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CURRENT LEVEL OF KNOWLEDGE ON LICHENS INVOLVED IN ENVIRONMENT PROTECTION IN POLLUTED AREAS OF ROMANIA

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Abstract. A brief review of the Romanian lichenological studies is done; the main Romanian lichenologists and their research fields of interest are presented. The use of lichens as biomonitors is exemplified with a case study in the surroundings of Zlatna, a well known industrial centre in Transylvania (western part of Romania). The present paper synthesises the research work performed in the area in the last 20 years. The mineral processing plant and smelter of Zlatna town cause acid precipitation and heavy metal contamination due to gaseous emission (SO_2, NO_x) and fall-out of particles enriched in Pb, Zn, Cu, and Cd. The impact on the terrestrial environments consists in extremely high soil and vegetal lead level. The aim of this paper is to present the long term biomonitoring of different contaminant elements using passive and active monitoring methods based on the lichens in the studied area. In 1980, two corticolous lichen species, *Parmelia conspersa* and *Lecanora subfusca,* were transplanted into Zlatna area from an uncontaminated site. The results of short and long term exposure were compared, then the experiment was repeated after 5 years. In 1998, also the heavy metals content of samples of *Cladonia fimbriata*, tericolous native lichen located only outside the strongly polluted Zlatna town was investigated. The heavy metal content of the samples of *Cladonia fimbriata* was compared with that in soil samples collected from the same stationary. The results show that Zlatna region is excessively polluted, and can be included among the strongest polluted areas of the world.

Key words: *lichens, history, Romania, pollution, Zlatna, biomonitoring*

BRIEF SUMMARY OF ROMANIAN LICHENOLOGICAL STUDIES

The debut of lichenology as an independent science in the field of botanical research was marked by the studies of Acharius (1803), who described the morphology of lichen thalli, showing that the soredia and apothecia play a reproductive role. Schwendener (1867-1869), by his theory on algal-fungi symbiosis underlined the complexity of lichens and thus lead to an increased scientific interest in this field.

As in other European countries, before 1900 in Romania no paper exclusively dealing with the study of lichens was published. Lichens as components of the vegetal cover were only recorded besides mosses, pteridophytes and cormophytes. One can mention the studies of Heufler (1853), Schur (1859), Cserni (1877-1878), Simonkai (1893) and Barth (1877-1905) [4]. Between 1862 – 1878, Fuss [4] published a list of over 100 lichen species in the journal *Verhandlungen und Mitteilungen des Siebenburgischen der Vereins für Naturwissenschaft*, then additionally another 48 species in the in the Centuria issues I – XI. In his fundamental work *Systematiche Aufzahlung der in Siebenburgen angegebonen Cryptogamen* (1878), the third chapter contained exclusively data on lichens collected from Transylvania.

The studies of Hazslinszky [4], concerning only cryptogams, were materialized as lichen research in the paper *Magyar Birodalom zuzmóflórája* (1884), the first book that contained all the current data on Transylvanian lichens for that period.

Lojka (1873-1885) played an important role in the study of lichens in the same region, by describing numerous new species, in papers that are still considered as reference publications[4].

Before 1900, in the southern part of Romania (Vallachia), the activity of two botanists Kanitz (1879-1881) – who published about 22 lichen species collected from

Bucegi Mountains, Ceahlău Mountains and the peaks around Râmnicu-Vâlcea area, and Loitlesberger (1897) – who described two new species from Bucegi Mountains, are worth to mention [4].

Starting with the beginning of the XXth century, the number of papers on lichens increased considerably. In Moldavia, Stamatin (1904 – 1907) collected lichenological material from Iaşi, Vaslui, Suceava, and Neamț counties, as well as from Mehedinți area [4]. Among the 100 collected species, 74 have been checked by Zahlbruckner, the most prominent lichenologist of the period. In Transylvania, Zschache (1910-1913) has organised numerous field campaigns in Rodnei, Făgăraş, Retezat, and Bucegi Mountains, and in Hunedoara and Caraş-Severin counties and, as a result, he has described many new lichen species for Romania [4]. Szatala (1927 – 1937) published in the journal *Folia Criptogamica* his work *Lichenes Hungariae,* a reference paper concerning the lichen distribution in Transylvania [4]. Additionally, Foriss (1928-1937) – who studied lichens from Cugir Mountains area and Satu-Mare County – and Gyelnik (1931 – 1933) who published data on lichens occurring in the Secuime area brought their contribution to the field [4].

Cretzoiu was the best known and most prolific lichenologist of Romania; during a relatively short period (1929-1945) he published 35 lichenology papers, besides 140 on cormophytes and 400 papers for the general public. Among the papers on lichens, *Flora lichenilor folioşi şi fruticolşi epidendrii şi epixili din România* (1941), *Conspectul lichenilor Pyrenocarpi* (1942) and *Gymnocarpi* (1943) represent reference works for the topic [4]. His papers were published in numerous prestigious journals in Romania and abroad, but also in the journal he founded, *Acta pro Fauna et Flora universali*. Cretzoiu studied the lichen flora from Bucegi and Ciucaş Mountains, Dobrogea, Braşov area and Târnavelor hydrographic basin, and he described numerous species, varieties and forms new for science.

After the second world war, in the three main universities of Romania - Cluj, Iaşi and Bucureşti, the number of experts in the field increased, and correspondingly the number of areas under study. In Bucharest, the research team consisting of Petria, Mantu and Toma, under the supervision of Moruzi, has produced a large number of studies and papers. They studied Dobrogea area, Bucegi, Cibinului and Retezat Mountains, as well as the forested areas around Bucharest. The main scientific contribution of this group was represented by the *Catalogul lichenilor din România* (1967), the first consistent work – 390 pages – presenting the distribution of all the lichen taxa in Romania, based on reference data [4].

In 1971, the handbook *Lichenii* written by Moruzi and Toma was published [4]; this reference contribution, even if it addresses both the experts in the field, and the amateurs represented until 2004 the main work tool for lichenologists. The retirement of Moruzi, at the end of the ‘70es, also meant the dissolution of the research group; currently there are no specialists in the field at the university of Bucharest.

Between 1961-1979, at the university in Iaşi Burlacu-Rotărescu was active in the study of the lichens flora and vegetation in Moldavia - Ceahlău, Rarău, Cheile Bicazului and Vrancei Mountains. In the ‘70es – ‘80es, from the same area, Sava published 14 studies on the lichen flora around the localities Bacău, Adjud, Tg. Ocna, Nemira and Ciuc Mountains; his PhD thesis concerned the lichen flora and vegetation along the Trotuş Valley. After 2000, in Moldavia lichen studies were revived by two female researchers, Coroi and Marcoci, the first one studying the lichens of Vrancea Mountains, and the second one that of Nemira Mountains.

At the University in Cluj, the period 1950 – 1980 marked an intense activity in the field through the studies of Codoreanu and Ciurchea. They have mainly investigated the Apuseni Mountains area and they have published numerous data on the crustose saxiculous lichens also from other areas such as Făgăraş, Călimani, and Căpățânei Mountains, and the Porțile de Fier area. Ciurchea has published in 2004 the handbook *Determinatorul lichenilor din România*, representing the most complete work in Romania in this field of study, containing both search keys and information on the lichen distribution in our country [4].

From the beginning of the'80es, first as a researcher within the Institute for Biological Research and then as a member of the staff of the „Babeş-Bolyai" University of Cluj-Napoca, Bartók has approached a wide panel of areas of research concerning lichens, including taxonomy, ecology and pollution monitoring. The flora and vegetation studies were mainly performed in the Apuseni Mountains area (Bihor, Vlădeasa, Zărand), Retezat, Cozia, and Țibles Mountains etc. Bartók has also intensively studied the usage of lichens as bioindicators in the industrial areas Zlatna, Copşa Mică, Baia Mare, and Dej. She was concerned with the influence of radioactive pollution on lichens following the nuclear accident at Cernobîl. The results of her research were reported in more than 100 scientific papers published in acknowledged journals in Romania and abroad. At the same university in Cluj, starting with 1992 Crişan was also involved in the study of lichens, being mainly concerned with taxonomy, ecology and lichens vegetation in the Pădurea Craiului Mountains, as well as in other areas of Transylvania. In 2005, Bartók and Crişan have published, together with Drăgulescu, a book on the lichen flora of Sibiu County (*Lichenoflora județului Sibiu,* Drăgulescu et al, 2005) [14].

LICHENS AND POLLUTION

Evaluating air quality is one fundamental component of any strategy of environmental management; lichens are the best-known biological indicators for terrestrial environments.

Lichens are characterized by an assembly of properties that allow their usage as biomonitors: they are capable to accumulate quantifiable amounts of pollutants; their organisms, or significant parts of their bodies are easily available concerning quantity and distribution in time and space for providing samples needed for research; their adsorption or accumulation processes are differentiated according to the exposure; repeatability is essential; low costs for sampling and analyses.

Lichens represent ideal monitors due to the following reasons:

- some species may show a wide geographical distribution, allowing comparative studies of the concentration of pollutants in various regions;
- they are perennial plants that may accumulate pollutants through the year; in general, they have long duration of lives, their storage capacity being preserved for long time intervals;
- these plants accumulate metals in much higher amounts as compared to their physiological requests.

Among the properties that point to lichens as ideal tools for monitoring, one can mention: the absence of the cuticles, stomata and of the radicular system; a lax structure (allowing the accumulation of chemical elements and compounds); water adsorption and gaseous exchanges are achieved through the whole surface of the thallus; a slow growth and a remarkable longevity (they are active throughout the whole year), a high adaptive capacity allowing their survival in habitats where other life forms are excluded, continuous

metabolic activity (perennial plants), the dependence of their metabolism mainly on the physical-chemical composition of the atmosphere.

The continuous pollution of the atmosphere is negatively influencing the lichens, which progressively accumulate lethal concentrations of sulphur, heavy metals, and radioactive elements. Currently it is known that the massive decrease of the number of lichen species is the consequence of an enhanced acid pollution, while in the case of nitrate pollution a reverse effect is noticed, *i.e.* an expansion of nitrophylous species.

The specific and controversial biology of lichens, their dual nature, ecology and sensibility to pollution represented the premises in their usage as indicators or biomonitors for the SO_2 and heavy metals content in industrialized areas.

The basic methods used for monitoring consist of:

- mapping of one or of several lichen species around the polluting source; the maps obtained in this way contain the description of the studied species, their frequency or coverage of the substrate (%), respectively the correspondence between the lichen vegetation and the pollution degree [25]. By using the index for air pollution, IAP, the pollution degree of each stationary may be quantified, allowing their assignment to various pollution areas [2].

- recording the morphological (size and colour of the thallus) and the physiological (content of assimilatory pigments, breathing activity) changes; these parameters have been used for evaluating the Dej industrial areas [6], [7].

- lichen transplant method, consisting in mounting of disks or squares of tree rhytidome together with the lichens vegetating on them, from unpolluted areas on host trees from polluted ones; this method provides both qualitative and quantitative information and it is accessible even in the cases when the lichen flora is destroyed; it allows checking and measuring pollution during a certain time interval and the transplants may be transferred back to the unpolluted areas for checking if the damage had a permanent or a reversible character. In Romania, this method has been applied in the study of the industrial areas Zlatna, Baia Mare and Dej.

There are numerous studies focused on the study of air pollution caused by the activity of metallurgical, chemical and in general industrial polluting sources. Thus, the changes in environmental quality are reflected in changes of the lichen flora composition. Many expert studies demonstrate the negative impact of SO_2, heavy metals or other pollutants on lichens distribution [3], [5], [16], [24]. These studies have pointed out the existence of lichen distribution zonation around industrial centres.

However, only little research was done concerning the effect of pollution on lichen flora and vegetation around urban areas where there is no industrial polluting source. A reference paper in this respect was published by Skye [28], who set the milestones for further studies concerning the relationship between the environment and the presence of epiphytic lichens around metropolitan areas. The investigation of Skye on the Stockholm area connected the decrease of the number of lichen species to both the global warming phenomena, and the microclimate changes and Pb and SO_2 pollution resulted by vehicle traffic.

An inventory of corticolous macrolichens was done by Tanghe, Crişan et al. [30], concerning the Brussels-Capitale region – area traditionally considered as a “semidesert area for lichens” – where, from the 26 investigated stationaries, a number of 17 macrolichen species was included. During the year 1996, the first inventory of corticolous macrolichens from Cluj-Napoca was performed by Crişan and Pop [11]. For the large urban areas it can be stated that the main polluting factor is represented, in the absence

of industrial polluting agents, by traffic; in Romania in particular, the vehicles are often non-ecological, as evidenced by the studies of Bartók, Crişan and Rusu in towns like Cluj-Napoca [9], [12], [13], Satu-Mare [18], Baia Mare [27], or Suceava [10].

As bioindicators, lichens provide information in environmental pollution, while their occurrence indicates the restoration of the quality of the environment.

Some studies [32] underline the fact that lichens may also be used in bioremediation, the experimental work proving that large copper, lead, zinc, arsenic and uranium concentrations may accumulate in their thalli.

CASE STUDY - ZLATNA

Hundreds of years of mining and minerals processing in the Apuseni Mountains of Romania have caused severe environmental damage with important consequences for human and environmental health. These effects are particularly serious where the minerals industry is in close proximity to urban environments. In the town of Zatna, in the Apuseni Mountains (Fig. 1), a mineral processing plant and smelter are located within two minutes walk from the town centre. Gaseous emissions (SO_2, NOx) and fall-outs of particles enriched in Pb, Zn, Cu and Cd cause acid rain and heavy metal contamination for more than 30 km down-wind from the smelter. Severe health problems in local communities were first reported more than 25 years ago [29]. A subsequent environmental health study by the U.S. Agency for International Development (USAID) identified high blood Pb levels in local children of up to 35 to 60 ppm and a marked increase in the incidence of chronic bronchitis due to high levels of SO_2 [15]. Lead shows neurotoxic effects in children when blood levels exceed 0.1 ppm (U.S. Centre for Disease Control and Prevention).

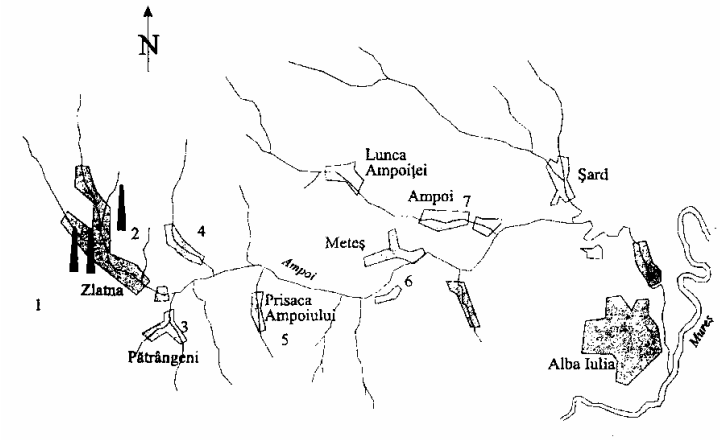

Fig. 1. The sketch map of the Zlatna region and the location of the studied sites.

The geology of Zlatna area is complex, there are two main types of mineralization in the area: minor mercury deposits related to Neogene low temperature hydrothermal activity and extensive hydrothermal copper, lead, zinc and gold deposits related to the Tertiary volcanics. The Tertiary deposits, which are by far the most extensive in the region, are dominated by such sulphide minerals as galena (PbS) and chalcopyrite ($CuFeS_2$) which are still mined today. All the mines in the area are underground workings which mainly contribute to environmental contamination through metal-enriched acid

drainage from their adits and small tailings heaps. Copper ore from mines all over Romania as well as local ores containing copper, lead, zinc, cadmium and arsenic, are transported to the processing plant and smelter at Zlatna. In the industrial area of Zlatna, the landscape-related, topographical and meteorological factors represent a complex playing an unfavourable part in the self-purifying process [32].

The smelter lies on Ampoi valley at 400 m altitude, surrounded on either side by hills rising to over 900 m. The prevailing winds are westerly although local weather conditions are varied with frequent changes in wind direction. Smoke emissions from the smelter often sink to the valley floor enveloping the town in a heavy sulphurous mist which is occasionally accompanied by fall-outs of ash containing particles rich in metals. This results in extremely high soil lead levels on the valley sides of between 50 and 4,000 ppm [15]. Limited studies on metal accumulation in different types of soils have shown that lead is most strongly accumulated in the uppermost "brown earth" horizon of forest soils [23]. This behaviour is not common to all metals with cadmium, another extremely toxic metal, showing highest concentrations in agricultural soils [23]. Despite lead being apparently less abundant in agricultural soils, locally grown vegetables may still contain high concentrations. Turnips, cabbages and grass, for example, have been found to contain 536 ppm, 347 ppm and 1971 ppm lead respectively [33], largely depending on soil type [17]. The European Commission has set maximum limits on lead in cereals, fruits and vegetables of less than 0.3 ppm.

There were years when Zlatna town was so polluted, that only the most tolerant crustose lichen, *i.e. Acarospora smaragdula* could survive [8], thus it was necessary to transplant lichens from uncontaminated sites. Two epiphytic species, *Parmelia conspersa* and *Lecanora subfusca*, were collected from uncontaminated (control) forest (Muncel pe Arieş) and transplanted in the vicinity of Zlatna town, along the Ampoi river valley in 1980.

Both species were sampled for analysis 4 and 12 months, respectively, after the transplantation. Five years later, in order to obtain an accurate image of pollution evolution in this industrial area, the lichen transplantation was repeated [3].

In 1998, in the frame of a common project with researchers from The Natural History Museum, *Cladonia fimbriata* terricolous lichens were collected “in situ”, from locations outside Zlatna city at 5,15, and 20 km far from the smelter chimneys.

The study was carried on in 7 stationaries (Fig. 1), where both lichen transplants and soil analyses, and sampling of *Cladonia fimbriata* were performed.

Lead, Cu, Zn and Mn content of transplanted lichen species were determined by flame atomic absorption spectrometry after digestion with HNO_3 and H_2O_2 mixture, and the C*ladonia fimbriata* species elemental content by inductively coupled plasma – atomic emission spectrometry after the same digestion procedure.

Table 1.

Accumulation of Pb, Cu, Zn and Mn (μg/g) in two lichen species transplanted for 12 months in Zlatna polluted area.

Species	Element	Sampling sites			
		Control	Zlatna	Pătrângeni	Ampoița
Parmelia conspersa	Pb	0	2550	2000	50

Lecanora sufusca		0	480	310	140
Parmelia conspersa	Cu	15	550	370	200
Lecanora sufusca		0	340	0	0
Parmelia conspersa	Zn	50	970	250	220
Lecanora subfusca		80	500	130	100
Parmelia conspersa	Mn	230	110	90	110
Lecanora subfusca		410	320	290	180

Among the two lichen species transplanted, the folicolous *Parmelia conspersa* accumulated the largest quantities of Pb, Cu and Zn, their concentration diminishing further from the source. The element with the highest concentration was Pb (2550 μg/g) which was not traced in the control lichen (*Lecanora subfusca*).

Parmelia conspersa accumulated Zn in concentrations about 2 times, and Cu 1.6 times higher than *Lecanora subfusca.* A paradoxical situation occurred in case of Mn, where the concentrations in the control lichens were larger than those of samples exposed to pollution for 12 months, while the minimum values were recorded in samples from the most polluted areas. According to Westman (1975) [26], whose opinion we support, the Mn content of lichens is not a good indicator of pollution, because large amounts of this metal are involved into exchange reactions with other elements.

The elemental concentration was found to vary in a direct ratio with the distance from the pollutant source.

Parmelia conspersa was the species best adapted to the transplantation experiment, thus the species was the only one we used for further comparative studies (Fig. 2).

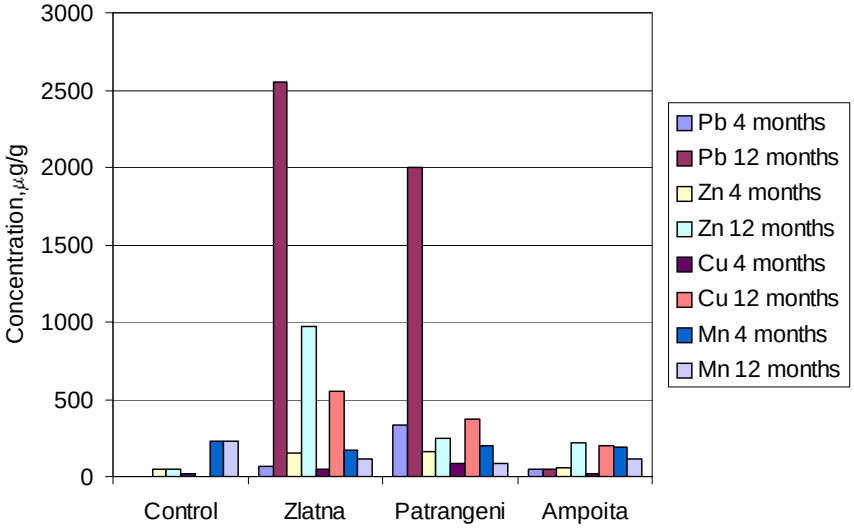

Fig. 2. *Pb, Zn, Cu and Mn concentration in Parmelia conspersa following an exposure to noxae for 4 and 12 months, respectively.*

As expected, the results have shown that the accumulation was greater after the longer (12 months) exposure. The lack of direct correlation between the accumulation during a short period and that during the longer one may be explained by the fact that the tree crowns in the lichen structure partially protect them from noxae during the summer-autumn (July-November) short exposure; the longer exposure allows the rains and snows loaded with noxae to reach the lichens directly, thus heavy metals accumulated in larger amounts. This idea is also supported by Vestergaard [31].

To obtain an image of pollution evolution in this area, the data obtained in 1980 were compared with those collected in 1985. In both cases, the experiments had been carried out during a 4 month interval (Fig. 3).

