful to reveal the benefits (WIESER, R. 2004). Multivariate regression models are often used in the investigation of possible integration effects (BUETTNER, T.–RINCKE, J. 2007; HUBER, P. 2004), and in the exploration of special impacts of border regions on the border situation can easily be built in them as a determinant factor (NIEBUHR, A. 2004, 2005).

Several spatial econometric models of macroeconomics – for example the spatial computable general equilibrium (SCGE) model (BRÖCKER, J. 1998) or OEF World Macroeconomic Model (BREUSS, F. 2001) – can be found among the techniques of measuring the integration benefits and border effects. Besides, core-periphery models of New Economic Geography have their role in exploring how an integration process affects border regions (NIEBUHR, A. 2005). Completed by other techniques, for example, regression analysis (BUETTNER, T.–RINCKE, J. 2007; NIEBUHR, A. 2004), these applications can give a properly complex explanation of the phenomenon.

However, beside the great variety of measurements to describe the integration benefits and impacts especially on border regions, the most frequent methods of investigations are rooted in gravity based approaches. Based on a formal-logical analogy with the Newton Law, gravitation models are often used to estimate the measure of trade or migration (labour and employment) flows. For these types of flows, physical borders and other barriers (tariffs, currency and language) are strict impediments and it is hard to cross them. Nevertheless, these elements are used to be built in the models to denote border effects (MCCALLUM, J. 1995). The possible benefits of integration on borders can be revealed by simulating the reduction of border effects (BROWN, W. M.–ANDERSON, W. P. 2002), modelling unimpeded trade and migration flows and an advantaged market access.

Potential model applications and their use in the investigation of borders and integration

The potential model developed by STEWART, J. Q. for geographical application (1941) is one of the key methods of measuring spatial interaction. Similar to gravity models, in potential model applications the strength of interaction is taken into account by the masses (economic power, number of inhabitants) and distances of spatial bodies (in most of the cases settlements, regions, countries). In contrast to the former one, the potential model does not focus on single forces affecting an entity, but on the sum of them. Notably, it shows how the whole system affects one of its elements.

To describe the complex situation of a system built up by spatial relations it is useful to investigate all the influencing factors. The most important thing is to reveal the internal conditions of a system, how large impulses overtake a given point. It is expressed in the term of internal potential and it is used to be measured according to the next formula (1):

(1)
$$P_{in}(A_i) = \sum_{j=1}^{n} \frac{M_j}{d_{ij}^b}$$

where $P_{in}(A_i)$: internal potential of „i" point; M_j: the weight of „j" point within the investigated area; d_{ij}: distance between „i" and „j" points.

Besides, as the elements of the system have their effect on themselves, self potentials in many instances need to be regarded (2).

(2)
$$P_{self}(A_i) = \frac{M_i}{d_{ii}^b}$$

where $P_{self}(A_i)$: self potential of „i" point; M_i: the own weight of „i" point; d_{ii}: the distance assigned to „i" point.

Internal and self potentials reveal the inner structure of an investigated system as it would be completely closed without any external connections (3). Generally, it would conduce to a misleading result, as closed (economic) systems are hard to find in the world. Thus, external effects of a defined area outside the investigated system could also be taken into account, through external potential.

(3)
$$P_{ex}(A_i) = \sum_{k=1}^{n} \frac{M_k}{d_{ik}^b}$$

where $P_{ex}(A_i)$: external potential of „i" point; M_k: the weight of „k" point locating outside the investigated area; d_{ik}: distance between the „i" and „k" points.

For (1), (2) and (3) b: index based on experience, in this investigation equals with 2.

By summing up the elements, total potentials can be supplied.

One of the original meanings of the term 'potential' is the measure of proximity of people or economic goods to a given point (Stewart, J. Q. 1948). The proximity of a place indicates the accessibility of people to the given system. As the probability of the occurrence of social interactions is greater in the easily accessible places, accessibility can be interpreted as a measure of the intensity of possible contact or social intensity (Pooler, J. 1987).

The intensity of possible contacts can change in several ways. It might occur that the weight of a social or economic mass is the changing element of a system (Frost, M. E.–Spence, N. A. 1995). Similarly, accessibility conditions can also be developed (Smith, D. M.–Gibb, R. 1993; Tóth, G. 2005). When an improvement in potential values cannot be attached directly to accessibility or mass function, but it is related to the reduction of impediments (tariffs, borders) among the parts of the system, integration benefits can be estimated (Clark, C. *et al.* 1969; Keeble, D. *et al.* 1982).