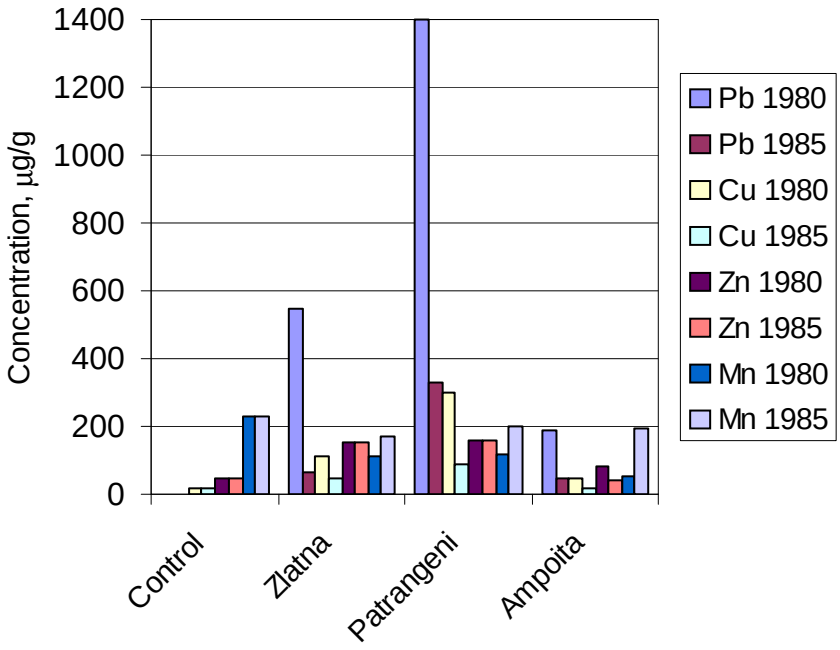

Fig. 3. *Comparison of data obtained in 1980 and respectively in 1985 regarding Pb, Cu, Zn and Mn contents.*

A slight improvement on air quality was noticed over the five year period as a result of the installation of a new, much higher smelter chimney.

In 1998, the terricolous lichen C*ladonia fimbriata* was found “in situ” (native) only in three sampling sites out of Zlatna town (Pătrângeni, Crucea, and Meteş), being absent from the more distant sampling sites; this fact prevented us from drawing a real conclusion (Table 2).

Table 2.

Concentration of 8 pollutant metals and of S (µg/g) in Cladonia fimbriata collected in 1998 from Zlatna area, compared with one collected in Retezat National Park in 1985.

Sites	Concentration, µg/g								
	Pb	Zn	Cd	Ni	Fe	Cu	Ag	As	S
Pătrângeni	3254.0	226.5	3.3	4.8	2908.0	483.0	35.5	28.0	2046.0
Crucea	331.4	198.1	4.1	4.7	1489.0	245.1	5.0	5.7	1405.0
Meteş	1604.5	117.2	3.2	8.2	3575.0	306.3	5.7	14.2	1575.0
Retezat	0.0	38.0	0.3	0.	125.0	25.1	0.0	0.0	15.5

The difference between the elemental content (thousand times higher values in some cases) in *Cladonia fimbriata* living in an unpolluted, uncontaminated place as the Retezat National Park and those in the same species collected from Zlatna industrial area is obvious. In the same time, a good correlation between the elemental concentration in the lichens thalli and the distance from the polluting source is evident.

By comparing the concentration in the heavy metals Pb, Cu, Zn in the thalli of the *Cladonia fimbriata* with that recorded in soil samples from the same stationaries, one can notice that the highest levels are reached for lead, which accumulated about 3.5 times more in the lichens thalli as compared to soil.

A reverse case was recorded for zinc, where accumulation was two times higher in soil than in lichens, while for copper the accumulation was comparable in the two types of samples (Table 3).

Tabel 3

The minimum and maximum concentrations of Pb, Cu, Zn (mg/kg) recorded in Cladonia fimbriata and soil samples in Zlatna areas

Heavy metals	Concentration in *Cladonia fimbriata*		Soil concentration	
	minimum	maximum	minimum	maximum
Pb	317	5399	200	1680
Cu	169	575	25	600
Zn	20	267	180	500

The resulted were also confirmed by other research works in the same area, but on other groups of living species. Air pollution from the smelter also has a major impact on the mixed deciduous woodland of the area which is dominated by beech *(Fagus sylvatica),* hornbeam *(Carpinus betulus)* and oak *(Quercus petraea)* [17]. Forest soils are highly acidic down to pH 2 [1]. On the valley sides, down stream from the smelter, the tree and herbaceous plant cover is sparse and evidences severe damage from sulphur dioxide and acid rain. Most of the trees show transformations such as extensive necrosis, dying off of the upper canopy branches, blackening of their trunks, and by mid July, yellowing of leaves. The lack of vegetation on many of the steeper slopes has led to severe soil erosion. On more gentle slopes, leaf litter on the forest floor is extremely deep (up to 60 cm) due to the quantitative decrease of microfaunal organisms such as nematodes, which usually cause its decomposition [22]. Beech woodland around Zlatna contains only 27% of the average number of earthworms found in similar, less contaminated ecosystems 30 km away from the town [20]. The diminishing of invertebrate fauna has led to a marked decrease in the number of organisms at upper levels in the food chain including birds [19]. Fungi are amongst the most successful organisms living on the forest floor, including the edible mushroom *Macrolepiota procera.* However, these have been shown by Pop and Nicoară [21] to contain thirteen times the Cd and four times the Pb levels allowed by World Health Organization health security standards, with young fruit bodies containing the highest levels. The extraordinary capacity of fungi to accumulate metals is well known and therefore, as a precautionary measure, those growing in the Zlatna area should no longer be consumed.

However, in 2006 SC Ampelum SA Zlatna terminated the activity, thus in the future an improvement of the air quality is foreseen.

In conclusion, this study demonstrated the use of lichens in monitoring the effectiveness of environmental initiatives to reduce polluting emissions.

The heavy metal accumulation was species dependent and correlated with the distance from the polluting source, wind direction, meteorological conditions and microhabitat. The most aggressive element was Pb, emitted not only from the smelter, but possibly also by the vehicles in the traffic. The uptake ratio for different elements presented the following sequences:

- for *Parmelia conspersa* : Pb>Mn>Zn>Cu
- for *Cladonia fimbriata* : Pb>Fe>S>Cu>Zn>Ag>As>Ni>Cd

Zlatna is just one of the many towns in Europe suffering the effects of decades of chronic industrial pollution. Worldwide, the 20th century has become synonymous with the sight of smoking chimneys, slag heaps, rubbish tips, illegal dumps and 'contaminated land'. Almost the planet's entire surface is contaminated in some degree by metals and other toxic substances. A better understanding is important not only in conserving natural habitats but also for protecting human health as metals may be accumulated/concentrated through the food web. Low cost solutions to the problems of metal contamination are therefore urgently required. Natural remediation systems are likely to provide the most cost effective long-term solutions. The survival of organisms in the presence of toxic metals in contaminated sites such as Zlatna depends on intrinsic biochemical, physiological and genetic features. Whilst it is certainly true that Zlatna has suffered intense environmental degradation, the area is also a natural laboratory for studying fundamental processes of metal mobilisation and bioaccumulation. Our studies are designed to both identify risks to human health and to work towards better natural systems for cleaning-up such metal contaminated environments.

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ISTORICUL CERCETĂRILOR LICHENOLOGICE ÎN ROMÂNIA. LICHENI IMPLICAŢI ÎN PROTECŢIA MEDIULUI ÎN ZONE POLUATE DIN ROMÂNIA

(*Rezumat)*

Lichenologia ca ştiinţă de sine stătătoare în domeniul botanic a apărut în urma cercetărilor lui Acharius (1803), care a descris primul morfologia talurilor de licheni. Ca şi în alte ţări europene, nici în România, înainte de 1900, nu au existat lucrări care să se ocupe exclusiv cu studiul lichenilor. Ca şi componenţi ai covorului vegetal, lichenii au fost doar amintiţi alături de muşchi, pteridofite şi cormofite. Astfel amintim studiile lui: Heufler (1853), Schur (1859), Cserni (1877-1878), Simonkai (1893), Barth (1877-1905), Fuss (1878) şi Hazslinszky, care în 1884, publică prima carte care conţinea toate datele referitoare la lichenii din Transilvania la momentul respectiv. Cel mai cunoscut şi mai prolific lichenolog român a fost Cretzoiu, care într-o perioadă relativ scurtă (1929-1945), a publicat 35 de lucrări de lichenologie, trei fiind fundamentale, respectiv *Flora lichenilor folioşi şi fruticuloşi epidendrii şi epixili din România* (1941) şi *Conspectul lichenilor Pyrenocarpi* (1942) şi *Gymnocarpi* (1943). După al doilea război mondial a crescut numărul lichenologilor în cele trei mari centre universitare ale ţării, Bucureşti (Moruzi, Petria, Mantu, Toma), Cluj (Codoreanu, Ciurchea), Iaşi (Burlacu-Rotărescu, Sava), studiile lor având drept obiective flora şi vegetaţia lichenologică din cele trei provincii istorice. În ultimele decenii au fost continuate studiile lichenologice la Iaşi de către Coroi şi Marcoci, la Cluj de Ciurchea, Bartók şi Crişan, studiile tratînd, alături de flora şi vegetaţia lichenologică şi biomonitorizarea poluării cu ajutorul lichenilor.

În gama variată a biomonitorilor, lichenii prezintă un interes deosebit datorită proprietăţilor fizice, chimice şi biologice pe care le posedă. Prin monitoring se pot determina variaţiile nivelului şi efectele poluanţilor în timp sau spaţiu.

Una dintre zonele cele mai poluate din România este Zlatna, unde au fost aplicate mai multe metode utilizând lichenii ca biomonitori ai poluării cu metale grele (Pb, Zn, Cu, Cd, Mn) şi emisii gazoase (SO_2, NO_x), provenite de la fabrica de procesare a minereurilor neferoase Ampellum S.A. Cercetările s-au desfăşurat pe o distanţă de 30 km, în amonte şi aval de sursa de poluare, timp de mai mulţi ani. Cercetările au arătat că

numărul lichenilor creşte direct proporţional cu creşterea distanţei faţă de sursa poluantă, în zona martor, nepoluată, identificându-se 47 de specii, la 10 km de sursă 9 specii, iar în imediata apropiere a coşurilor de evacuare instalându-se aşa numitul “deşert lichenic”. O altă metodă utilizată a fost cea a transplantărilor, fiind folosiţi licheni recoltaţi dintr-o zonă nepoluată (Muncel, Valea Arieşului). Analiza probelor, după o perioadă de 5 luni, a evidenţiat creşterea de la 2 până la 7 ori a cantităţilor de Pb, Zn, Cu, Mn, în funcţie de carcteristicile speciilor de licheni folosite şi distanţa faţă de sursa poluantă. S-a utilizat şi o a treia metodă, cantitativă, respectiv cartarea pe baza indicelui de poluare atmosferică (IAP), urmărind acoperirea, frecvenţa, abundenţa şi toleranţa specifică. Cele trei metode se completează reciproc, rezultatele obţinute susţinând concluziile. Monitorizarea zonei s-a făcut timp de un deceniu până la suspendarea activităţii societăţii de prelucrare a minereurilor.

În anul 1980, două specii de licheni corticoli, *Parmelia conspersa* şi *Lecanora subfusca*, provenind din arii nepoluate, au fost transplantate în zona Zlatna. Au fost comparate rezultatele expunerii eşantioanelor transplantate pe termen scurt şi lung, experimentul fiind repetat după o perioadă de 5 ani. În 1998 a fost analizat şi conţinutul în metale grele al unor eşantioane de *Cladonia fimbriata,* specie tericolă nativă în aria de studiu, dar numai în afara zonei puternic poluate. S-a realizat şi analiza comparativă a conţinutului de metale grele în eşantioanele de *Cladonia fimbriata* şi solul colectat din aceleaşi staţionare. Rezúltatele obţinute au arătat că zona Zlatna este puternic poluată, putând fi inclusă printre regiunile cele mai afectate de poluare din lume.

AN ECONOMIC ANALYSIS FOR LANDSCAPE DEVELOPEMENT IN“LAHANOKIPOI” AREA OF THESSALONIKI

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Abstract An Economic analysis for Landscape Development in“Lahanokipoi” area of Thessaloniki. This paper is about an economic investigation in order to analyze the existing situation of Lahanokipoi landscape development and the possibilities that can come out when exploring it, starting by writing down the existing business companies and industries, the value of landscape by using economic ratios and the perspectives that can come out. The Lahanokipoi area covers a big part of old industries that are no longer in use and there is very low development, which suggests that there could be a total reconstruction of landscape, either by building a business park or a business center with all kinds of facilities and parks. The project suggests a new model that is economic stable and introduces not only the economic and business development that can be achieved but also the environmental and architectural structure that can maximize the value of landscape. It is the first time in literature that we have a landscape economic and architectural analysis in this part of the city and so the contribution of this paper is of vital importance. The fact that there is a low construction in the area clearly shows the perspective of future development. The proposed methodology is of interest for architects, civil engineers, environmental analysts, businessmen, public sector representatives, local authorities, economologists and many others.

Key words: *Landscape development, economic analysis, SWOT analysis, Business plan, Business park,Cconstruction*

INTRODUCTION

The study of Lahanokipoi area started due to a university project that has been given from the Municipality of Thessaloniki and intends to analyze the objective value of the area in order to create a full-organized bussiness park that will increase the value of landscape and of the whole area [1]. It is of vital importance because this area has been deserted up to a point and needs to be rebuilt in order to attract the interest of the ctizens.This area has already attracted many scientists such as architects, civil engineers and economologists, who have been occupied with various suggestions for it [2].

Lahanokipoi area is situated in the west entry of Thessaloniki city, is close to the port and at the moment there are a few businesses that function there, some of them are new but most of them are old and count many years of function [3]. The area is now at “crisis”, as it’s said, which has given the motivation to local authorities to restudy the perspectives of the specific area and to organize a project to explore the landscape [4].

It is actually amazing the fact that the area could be transformed into a second metropolitan center of the city, due to it’s priviledged location. It combines all the nessesary conditions for such a thing. The perspectives are many and the authorities have finally understood it [5].

This investigation intends to present all the possibilities that Lahanokipoi area can show and it suggests solutions that can be really usefull [6]. The first step is to show the landscape right now, how many companies are there and which of them have a real reason to be there. How many buildings are deserted and how dangerous it can be to even consider walking there during day time. How the garbage and the dirt ruin all the atmosphere and make it impossible for someone even to stand there, imagine working there [7].

The second step is to give some details of the existing suggestions, compare the advantages and disadvantages of these suggestions by using SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) and end up to the best suggestion [8].Finally, the third step presents a fullfilled suggestion of a business park with all the nesessary facilities, that proves to be the best choice for the area and analyzes the importance that could have for the city [9].

THE PROJECT (ANALYSIS)

Lahanokipoi area, as it is reffered above, is situated in the west side of the city, near the port and the center. There are many businesses that are founded and function in the wide zone of the area, such as business centers, technical companies, small entreprizes, ship companies, import-export companies, advertisement offices, amusement clubs and many others [10]. Some of them are situated in new, modern buildings, some others, usually the olders, in older buildings [11]. The area is characterized by the coexistance of old and ugly buildings with new and more priviledged ones [12].

The general idea is to create a business park where a big number of those businesses or all of them could be situated in similar and more ellegant buildings, that would express the style and the image of those companies, according to the services that each one of them provides [13]. It would be extremely interesting if we could gather in the same business park all kinds of businesses with different objects each one, and in different kinds of buildings. It could be an architectural revolution for the city and could also attract many visitors, instead of only the citizens themselves [14]. This could also be very helpful, because it would provide a sort of identity for those businesses and people could identify at once the kind of businesses that each building represents [15].

This of course, is not at all easy to acheive. There are many key factors that need to be consider, such as the number of businesses that a business center could have, the object of the business and the reasons why a company should move to a business center, the benefits that it provides, the area that it should be situated, how close to the city and the objective value of landscape right now [16]. It is an endless catalogue and it needs the cooperation of many scientists and researchers in order to acheive the best possible result with the maximum benefit [17].

Right now the situation is considered to be rather wild or even dangerous [18]. This is because the area lacks of control and after daytime is dangerous even walking there on foot. The suggestion is to create a business center that would increase mobility and traffic in the area and would attract more people in order to minimize the danger. There are three issues that need to be considered here [19]. First the exact location of the business park, second the definition of necessary and basic infrastructure and facilities of the business park and third the budget that such a plan needs. We are going to analyze each issue separately [20].

Location

Especially the term “location” refers to the geographical placement of the space in which the business park will take place in relation to the characteristics of the area that will be chosen [21]. Lahanokipoi area is selected because it combines all the below characteristics in addition to the necessity of it’s immediate exploration [22].

Restrictive factors such as the incorporation of the site in the urban-planning, the institutional and property-ownership regime, the value of the land etc will also be

studied.An additional important restrictive factor is the enviromental impact of the project [23].

It is evident that “site” and “infrastructure”are interrelated. Indicate factors that relate the two are:

-availability and value of the land

-accessibility and connection with highways or central roads, distance from the port, etc.

-enviromental impact

-availability of power networks and telecommunications

It is also nesessary to be considered [24]: the geo-morphological characteristics, land-usages, sensitive and protected areas, transportation accessibility, incorporation in the urban-planning, developement trends of the area and architectural innovation [25].

Definition of necessary and basic infrastructure and facilities

In this issue we need to consider the necessary natural and enviromental infrastrusture such as water-sewage, waste management, etc. [26]. Also the nesessary technology and telecommunication infrastructure that will make the business park even more priviledged and attracted.

Most importantly is the parking space that will be designed in order to solve the big parking problem of the area and therefore will attract even more businesses [27].

It could also be wise to include some conference spaces that will gather bussinessmen from abroad and will increase in such way motivation and innovation in the area [28].

Finally, allocation of open-air spaces such as open-air stands, rest areas, etc will be equally usefull and necessary in addition to the security and monitory systems that will make the area safe including fencing [29].

Budgeting

Before the exact estimation of the cost of such a business park it is important to start a pre-marketing analysis in order to examine the business trends of the area. This is possible by creating a small questionnaire that will be handed to businessmen of the area but also to other bussinessmen of the city in order to understand their future moves and to examine their intention to move to this business park [30].

The budget of the park is interrelated with the objective cost of landscape and it’s accessibility. This is now under examination and by the end of the year a fullfilled budget prediction shall be ready [31].

A SWOT analysis or a cost benefit analysis will make this proposal even more clear.

SWOT ANALYSIS OF LAHANOKIPOI AREA

SWOT analysis is an important instrument in order to evaluate the right exploration of landscape and this study presents all the benefits for creating this business park in Lahanokipoi area [32].

There is also the need to provide the economic ratios of the objective value of landscape in order to estimate the benefits that can come out by exploring the area. These ratios are stable and adjustable, according to the position of landscape and they will provide an exact prediction for budgeting [33].

Strengths:

-Location of the area (near the center of the city, accessible to the sea and the port, business area, free unexplored space and landscape) [34]
-developement trends, since there is already business infrastructure in the wide area
-there is no other business park so it is an important innovation for the city
-free parking space
-accessibility to the center and other businesses
-better business enviroment
-better access and parking spaces
-better accomodation and facilities
-architectural innovation
-better security of the area – increase of safety
-approriate exploration of landscape

Weaknesses

-Difficulty in estimating the exact land evaluation, because there is a complexity in landscape ownership [35]
-difficulty in convincing the state(municipality) for immediate funding (bereaucracy) in order to explore landscape
-several delays of the project

Opportunities

-New business oppurtunities for young businessmen
-opportunities for expanding the already existing businesses
-opportunity for creation of business clusters

Threats

-Enviromental organizations that might be against it
-small older businesses will close down or be ruined
-historical value of the buildings will be destroyed.

RESULTS, DISCUSSION AND FUTURE PERSPECTIVES

This project intents to show the dynamics that Lahanokipoi area presents and with the right exploration it could lead to important and beneficial perspectives [36]. By accomplishing the exploration of landscape and creating a full- planned and well organized business park, small and big companies could gather all together in a friendly and healthy enviroment, just a bit away from the noise of the city and could function in the best possible way [37]. The job enviroment is one of the most nesessary things when it comes to job selection and it could play a very important role in a company's choice to move.

The selection of the appropriate location is the first step [38]. The second step is to choose the architectural characteristics of the buildings and the facilities that the park could offer, after examining the market situation and predicting the business preferences [39].This could happen with the cooperation of a team of scientist such as architects, civil engineers, economologists, laywers, marketeers, analysts, managers and also enviromental scientists [40].

It is proved above that with the right organization and cooperation this business park will increase the business and developement trends of the area and will motivate

many businessmen [41]. Additionally, it could lead to a great architectural innovation for the city and attract many visitors [42].

SUGGESTIONS FOR BUSINESS PARK

In order to examine the situation closer, we have examined some of the worlds most known business parks and they are presented below.

Fig. 1. *The Alabama Business Park*

This is one of the U.S. bigger business parks, and it clearly presents the succesful exploration of landcape, as well as the facilities that it provides.

I-565 Business Park in Alabama is conveniently located at the Intersection of I-65 and I-565, one of the South's major transportation routes. The property is owned by I-565 Partners, LLC and zoned for commercial, industrial, warehousing and technology use (see Fig. 2 & Table 1).

Fig. 2. *The I-565 Business Park.*

Table 1.

The Land Information of the I-565 Business Park

Land Information:	
Type:	Industrial Park
Total Acres:	60 acres
Available Acres:	37 acres
Largest Tract:	15 acres
Minimum Tract:	1 acre
Topography:	Gently rolling
Fire Rating:	Huntsville
Protective Covenants:	Yes Brick/Block building facade
Zoning:	Commercial Industrial Park
Former/Current Land Use:	Agriculture
Major tenants	Clear Channel Radio, CINTAS, CTA, Cowan
Land Lease:	Yes
Price:	$75,000 - $100,000 per acre
Property Tax:	Various (Limestone County)
Land Owner	I-565 Partners, LLC

Utilities:	
Gas:	Huntsville
Water:	Limestone County
Sewer:	Huntsville
Electric:	Athens
Transportation:	
Highway:	I-565 on site; 2 miles to I-65
Rail:	7 miles to International Intermodal Center
Water:	9.5 miles to Morgan Co. Port Authority
Air:	6 miles to Huntsville International Airport

Fig. 3. *The Map of the I-565 Business Park*

As we can see in the pictures above (see Figs. 2, 3), I-565 business park has a priviledged location, near Huntsville international airport, combines commercial and industrial facilities and is very well orginized. The exploration of landscape in this case clearly represents the standards of the area and could be a good example for Lahanokipoi area inThessaloniki.

Fig. 4. *The Toronto Business Park.*

The Toronto Business Park is located at Toronto NSW, approximately 1 hour North of Sydney (see Fig. 4).

Within one hours range of over 600, 000 residents of Newcastle and the Hunter and 300, 000 residents of the Central Coast. Toronto Business Park is conveniently central.

With an estimated population growth to 850, 000 within the next 20 years. The Hunter* is a rapidly expanding, boom region.

* The Hunter is made up of the following shires: Cessnock, Dungog, Glouster, Great Lakes, Lake Macquarie, Maitland, Merriwa, Newcastle, Port Stephens, Singleton, Murrurundi and Scone.

Toronto Business Park is proud to announce the launch of a new website. Toronto Business Park provides people with a purpose built warehouse, receiving and distribution facility in the heart of the Hunter. Also the location here is privileged, because it is close to many cities and towns in Wales and this makes it attractive to more companies and to the residents of the area of course.

Fig. 5. *The Orco Business Park (Budapest, Hungary)*

The ORCO Business Park is situated at Budaörs on the outskirts of the Buda mountains. Thanks to its well positioned location and the closeness of the major motorways (M1, M7), Budaörs is rightly called the **western gate of the capital**, Budapest.

Its character, that of a logistic junction is an important factor not only because of the domestic but also due to the international trade traffic as well. The exploitation of motorways M0 and M1-M7 is still the highest in the region. This is the reason, besides the pleasing environment and the close proximity to Budapest, that numerous multinational companies choose Budaörs as its headquarters.

The three main buildings and the surrounding infrastructure which the Park currently consists of, is gradually flaring and changing considering the widening market demands. As of now it has a 17.800 sqm office area, parking spaces, garages and a notable garden. Restaurant can be found within the facility and there is an exclusive shuttle bus service available for tenant workers.

The ORCO Business Park offers an ideal location for its partners in the midst of this busy, yet still pleasurable and verdant, commercial area. It could be a nice example for Lahanokipoi area too, because the latter is also in the west side of the city of Thessaloniki and it could be transformed, as it is referred above, into a second metropolitan center, since it is so close to the city and to the port (see Table 2).

Table 2.

The ORCO Business Park

Information	
Company	ORCO PROPERTY GROUP - Hungary
City	Budapest
Region	Hungary
Project type	Offices
Address	H-2040, 117 Szabadsi Road
Construction start	I.Q 2002
Completion / Delivery	I.Q 2002
Sales start	I.Q 2002
Number of units	14.353 sqm

Fig. 6. *The Shanghai Business Park*

AIG/LINCOLN LOGISTIC COMPANY FOR BUILDING AND ORGANIZING A BUSINESS PARK

The AIG/Lincoln logistic, warehouse and light industrial facilities are developed with state-of-the-art construction techniques and allow maximum flexibility for customization of space to meet the needs of our clients.

The prime locations are strategically selected for access to essential lines of transport.

AIG/Lincoln is also an expert in providing mixed-used facilities, offering clients flexibility of warehousing, logistics processing areas, and office space in one location. These products may include show-room areas as well as modules for light industrial uses.

AIG/Lincoln is one of the market leaders in Eastern and Central Europe for Business Parks.

For instance, the “Diamond Business Parks” in Poland have already developed their own reputation as an individual brand name. The architecture is distinctive, the technical construction and materials of the highest quality.

- Their Business Park projects offer a wider variety of practical amenities (e.g. snack shops, ATMs, laundry services), successfully combining a pleasant working environment with practical and efficient everyday facilities.

Fig. 7. *The M1 Business Park*

Project: M1 Business Park

Location address: H-2071, Páty, M1 Business Park

Project description: Logistics and distribution warehousing light industrial assembly The M1 Business Park (see Fig. 7) totals some 72,000 m^2 of logistics and distribution warehousing built to the latest standards. The five phase development can also accommodate light industrial assembly on request. The current plans are designed to achieve optimum efficiency and clear internal height combined with flexibility. Due to the size of the M1 Business Park, future expansion can be accomodated, as well as build-to-suit solutions for companies seeking individual identity or technical requirements. M1 was constructed and completed in five independent buildings with different layouts and internal traffic systems (see Table 3).

Table 3.

The M1 Business Park

Total size:	70,000 sqm
Status:	3 phases (Buildings A, C and D) completed and 100% let 4th phase (Building E) is completed and 75% let Building B completed in Q2 2006
Completion Date:	3rd phase of Building B: April, 2006
Location:	Distance to Törökbálint Railway Freight terminal: 5 km Distance to Austrian Border: 160 km Distance to airports: Budapest Ferihegy 40 km, Vienna Schwechat 200 km Bus Services: every 15-30 minutes from Budapest center directly to the park
Amenities:	▪ 11 m clear internal height ▪ Floor load 5 t/m2
Services:	▪ Built-to-suit solutions ▪ Full-service property management with 24-hour security ▪ Secured parking spaces on site ▪ Landscaped environment ▪ Petrol station adjacent ▪ Light industrial use possibility

Building A, completed towards the end of 2001 comprises a total leased area of 4 088 m2 warehouses and 618 m2 of office space arranged over two floors. **Building B**, has potential area of 22 000 m2 for warehouses and 2 695 m2 for offices. This building is the last development of the park, which was built in 3 phases. Completion of the third (last) phase was in April, 2006. **Building C**, completed towards the end of 2001 comprises a total leased existing area of 14 181 m2 warehouses and 1 364 m2 of office space arranged over two floors. **Buiding D**, completed towards the end of 2002 comprises a total leased existing area of 5 540 m2 warehouses and 1 800 m2 of office space arranged over two floors. **Building E**, was completed by the end of 2003 and comprises of a total leased existing area of 8 080 m2 warehouses and 980 m2 of office space arranged over two floors. Building E has potential area of 6 060 m2 for warehouses and 735 m2 for offices. 139 parking places are available.
The Park represents the future of light industrial, logistics and distribution in Hungary (see Fig. 8).

Fig. 8. *The M1 Business Park*

CONCLUSION

The business parks that are presented above combine the priviledged location in addition to the facilities that offer, which makes it attractive for companies to transfer their products in the business park, and for residents to enjoy their services[42].This could lead to big business oppurtunities, and the fact that the exploration of landscape is so well organized, with protection to the enviroment, provides a nice example for the local authorities of Thessaloniki to follow and with the right approach and planning to transform the area of Lahanokipoi into the second metropolitan center of the city, with a business park that offers business oppurtunities for companies and many facilities for the residents of the city!

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ANALIZA ECONOMICĂ A DEZVOLTĂRII PEISAJULUI ÎN ARIA LAHANOKIPOI (THESSALONIKI)

(*Rezumat*)

Lucrarea se referă la investigarea economică cu privire la analiza situației existente în dezvoltarea peisajul ariei Lahanokipoi. Aria Lahanokipoi acoperă o mare parte a vechilor industrii care nu mai sunt în funcțiune de aceea această arie este foarte slab dezvoltată, ceea ce sugerează faptul că în această zonă s-ar putea face o reconstrucție totală a peisajului, fie prin construirea unui parc industrial sau a unui centru de afaceri cu toate facilitățile. Proiectul sugerează un nou model care este stabli din punct de vedere economic care nu include doar partea de dezvoltare economică care poate fi realizată ci şi cea de mediu, arhitectură care pot maximize valoarea peisajului. Este pentru prima oară în literatură când avem o analiză economică şi arhitecturală a peisajului în această parte a oraşului, prin urmare contribuția acestui proiect are o importanță vitală.

CLEAN TECHNOLOGIES IN THE MINING

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Abstract: Clean technologies in the mining. The development of clean technologies is one of the most important tools in decreasing the environmental impact of different industrial activities. This question is of outstanding importance in the mining industry, since production is related to nature in a much stronger and more direct manner than in other industries.

The development of clean technology starts already with design. Mining design has been taking care of the natural environment before, although without being aware of the fact. That is why it is very important to summarise the principles of an environmentally oriented design system.

The choice of the mining system, mining location, extraction mode, related preparation technology, determination of the transportation system are the basic design phases, which determine for years the framework of production and intervention into the environment, and establish an opportunity for cleaner production.

Key words: *clean technologies, mining, extraction mode, industrial activities*

INTRODUCTION

The concept of clean technology was first applied to the environmental projects of companies by the environmental protection program of the UN (UNEP) and its organisation concerned with industrial development in the early 1990s. Clean technology is an overall strategy that can be applied to processes, products and services and is aimed at increasing their efficiency and decreasing the dangers to man and the environment.

In this way clean technology focuses on prevention as opposed to what is called end-of-pipe technologies, where the main emphasis is on reducing the impact on the environment (e.g. cleaning waste waters, flue gas) without any intervention in the technological processes and without any changes to the quantities of emission. Similar approaches are reflected in the concepts of eco-efficiency, pollution prevention, or industrial ecology, appearing recently in professional literature.

The essence these concepts share is that the focus within one technology is not on a single process, but complete systems and their material and energy as well as technological processes are investigated and intervention in the sources is considered to be primary while the objective to be achieved is the complex utilisation of products, by-products and other emissions.

This approach can be followed in all the phases of research, design, and implementation, production, processing, abandoning production, and abandoning sites. With products, reduction of load on the environment during the complete life cycle is the main focus.

The investigation of environmental friendly technologies and of the issues of clean or cleaner technologies in mining requires a number of considerations highly different from those in other industries. Mining is one of the ancient production technologies of mankind and as such, is a basic condition of all conscious human activities aimed at meeting human requirements.

Mining does not produce new materials, products, consumer goods or goods for use, but is involved in exploring the existing materials (mineral resources) which originate in the various periods of the history of the Earth and are necessary and can be exploited for various production processes, in extracting them from the mass of the Earth (the

geosphere), from its surface crust, in their preparation for processing (enhancing the quality) and even in their transportation and marketing.

Mining is more deeply and to a much greater extent involved in the natural environment than other industrial areas, perhaps only agriculture is in a similar situation. As compared with other industries, mining is also in a special situation because the object of its activities, the non-renewable mineral resources, which are limited in their availability both geographically and quantitatively, can be extracted under highly different natural conditions. Another difference is that the natural-geographical environment, the quantity and quality of the mineral deposits can only be explored in a limited manner (in many cases only in the course of the mining activities).

As a result of mining being a conscious intervention in the environment, throughout the history of its activities the considerations regarding the natural environment have always formed part of the design principles even when these were not formulated with the protection of the environment in mind.

Mining extracts the exploitable mineral resources from the earth's crust, it develops in the earth's crust the working sites where miners perform their activities and have to fight against natural hazards (rush, water hazard, gaseous mine) day by day for achieving successful production. Materials (water, gas, rock refuse or waste) whose production is basically not required but unavoidable have to be extracted from the natural environment. These are by-products but their utilisation is a task to be solved.

If the process of mining design includes among its targets conservation and improvement of the state of the environment and the technologies are decided upon, the selection of the sites and equipment is performed and the materials, energy and labour are exploited accordingly, then the principle of prevention can prevail in the most efficient manner. In mining taking the principle of prevention into consideration is of particular importance because decisions will determine the fundamental parameters of the facilities for decades and that includes the majority of the environmental impacts as well.

Mining is an industry in close connection with the environment; the material to be produced is part of the environment which has to be extracted from its original place and has to be transported to the surface, has to be enhanced in the classical terminology and finally the traces of the mining activities have to be eliminated as far as possible.

Since the medium of mining is the environment, design always includes its protection in some form. It would be an exaggeration to claim that many centuries ago the protection of the environment enjoyed top priority, however, a great many measures hint at the protection of the environment (forestation of dumps by the order of Empress Maria Teresa) and even early professional literature covers the issue.

MAJOR CONSIDERATIONS IN ENVIRONMENT CENTRED MINING DESIGN AND PRODUCTION

Selection of mining methods

In the design of the extraction of mineral deposits the choice is primarily between four basic mining methods: underground mining, open-cast mining, underwater extraction and borehole extraction, and in certain cases between the special technologies. The selection is based primarily on economic considerations, although the decision is also influenced by the properties of the raw materials, the geographical location of the deposit or occurrence, the geological and geotechnical parameters, the protection of the mineral

resources as well as the environmental impact incurred by the extraction in addition to material, energy and labour efficiency.

If the mine operators do not perceive the environmental costs, they will appear as externalies (external impact, external costs). In design only an environmentally conscious approach can make the requirements of clean technology prevail. In mining certain environmental costs have become internal or partially internal costs (recultivation, water elevation), which assists in achieving environment centred mining design.

The selection of the mining method is primarily influenced by the depth of the deposit. Deposits closer to the surface are mined with open-cast mining methods; deeper ones are mined with underground mining. The boundary depth, where the two mining methods are separated from each other, can be determined according to the cost functions depending on the depth of the deposit. If the costs of open-cast mining exceed the costs of underground mining, which also increase with depth, underground mining methods have to be employed:

$$k_{kf}(h) \geq k_m(h).$$

Nowadays it happens quite frequently that for environmental and landscape protection considerations underground mining methods are used also in cases where the production costs do not require it. The quantity of waste produced decreases significantly when a switch from open-cast mining to underground mining takes place. In the case of a large lignite open-cast mine the economic advantage for open-cast mines is so great that it is justified to employ open-cast mining even with the much larger extent of waste haulage.

In the design detailed investigations have to be carried out to explore the possibility of using a *combined extraction method.*

It is to be investigated whether it is possible to use the method when at the edges of open-cast mines underground mining is developed in lengths of several hundred meters, which will reduce the annual waste production by 20-30 %, and the waste can be deposited in the cavities or on the surface in order to correct subsidence. Before open-cast mines come to the end of their operation, the same method can be used.

The combined extraction method can be achieved not only through the traditional underground mining methods, but also through horizontal drilling with a large diameter. In that case, however, the loss of coal will increase. The combined extraction method is used not only to reduce the production of waste but also for landscape protection considerations.

The cavities created, depending on the strengths of the rocks, may be suitable for other purposes as well, including primarily storage, which indirectly serves environmental purposes and enables a cleaner technology.

Underwater extraction in Hungary is most frequent in open-cast mines close to the surface, in gravel and sand pits. The advantage of this mining method is that water is not to be hauled and removed from its original place, which is beneficial both environmentally and economically. Protecting the water quality along with a series of other environmental problems is to be solved in such cases. Naturally it may also occur that, e.g. in gravel production, underwater extraction is replaced by dry extraction by means of active water level decrease (an example of forced measures is Fehérvárcsurgó, where underground quartz sand production had to be replaced by dry production because underground bauxite mining depleted the water in the mining pond). In such cases it is to be considered

whether dewatering is necessary or not, how much it costs and what environmental impact the drainage of water will have.

*Borehole extractio*n can theoretically also be used with solid materials, it involves little surface impact but its use is limited with the exception of fluids. The impact of this mining method on underground water reserves cannot be monitored or controlled in every case

Special technologies, such as e.g. in situ chemical leaching or, bacterial extraction, require special analyses in each case with regard to environmental aspects, since the effects of mining moving drastic rock masses are replaced by impacts of a different nature.

Mine sitting and clean technology

Professor J. Zambó created the foundations of sitting theory, which investigates the determination of the optimum values of a great number of fundamental mining parameters, laying the emphasis, however, on the following three main parameters: *the optimum opening point, optimum production capacity and optimum quantity of mineral deposits.*

The method is aimed at determining the economic optimum, although the optimum opening point can be regarded as optimum also from an environmental aspect, since the selection of sites based on the minimum of motion and haulage work minimises the energy and material requirements of transportation, water elevation, and ventilation. It reduces the amount of waste unavoidably produced in the development, the total length of the roads in underground mining and the loss of mineral resources.

Consideration is to be given to the fact that mining involves a highly significant amount of preparatory (unproductive) work so that extraction can be feasible. The main exploration areas of the mine serve a larger production area; the field development and the winning preparation serve a smaller area. However, this work is to be continued regularly, for only appropriately explored mineral resources can be extracted.

The working areas move around, and accordingly, development work is to be done in different places within the field.

After production has been started, the auxiliary activities, the long transportation distances, a number of safety activities, ventilation, water drainage, etc., all represent unproductive activities. A large proportion of these activities have a leading role in loading the environment because the product they produce cannot be utilised. Siting theory investigations are therefore aimed at reducing these harmful effects in the course of design.

Secondary materials in mine production

One of the special features of mining is that it does not use basic materials only secondary materials for production, and even those in an ever decreasing quantity. At the same time, in the course of and in the interest of production it has to extract large quantities of other materials that cannot be utilised, such as waste rock, various waters and gases, which are called secondary materials.

The possibilities of clean production as regards secondary materials are as follows:

- reducing the quantity of secondary materials per product unit,
- in situ deposition of the secondary materials produced,
- in situ or nearby separation and deposition of the secondary materials (waste) from the mined product,

- in situ deposition of materials originating right after use (cinder in power plants),
- efforts at complex utilisation.

According to considerations of clean technology, it has to be generally accepted today that the secondary materials produced in mining, the by-products of the mining methods and the materials produced due to the circumstances that cannot be deposited in their original place are raw materials that can be utilised; they are secondary raw materials with all the consequences including the regular registration of mineral resources.

This can reduce the quantities of deposited material regarded as valueless, the area occupied by it and that could be utilised for other purposes and, along with it, the number of production sites that produce materials with similar properties, e.g. for road construction, can be reduced. This solution, which is desirable from every aspect, is limited by the economics, for these materials (particularly waste) cannot bear longer transportation distances.

The economic analysis is to be performed with a lifecycle analysis approach showing whether it is more economical to support the use of the secondary material as compared with the primary material. In the course of analyses we have already mentioned the internalisation of externalies; and the income generated in that way can provide funds for this type of support. Finding the optimum solution requires a thorough analysis and research of the economic and environmental-social impacts. Complex utilisation is often faced with the problem that there is no market for the secondary material in the given area. It happens frequently that in petroleum production poor quality natural gas is often brought to the surface, which has to be burned due to its toxic gases and hydrocarbon content (methane is considered to be one of the major contributors to the greenhouse effect). In the course of burning there is a considerable amount of heat generated, part of which is used in the production of petroleum or for communal purposes. But in many cases it is impossible to do anything with the heat, or part of it, generated since there is no demand for it, although it would be perfectly suitable for water heating, green houses etc. The issue of targeted support has been raised in this connection at least in areas where there are considerable quantities of waste heat available.

The situation is similar with gypsum produced in the cleaning of flue gas in coal-fuelled power plants, and as there is nothing to be done with the large quantities of the by-product, it is deposited on dumps. Initiatives have to be taken for research into the utilisation of these materials, extending their current application fields, for the materials produced as a by-product of the cleaning of flue gas spreading for the purpose of prevention of air pollution land in larger and larger quantities in the dump heaps.

Protection of mineral resources

Exploitable mineral resources are resources that cannot be renewed in situ (are non-renewable), which have provided long lines of generations with the required materials, and the generations to come cannot give up these materials either, since they are essential for life and therefore it is our duty to treat them in an economical way.

There are two possibilities for economising on resources of mineral origin:

- increasing the efficiency of utilisation (energy and materials efficiency, and recycling of materials),
- minimising the losses in mining extraction.

The minimisation of losses is primarily related to production, although it has elements determined by the mining methods. In *underground mining* the losses in pillars (safety pillars, barriers, the safety pillars in permanent mining cavities, the protection pillars of surface facilities and of natural facilities) and the losses arising from undercutting are the decisive ones. The undercutting can destroy parts of deposits in multi-deposit occurrences. In open-cast mining the role of safety pillars along the barriers is decisive. In gravel deposits the total deposit thickness is to be extracted if possible, and then the total of the pillar losses will be smaller. Efforts have to be made to develop mines with large areas, which reduce the specific loss per extracted quantity*. In underwater and borehole extraction* losses are increased by the limited possibilities for visual inspection during production, which has lately been improved by global positioning via satellites.

In underground mining mention must be made of *selective cutting* among the general environmental issues of *mechanical cutting.* The increase in the dimensions of machinery results in a decrease in the rate of *selective cutting.* It would require a thorough investigation (with a lifecycle analysis approach) to establish whether selective cutting, with its much smaller performance and less efficient mechanisation is more favourable or not than using high-performance large machinery with complete lack of selectivity and all its advantages and disadvantages. It can be assumed that the widely used technology considered to be economically more efficient would prove to be the opposite in a thorough cost-efficiency analysis (with consideration of environmental costs). Selective cutting reduces primarily thinning and its impact on losses in controversial.

Clean technologies in gravel mining

The objective of clean technology is to integrate environmental aspects into the production process so that together with the use of material and energy (costs), the waste and emission should also decrease.

The less intervention it makes in the environment, the cleaner a technology is. This can be achieved in gravel mining, particularly in wet mining, if the mineral resources available in the production areas are extracted as fully as possible. If this does not happen, we will be forced to return to areas already mined to some extent (re-dredging) after extracting the deposits that are easy to mine and with great efficiency. Bringing such areas into production for a second time has several different disadvantages.

- Technological problems: in wet production the areas once dredged develop thick silting (clay, mud), the production of which requires a special technical background.
- Environmental problems: returning to the area that has been mined to some extent will again disturb the eco-system that has developed in the given area.

Accordingly, we have to make efforts to mine the deposits under production as fully as possible within the framework of economic production. Therefore the selection of the production equipment has to consider the smallest possible loss of the mineral resources planned to be extracted with the production equipment in addition to the costs of the equipment and the properties of the mineral resources under production. It is of great importance which mining method is chosen, for according to the data in the Table the theoretical mining efficiencies may show significant differences.

In addition to selecting the appropriate production equipment, the losses caused by the equipment can be further decreased by advanced GPS navigation technology and integrated automation systems.

Production equipment	Theoretical production efficiency (%)
Dredger with cutting disc	97
Dredger with cutting head	93
Dredger with buckets	93
Dredger	89
Floating dredger	75
Scraper	71

In the wet production of gravel and sand it is of particular importance to incorporate a positioning system so that the accurate advance of the dredging operations can be continuously monitored and documented. In addition to the accurate horizontal position of the dredger, it is also important to indicate the current production depths as well. The positions and the production depths can be displayed on a digital map, which can be compared with the results of the geological exploration conducted prior to production. In this way the rate of production can be established and graphically shown.

Water management in gravel mining

The production of gravel mining products (fractions) is usually achieved by wet sorting (due to technological reasons). In wet sorting large quantities of sorting water are extracted from the mining lake in wet production and from bored wells in dry production. In order to give an estimate of the sorting water used, it can be said that the wet sorting of 1 m^3 of gravel requires approximately 2 m^3 of sorting water. Thus a wet sorter of 100 m^3/h uses 1600 m^3 of sorting water in every shift. Since the majority of gravel pits are in areas with particularly sensitive or especially sensitive underwater water quality, it is a decisive issue from an environmental point of view to protect and sustain the quality parameters of the sorting waters and to reduce the quantities used. The demand for fresh water can be reduced by 50-60 % through the introduction of closed water management systems replacing the currently generally used open water management systems.