Without barriers, border regions become more permeable and can be the main beneficiaries of the gains related to an integration process, on the basis of the principles of the model, as they are closer to foreign economic centres than the internal parts of the country NIEBUHR, A. 2004, 2005). The roles of distance, market size and agglomeration economies in the process of cross-border interaction, which are built in the potential model, constitute a complex framework, which shows how the removal of different barriers provides benefits not just for the border region but for the whole system, too (PETRAKOS, G.–TOPALOGLOU, L. 2006; PFAFFERMAYR, M. *et al.* 2004). By the combination of the model with other techniques and applications this image can be rectified further (TOPALOGLOU, L. *et al.* 2005; NIEBUHR, A. 2004, 2005).

Methods of the analysis

In order to measure the contribution of the substantial local economies along the Hungarian national border to the economic potential of the border area, it is essential to find an indicator that:

– represents the extent of the local economies (namely settlements or municipalities),

– is calculated by the same (or at least similar) methods of data collection in several countries,

– spans the same time period.

Under these constrains the number of persons in employment by the locality of place of work has been chosen in the investigation (in fact this definition might be simplified as the number of local workplaces). The data collection was based on the census of Hungary and those of the neighbouring countries in 2001 and 2002. In the case of several countries only the data about the number of persons in employment by the locality of residence were available. Though this indicator did not allowed for commuting to have been considered, it was appropriate to represent the economic weight of the localities.

In order to create a detailed model about the border area the basis of the analysis is the lowest territorial level that can be studied through statistical data available in the censuses. According to data collection referring to the different public administration categories in the countries involved, settlements or municipalities (the LAU2 or former NUTS5 level in the methodology of the European Union) are considered here. Nevertheless, it was also necessary to narrow the number of localities. It was assumed that the larger centres might represent appropriately the economic potential of a given area. Therefore, only those localities were involved in the investigation, which had higher value than the Hungarian average number of persons in employment by the locality of place of work according to the censuses of 2001 and 2002. This threshold value is 1117 employed persons by settlements.

The primary aim of the current study is to analyse the border areas in Hungary, so a specific zone has been marked out. The zone was based on the accessibility of the non-stop road border crossings. It has also been assumed, that only a narrow belt is affected directly by the economic centres located beyond the state border. In the current study, this distance was limited in 60–65 minutes from the border crossings located along the Hungarian state border. Distances were calculated by road accessibility and expressed in minutes. The localities involved in the investigation were plotted with the help of a route planner (Marco Polo EuroRoute 2005) and mapping software (ArcView GIS version 3.3) *(Fig. 1).*

After limiting the size and reducing the territorial extent, 145 Hungarian and 367 foreign settlements became involved in the subsequent analysis. There were 67 Austrian, 83 Slovakian, 12 Ukrainian, 98 Romanian, 11 Serbian, 88 Croatian and 8 Slovenian localities to have been reckoned with. The number of localities was particularly affected by the physical geography, the history and the economic characteristics of a given area.

Results of the application of the potential model

The core question of the study is how the potential effect of the external economic centres can be modelled in the case of the settlements of the Hungarian border area. In order to illustrate the value of the influence the potential model has been applied for the concerned zone.

The formula and the most important attributions of the potential model have already been discussed. Of the three components of the model only the internal and external potentials were taken into account in the calculation as self potential was indifferent for the problem analysed. In the case of the two components of the calculation the points of potential fields are represented by the localities. The weight of points was expressed by the number of persons in employment by the locality as af place of work or by the number of persons in employment by the locality of residence. Finally, the distances between the localities have been calculated on the basis of accession by road in minutes. The following maps illustrating the potential field were created through interpolation (by the GoldenSoftware Surfer software) that simplifies and models the real pattern.