Unfortunately, today in Hungary it is not possible to follow the environment-centred design and operation through the complete lifecycle of a mine from the planning of raw material production and the operation of the technological systems. Perhaps it is in the course of recultivation and area rehabilitation mandatory after the abandoning of production that responsibility for the environment can be observed. For the sake of the long-term operation of Hungarian mining companies it is necessary to develop the basic principles and system of conditions of mining design with consideration of the aspects of clean technology in mining as well.

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TEHNOLOGII CURATE ÎN INDUSTRIA MINIERĂ

(Rezumat)

Dezvoltarea tehnologiilor curate, este unul dintre cele mai importante lucruri în scăderea impactului asupra mediului a diferitelor activități industriale. Această problemă este de o importanță deosebită în industria minieră, deoarece producția este în strânsă legătură cu mediul în acest domeniu mai mult decât în alte industrii.

Dezvoltarea tehnologiilor curate începe o data cu lansarea proiectului. Grija față de mediu are loc încă din faza de proiect în cazul mineritului. Din această cauză este foarte important să ținem cont de principiile sistemului.

Alegerea sistemului de minerit, locația minei, modul de extracție, tehnologiile de preparare, sistemul de transport sunt fazele cele mai importante din proiect, acestea determinând în viitor producția, impactul asupra mediului şi deasemenea ne asigură o producție curată.

ENERGETIC EFFICIENCY IMPROVEMENT STRATEGY IN THE REPUBLIC OF MOLDOVA

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Abstract: Energetic efficiency improvement strategy in the Republic of Moldova. This paper presents the current situation of the main energy production sources in the Republic of Moldova, emphasizing their role in environmental pollution. The environmental policy in the Republic of Moldova deals with technologies' transformation, taking into account the ecological and economical requirements.

Key words: *energetic efficiency, pollution, environment.*

CURRENT SITUATION

The technologies for producing electrical and thermal power are among the main sources of environmental pollution in the Republic of Moldova. By the quantity of the polluting substances emitted into the atmosphere, the thermal-energetic and thermal objectives are located on the second place after transport. The emissions from the energetic sector represent approximately 80% of the summary quantity emitted from fixed sources of pollution [3, 4].

The main objectives of producing the electrical and thermal energy in the Republic of Moldova, are the electro-thermal plant from Cuciurgan, located on the territory of the Republic occupied by Russia. It produces approximately 85% of the total amount of energy produced in the Republic of Moldova, the hydro-electric power plants Dubăsari and Costeşti. The main energetic objectives from the right side of the Nistru River are: CET-1 with a capacity of 66/239 MW/Gcal, CET-2 with a capacity of 240/1200 MW/Gcal and CET-North with a 24/350 MW/Gcal capacity. In addition to these another 11 block stations from the sugar plants with a power of 6-12 thousands kW and the power plants. In 2006 the Republic owned 2183 power plants, among which 99 were recently built. Off all, 1375 units are functional. The number of the power plants with a fuel input lower than 15 tons/year is of 989, among which 334 function using solid fuel, 57 use crude oil, and 598 use natural gases. There are 779 power plants with an input larger than 15 tons/year, among which 295 use solid fuel, 83 use crude oil, and 401 units natural gases [16].

The energy sector in the Republic of Moldova functions approximately at 98% based on the important energy resources. In parallel, the electrical power is imported. The ratio of the production/consumption of electric power in millions of KWh was in 1997 of 1450/3767; in 2000 - 904/2244; and in 2005 - 1229/2921. The entire production capacity of the thermal energy in the Republic of Moldova is 1300 Gcal. The central heating systems are only in the towns Chişinău and Bălți.

For the production of the electrical power are practically used only natural gases. The thermo-energetic sector consumes approximately 43% of the energetic resources of the Republic. The largest consumers are CET-1, CET-2, CET-North and SA Termocom (Chişinău). In 2005 they consumed 52660 thousand m^3 natural gases as compared to 454498 thousand m^3 in 2004, 3784 tons crude oil as compared to 288 tons in 2004 and 438 tons of coals as compared to 544 tons in 2004. The emissions into the atmosphere from these factories were of 1977 tons, increasing with approximately 14% as compared to the year 2004. The actual emission of polluting substances from the thermal-energetic

and thermal objectives is about 8970 tons/year. The specific fuel input of CET-1 and CET-2 during the last years is increasing, which illustrates the high degree of technical wear of the equipment, at the CET-North the situation is more favorable [17].

During the period 1990-2000, the share of energetic resources was reduced in industry, agriculture and transports, while the public sector share increased. The minimum input was reached in 1998-1999. Between the years 2000-2006, the input of electric power experienced an ascending trend, with a total and per capita increase of the energetic resources input [16, 17].

One should mention the technical problems of the energy sector: the high degree of wear of the equipment used in electric power production and transport; low level of high voltage networks and equipment usage; considerable losses of electric power (up to 50%) and the lack of transparency of the energetic resources metering system.

The economic development strategy of the Republic of Moldova stipulates as main objective the creation of the necessary conditions for a sustainable economic development with an average annual rhythm of GDP (Gross Domestic Product) increase of 5% - 8%. The strategic objectives in the energy sector are: finalize the restructuring and privatization of the energetic sector; ensure the energetic safety of state; environmental protection. These objectives will be achieved by: the de-monopolization an privatization of the energy complex; implementation of efficient energy technologies with a minimum impact upon the environment; diversification of import routes of the energy resources; development of the legislative and normative framework in the energy sector; alignment to environmental protection European [16].

Nowadays, within the Republic there were initiated some re-engineering and modernizing works of the energetic objectives in order to increase the energy efficiency and to mitigate the emissions of polluting substances within the environment.

THE OBJECTIVES OF THE ENERGY EFFICIENCY IMPROVEMENT STRATEGY

The main strategic objectives [6,10]: - Increase of energetic capitalization for the entire chain of resources – production – transport – distribution – consumption; Reconsideration of the production capacities and of those under construction, as well as establishment of the evolution trends; - Reconsidering and diversifying the basic materials resources, modification of the production and consumption structure and of the related energy consumption; - Reduction of the environmental impact of the energetic activity.

The support objectives of the energetic strategy: - Creation of an economic – institutional mechanism and of the institutional framework which allows the conception, pursue, implementation and coordination of the policy of financial energetic sector adopted at the request of market economy; - Development of a legislative framework according to the efficient functioning of the energetic sector.

THE ENVIRONMENTAL POLICY

An integrated policy is necessary for the reforming of the energetic system for the establishment of the priorities and possibilities to reach the energetic purposes, without neglecting the ecological and economic purposes.

The alignment of the Republic of Moldova to the Environmental International Conventions imposes the ecology of the sector strategies of economic and technological development of the Republic. The fundamental support of the economic and technologic development strategy must be based upon the principles of the sustainable development.

The overrun of the economic crisis and the subsequent re-launch of the economy in the Republic of Moldova will need the development of the energetic objectives, which will inevitably lead to the increase of the atmospheric emissions. If the emission limit for each country in the Environmental International Conventions is established as the quantity of the polluting substances emitted by the states in 1990, then the Republic of Moldova disposes nowadays of an extent range of about 800 kt of polluting substances. The annual total emission in the year 1990 was 1100 kt (350 kt from the fix sources and 750 kt from the mobile sources) then, in the year 2006 it represented approximate 270 kt (18 kt from the fix sources and 252 kt from the mobile sources). The background level of the atmospheric pollution in the Republic of Moldova is given by the transboundary pollution and in the elaboration of the environmental policies one should take into consideration the regional pollution sources [3, 4].

The energetics is responsible for 30% of the total of CO_2emission, 60% of the SO_2, heavy and radioactive metals emissions, as well as the toxic ashes. The energetic objectives are the focal point no. 2, after transports, for the concentration of the efforts to reduce the ecologic impact from the local sources of pollution [5, 6].

The lack of energetic resources in the Republic of Moldova emphasizes the fact that energy saving should represent a priority in environmental policy, as it allows the reaching of the economic and ecologic purposes, in parallel with saving the energetic primary resources. Though, in the transition period, the requirements should be different for new and old factories, which need to be given a real time for improvements. Within the process of transition to the market economy, the gradual liberalization of the energy prices will positively influence the ecological aspect f the issue.

The ecological objective can be reached if the government will accelerate the restructuring and reforms by: - real development of the economic reform, the privatization; - restructuring of the energetic units; - reforming of the energetic policy; - liquidation of the endowments for polluting technologies; - intensification of state possibilities; - elaboration of the internal mechanisms for financing the restructuring process of the energetic sector.

The ecological policy will include: - short, medium and long term objectives; - economics mechanisms for the transition period; - supervision, control and implementation mechanisms of the energetic capitalization programmes; - permanent control of the dangerous pollution sources; - expertise and prognosis of the ecologic impact of the projects; - elaboration of the principle according to which the polluter pays; - slow transition towards the market prices; - elaboration of the support mechanisms by the state of the energetic modernizing programmes.

The ecological-economic problems depend on the: - rhythm of the economy restructuring; - restructuring may change the energy usage regime; - the energetic policy may diminish the impact of its production upon the environment; - the ecological policy may influence the restructuring of the energetics.

The energy assurance programmes and the ecology policy will include: - collecting the ecological data; - assuring the fulfillment of the ecological requirements; - dissemination of the information regarding energy saving; - inspection and control methods; - emissions' reduction programmes; - external funding proposals; - demonstration projects.

The most important improvement possibilities come from the local, commercial and industrial sector and they will be supported by the state through the simulation of: - informational and saving programmes; - science research for the development of new

technologies; - training courses; - projects for the elaboration of energy use standards through laws, simulative structures and specific programmes. The development of new standards for buildings, equipments, technologies, taking into account ecological principles, represents one of measures for supporting investments in the energy efficiency improvement, promoted also by the energy conservation law.

One approachable way for the improvement of the energy use sector is payment of the external debt through ecological improvements, because the resources used for the technical maintenance of the bankrupted energy objective will be lost, due to the market situation, which will impose their closing.

For every investment in the energy efficiency improvement there must be a motivated shareholder, who will lead the project's implementation. The major participants are: funding agencies, multilateral development banks/ECA, energy or governmental agencies, NGO's. Motivations for investing in the energy efficiency improvement strategy are: - new economical policies; - new environmental policies; - long-term development; - social benefits; - supporting the export. The minor participants are: energy end-users, services and equipments suppliers, financial institutions, multilateral development banks/ECA, services. Motivations for investing in the energy efficiency improvement strategy are: -profit growth; - market conditions; - business strategies [5,13].

In Eastern countries, the major part of the investments is aimed in new technologies implementation or the renewal of the existing equipments. Growing economies offer more possibilities for investing in new equipments, then for re-adaptations. Before assuring the investment capital for energetic efficiency, trade markets must be developed, projects identified, partners chosen and the investment decision must be taken. In fact, all of these aspects are part of the ability to obtain funds. A good strategy always considers the favorable market conditions, from which four have the most powerful influence. The basic elements which affect the investments in the energy efficiency are [13]: - the nature of market opportunities for energetic efficiency (Investment opportunities, Market structure, Market growth); - the conditions of the energy sector (Energy costs, Industry structure, electrical power availability); - governmental policy in the field (Regulations, Stimulants, Specific programs); - economical and business conditions within the country (Economical reforms, investments market level, currency availability, legal framework, internal impediments in the company).

The investments for energetic efficiency are aimed mainly in the fields which allow major savings, which include lamps and lighting improvements, high efficiency heating and ventilation systems, isolation systems outside the blocks of flats, low energy consume equipments.

ENERGY RESOURCES

The electrical power consume worldwide, will be, according to prognosis, in the year 2100 four times greater than in the year 1990. The energy resources are estimated to be: oil, natural gas for the following 40 years, uranium – 60 wears, coal – 220 years or 490 years including brown coal [5].

The world energy consume is continuing to increase by 2% every year, and in many countries having a growing economy, it will be approximately 6% every year. The energy demand will rise in the year 2020 from 5% to 100%, depending on the population growth, which will be from $5{,}1 \cdot 10^9$ to $8 \cdot 10^9$ people. Worldwide, the energy demand will

increase from 8,5 billion. TOE presently, to 13 billion. TOE in 2020. It is assumed that the reserves will be approachable, but the prices will be explosive [5, 15].

The main source for energy production continues to be the fossil fuels, which produce significant quantities of CO_2. For example, the percentage of the household sector in the total emissions represent - 22%, industry - 18%, transport - 28%, energy industry - 32%. The improvement of the situation will demand an important shift towards the use of electricity produced from other fuels, like the nuclear power and renewable sources [5,15].

The reduction of the energetic dependence represents a key problem in assuring the energetic security of a country. Though, there is a general solution for this problem – the diversification of the import sources. On a long-term period, an important contribution for the energetic security development in the Republic of Moldova could be brought by the usage of their own resources andbz using the renewable energy sources we own.

Coal will maintain its importance on the energetic reserves trade market (~30%) and will take over, approximately in 2020, the share resulted from the reduction of the natural gas and oil reserves. Nowadays, 40% of the world electrical power is produced by coal CET. CET IGCC (integrated gasification cycle) will be leaders in producing energy and using dirty oil products [5,12,15]. Significant growth will be registered by the decentralized co-regeneration plants and by the renewable energy reserves, especially biomass. The role of the renewable resources will be significant beginning with the year 2020. Small and cheap CETs, which use the combination between gasification and a power plant with combined flow – one of the flows with integrated biomass gasification and gas turbines will become more important. This complex flow will reach an efficiency of more than 40% [5]. Combining the gasification technologies with the fuel cells will increase the efficiency to 60%.

THE ENERGY CONSERVATION POLICY

The studies showed that the growth of the efficiency of using the electrical power by implementing equipments with a low energy consume is cheaper then building new CETs for producing the necessary energy needed for the economical development and for obsolete and inefficient equipments. The development of a new integrated system for planning the resources and for the demand management is needed. By improving the efficiency, the growing rate of the consume might be reduced with 25% in the next three decades, for example, only the improvement of the lighting could reduce the consume with 2,5% [5].

The government must impose to public services, which are not interested in reducing the energy consume, although the profit depends directly on the consume, the development of plans for integrating resources, in which the environmental costs will be regarded as direct investments. For the Republic of Moldova, the main emergency consists of changing the priorities established by the World Bank, which is usually against investments in improvement the energy efficiency [5,6].

The main components of the energy conservation strategy are described below, in Figure1 [6].

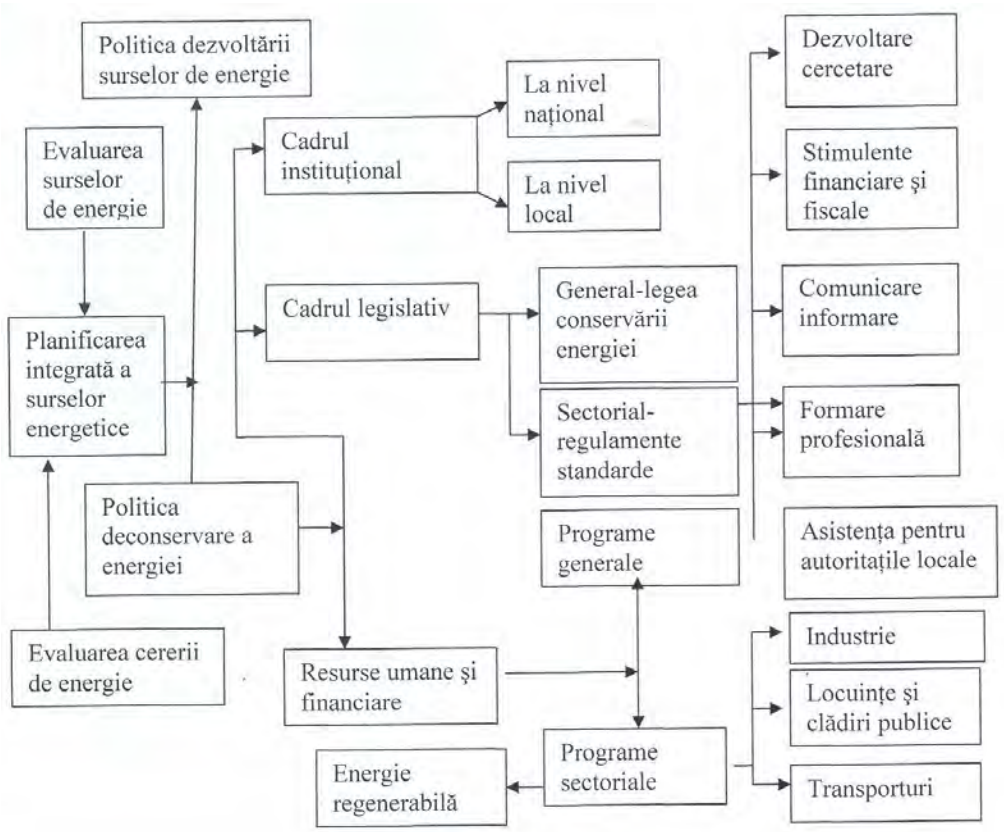

Fig. 1. *The main components of the energy conservation strategy*

FUNDING SOURCES

Funding the energy efficiency improvement projects needs the development of the funding strategies, which must take into account the following: investment recovery, risks, technical performance, fluctuant use, maintenance, cost evolution, building and guarantee risks.

The main market elements improvement strategies must include: - supporting an energy sector market oriented; - implementing policies regarding known failures on the market or support energy efficiency; - promoting the market shifting towards efficient technologies and services.

Strategies for obtaining funding through leasing: - finding the appropriate partners and market management, like international funding corporation (IFC), multi-sector development banks (long-term finance), public companies, equipment marketer and energy services contractors, donor agencies; - policy changes, recommended for leasing promotion.

Strategies for obtaining performance, which include: - market development; - debts source finding and financial funding for projects; - dedicated debts facilities; - contracts and protocols standardization; - managing the obtaining of energy efficient projects.

Strategies for marketer and public services funding.

The commercial funding sources include loans and credit lines, leasing, change finances, consumer credits, marketer and project funds [6,13].

The improvement of energy supply and the infrastructure establishment can be achieved by shifting the present funding of energy activities to short-term funding projects and by not offering funding on long-term periods.

The development of energy efficiency faces many obstacles, but the number of financial institutions which have an interest in this field is growing. If in the developing countries, the commercial banks are not aware of the potential market for energy efficiency, the development of national funds with special destination can be a good strategy. In the beginning, the funds need governmental support [6,13].

The transition to market economy can develop in real time, if the old employees' policy is replaced by the human resources management – beginning with personnel study and planning, employment and selection, personnel development and the efficient use of the entire human resources.

One of the energy efficiency improvement role is to assure the financial means for costs reduction, by promoting economical growth through competitiveness growth. The new economical development in the Republic of Moldova will demand new energy quantities, which will impose the increase of energy producing capacities, which in turn will generate a new pollution wave and which will oppose the obligations the Government took within the International Environment Convention and which will need a great financial investment capacity. The energy efficiency improvement can reduce the need of major investments in new energy producing units [6,13].

New technologies for producing and energy efficiency improvement: The concept of global technological development "clean coal" is becoming more and more important [5,6]. The most efficient technologies for coal use and their evolution in time are **Flows in Power Plants** [5,6,12,11]: First stage - Rankine Flow (USC- Ultra Super Critical Steam Conditions, AFBC– Atmosferic Fluidized Bed Combustion), Second stage – Combined cycle with gas turbine (IGCC - Integrated Gazification Combined Cycle, PEBC - Pressurized Fluidized Bed Combustion), third stage – electro-chemical flow (MCFC MCFC - Molten Carbonate Fuel Cell (fuel cells on melted carbonates), MHD, SOFC- Solid oxide Fuel Cell).

Allowing a competition in electrical energy production created a boom regarding the diversification of sources and energy production technologies, which have efficiency higher then 30% then the traditional energy production technologies and a lower impact on the environment.

Table 2 shows the conversion efficiency and the air pollution coefficients for different technologies [5,6].

The combination between low costs and reduced gaseous emissions can cause the transformation of hundreds of coal CET into gas or combined cycle plants. Gas turbines are ecological more efficient, because they can use different fuels, including coal, which is forehand gasified. Coal burning on flowing bed is an expensive process, compared with the similar process from a gas turbine plant, with a simple construction. Nowadays, turbine power plants can use biomass (wood, agricultural wastes), without any sulfur emissions. Gasification seems like an attractive way for waste capitalization, too, by converting them in singas [5,12,15].

Table 2.

Conversion efficiency and pollution coefficient

Technology	Efficiency %	Emission, g/kwh		
		NO_x	SO_2	CO_2
Coal (2,2% S) Conventional steam cycle	36	1,29	17,2	884
Conventional steam cycle (with purifier)	36	1,29	0,84	884
Flowing bed	37	0,42	0,84	861
Integrated gasification combined cycle	42	0,11	0,30	758
Natural gas Electro voltaic cell	36	0,04	0,00	509
Gas turbines	39	0,23	0,00	470
Gas turbine with combined cycle	53	0,10	0,00	345

The possible growth of gas turbines' efficiency is realized by applying water vapors catalytic transforming procedures, through the transformation of the burned natural gas into hydrogen and carbon oxide at entering the gas turbine, using the heat from the exhaustion gases, process described by the following equations: $CH_4 + H_2O = 3H_2 + CO$ (endothermic process) in parallel with the following equation $CO + H_2O = H_2 + CO_2$ (exothermic process). The hydrogen is separated by adequate selective membranes [10,2]. This is called the catalytic burning process, and at the same time the NO_x emission reduction is obtained. Using this procedure, other liquid fuels can de transformed, this process being used in the fuel cells.

The development of new technologies, like gas turbines, wind mills, fuel cells and solar panels, represents a new force in the present. The potential of these sources is relative low, but the possibility of scale production can lead to the development of a new energy system, which is cheaper and more decentralized. The role of non-fossil fuels, like the nuclear energy, renewable resources, heat waves and heat pumps will increase [5,6].

Every strategy must take into account the following: - the use of rare resources will have as a result the growth of the energy cost; - natural resources are also raw materials for the chemical industry and must be left for the future, too.

There are a lot of possibilities for energy efficiency improvement. The use of new technologies will allow the consume reduction, without limiting the energy demands with 25-30% from the present consume. The energy efficiency improvement technologies and the management procedures are showed in Table 3 [5,6,13].

Table 3.

Technologies for efficiency improvement in final use

Trade	Industry
HVAC systems	Process control
Heat pumps	High efficient boilers
Load control systems	Cogeneration
Freezer and deepfreeze	Waste heat recovery boilers
Building control systems	Variable speed motors
Isolation	Isolation
Low emission windows	High efficient lighting
Deposition and film windows	Instrumentation
Power factor correction systems	Power factor correction systems
Thermoelectrically power plants	Flow throttle
Households	Agriculture
Efficient apparatus	Water pumping systems
HVAC systems	Pumping systems
Heat pumps	
High efficient lighting	
Isolation	

In the field of energy production, other three sources, practically inexhaustible, are used. These sources are geothermic, wind and solar energy. The global geothermal energy production was estimated at the end of the XX Century at approximately 15000 MW. Wind mill produce about 12000 MW around the world. The solar energy is still used at a very small scale, but new technologies were created, like the photovoltaic cell, to support the production on a large scale [5,6].

The recommended emission reduction measures are: the implementation of pure technologies, which assure a forehand preparation of the fuel, regarding its quality and content; the implementation of modern technologies which use the stages combustion and at a low temperature; the use of exhaustion gases' energy; the use of stack gases purification [2, 6].

A method for reducing the contamination level is to minimize the energy demand, by the energy-eater technological processes. This means that by reducing the energy consume, the pollutants emission in the atmosphere by the CTE's will also be diminished [5,6].

Measures for reducing the emissions: - CET-North, CTE-1 and CTE-2 rehabilitation; - implementing technologies for reducing wastes and emissions; - slow shift

towards co-producing systems, with local biomass use; - wind and solar use; - the implementation of decentralized production technologies, with photovoltaic cells.

By developing a national program for energy saving, practically with very small expenses, the polluting emissions in the atmosphere from the CETs can be drastically reduced.

CONCLUSIONS

The practical implementation of energy efficiency improvement strategy will allow the economical development of the Republic of Moldova and the reducing of polluting emissions in the atmosphere.

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STRATEGIA DE EFICIENTIZARE A ENERGIEI ÎN REPUBLICA MOLDOVA

(Rezumat)

Tehnologiile de producere a energiei electrice şi termice, sunt printre sursele principale de poluare ale mediului în Republica Moldova. După cantitatea de subtanțe poluante degajate în atmosferă, obiectivele electrice şi termice se situează pe locul doi, după transporturi.

Se precizează că 98% din sectorul energetic al Republicii Moldova se bazează pe resurse naturale importate.

Problemele tehnice ale sectorului energetic din Republica Moldova se referă la: gradul înalt de uzură al echipamentului şi a rețelelor de transport, pierderile considerabile de energie (până la 50%) şi netransparența sistemului de evidență a consumului de resurse energetice.

Strategia de dezvoltare economică a Republicii Moldova are ca obiective principale în domeniul energetic: finalizarea procesului de restructurare şi privatizare a sectorului energetic, asigurarea securității energetice a țării şi, bineînțeles, protecția mediului înconjurător.

Lipsa de resurse energetice în Republica Moldova face ca economisirea de energie să ocupe, în mod obligatoriu, un loc prioritar în politica de mediu. În procesul de trecere la economia de piață, liberalizarea treptată a prețurilor la energie va influența pozitiv partea ecologică a problemei.

Se recomandă inițierea unui program național de economisire a energiei, care poate influența considerabil fluxul de substanțe poluante, degajate în atmosferă de către CET-uri.

Măsurile de diminuare a emisiilor de la sectorul energetic: Reabilitarea CET-Nord, CET-1, CET-2; Implementarea tehnologiilor de minimalizare a deşeurilor şi degajărilor; Trecerea lentă la sisteme de cogenerare cu utilizarea biomasei locale; Utilizarea energiei eoliene şi solare; Implementarea tehnologiilor de producere decentralizată a energiei electrice cu celule fotovoltaice.

LE SECTEUR DE LA VIANDE BOVINE DANS L'UNION EUROPÉENNE : SITUATION ET PERSPECTIVES DANS LE CONTEXTE DE L'ENVIRONNEMENT

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Abstract: Cattle meat sector in European Union: Perspectives and situations in the environmental context. Cattle meat sector is, to the origin one of the most important domains governed by P.A.C. In many regions of Europe the Cattle meat production is practice, where this is the only activity possible in the agriculture.

Also the consume of cattle meat increased whit the decrease of buying capacity.

Like other European agricultural sector, the common organization of cattle meat market, initiated in 1968, has registered three consecutive reforms: in 1992, 1999, 2003.

Key words: *cattle meat, environment, agriculture in UE*

INTRODUCTION

Le secteur de la viande bovine est, dès l'origine, l'un des principaux domaines réglementés par la Politique Agricole Commune (PAC). La production de viande bovine est pratiquée dans de nombreuses régions d'Europe, où elle est parfois la seule activité agricole possible.

Par ailleurs, la consommation de viande bovine a pris de l'ampleur avec l'amélioration continue du pouvoir d'achat.

Comme les autres secteurs de l'agriculture européenne, l'organisation commune du marché de la viande bovine, initiée en 1968, a enregistré trois réformes successives, en 1992, en 1999 et en 2003. Dans les lignes qui suivent, on s'intéressera plus particulièrement à la réforme de la revue à mi-terme de l'Agenda 2000 et à ses conséquences, ainsi qu'aux perspectives d'avenir de la production de viande bovine européenne.

LA RÉFORME DE LA PAC DE 2003

Le Sommet de Berlin de mars 1999 avait tracé les grandes lignes des politiques communautaires pour la période 2000-2006 et prévoyait un examen à mi-parcours, soit vers 2003, de l'évolution de la situation agricole, prévoyant donc de réaliser des ajustements mineurs éventuels. Cependant, la « revue à mi-terme » de l'Agenda 2000, s'est avérée être une nouvelle réforme en profondeur de la PAC.

En résumé, les principes de la réforme décidée à Luxembourg en juin 2003 sont les suivants :

- découplage des aides par rapport aux quantités et à la nature des productions ;
- établissement de droits à paiement unique (DPU), réunissant les aides découplées sur des bases historiques individuelles ou régionales ;
- modulation des aides au-delà d'un seuil de 5 000 euros par exploitation, en vue du financement des mesures de développement rural, devenu un véritable « deuxième pilier » de la PAC ;

- conditionnalité des aides au respect de normes environnementales, sanitaires, de bien-être animal et de bonnes pratiques agricoles.

Pour pouvoir s'exercer et donner lieu à un paiement effectif, les DPU doivent faire l'objet d'une déclaration de superficie, le nombre d'hectares déclarés correspondant au nombre de DPU.

Un plafond national est attribué à chaque Etat-membre. La somme des demandes de paiement ne peut dépasser ce plafond.

Par ailleurs, l'article 69 du règlement (CE) n° 178 2/2003, qui contient les principes de la nouvelle PAC, prévoit la possibilité de réserver jusqu'à 10 % des DPU pour des types particuliers d'agriculture et pour les productions de qualité.

L'année d'entrée en vigueur du découplage peut être 2005, 2006 ou 2007 selon la décision de l'Etat-membre.

L'Autriche, la Belgique, le Danemark, l'Allemagne, l'Irlande, l'Italie, le Luxembourg, le Portugal, la Suède et le Royaume-Uni ont choisi 2005, la Finlande, la Grèce, les Pays-Bas, l'Espagne et la France ont opté pour 2006 et Malte pour 2007.

Les références historiques individuelles sont appliquées par l'Autriche, la Belgique, la France, la Grèce, l'Irlande, l'Italie, les Pays-Bas, le Portugal, l'Espagne et, à l'intérieur du Royaume-Uni, par l'Ecosse et le Pays de Galles.

La Finlande, l'Allemagne, le Luxembourg, la Suède, le Danemark, l'Angleterre et l'Irlande du Nord mettent en œuvre un système mixte, fixe ou progressif dans le temps (références historiques individuelles + forfait régional à l'hectare).

Les dix Etats devenus membres en 2004 appliquent, quant à eux, un modèle simplifié.

Par ailleurs, la Grèce, la Suède, le Portugal, l'Espagne, l'Italie, la Finlande et l'Ecosse ont recours à l'article 69 du règlement (CE) n° 1782/2003.

APPLICATION DE LA RÉFORME DE LA PAC AU SECTEUR DE LA VIANDE BOVINE

L'accord de Luxembourg a été obtenu à la suite d'un compromis laborieux, certains Etats souhaitant une réforme radicale de la PAC alors que d'autres étaient hostiles à toute modification.

En conséquence, le règlement (CE) n° 1782/2003 aut orise une certaine flexibilité de l'application de la réforme de la PAC par les Etats-membres.

Si la volonté de la Commission européenne était d'assurer un découplage maximum des aides, le Conseil des Ministres a permis aux Etats membres qui le souhaitaient de n'appliquer qu'un découplage partiel.

C'est ainsi qu'en matière de grandes cultures, il est possible :

- de maintenir un couplage à hauteur de 25 % maximum de l'aide aux grandes culturesou
- de maintenir un couplage de la prime supplémentaire pour le blé dur à hauteur de 40 % maximum

Pour le secteur ovin/caprin, la prime à la brebis, la prime à la chèvre et la prime supplémentaire peuvent rester couplées jusqu'à 50 % maximum.

Dans le domaine de la viande bovine, les Etats-membres ont la possibilité de maintenir la prime à l'abattage (PAB) pour les veaux couplée à 100 % et

- soit maintenir la Prime au Maintien du Troupeau des Vaches Allaitantes (PMTVA) couplée jusqu'à 100 %, ainsi que la PAB pour gros bovins couplée jusqu'à 40 % ;

- soit maintenir la PAB pour gros bovins couplée jusqu'à 100 % ;
- soit maintenir la Prime Spéciale Bovins Mâles (PSBM) couplée jusqu'à 75 %.

Par ailleurs, le seuil de chargement des animaux par rapport à la superficie fourragère pour bénéficier de la PMTVA est supprimé. Les veaux abattus entre 1 et 8 mois sont éligibles à la PAB (contre 1 à 7 mois précédemment).

Selon les Etats membres qui ont choisi de garder un certain couplage dans le secteur de la viande bovine, la situation est la suivante (tableau 1).

Tableau 1

Types de couplage dans les Etats membres qui n'ont pas totalement découplé les aides dans le secteur de la viande bovine

Autriche	100 % PMTVA 40 % PAB gros bovins 100 % PAB veaux
Belgique Flandre Wallonie	 100 % PMTVA 100 % PAB veaux 100 % PMTVA
Danemark	75 % PSBM
Finlande	75 % PSBM Art. 69 : 10 % pour viande bovine
France	100 % PMTVA 100 % PAB veaux 40 % PAB gros bovins
Grèce	Art. 69 : 10 % pour viande bovine
Italie	Art. 69 : 8 % pour viande bovine
Pays-Bas	100 % PAB veaux 100 % PAB gros bovins
Portugal	100 % PMTVA 100 % PAB veaux 40 % PAB gros bovins Art. 69 : 1 % pour viande bovine
Espagne	100 % PMTVA 100 % PAB veaux 40 % PAB gros bovins Art. 69 : 7 % pour viande bovine
Suède	74,55 % PSBM Art. 69 : 0,45 % du plafond PSBM
Ecosse	Art. 69 : 10 % pour viande bovine

Source : BORZEIX, V., CODRON, S., LAUREAU, D. et SEBAN, S. (2006)

LIENS ENTRE LA PRODUCTION DE VIANDE BOVINE ET L'ENVIRONNEMENT

La production communautaire de viande bovine est soumise à des contraintes environnementales (conditionnalité).

Afin de pouvoir toucher la totalité du paiement unique, les agriculteurs doivent prouver qu'ils respectent toute une série de réglementations préalablement établies, la plus ancienne datant de 1979 (directive 79/409/CEE).

Diverses exigences sont intégrées progressivement à la conditionnalité (BOUQUIAUX et MARSIN, 2004) :

- au 1er janvier 2005, ce qui a trait à l'environnement et à l'enregistrement et l'identification des animaux ;
- au 1er janvier 2006, ce qui touche à la santé publique, à la santé animale et aux aspects phytosanitaires ;
- au 1er janvier 2007, ce qui concerne le bien-être animal.

En matière environnementale, il s'agit notamment de respecter les directives concernant :

- la conservation des oiseaux sauvages ;
- la protection des eaux souterraines contre la pollution causée par certaines substances dangereuses ;
- la protection de l'environnement et notamment des sols lors de l'utilisation des boues d'épuration en agriculture ;
- la protection des eaux contre la pollution par les nitrates à partir de sources agricoles ;
- la conservation des habitats naturels ainsi que de la faune et de la flore sauvages.

Les directives « oiseaux » et « habitats » susmentionnées ont donné lieu à l'élaboration du réseau « NATURA 2000 ».

La directive « nitrates » (directive 91/676/CEE – JO L 375, du 31.12.1991) concerne plus particulièrement les élevages, et notamment l'élevage bovin.

Les Etats-membres doivent élaborer des plans de gestion durable de l'azote. Des « zones vulnérables », particulièrement sensibles à la pollution par les nitrates, doivent être définies et faire l'objet de mesures spécifiques.

L'épandage des effluents d'élevage est soumis à des règles :

- des normes d'épandage maximales sont définies en fonction de la nature de la parcelle (prairie ou culture) et de sa situation en zone vulnérable ou non ;
- des périodes d'épandage sont définies en fonction du type de fertilisant (azote minéral, fertilisants organiques à action lente (comme le fumier de bovin), fertilisants organiques à action rapide) et de la nature de la parcelle (prairie ou culture) ;
- interdiction d'épandage sur sol inondé ou enneigé, à moins de 4 m d'un cours d'eau, avant et après une culture pure de légumineuses (BOLLEN, 2006).

Par ailleurs, afin de respecter les périodes d'épandage, les éleveurs sont obligés de disposer des structures de stockage des effluents d'une capacité de six mois au moins. Des aides publiques sont accordées pour réaliser la mise aux normes.

Le principe de découplage des aides est de laisser aux agriculteurs toute liberté de choix des productions. Cependant, il existe une limite importante : les prairies permanentes, valorisées par les ruminants, doivent globalement être maintenues.

Chaque Etat-membre doit établir un ratio de référence.

Ce ratio est calculé de la façon suivante :

$$\frac{\text{(superficie en prairies permanentes en 2003) + (superficies nouvelles en prairies permanentes déclarées en 2005)}}{\text{Superficie agricole utile déclarée en 2005}}$$

Tous les ans, un nouveau ratio est établi à partir des déclarations de superficies et comparé au ratio de référence.

Si le ratio calculé pour l'année N est inférieur au ratio de référence d'un pourcentage donné de celui-ci, il y a interdiction générale d'affecter à un autre usage les prairies considérées comme faisant partie des pâturages permanents. Si l'écart dépasse un deuxième seuil, il y a obligation pour les agriculteurs concernés de remettre en pâturages permanents une superficie équivalente à la superficie en pâturages permanents qu'ils avaient affectés à un autre usage.

A côté de toutes ces dispositions restrictives, il existe, parmi les mesures agri-environnementales, sur base volontaire et non plus obligatoire, la possibilité d'obtenir une aide financière pour le maintien de faibles charges en bétail par hectare de prairie.

Quant à la charge en bétail maximale pour l'obtention de la prime à la vache allaitante, elle a été supprimée par la réforme.

PRODUCTION ET CONSOMMATION DE VIANDE BOVINE DANS L'UNION EUROPÉENNE

La production de viande bovine dans l'Union européenne à 25, en comparaison avec les principaux producteurs mondiaux, a évolué comme indiqué au tableau 2 au cours de ces dernières années.

Tableau 2

Evolution de la production de viande bovine chez les principaux producteurs mondiaux, de 2001 à 2006, en milliers de tonnes équivalent carcasses (tec)

	2001	2002	2003	2004	2005	2006
USA	11 983	12 427	12 039	11 261	11 317	11 891
Brésil	6 895	7 240	7 385	7 975	8 592	8 810
UE-25	8 084	8 145	8 061	8 007	7 770	7 820
Chine	5 488	5 846	6 305	6 759	7 140	7 575
Monde	49 646	51 241	50 095	51 327	52 247	53 592

Source : MOREAU J.-M. (2007)

On constate dans le tableau ci-dessus que la production bovine est en hausse sensible au Brésil et en Chine. Elle est stationnaire aux Etats-Unis et en légère baisse

dans l'UE, qui représentait 16,3 % de la production mondiale en 2001, en deuxième position derrière les Etats-Unis, et 14,6 % en 2006, derrière les Etats-Unis et le Brésil.

La réforme de la PAC, entraînant une diminution du cheptel, l'abandon de l'activité par certains producteurs et l'extensification des méthodes de production (GOHIN, 2006), conduit à une diminution de la production. Ces impacts de la réforme de la PAC sont confirmés par CHATELLIER (2006) pour la France et par l'Institut de l'Elevage (2006) pour le Royaume-Uni, bien que l'hétérogénéité des structures de production rende toute généralisation difficile.

La consommation de viande bovine, quant à elle, a évolué comme indiqué au tableau 3.

Tableau 3

Evolution de la consommation de viande bovine chez les principaux consommateurs mondiaux, de 2001 à 2006 (x 1 000 tec)

	2001	2002	2003	2004	2005	2006
USA	12 351	12 737	12 340	12 667	12 666	13 061
Brésil	7 658	8 187	8 315	8 292	8 145	8 200
UE-25	5 434	5 818	6 274	6 703	7 051	7 478
Chine	6 191	6 437	6 273	6 400	6 774	7 035
Monde	48 708	50 265	49 017	49 817	50 273	51 743

Source : MOREAU J.-M. (2007)

Les chiffres ci-dessus montrent que les Etats-Unis, de loin le plus gros pays consommateur au monde, voient leur déficit en viande bovine se creuser. Au contraire, le Brésil devient de plus en plus excédentaire, malgré une hausse sensible de la consommation. La consommation chinoise suit l'évolution de la production.

Quant à l'Union européenne, on constate qu'elle est devenue déficitaire en viande bovine, alors que son auto-approvisionnement était garanti depuis de nombreuses années et que le fait d'assurer les approvisionnements est un des cinq objectifs fondamentaux de la PAC.

COMMERCE EXTÉRIEUR DE L'UNION EUROPÉENNE EN VIANDE BOVINE

Les exportations de viande bovine de l'Union européenne ont évolué comme indiqué ci-dessous (tableau 4).

Tableau 4

Evolution des exportations de viande bovine de l'Union européenne, de 2003 à 2006 (tec)

	2003		2004		2005		2006 (janv. – nov.)	
Russie	262 326	59,5 %	206 170	51,2 %	120	42,1 %	111	52,7 %
Liban	59 830	13,6 %	56 017	13,9 %	246	10,1 %	293	2,0 %
Croatie	264	0,1 %	8 372	2,1 %	28	5,0 %	4 305	4,1 %
FYROM	5 642	1,3 %	9 081	2,3 %	849	3,5 %	8 672	2,3 %
Bosnie	3 666	0,8 %	11 622	2,9 %	14	3,4 %	4 755	1,4 %
Algérie	3 377	0,8 %	16 410	4,1 %	202	5,0 %	2 976	4,4 %
Angola	17 834	4,0 %	13 875	3,4 %	10	4,8 %	9 397	3,0 %
Total	441 107		402 544		010		6 440	
					9 754		211	
					14		217	
					373			
					13			
					808			
					285			
					391			

Source : BOLLEN (2007)

On constate que les exportations communautaires ont fortement chuté ces dernières années. La réduction d'environ 50 % des restitutions à l'exportation depuis juin 2005 et l'abolition des restitutions pour bovins destinés à l'abattage en décembre 2005 ont certainement contribué à la réduction de moitié de la viande bovine, à côté de troubles intérieurs comme c'est le cas au Liban.

Quant aux importations communautaires de viande bovine, leur évolution récente est reprise au tableau 5.

Tableau 5

Evolution des importations de viande bovine de l'Union européenne, de 2003 à 2006 (tec)

	2003		2004		2005		2006 (janv. – nov.)	
Brésil	277	54,7 %	323	60,2 %	339	64,3 %	302	66,3 %
Argentine	706	17,8 %	926	20,1 %	579	20,5 %	498	16,6 %
Uruguay	90 222	5,4 %	107	4,9 %	108	6,1 %	75 874	8,2 %
Australie	27 242	1,3 %	928	1,7 %	378	1,6 %	37 222	2,1 %
Nouvelle-	6 846		26 113		32 079		9 393	
Zélande		0,2 %	9 182	0,3 %	8 408	0,3 %		0,7 %
Roumanie	1 084	1,2 %		1,2 %		1,3 %	3 332	1,4 %

Suisse	5 993	0,5 %	1 388	0 5%	1 653	0,4 %	6 219	0,4 %
Total	2 756		6 631		6 921		1 757	
	508		2 775		2 107		456	
	062		537		527		243	
			666		992			

Source : BOLLEN (2007)

Les importations communautaires de viande bovine sont de l'ordre d'un demi-million de tonnes. Le Brésil est de très loin le premier fournisseur et sa part ne cesse de croître pour atteindre les deux tiers en 2006. Deux autres pays sud-américain, l'Argentine et l'Uruguay viennent ensuite. A eux trois, ils assurent 90 % des importations communautaires.

La Roumanie apparaît comme un des principaux fournisseurs de l'UE à 25, avec environ 6 000 tonnes, soit un peu plus de 1 % du total.

Finalement, la baisse de la production européenne correspond à une diminution des exportations, les importations se maintenant.

PERSPECTIVES

Sur un plan interne, une évaluation des mesures décidées en juin 2003 à Luxembourg doit être réalisée en 2008-2009. D'ores et déjà, cependant, la Commission européenne a clairement montré sa volonté de poursuivre le découplage des aides. Dans le secteur de la viande bovine, il est de plus en plus souvent envisagé de découpler toutes les aides, y compris celle à la vache allaitante, pourtant souvent considérée comme indispensable au maintien de nombreux troupeaux.

Jusqu'à présent, l'impact de la réforme de la PAC a cependant été faible sur l'orientation des productions car, bien souvent, le choix des productions possibles est très limité au vu des conditions naturelles. Une certaine extensification des méthodes de production, avec réduction des coûts et une meilleure valorisation des prairies et des fourrages, est cependant prévisible. La conditionnalité des aides, dont l'obtention est soumise au respect de règles environnementales strictes, va dans ce sens.