The internal potential has been calculated for all the Hungarian settlements – not only for those located in the border area – that have higher number of persons in employment by the locality of place of work than the average value. Altogether 297 settlements have been involved, disregarding their administrative status. The results can be summarised as the value of internal potential depends on the distance from Budapest (the number of

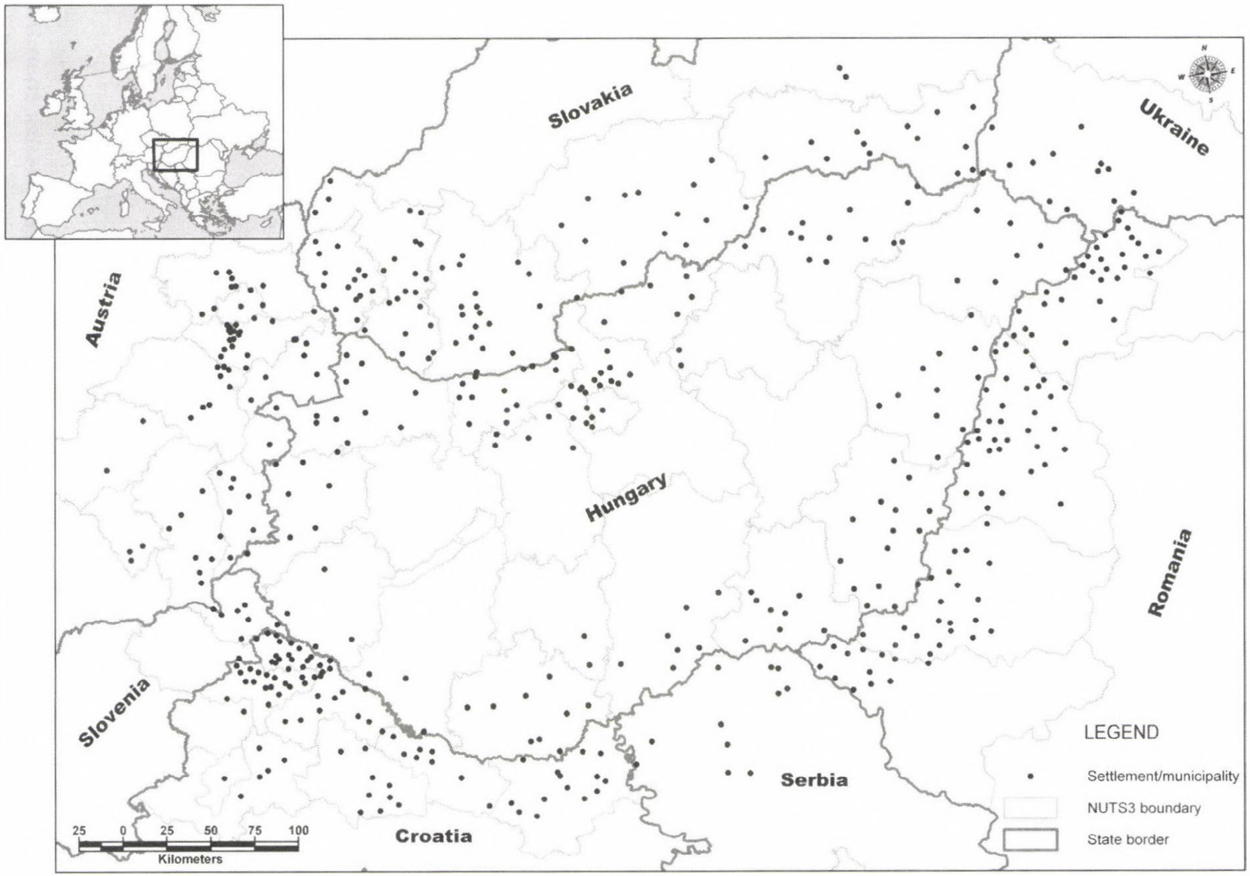

Fig 1. The settlements and municipalities involved in the investigation

persons in employment is approximately tenfold higher in the capital than in the second largest town, Debrecen). The highest internal potential values occur at the western 'gate' (suburban) settlements of Budapest, close to the turn-off motorways. However, a continuous zone of low internal potential appears on the northern, eastern, southern and western rim of the country along the state border (except North-west Hungary). The effect of the largest regional centres in Hungary (Miskolc, Debrecen, Szeged, Pécs) cannot modify significantly this kind of peripheral situation *(Fig. 2).*

The external potential was calculated for the settlements of the Hungarian border area by the weight or effect of the main localities beyond the state border. The pattern obviously shows a completely different distribution of the values *(Fig. 3).* The represented effect appears in the centre of Hungary far away from the border zone due to the interpolation. In spite of this, the external effect is confined basically to the Hungarian border area. The highest values of external potential and the most extended influence occur in the north-western part of the country, with an easy accessibility of Bratislava and Vienna by motorway.