Sur le plan international, les négociations à l'OMC, ainsi que les discussions « bilatérales » entre l'Union européenne et le Mercosur, auront une influence non négligeable sur le secteur bovin communautaire (Institut de l'élevage, 2006). Les taxes à l'importation appliquées par l'Union européenne sur la viande bovine sont particulièrement élevées. Leur réduction ne pourra que renforcer encore la compétitivité des viandes sud-américaines. Il apparaît d'ailleurs préférable pour l'Union de négocier des contingents de viandes de haute qualité avec une protection plus élevée, plutôt que d'appliquer une réduction uniforme des tarifs.

Sur un plan qualitatif, on note une hausse constante de la viande préparée, de la viande hachée. Ceci n'exclut cependant pas l'existence d'une demande pour des viandes de qualité, comme par exemple le Blanc-Bleu Belge, particulièrement tendre et maigre.

D'une manière générale, la concurrence sera donc plus rude à l'avenir pour la production communautaire de viande bovine, qui devra s'adapter en maîtrisant ses coûts au maximum.

CONCLUSIONS

La réforme de la PAC de juin 2003 et les négociations à l'OMC orientent nettement le secteur communautaire de la viande bovine vers le marché alors qu'il était fortement réglementé et bénéficiait de nombreux types de primes.

Une confrontation plus forte à la concurrence internationale a entraîné une baisse de la production européenne, parallèle à une diminution sensible des exportations, et cela d'autant plus que des contraintes environnementales strictes s'imposent. Par contre, les importations se maintiennent et le Brésil y joue un rôle toujours plus prépondérant, malgré l'existence de problèmes sanitaires récents.

La seule façon de réagir sera une valorisation maximale des ressources naturelles et du potentiel génétique des races bovines, afin de réduire les coûts de production, d'une part, et de répondre au mieux à la demande ou, plutôt, aux demandes, d'autre part.

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SECTORUL CARNE DE BOVINE ÎN UE: SITUAȚIE ŞI PERSPECTIVE ÎN CONTEXTUL MEDIULUI

(Rezumat)

Sectorul cărnii de bovine este la origine unul din domeniile principale reglementate de PAC. Producția de carne de bovine este practicată în numeroase regiuni ale Europei, unde ea este uneori singura activitate agricolă posibilă.

De asemenea, consumul de carne de bovine a luat amploare cu ameliorarea continuă a puterii de cumpărare.

Ca şi alte sectoare ale agriculturii europene, organizarea comună a pieții de carne de bovine, inițiată în 1968, a înregistrat trei reforme succesive: în 1992, în 1999 şi în 2003.

Lucrarea se ocupă în detaliu de reforma cuprinsă în Agenda 2000 şi consecințele sale, cât şi de perspectivele de viitor ale producției de carne de bovine în aria europeană.

În ceea ce privesc perspectivele, autorul consideră că până în prezent impactul reformei din PAC a fost modest privind orientarea producțiilor, căci, adeseori, alegerea producțiilor posibile este limitată de condițiile naturale. O anumită extindere a metodelor de producție, cu reducerea costurilor şi o mai bună valorificare a păşunilor şi a furajelor este, totuşi, previzibilă. Condiționalitatea unor ajutoare, a căror obținere este dependentă de respectarea strictă a reglementărilor de mediu, merge în acest sens.

Pe plan internațional negocierile cu OMC, cât şi discuțiile bilaterale între UE şi Mercosur vor avea o influență asupra sectorului comunitar de bovine.

Pe plan calitativ constatăm o cerere ridicată de carne preparată şi semipreparată. Nu este exclusă pe viitor o creştere a cererii de carne de calitate superioară.

De o manieră generală se concluzionează că, pe viitor, concurența va fi din ce în ce mai dură pentru producția comunitară de carne de bovine, producție care trebuie să se adapteze prin stăpânirea costurilor la maximum; răspunsul față de exigențele de mediu trebuie luate, de asemenea, în considerare.

NEW RESEARCH AND APPLICATIONS OF ORGANOZEOLITES IN WATER TREATMENT

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Abstract: New research and applications of organozeolites in water treatment. Zeolites are natural compounds widely spread around the world. They prove to well retain cations, by mechanisms of ion exchange and adsorption. New techniques have turned these zeolites into compounds that retain anions and organic substances as bacteria and viruses. In order to acquire such capacities, zeolites are being treated with quaternary amines that turn them into organozeolites. Thus, they have become eligible for the retaining of anions of the types of sulfates, rhodanate, chromates, bichromates, phosphates, nitrites, nitrates, etc., but also bacteria and viruses. These new techniques tested by researchers from all around the world can apply also in Romania, due to the pollution of groundwater with such compounds.

Key words: *organozeolites, pollution, anions, nitrates, nitrites.*

INTRODUCTION

Following studies carried out in different areas of Romania by researchers but also after a study performed by the Autonomous Direction of the Romanian Waters, there has been concluded that the groundwater is polluted with various compounds of nitrogen (nitrites, nitrates, ammonium) but also with phosphates, organic substances and bacteria. All these compounds come either from industrial infiltrations or from intensive breeding farms, or from past irrational use of fertilizers, in view to obtain larger crops. A recent study performed on the Western part of the county of Timiş shows the degree of use of the drinking water coming from the groundwater within the households. The study shows that only 60% of the considered population uses drinking water from the public water supply, that is from controlled sources. The rest of 40% uses for drinking water from the underground. These water sources are highly polluted especially with nitrogen compounds, due to the irrational use of chemical fertilizers in the past, or to intensive breeding farms that have caused waste leakage and consequently a serious decrease of the quality of groundwater in the area. This pollution shows also in the occurrence and persistence of methemoglobinemy at newborns between 2003 and 2005 [23]. There can be thus concluded that the pollution with nitrogen compounds is a permanently current issue, due to the presence of these compounds in the ground and water and to the transformations that take place within the soil.

Another study performed in regard to the water of the Jiu-Danube rivers water system along the year 2002 proved that the pollution with nutrients and organic substances is still present in this area, and the data regarding the main pollutants are insufficient [27].

Concerning the North-Western part of Romania, there has been proven the existence of infiltrations with cadmium and arsenic due to the local industry [4,13,30,33]. Cadmium poisoning has serious effects on human health and it attacks liver and kidneys, especially by its cumulative effect. Arsenic generated diseases are proportional with the degree of exposure and the bio-availability. Arsenic poisoning can lead to respiratory diseases, cancer, neurological and reproductive diseases. The transfer of arsenic into the environment depends on its form (organic or inorganic). Organic species are generally

less toxic than inorganic ones. In case of long exposure to inorganic compounds of arsenic, there occurs an increase of cancer risk, in the liver, kidneys, lungs and skin.

There are also non-polluted area, as shows a study carried out in the county of Maramureş, where the quality of drinking water with underground sources comes close to standards. This happens due to the structure of the soil, that is made up mainly of illite and chlorite, that have a filtering effect, thus proving once more the adsorbing qualities of zeolites [3].

More recently, that is between 2005 and 2006, there has been performed a study for the evaluation of underground water quality in the neighboring areas of Timişoara, just where the domestic waste of the city are disposed of. There have been found increased concentrations of nitrogen compounds, especially ammonium and nitrites, phosphates, chlorides, sulfates, as well as triazinic pesticides [11].

OBTAINING AND ANALYZING ORGANOZEOLITES

The spreading of zeolites at the earth shell level is wide: there are large reserves of zeolites in Italy, Japan, Roumanie, Hungary, Bulgaria, etc. There are between 100,000 and 150,000 ton of zeolite products used every year only in Japan. Clinoptilolite and mordenite are the most used zeolites. During the last years, there have been found new applications of the natural zeolites, in view to improving the polluted environment. In Romania, zeolites can be found in the North-Western regions. Zeolites are known as exchangers of natural ions, mainly due to their capacity to retain cations as ammonium, calcium, etc.

Due to these characteristics, zeolites can be used for water treating in pisciculture, for treating the water in the swimming pools, or for decreasing the hardness of water used in food industry. The new applications of zeolites are related to using them for retaining oxianions from water, as sulfates, chromates, etc. In order to use zeolites for these applications, they are firstly treated with quaternary amines.

A study performed in order to determine the adsorption mechanism of amines on the sepiolite surface shows an adsorption of the Langmuir-Freundlich type, with adsorption capacity of about 300%. During adsorption, there have been released magnesium ions in a higher quantity than the CEC value of the sepiolite, due to the simultaneous dissolution of minerals. There was also studied the kinetics of the adsorption. The characteristics of the obtained organozeolite have been studied with the use of different analytical techniques as thermogravimetry and differential thermogravimetry. The surfactant molecules adsorbed on the sepiolite have formed a multi-layer. The first layer has been retained by ion exchange between magnesium and the surfactant cations, and the other layers have been retained due to the hydrophobicity of surfactant molecules. The maximum quantity of SDBAC adsorbed on the sepiolite was 0.4 h. The thermal analysis showed the forming of the multi-layer as well as the fact that the adsorption is influenced by the quantity of adsorbed surfactant [19].

The structural and chemical characterization of organozeolites may also be performed by Ramann spectra and IR spectra at low temperature [2,19,21], diffraction and differential analysis [5] or X rays [14]. The analysis of the dimensions of the zeolite granules can be carried out by laser granulometry [19] or ICP [32].

STUDIES AND APPLICATIONS OF ORGANOZEOLITES

The interest of researchers has lately focused on the possibility to retain anions from water and soil. Bowmann and his team have carried out large studies on the

thermodynamics and kinetics of retaining non-polar organic compounds and organic anions. There have been drawn the isotherms of adsorption for benzene, toluene, xylene, ethyl benzene, perchloretylene, lead, chromates, selenates, and sulfites. It seems that the mechanism of retaining these anions on organozeolites is one of surface precipitation of a complex between the surfactant and the oxianion [19]. The conclusion of the research is that organozeolites keep their capacity to retain cations and additionally gain characteristics of retaining oxianions, so they are practically appropriate for retaining a large majority of the pollutants found in the underground waters [4,13,23,27,30,33]. Moreover, the low costs of these organozeolites, around 0.3-0.5$/kg, make them attractive for use instead of the activated coal or of synthetic ion exchangers.

In parallel, there have been carried out studies about the retaining of the rhodanate ion on hydro-talcite, and the result thereof was a Lagergreen type adsorption [29].

In 2006 there was performed a comparative study about the retaining of lead on zeolites, by static or dynamic experiments. The Langmuir and Freundlich equations verified. The conclusion of the study was that Langmuir's equation was the one that best suited the adsorption process [7,20].

In the soil, the organo-illite can slow down the migration of anionic pollutants like the chromate. Kinetic, thermodynamic and dynamic studies were performed, as well as studies on pilot stations [7]. The thermodynamic and kinetic studies about the retaining of nitrite on organoclinoptilolite led to the conclusion that the reaction is of pseudo-order one and the thermodynamic studies show a Langmuir type adsorption [18,24,25,34].

The new research focuses on the adsorption of cadmium, lead, nickel, phosphates, rhodanates on calcined or non-calcined hydro-talcite [18].

The applications of organozeolites derive from experimental studies performed on these compounds. There were studied applications of using exhausted zeolites for developing plants under conditions of microgravity [17]. The experiment was carried out on the MIR orbital station. NASA has performed a similar experiment and there was noticed that substrata made up of zeolites led to an excellent vegetative development of plants, but also to low wheat production [25]. There were also tested for this purpose other types of zeolites like the analcime, previously mixed with natural fertilizer. Organozeolites can also be used as natural barrier for cleaning polluted soils. Better effects were proven concerning the retaining of nitrogen and carbon as well as arsenic, cadmium and lead, when soils were enriched with zeolites, and even the retaining of nuclear pollutants [1,8,9,10,12,16,26,28]. The effects of modified zeolites also cover the domains of bacteriology and virology, as zeolites are good adsorbents for viruses and bacteria [22].

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CERCETĂRI ŞI APLICAȚII NOI A ORGANOZEOLIȚILOR ÎN TRATAREA APELOR

(Rezumat)

In urma studiilor efectuate in diferite zone din România rezulta ca pânza freatica este poluata cu diverşi compuşi ai azotului (nitriți, nitrați, amoniu) dar si cu fosfați, metale grele, substanțe organice si bacterii. Toți aceşti compuşi provin fie din infiltrațiile din industrie sau din fermele de creştere intensiva a animalelor fie din folosirea neraționala a ingrasamintelor in trecut, cu scopul de a obține producții mari. Poluarea cu compusi ai azotului este inca de actualitate si este demostrata si de persistenta cazurilor de methemoglobinemie la sugari. Pentru zona de NV a Romaniei s-au demonstrat infiltratii cu cadmiu si arsen proveniti din industia locala. Exista si zone nepoluate aşa cum rezulta dintr-un studiu efectuat in județul Maramureş unde calitatea apei potabile provenite din pânza freatica este aproape de standarde datorita structurii solului format in special din illit si chlorit care exercita un efect de filtrare.

Zeoliții sunt compuşi naturali larg raspanditi nivel mondial. Ei au bune proprietati de de reținere a cationilor prin mecanisme de schimb ionic si adsorbție. In ultimii ani s-au gasit noi aplicatii ale zeolitilor naturali in vederea remedierii mediului poluat. Tehnici mai noi au transformat aceşti zeoliți in compuşi care rețin anionii si substanțele organice precum si bacteriile sau virusurile. Pentru a capata astfel de proprietati zeoliții sunt tratați cu amine cuaternare care ii transforma in organozeoliti. Astfel ei au devenit aplicabili pentru reținerea anionilor de tipul sulfaților, tiocianatilor, cromaților, bicromaților, fosfaților, nitriților, nitraților, etc. si a bacteriilor si virusurilor. Concluzia studiilor este ca organozeolitii isi pastreaza capacitatea de a retine cationii si castiga in plus proprietati de retinere a oxianionilor deci practic sunt potriviti pentru retinerea unei mari majoritati a contaminantilor regasiti in apele subterane.

Costurile reduse ale acestor organozeoliti ii fac atractivi pentru utilizarea lor in locul carbunelui activ sau a schimbatorilor de ioni sintetici. Organozeolitii pot fi folositi ca bariera naturala pentru ecologizarea solului poluat. Deasemenea organozeolitii epuizati pot fi utilizati pentru amendarea solurilor. Aceste tehnici noi, experimentate de cercetători din toate tarile, sunt aplicabile si in România din cauza poluării pânzei freatice cu astfel de compuşi.

PROPERTIES OF LIGNITE FROM OLTENIA AND THEIR INFLUENCE ON THE ENVIRONMENT

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Abstract: Properties of lignite from Oltenia and their influence on the environment. Extraction of lignite in the area between Danube and Motru has an important influence on the environment. Studies on petrographic charcteristics as well as on physical and chemical properties of coal can yield information on the potential negative incidence of quarry exploitation on the environment. The coal bed from Berbesti (Dacian Inferior) includes lignite layers I-IV. Layer I is exploited in the Zegujani and Livezile mines, the East Husnicioara quarry and Zegujani quarry. Layer IV is the most important in the central area of sector Danube – Motru and is exploited in the Husnicioara quarry. The investigations we have conducted in our laboratory focus on the above mentioned quarry. Coal mining increases the radioactive background. Moreover it is known that through technological processes the radioactive concentration of these elements can increase in products, byproducts and waste materials. Measurements were performed using state of the art techniques (high resolution gamma ray spectrometry). On average the concentrations have acceptable values, but in some layers the concentration of uranium measured reached up to values of one order of magnitude higher than the worldwide average. Thus we stress upon the need of increased environmental awareness in this region.

Key words: *Romanian lignite deposits, radioactive background, high resolution gamma ray spectrometry.*

INTRODUCTION

Coal provides about 40 percent of the world's electricity, compared to about 20 percent for natural gas, 20% nuclear power and renewable sources, respectively (U.S. Energy Information Administration (2003)).This is because coal is abundant and cheap. Still, if environmetal awareness is not implied, coal can be a killer. It has to be emphasized that environmental problems regarding coal don't just come from mining; they also come from burning it. Coal is also radioactive: most coal is laced with traces of a wide range of other elements, including radioactive isotopes such as uranium and thorium, and their decay products, radium and radon. Some of the lighter radioactive particles, such as radon gas, are shed into the atmosphere during combustion, but the majority remain in the waste product - coal ash. Up to 100 years ago the natural radiation was the only radiation burden for the humans. Even nowadays it still dominates the radiation burden of the population. The worldwide average radiation burden for the population is estimated to be around 3.6 mSv/y of which 2.4 mSv/y comes from natural sources, with the specification that this value is highly variable (RSRP, 1994).

The main terrestrial primordial natural radionuclides are ^{238}U, ^{232}Th and ^{40}K. They can be found in trace or even appreciable amounts in every component of the environment and they are generically named “natural occurring radioactive materials”. Through technological processes the radioactive concentration of these elements can increase even by an order of magnitude in products, byproducts and waste resulted from the processing of natural materials. These are the so-called technologically enhanced natural occurring radioactive materials (TENORM).

The average concentration of ^{238}U, ^{232}Th and ^{40}K in coal is estimated at 25, 20 and respectively 50 Bq/Kg, with a variation of more than two orders of magnitude. (RSRP,

2000). The natural radioactivity of coal can exceed in some cases even with an order of magnitude the average values encountered in Earth's crust (^{226}Ra-32 Bq/Kg, ^{232}Th- 45 Bq/Kg, ^{40}K- 420Bq/kg) (UNSCEAR, 1993). An explanation for the high uranium content of some coal deposits is related to uranium restraint from sodium uranyl carbonates dissolved in ground water by the coal bed during its formation (Breger, 1974).

In Romania the present reported uranium content of coal ranges from 37 Bq/m^3 (Valea Jiului and Banat deposits) to 108 Bq/m^3 (Oltenia) (Bolocan-Viasu, 1996). In Hungary the high levels of radioactive nuclides concentrations were found in the Cretaceous coal of Ajka, certain deposits from Tatabánya basin (Somlay et al., 1998) and in the Liassic coal from Mecsek Mountains (Kóbar et al., 2002). Values of 480 Bq/m^3 have been reported for uranium content of Ajka coal (Bódizs et al, 1993).

The lignite deposits in Oltenia, which represent 80% of the total lignite deposits in Romania, are divided in 5 large sectors, based on their geologic characteristics: 1- Danube-Motru, 2- Motru-Jiu, 3- Jiu-Gilort, 4-Gilort-Bistrita, 5- Deposits in Center and South Oltenia. Due to the fact that ¾ of the national energy coal production is assured by the Oltenian lignite deposits, there are several geologic studies, of which we mention the synthesis elaborated by Ticleanu et Patrutoiu 1987. In a previous paper (Codrea et al, 2007) some of the environmental consequences of lignite exploitation in the Danube-Motru sector are assessed. The soil, water (ground and surface) and air impact is mentioned; the impact on flora, fauna and human settlements is also described. From the high number of mines and underground exploitation of Pliocene coals in the Danube-Motru sector functioning before 1990, nowadays only the quarry from Husnicioara and the Zegujani mine are still operating. The present paper aims to present a preliminary estimation of the concentration of radioactive elements in coal samples collected from Oltenia using the state of the art techniques (high resolution gamma ray spectrometry). ^{238}U, ^{226}Ra, ^{232}Th, ^{40}K contents of six samples collected from layer IV of Husnicioara quarry.

GEOLOGICAL DESCRIPTION OF LIGNITE FORMATIONS

The lignite deposits from the Western part of the Dacic Basin belong to Dacian and Romanian. The Dacian-Romanian deposits, in which these lignite are situated, belong to two different lithostratigraphical entities: Berbesti Series (Early Dacian) and Jiu-Motru Series (Upper Dacian – Early Romanian). The Berbesti Series (Early Dacian) has a significant economic importance in the Western part of the Dacic Basin. West of the Motru River, in this series, the A-D layers are situated at the lower part, and I-IV layers at the upper part. **Figure 1A** represents the location of the study area on the map of Romania. **Figure 1B** illustrates the lithological columns throughout the upper Neogene deposits investigated.

Layer IV, from the Husnicioara quarry is composed of two main coal packets, separated by a clayey-coal packet. Obviously, the entire 8 m thickness deposit is exploited as a whole. It is assumed that in the western part of Husnicioara area, the coal complex IV comprises the II and III layers, too. The Jiu-Motru Series (Upper Dacian) is poorly represented in comparison with the previous one. The Husnicioara area comprises the V-VI lignite strata and sometimes these strata are eroded. The coal characteristics are briefly described in Ticleanu and Patrutoiu 1987 . The conclusion is that the wooden lignite, with stratified structure, from the Husnicioara-Zegujani area have qualitative characteristics varying from one stratum to the other and from one area to another. The palynologic studies of Upper Neogene, from the Danube-Motru sector, revealed vegetation formations, which were the basis for lignite genesis. Based on the same

palynologic criteria, the paleoclimatic conditions existing in the upper Neogene in the western part of the Dacic Basin have been reconstructed (Petrescu 1992).

SAMPLES, MEASUREMENTS AND RESULTS

Lignite samples were collected from layer IV of the coal bed, at Husnicioara quarry. Layer IV consists of two packets of coal. Between these layers an intermediate clayey-coal layer is intercalated. Samples were collected from the upper and lower parts of the above mentioned packets. A schematic representation of the coal formation as well as the sampling points is illustrated in **Figure 2.**

Before being measured the samples were homogenized and dried till constant weight and kept for three weeks in order for equilibrium between ^{222}Rn and its daughters to be reached again. High resolution gamma ray spectrometry analysis was carried out on a ORTEC hyperpure germanium detector having the following characteristics: active volume of 181 cm^3, 0.878 keV FWHM at 5.9 keV, 1.92 keV FWHM and 34.2% relative efficiency at 1332.5KeV. The system was calibrated in energy using a standard Eu source.The detector is mounted in a lead castle and has a 0.5 mm beryllium window which makes it suited for measuring several U and Th decay products, down to ^{210}Pb with a gamma ray energy of 46.5 keV. The lines that were investigated in ^{238}U series are ^{234}Th (63.3 keV), ^{226}Ra (186.2 keV), ^{214}Pb (295.2 and 351 keV), ^{214}Bi (609 keV). The lines at 63.3 keV and 186.2 keV are moderately to heavily interfered by the 63.8 and 185.7 keV lines of ^{232}Th and ^{235}U, respectively, thus requiring proper corrections. In the ^{232}Th decay chain we measured ^{228}Ac (338.3 and 911 keV) and ^{208}Tl (583.2 keV). Eventually, also the 1460.8 keV gamma ray of ^{40}K can be measured.

As previously mentioned, ^{226}Ra 186.2keV is heavily interfered by the ^{235}U 185.7keV line and a correction for this interference is needed to obtain unambiguous results, directly obtained values for ^{226}Ra being of major importance as usually equilibrium cannot be assumed between ^{238}U and ^{226}Ra the latter being soluble and thus being subjected to transportation by percolating groundwater. Correction for the interference was made following a suggestion of De Corte et al (2005).

Detection efficiencies were computed for the energies of interest using a Monte Carlo Code (GES-Gamma Electron Efficiency Simulator version 2.7 copyright 2006-2007 Dan Fulea). Moreover, in order to validate the procedure used we also determined the detection efficiencies experimentally, using radiometric reference materials RGU-1 (400 ± 2 μg/g) and RGTh-1 (800 ± 16 μg/g), measured in the same geometry as the soil samples, issued by the IAEA. In this standards the U and Th decay series are in equilibrium. All the samples were measured for at least 160 000 seconds the measurement geometry being a cylinder in all cases. Values obtained are presented in **Table 1**. A typical spectrum is represented in **Figure 3**.

As it can be seen from the tabulated values, the concentrations of ^{232}Th and ^{40}K range between 15-36 Bq/kg, respectively 72-115 Bq/kg (excluding sample I b in the case of potassium). This values are comparable to values previously reported for Oltenia and Hungary and as well as to worldwide averages: 20 Bq/kg for ^{232}Th and 117 Bq/kg for ^{40}K (Kóbar, 2002 and Bolocan-Viasu, 1996).

Regarding ^{238}U, it can be noticed that the concentrations found in the clayey packet (II a and II b) are 10-13 times higher than the concentration found in the upper layer (III a, III b). In the inferior coal packet (I) a migration of uranium from the intermediary sub-layer was noticed. This phenomena is more pronounced as expected in the upper part of the formation (I a) and has a smaller magnitude in the lower part (I b). The same migration

effect can be observed for radium, with the remark that the migration rate of this nuclide is higher than the diffusion rate of uranium.

The high content of uranium found in clayey coal packet II can be attributed to the high power of retention of clayey materials for the uranium dissolved in the probably alluvial materials that were deposited above sub-layer number I of strata IV and led to the development of the intermediary sub-layer II. We assume that during the deposition process a part of this uranium migrated downwards in inferior packet I, most of it being retained by its upper part. As for radium we assume a more constant diffusion process throughout time.

We emphasize that a high resolution profile of uranium and radium concentrations, together with the determination of $^{234}U/^{238}U$ isotopic ratio (Vasaru and Cosma, 1998) could provide precious information about the formation process and age of the coal bed at Husnicioara.

CONCLUSIONS

Measurements carried out on samples collected from Husnicioara quarry indicated that high levels of natural radioactive elements (^{238}U, and ^{226}Ra) can be found in the clayed coal sub-layer. As Strata IV is being exploited as a whole (including the clayed coal sub-layer) we can roughly estimate a mean value of the uranium concentration of the coal at around 150 Bq/kg. This can result in an increase of the natural radioactive background of the environment. Further studies have to be carried out to determine the degree of radioactivity of ashes resulted from burning this coal, but if we take into consideration previous studies available from other regions (Bolocan-Viasu et al 1996, Karangelos et al 2004) and consider an enhancement of about 4-6 times we can roughly estimate an average specific activity of ^{238}U of 800-900 Bq/kg. This concentration of uranium, and obviously of radium as well would make the use of these ashes (as additives in building materials) prohibitive. We also emphasize on high environmental awareness concerning the placement of the sterile and waste materials resulted from mining activities as well as regarding the flying ashes and ashes of coal from Husnicioara quarry.

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RADIOACTIVITATEA LIGNIȚILOR DINTRE DUNĂRE ŞI MOTRU ŞI IMPACTUL ACESTEIA ASUPRA MEDIULUI

(*Rezumat*)

Zăcămintele de cărbuni inferiori (ligniți) din Oltenia de Sud-Vest (aria dintre Dunăre şi Motru) au o pondere economică importantă, în producția de cărbuni energetici din țara noastră Formațiunea de Berbesti (Dacian inferior) înglobează stratele D-A şi stratele I-IV de ligniți. Stratul I a făcut obiect de exploatare în minele Zegujani şi Livezile, în cariera Husnicioara Est şi microcariera Zegujani. Stratul IV este cel mai important din zona centrală a sectorului Dunăre - Motru şi a făcut obiectul exploatării în mina Prunişor Vest şi în cariera Husnicioara. Investigatiile noastre de laborator privesc mai ales suita stratigrafica (atribuita Pliocenului) care se dezvolta in cariera Husnicioara si care reprezinta un larg camp de exploatare, cu incidente directe asupra mediului inconjurator

Formațiunea de Jiu – Motru (Dacian superior – Romanian) cuprinde stratele V-XIII, cu dezvoltare diferențiată în sectorul Dunăre – Motru şi, respectiv Motru – Jiu.

Carbunii contin cantitati variabile dintre radionuclizii primordiali (U, Ra, Th, K) in cantitati mici in general, dar in unele zacaminte radioactivitatea acestora poate fi crescuta. Procesele geochimice de transport pot altera echilibrul radioactiv dintre U si Ra.

Iradierea populatiei datorata radioactivitatii naturale este un fapt de viata. Mineritul inclusiv cel legat de carbune aduce la suprafata o parte din radioactivitatea din scoarta, mai mare decat cea de la suprafata. Prin prelucrari tehnologice concentratia acestor elemente radioactive in subproduse sau deseuri poate creste cu ordine de marime contribuind la marirea expunerii populatiei la aceasta radioactivitate naturala. Lucrarea prezinta rezultatele unor masuratori recente asupra radioactivitatii carbunilor din cariera Husnicioara. Se fac referiri privind lignitii propriuzisi cat si asupra argilelor carbunoase din succesiunea stratigrafica pliocena studiata. Analizele cantitative au fost efectuate utilizand o instalatie gama spectrometrica cu detector HP-Ge, calibrata prin utilizarea unei metode Monte-Carlo. Un continut ridicat de uraniu (300-400 Bq/kg) şi radiu (250-450 Bq/kg) a fost identificat in stratul intermediar de argila carbunoasa in cariera Husnicioara. Aceste concluzii trebuie sa mareasca atentia asupra problemelor de mediu pe care o exploatare inadecvata a acestei cariere precum si o ardere necorespunzatoare sau o utilizare nepotrivita a cenusii rezultate in urma arderii acestor carbuni le-ar putea ridica.

Figure captions:

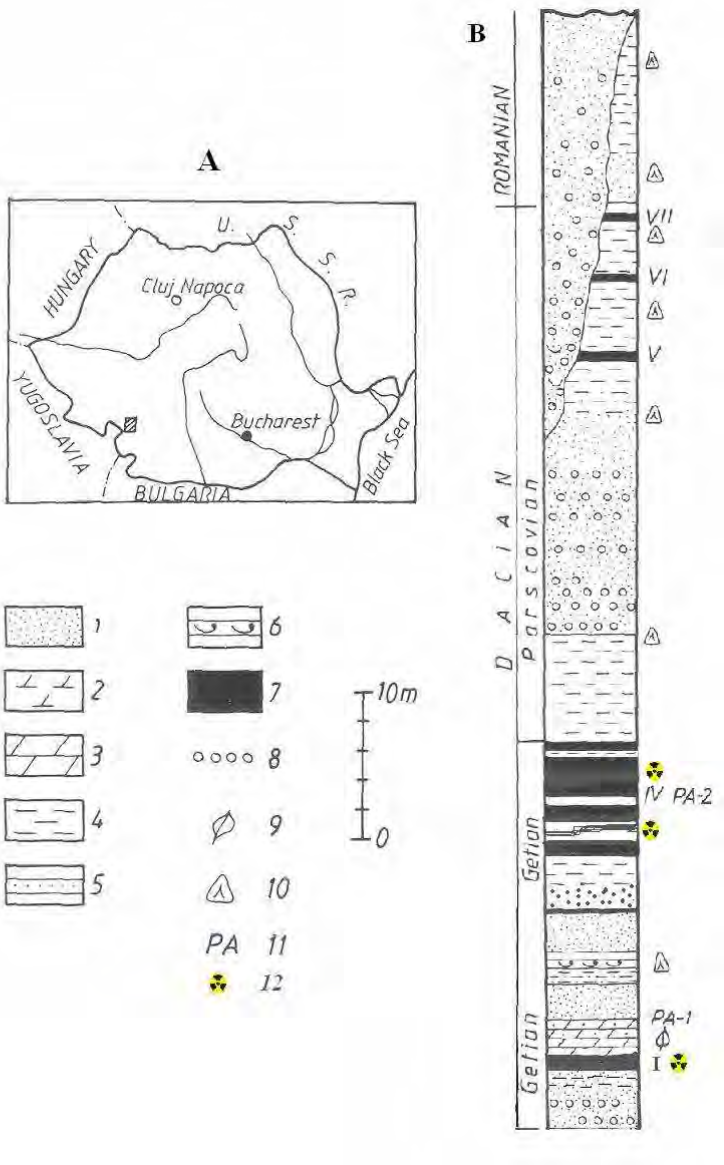

Fig. 1. *A- location of the study area on the map of Romania. B- Lythological collumns through the Upper Neogene deposits investigated; 1-sands, 2-marly clays, 3-marls, 4-clays, 5-sandstone seams, 6-shell rock, 7-lignite, 8-gravel, 9-fossil plants, 10-palynological samples, 11-palynological assemblies, 12-samples collected for radioactivity studies (Figure adapted from Petrescu 1992)*

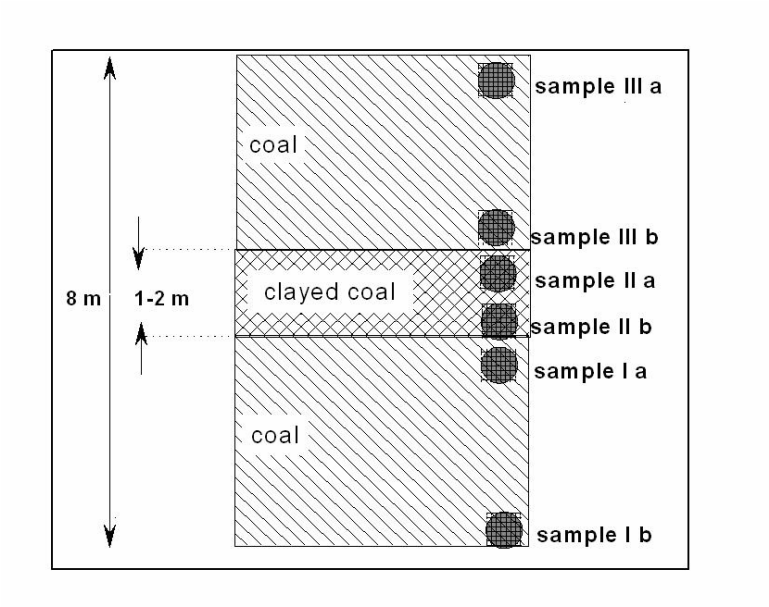

Fig. 2. *Schematic representation of layer IV, with sampling points indicated*

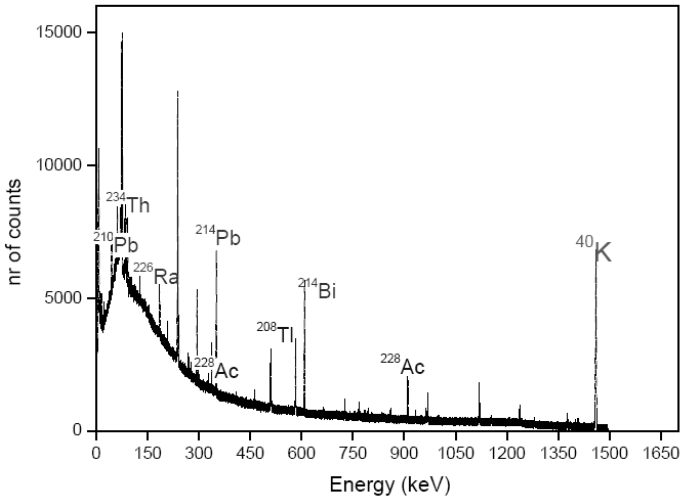

Fig.3. *Typical gamma spectrum of a coal sample.*

Table captions:

Table 1

Natural Radionuclide concentrations measured of lignites from Husnicioara.(Last collumn represents the ratios of the uranium concentration in the samples analyzed to the worldwide average concentration in the crust)

Sample	^{238}U (Bq/kg)	^{226}Ra (Bq/kg)	^{232}Th (Bq/kg)	^{40}K (Bq/kg)	Obs ($U_{sample}/U_{average}$)
I a	**210** (10-15% rel err)	**230** (10-15% rel err)	**25** (30-35% rel err)	**110** (10-15% rel err)	7 : 1
I b	**58** (30-35% rel err)	**81** (30-35% rel err)	**35** (30-35% rel err)	**480** (10-15% rel err)	2 : 1
II a	**295** (10-15% rel err)	**252** (10-15% rel err)	**22** (30-35% rel err)	**58** (10-15% rel err)	10 : 1
II b	**395** (10-15% rel err)	**453** (10-15% rel err)	**34** (30-35% rel err)	**155** (10-15% rel err)	13 : 1
III a	**25** (30-35% rel err)	**26** (30-35% rel err)	**18** (30-35% rel err)	**85** (10-15% rel err)	1 : 1
III b	**28** (30-35% rel err)	**24** (30-35% rel err)	**17** (30-35% rel err)	**72** (10-15% rel err)	1 : 1

GENETIC FACTORS AND ENVIRONMENTAL IMPACT OF ACID MINE DRAINAGE AT VĂRATEC BĂIUȚ MINE, BAIA MARE DISTRICT, ROMANIA

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Abstract: Genetic factors and environmental impact of acid mine drainage at Vâratec Băiuț mine, Baia Mare district, Romania. Extracting and processing of mineral resources is one of the most aggressive economic activities. The most important environmental impact of mining activity is Acid Mine Drainage (AMD) which affect especially the surface water. Baia Mare district is a well known mining area since Medieval Times; therefore the environmental impact of mining operations is a major issue. Varatec Băiuț Mine is located in the easternmost part of this district. The acidic mine water from underground workings is pumped to the surface. Due to the improper management of this water, the quality of the Văratec Valley is constantly degraded downstream the mine entrance. The watercourse is characterized by very low pH and increased values of TDS. Downstream, the mixing of affected water with clean surface water determines a slight neutralization process.

Key words: *acid mine drainage, epithermal ore, sulfides, pollution, watercourse, pH, TDS*

INTRODUCTION

Extraction and processing of mineral resources create a wide range of environmental impacts. The potential environmental problems associated with mining projects have been categorized in three types: environmental impacts, pollution impacts and occupational health impacts [22]. In the last twenty years, mining, like other industries, has tried to reach the goal of sustainable development, i.e. “qualitative development, in other words a balanced striving for all human values, whether material or intangible, in harmony with nature” [14].

The largest and the most difficult environmental problem in the mining industry is the acid mine drainage – AMD [13, 23]. AMD is defined as drainage that forms as a result of sulfide oxidation in earth materials exposed to water and air. Surface and underground workings, overburden and mine waste rock or tailings piles and ponds are typical mining places where acid drainage emanates.

For pyrite, the chemical reaction in the acid generating process can be simplified to [16]:

$$FeS_2 + 15/4O_2 + 7/2H_2O \rightarrow Fe(OH)_3 + 2SO_4^{2-} + 4H^+$$

Iron hydroxide, sulfate and hydrogen ions are generated during pyrite oxidation. The acidity in waters is caused by the releasing of hydrogen ions, every mole of pyrite creating four moles of acidity. In this acidic environment, other sulfide minerals are dissolved, different metals and chemical elements being liberated: lead, zinc, copper, cadmium, manganese, aluminum, nickel, arsenic etc.

Immediately after the exposure of sulfides to water and air, AMD generation starts very quickly. The process can continues many years (decades, centuries or longer) until all the acid generation minerals are completely oxidized. Groundwater and surface water courses are contaminated by AMD if the acidic effluents are not collected and/or treated by different methods: active treatment technologies and passive systems technologies

[1]. These polluted waters have a negative impact on vegetation, wildlife, fish, and human population.

Previous scientific works about Văratec Băiuț ore deposit were focused on the general geological description [12, 15], the different mineralogical peculiarities [7, 10], the ore forming processes [5,18] and the economic beneficiation aspects [9].

In this research, geological characteristics of this ore deposit are used in order to determine the genetic factors of the acidic mine waters produced in underground workings. The environmental impact of AMD is presented based on the electrochemical analyses made on water samples collected from the study area.

GEOLOGICAL SETTING

Văratec ore deposit belongs to the Băiuț – Văratec – Poiana Botizei metallogenetic field, located in the eastern end of the Oaş – Gutâi volcanic chain from East Carpathians (Figure 1). The mineralized structures were mined for centuries, providing one of the main economic activities in the region. Due to the age of mining activities, the negative environmental effects have accumulated over decades.

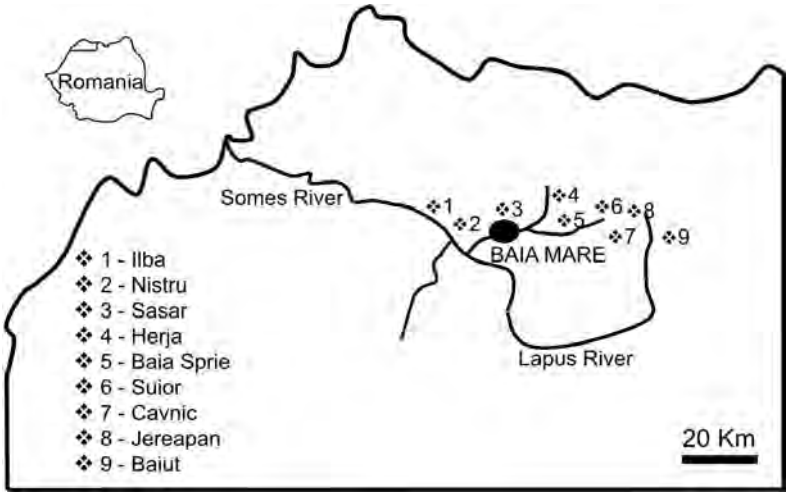


Fig. 1. *Location of Băiuț area in Baia Mare metallogenetic district. Legend: 1 to 9 – metallogenetic fields*

The metallogenetic processes leading to the formation of the Văratec ore deposits are closely connected to the evolution of the Upper Tertiary intermediary calc-alkaline magmatic regional events in Gutâi Mountains [24]. The magmatism was a consequence of the convergent movements of the European plate and the microplates within the Carpathian chain respectively [21].

The magmatic rocks in the Băiuț – Văratec – Poiana Botizei metallogenetic field were generated during the second, Pannonian volcanic cycle in the Gutâi Mountains. The corresponding ore deposits were formed during the third metallogenetic phase, being associated to pyroxenic andesites [3].

The geology of the area relates to Jurassic, Cretaceous and Paleogene sedimentary formations included in the Pienid units, post-tectogenetic Neogene and

Quaternary sedimentary deposits as well as explosive, effusive and intrusive volcanic sequences. The complex tectonic pattern resulted from the movements leading to the formation of the Pienid Nappes, followed by the reactivation of previously-formed faults and the formation of new ones, synchronous with the magmatism [4].

DESCRIPTION OF THE VĂRATEC BĂIUȚ ORE DEPOSIT

The sedimentary formations in Văratec area are Eocene, Badenian, Sarmatian, Pannonian and Quaternary in age. The magmatic processes lead to the formation of explosive, effusive and intrusive rocks. Hornfelses resulted at the contact between the subvolcanic bodies and the sedimentary rocks, while hydrothermal alterations represent the effect of postmagmatic fluids on the surrounding rocks. The Eocene and Neogene formations build-up a monoclinic structure, the former locally shows tight bending. Explosive volcanic sequences, followed by effusive rocks resulted from lava crystallisation occur at the top of the various sedimentary units. The ENE-WSW – oriented fractures were formed previous to the volcanic activity, while the NE-SW fractures – typical for the upper parts of the ore deposits – were subsequent (Figure 2).

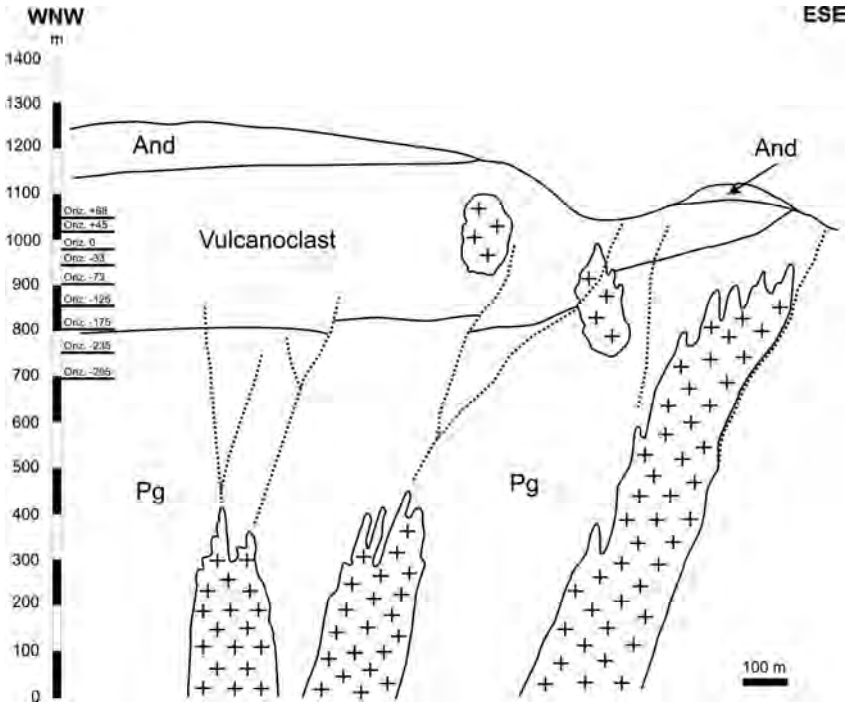


Fig. 2. *Geological cross section from Văratec Băiuț ore deposit. Legend: Pg – Paleogene, Vulcanoclast – volcanoclastics, And – andesites, +++ – diorites,* ***……*** *– vein, Oriz. – mining level*

Văratec ore deposit consists of 18 NW-SE – oriented veins. Three groups can be defined: north-western (TransLivia, Livia, Văratec, Radu – Vasile, Gheorghe, Ramură Livia and Maria veins), central (Ioan Vechi, Ioan Nou, Tereza, Alexandru and 200 veins),

and south-eastern (350, Botiza II, Botiza I, Botiza III, Botiza IV and Borcut veins) ones. The veins belong to three fracture systems: NE-SW, ENE-WSW and NNE-SSW. Their length varies between 0.2 km and 5.9 km, with an average of 0.9-1.5 km. The vein thickness varies between 0.2-0.3 m to more than 5.5 m. The current height of the mineralised level is variable, from tens of meters in the case of less-developed veins, up to about 500 m. The veins show diverse textures, most frequently being present the banded, brecciated, massive, cockade and geode ones; impregnations occur subordinately.