The maximum value appears in the surroundings of the border crossing at Komárom, which is located on the river Danube with the Slovakian Komárno situated on the opposite side of the river. The top value emerges in the area comprising these twin cities. The external effect on potential is weaker in the case of the other sections of the Hungarian state border, although the effect of Zagreb and Osijek can be detected along the Hungarian-Croatian border. Similarly, the influence of Subotica near the Hungarian-Serbian border and the effect of Oradea along the Hungarian-Romanian border are clearly discernible.

The sum of the internal and external potential shows a similar pattern to the internal potential, as the values of the internal potential are significantly higher than the latter ones. The potential field is modified significantly by the external effects only in the case of North-west Hungary. In other parts of the border area the external effect is not continuous and the influence appears only in the form of patches. This phenomenon seems to confirm the hypothesis that the north-western part of Hungary profits principally from the unifying economic space.

The contribution of external potential within the summarised potential value (the ratio of external potential) represents a particular spatial pattern *(Fig. 4).* The relative value of the external potential shows an even pattern, as also the Hungarian-Ukrainian border area can be emphasised besides the formerly mentioned influences with reference to the percentage of external potential. The tendency can be attributed to the low contribution of the internal potential, because these regions are the most distant from Budapest. Therefore, the importance of external potential is rather relative than absolute.

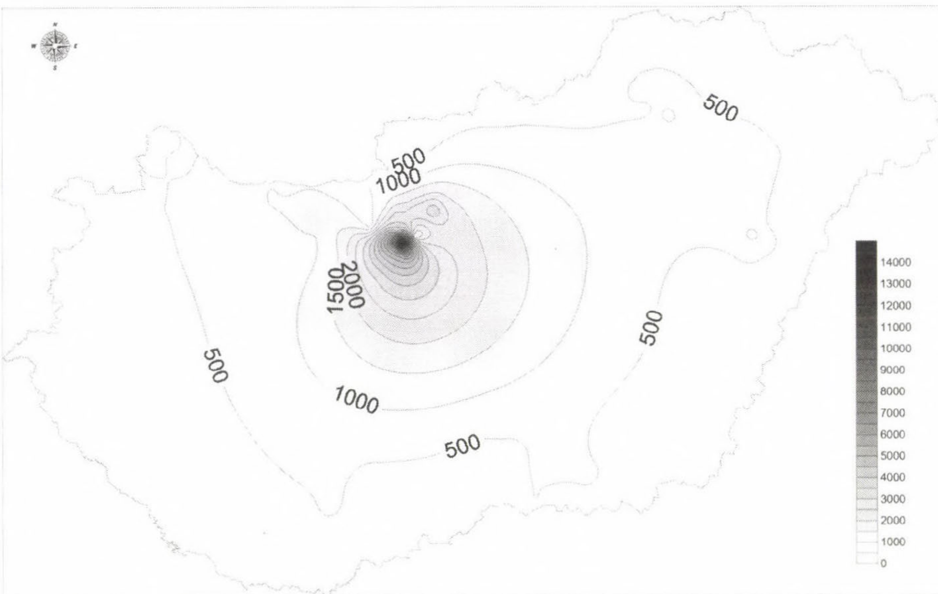

Fig 2. The pattern of internal potential

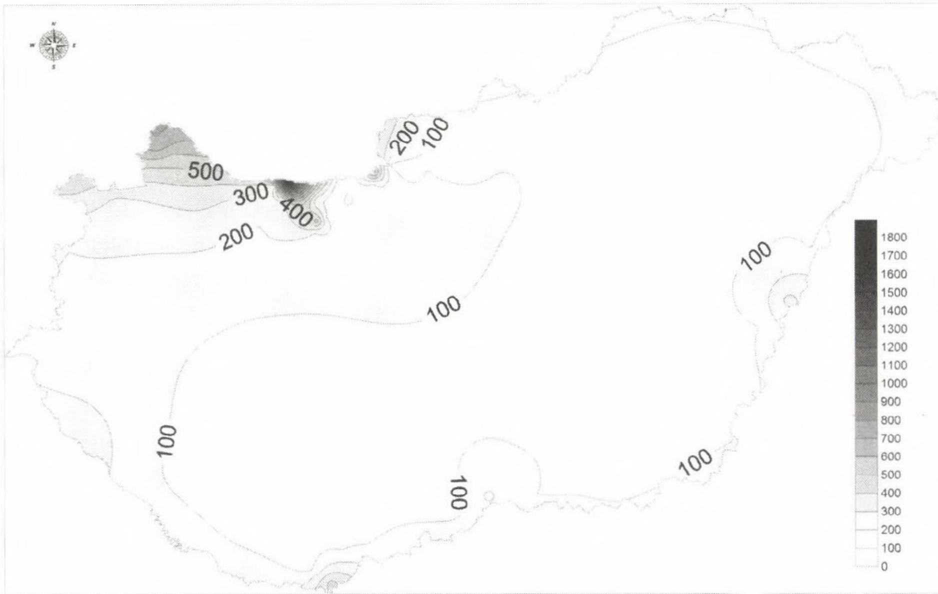

Fig 3. The pattern of external potential

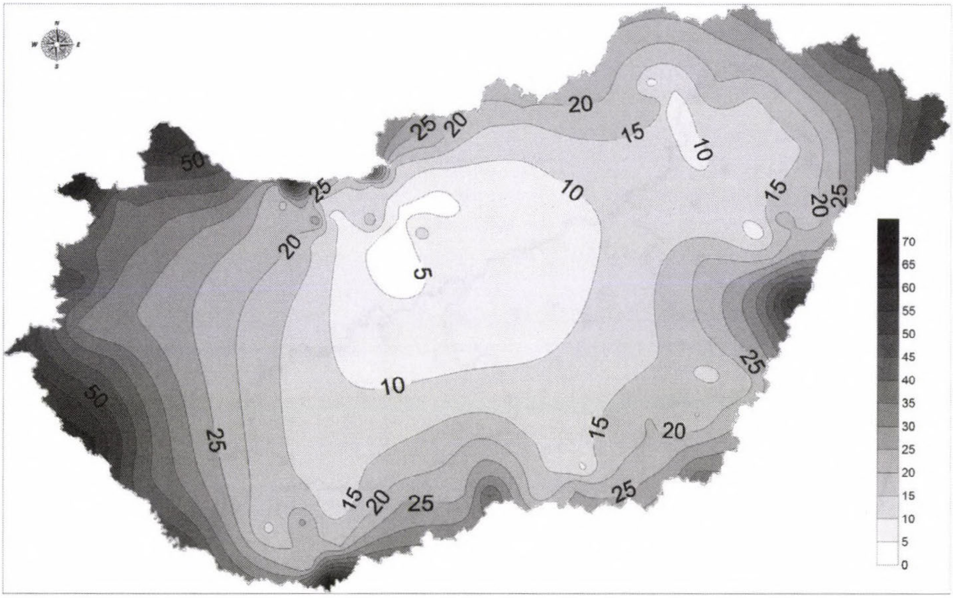

Fig 4. The contribution of external potential to the summarized potential value (without self potential), in percentage

Development level of settlements in the border area

The second part of the paper is aimed to investigate the level of and changes in the development of the settlements that are located in a given border area. In order to denote the development in quantified measures an indicator has been created according to the Bennett method. This complex indicator has been calculated for two years: 1990, the year of political-economic transition considered as the starting date and 2005, the latest year that statistics are available for. Unfortunately, some of the main indicators were not measured in 1990 and there are data available only in the censuses about the employment by localities. The complex indicator includes the following components from the mentioned years:

– taxable personal income per permanent population (1990, 2005),

– number of taxpayers per 1000 inhabitants (1990, 2005),

– number of newly built dwellings in the percentage of the dwellings (1991, 2005),

– number of persons in employment by the locality of place of work in the percentage of inhabitants (1990, 2001 – census),

– number of enterprises per 1000 inhabitants (1992, 2005),

Fig 5. Changes in the development level of the localities between 1990 and 2005. – (10 < – significant increase, 0–10 – moderate increase, -10–0 – moderate decrease, -10 > – significant decrease)

– gross value added of enterprises by locality per inhabitants (1992, 2005),
– export revenue of enterprises by locality per inhabitants (1992, 2005),
– number of private cars per 1000 inhabitants (1992, 2005),
– number of international tourist nights at public accommodation establishments per 1000 inhabitants (1990, 2005),
– own revenues of local governments per inhabitant (1993, 2005).

The maximum value of this complex indicator is 100 theoretically – it means that the settlement has the maximum values of all indicators among the studied group of localities.

Concerning the development of the settlements there were major disparities already at the time of the political transition. Based on the weighed average (by the number of inhabitants) of the development index the settlements located in the agglomeration of Budapest and along the western borders of Hungary have been relatively developed. The values are extremely high in the case of three settlements: Bábolna (it has been one of the most important centres of the extensive agricultural production), Bük and Harkány (two thermal spas of international renown).

Some of the localities experienced remarkable changes in the level of development between 1990 and 2005 *(Fig. 5).* After creating groups from the given settlements by the sections of state border it is stated that the development level of the localities in the agglomeration of Budapest and along the north-western and western state borders has increased generally (NEMES NAGY J. 1996). The positions of the settlements located near the eastern border have stagnated or decreased. Naturally, there are exceptions in the eastern section of the border – the average value of the localities near the Hungarian-Ukrainian border has increased. The Hungarian-Croatian border area showed depression during the examined period by the calculated complex development indicator *(Fig. 6).*

The development pattern of the localities in the group of border areas has been modified since the political transition. The position of Budapest agglomeration has become more dominant compared to the average development level of the border areas. The Hungarian-Slovenian, Hungarian-Austrian and Hungarian-Western-Slovakian border areas indicate higher development levels than the average of 2005. The Ukrainian part of the eastern border area produced a relatively moderate increase, at the same time the Hungarian-Romanian border area stagnated (but it might decrease without the value of Debrecen) or declined compared to the development level in the early 1990s. The development of Budapest agglomeration is indicated by the settlements along the surrounding motorways (Budaörs, Törökbálint, Biatorbágy), which show extremely high increase. Only Bük has been able to hold its position among the 'top settlements'. The majority of settlements with decreasing development levels are clearly seen along the eastern part of the state border.

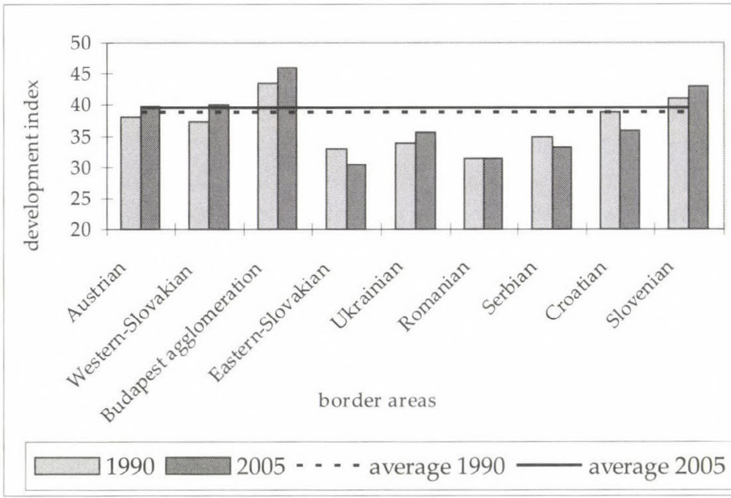

Fig 6. The average development level of the border areas in 1990 and 2005

The correlation between the development of settlements in the Budapest agglomeration and the potential values of the given area is relevant. The maximum values of the internal and total potential are located in the surroundings of Budapest. The values of internal potential are lower in the periphery (from a geographical point of view) therefore the role of external potential becomes more important in the pattern of the potential field. However, the emergence of the potential effects of the external economies also depends on the vitality of the economy on the other side of the border and the openness of a given state border. The localities in the north-western part of the country are in a favourable position from both aspects. There are settlements with relatively high external potential contribution on the eastern part of Hungary as well, but dynamism and development had emerged only in unique places. Current investigations also point out that those settlements that formerly reached high development stage have been able to increase their level of development.

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