MINERALOGY, GEOCHEMISTRY AND METALLOGENY OF THE VĂRATEC BĂIUȚ ORE DEPOSIT

The mineralogical composition of the veins from all three groups of the Văratec ore deposit is almost identical, only the ratios between the mineral species being different. The following mineral classes are represented: native elements, sulfides, sulfosalts, wolframates, oxides and hydroxides, carbonates, sulfates and silicates. Among the native elements, gold shows similar compositions throughout the deposit.

Quantitatively, sulfides dominate: the most frequent species are pyrite, chalcopyrite, sphalerite, and galena (Figure 3). Marcasite, pyrrhotite (Figure 3), arsenopyrite, bornite, chalcocite, covellite and bismuthinite are subordinate. Even if sulfosalts occur in considerably lesser amounts, they constitute an essential part of the mineralization. The most frequent sulfosalts are terms of the tetrahedrite – tennantite series, bournonite is subordinate, while terms of polybasite – pearceite series are sporadic. The presence of bismuth sulfosalts is a characteristic feature of the veins from Văratec. The chemical data showed the presence of some terms from the lillianite – gustavite series, of matildite, pavonite, berryite and wittichenite [11].

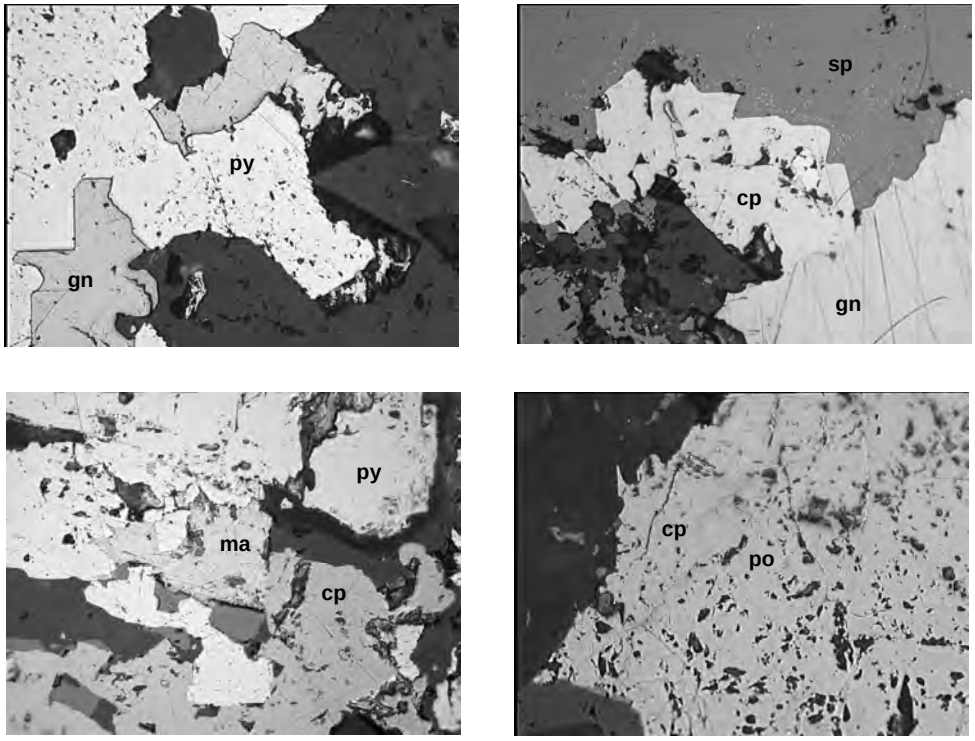
Another typical mineralogical aspect of Văratec ore deposit is the presence of wolframates. This class is represented by wolframite – the Fe-rich term (ferberite). Among oxides, hematite and magnetite were identified, while hydroxides are represented by lepidocrocite and goethite.

Quartz is the most widespread barren mineral in the veins from Văratec. It shows various colours: greyish-white, dark grey or smoky, violaceous or transparent. Carbonates are mainly represented by siderite and calcite, rarely by malachite and cerussite. Sulfates are scarce, among which gypsum, barite and rarely anglesite were noticed. Clay minerals occur as nests in the central parts of the veins.

Geochemically, the Văratec ore deposit belongs to the polymetallic type (Pb, Zn, Cu) with significant contents of precious metals (Au, Ag). Based on the variation of the major elements contents with direction, in the case of large veins several mineralised columns can be discriminated, separated by areas depleted in metals, along several horizons. These columns, showing maximum development in the central parts of the veins, usually disappear at deeper levels. In a vertical profile, an upper Pb-Zn zone enriched in precious metals, a clearly polymetallic, basically Pb-Zn median zone, and a lower, Cu-rich zone can be separated. The latter zone is also typically showing relatively larger amounts of Au and Ag. The veins in the north-western group are dominantly Cu-rich, while the veins in the central and south-eastern groups are Pb-Zn– rich.

Based on mineral elements, the veins in the north-western and central groups are dominated by W and Bi, while the south-eastern group is characterised by Cd and Sb. Pyrite and marcasite are rich in As, Co, and partly Ni and Ag. Relatively high contents of

Ag and Bi were noticed in chalcopyrite, especially in the Livia vein. Galena shows high amounts of Ag, Bi, and Sb, while sphalerite registers the highest values for Mn and Cd.



Scale: —— 100 μm

Fig. 3. *Microscopic photographs (reflected light, plane polars) of the main sulfides from Văratec Băiuț ore. Legend: py – pyrite, cp – chalcopyrite, gn – galena, sp – sphalerite, ma – marcasite, po – pyrrhotite*

The geological, tectonic, mineralogical and geochemical characteristics of the Văratec ore deposit define its assignment to the low-sulfidation, or adularia – sericite epithermal type [25]. All the features of the Văratec ore deposits indicate its best fit with the Creede model [19], while according to the mineralogy, depth and geotectonic setting it belongs to the arch low sulfidation subtype [8]. Among the two models previously defined for Baia Mare region, Văratec ore deposit is closer to the Baia Sprie model [24].

ACID MINE DRAINAGE AT VĂRATEC BĂIUȚ MINE

The environmental impact created by the exploration, mining and ore processing of the mineral deposits have been summarized in descriptive geoenvironmetal models for each deposit type [6]. Due to the extreme metalogenetic complexity of the epithermal ore deposit created by the mineralogical variations, geochemical zoning and variable alteration patterns, the environmental signature of this ore deposit type is very complex [20].

For the Văratec Băiuț ore deposit, the main environmental impact is created by the acid mine drainage. These acidic waters are the results of the ore minerals oxidation in underground mine workings. The host rocks of the veins are intensively tectonized, entailing a high permeability which allows the water to enter in the underground. In the presence of the oxygen, the percolating water reacts with the ore minerals, especially iron and other elements sulfides. The oxidation process is increased by the high content of different species of sulfides and by the relatively small dimensions of the grains (Table 1).

Table 1.

Dimensions of the iron sulfides grains from Văratec Băiuț ore

Mineral	Minimum (μm)	Average (μm)
Pyrite	100	250
Chalcopyrite	50	150
Galena	35	200
Sphalerite	20	200

The acidic mine waters generated in the underground workings are collected and pumped to the main adit. Then, these waters are transported by a 7 km underground channel to the ore processing plant (Figure 4). Due to the bad maintenance, this channel is not entirely sealed, sometimes the acidic being released in Văratec Valley, the main watercourses of the area.

Fig. 4. *Acidic mine water management: a – underground water pumped to the main adit, b – water transported by the underground channel*

Recent works have outlined that downstream Băiuț area, the watercourses have an acidic pH and they are polluted by Pb, Zn, Cu, and Cd. Moreover, the bed stream and associated floodplains sediments are contaminated by As, Pb, Zn, Cu, Cd. The exceeding values of the maximum allowable concentration recorded for this area are the highest from the Tisa basin [2, 17].

In order to evaluate the magnitude of the negative environmental effect of the acid mine drainage from the Văratec mine released to the Văratec Valley, several water samples have been collected. The sample location is (Figure 5):

- 1 – mine water from the underground channel;
- 2 – mine water released to the surface;
- 3A – clean water form the Văratec Valley upstream the confluence with the acidic water creek;
- 3B – acidic water from the creek formed by mine water released to the surface;
- 3C – water after the confluence with the acidic water creek;
- 4 – clean water from a springhead;
- 5A – water from the Văratec Valley upstream the confluence with the Izvorul Alb Valley;
- 5B – clean water from the Izvorul Alb Valley;
- 5C - water from the Văratec Valley downstream the confluence with the Izvorul Alb Valley.

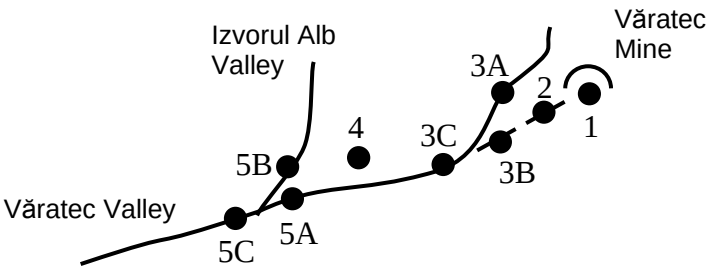


Fig. 5. *Sketch with the samples location from the Văratec Băiuț area (no scale)*

The electrochemical parameters of the samples (Table 2) have been determined using a CONSORT C533 instrument: pH, Eh (redox potential), EC (electric conductivity), and TDS (total dissolved solids).

The mine water released form the underground (sample 1, 2, and 3B) is extremely acid (pH < 3) and it has a very high TDS value. The electrochemical values of the water from Văratec Valley (sample 3A) and form the springhead (sample 4) indicate clean surface water. Downstream the confluence between the Văratec Valley and acidic mine water creek, the quality of the valley water deteriorates significantly (low pH and high value of TDS). This acidic character of the water from the Văratec Valley is preserved downstream (sample 5A), but it can be observed a slight neutralization process due to the mixing with the clean surface water (slight increase of pH and slight decrease of the TDS value). The water from The Izvorul Alb Valley upstream the confluence with the Văratec Valley is also clean (sample 5B). Downstream confluence, due to the mixing of the acidic water with the clean water, the electrochemical parameters of the Văratec Valley water

(sample 5C) indicates a neutralization process (slight decrease of the TDS value). Downstream this point, the Văratec Valley is affected by other acidic mine water effluents.

Table 2.

Electrochemical values of the water samples collected from the Văratec Băiuț area

Sample	pH	Eh (mV)	EC (µS/cm)	TDS (mg/l)
1	2.97	217	4000	2170
2	2.95	216	3880	2070
3A	7.03	-10	427	227
3B	2.93	218	3820	2060
3C	3.06	209	2900	1550
4	8.24	-73	413	220
5A	3.29	195	2670	1430
5B	6.9	-3	183	97
5C	3.29	195	2333	1250

CONCLUSIONS

In mining areas, Acid Mine Drainage (AMD) represents the main environmental issue, affecting the surface waters. AMD results when the sulfides from the ore are exposed to air and water. The oxidation process creates an acid environment which is favorable to dissolve the metals from the minerals. Often, these acidic waters are released without any control operations, the quality of watercourses being deteriorated.

Some geological characteristics of the Văratec Băiuț ore deposit are increasing the AMD generation potential: the high content of the sulfides, the permeability of the host rocks created by the tectonic events, and the small dimensions of the sulfides grains.

The acidic mine waters from Văratec Băiuț Mine are collected and pumped to the surface. An underground channel transports the water to the ore processing plant. The bad maintenance of the channel allows the acidic water to be released in the Văratec Valley. The electrochemical analyses made on water samples shows very low values of pH and increased values of TDS. Downstream, a neutralization process is present due to the mixing of the acidic water with clean surface water, showed by the slight decreasing of the TDS values.

Further researches are necessary in order to made a complete evaluation of the environmental impact of AMD on surface water in Văratec Băiuț area. More chemical analyses are necessary to quantify the metals contamination levels of the water and sediments from the watercourses.

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FACTORII GENETICI ŞI IMPACTUL AMBIENTAL AL DRENAJELOR ACIDE DE MINĂ DE LA MINA VĂRATEC BĂIUŢ, REGIUNEA BAIA MARE, ROMÂNIA

(Rezumat)

Producerea drenajelor acide de mină este cea mai importantă şi mai gravă problemă care afectează mediul ambiental în regiunile miniere. Acest fenomen are loc în urma oxidării sulfurilor conţinute în zăcăminte sub acţiunea apei şi a aerului. Managementul acestor ape acide constă în colectarea şi tratarea lor. Adeseori, datorită proastei întreţineri a facilităţilor cu care se face acest management, apele acide sunt deversate în cursurile de apă de suprafaţă, poluându-le.

Regiunea Baia Mare este una din cele mai cunoscute zone miniere din România şi din Europa. Activitatea minieră datează încă din Evul Mediu, astfel încât problemele ambientale asociate acestei activităţi economice s-au acumulat în timp.

Zăcământul Văratec Băiuţ este situat în extremitatea estică a regiunii Baia Mare. Din punct de vedere metalogenetic, acest zăcământ este de tip epitermal deficit de sulf. El este format din 18 filoane având dimensiuni variabile (înălţime, lungime şi grosime). La alcătuirea mineralogică a minereurilor participă: elemente native, sulfuri, sulfosăruri, wolframaţi, oxizi şi hidroxizi, carbonaţi, sulfaţi şi silicaţi. Din punct de vedere geochimic, zăcământul este de tip polimetalic (Pb, Zn, Cu) cu conţinuturi importante de metale preţioase (Au, Ag). Zăcământul este caracterizat de prezenţa unei zonalităţi geochimice pe verticală şi a unor coloane mineralizate pe direcţie.

Principalul impact ambiental al Minei Văratec Băiuţ constă în contaminarea apelor de suprafaţă cu drenaje acide de mină. Permeabilitatea ridicată a rocilor gazdă datorată tectonizării intense a formaţiunilor geologice face ca apa meteorică să ajungă cu uşurinţă în subteran. Conţinutul mare de sulfuri, în special de fier, şi dimensiunile mici ale granulelor minerale favorizează desfăşurarea reacţiilor de oxidare.

Drenajele acide de mină din subteran sunt colectate şi pompate la nivelul galeriei de bază de unde sunt transportate printr-un canal subteran de 7 km la uzina de prelucrare a minereurilor. Datorită proastei întreţineri a canalului, apele acide sunt deversate în cursurile de apă de suprafaţă începând încă din aval de galeria de bază.

Măsurătorile parametrilor electrochimici efectuate pe probe de apă recoltate din valea Vărateculuidemonstrează că acestea sunt contaminate cu ape acide. Valorile de pH sunt foarte scăzute, iar valorile de solide totale dizolvate sunt ridicate. Datorită amestecării cu ape curate de suprafață, poate fi observat un proces incipient de neutralizare demonstrat mai ales prin creşterea valorilor de solide totale dizolvate.

Pentru realizarea unei imagini complete asupra efectelor pe care drenajele acide de mină le au asupra apelor de suprafață este necesară efectuarea de studii mai detaliate mai ales în ceea ce priveşte compoziția chimică a apelor şi a sedimentelor asociate.

ASPECTS OF SETTLEMENT SYSTEM AND ENVIRONMENT RELATION IN GHEORGHENI REGION, ROMANIA, IN THE LAST SEVEN CENTURIES

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Abstract: Aspects of settlement system and environment relation in Gheorgheni region, Romania, in the last seven centuries. In Harghita-county, in Gheorgheni region, Romania, the evolution of settlement system is a centuries-old process. Comparing the Giurgeu-basin with the other intermountain basins of Eastern Carpathians, it can be proved that in this region it was mentioned only one tax-payer village. In 1567 only 9 villages were registered. The evaluation of today's settlement system lasted till the 20th century.

In the years of 1950's and 1960's the scattered settlements and detached farms were declared villages in Giurgeu-basin, in the alluvial fam of tha Bistricioara- and Bicaz-creek.

During centuries the town system had changed little. Near Gheorgheni, which had performed administrative duties for a short periods, Toplița and Borsec were declared to towns in the middle of 20th century.

The new administrative structure of the nearest future will be region-microregion-settlement.

Key words: *settlement system, environment, Gheorgheni region*

INTRODUCTION

During centuries settlement-systems of intermountain basins in the Eastern Carpathians had come into being after certain stages of development.

In the process of changing settlement systems not only the role of natural features, economic and social factors are determinant, but political decisions are also important. In the evaluation of settlement systems, in the organizing projects of microregions, in the resolving of environmental problems can be of help the knowledge of the evaluation of settlements system, changing of administration and settlement-environment system.

GEOGRAPHICAL POSITION, NATURAL FEATURES

The area of Gheorgheni region, situated in the north part of Harghita county comprises the most part of Giurgeu-, Bilbor- and Borsec intermountain basins and the mountain chains encircled them, which can be found in the centre of Eastern Carpathians.

The western border of this area is the inner volcanic range of the Eastern Carpathians, which came into being in the Tertiary and Quaternary period. In the southwestern part of Gheorgheni region extends the Gurghiu Mts. (1777 m) and the northwest the Călimani Mts. (2100 m). The border runs along the Bistrița Mts. (1859 m) composed of crystalline schist, and in the south-east the Hăşmaş Mts. (1792 m) built up by calcareous rocks. In the middle of this region there's the Giurgeu Mts. (1567 m), which belongs to the crystalline schist belt.

The Giurgeu-basin is one of the most characteristic intermountain basin of the Eastern Carpathians. It is similar to Ciuc- and Braşov-basin, but it is situated higher (640-850 m) than these ones. It is 75 km long , 35 km wide, where more hundreds wide marine and lacustrine sediments were deposited during upper Tertiary and fluviatile deposit filled up the basin during Quaternary. The Mureş river follows the stream gradient in SE-NW direction. It evolved five terrace surfaces: 4-5 m, 12-15 m, 25-30 m, 35-40 m, 60-70 m.

The tributaries of the main stream cuts up mostly the western part of the Giurgeu-basin. The Belcina, the two Borzont and Ditrău creek had made a large-sized alluvial fan.

The mean anual temperature of Giurgeu-basin is 5-6℃. The average temperature in July is under 14℃, in January is around -9℃. I n winter there's often -30℃. The anual rainfall is 700 mm on lower surface and 1000-1200 mm on the mountains. In winter, spring and autumn the thermal inversion is characteristic in this basin.

The lower part of Giurgeu-basin were covered by marshes in the middle and in the north of it. Their draining had started in the 13th-14th centuries. The natural vegetation is beeck-tree till 800 m height above sea level, above it there's pine-wood till 1700-1800 m height . The Bilbor- and Borsec-basins are traversed by the Bistricioara river and its tributary, the Borsec-creek. These basins hadn't so extent area as Giurgeu-basin, but they have the same natural geographical features as it.

The Mureş river and its tributaries, the Bicaz-creek, which had established the wonderful limestone gate (Bicaz-gate), and the valley of Bistricioara had an important role in the establishment and evaluation of line of communications in the settlements of the studied area.

The traditional sectors of the economy are wood cutting, wood-working industry, animal husbandry (cows and sheep) and potato production in Giurgeu-basin, as in other region of the Carpathians.

During centuries, the areas of pasture-, grasing-, and plough-lands were evolved mostly to detriment of wood and marshlands in the „county of wood".

The geographical position of Giurgeu-basin is favourable near the level of today's traffic. The closeness of passes, gates could establish significant communication and commercial roads.

Here an intersection of the roads came into being.Here meet roads, coming from the Transylvanian-basin, Moldova or Ciuc-basin. The most important line of communications follow the eastern margin of Giurgeu-basin and the valley of the Mureş river.

In the north-northwestern direction the Giurgeu-basin is connected to the Transylvanian-basin across the Mureş valley (Deda-Toplița), which is between tha Călimani and Gurghiu Mts. across the Bucin-pass (1287 m) and Şicas-pass (1000 m). Across the Izvorul Mureşului-pass (891 m) it is joined to the Ciuc-basin. Across the valley of the Bistricioara, the Pongrați-pass (1256 m) and the Bicaz-creek it is linked to Moldova.

A HISTORICAL OUTLINE OF SETTLEMENT SYSTEM DEVELOPMENT AND ADMINISTRATION CHANGING

In the first written documents from 1332-1335 the name of today's Gheorgheni (name of the town, situated in Giurgeu-basin) can be identified. In the papal memorandum it appear as „de Gyargio" (Documente … 1954). The settlement belonged to the archdeaconry of Telegd.

Comparing with the other intermountain basins of the Carpatians it is remarcable that in the Giurgeu-basin only one village is mentioned as a ratepayer settlement.

The development of settlement systems of this region was slowed down owing to the cold climate and the extensive marshland and woodland.

Joseni, situated lower than Gheorgheni and nearer to floodplain of the Mureş river, is mentioned in 1392 for the first time. Thereafter I couldn't found any other settlement in Giurgeu-basin in written documents. The assessment of taxes from 1567 made mention about 9 villages of Gheorgheni. The settlements without Remetea were established on

the alluvial fan of the right side tributaries of the Mureş (Belcina creek, Ditrău creek). As we can see on the 1st figure, there isn't any permanent settlement in the north of Giurgeu-basin, in the Bilbor-, and Borsec-basin, in the valleys of the Bistricioara- and Bicaz creeks and on the volcanic-plateau.

In the 16th century only 1/6 of settlement systems had existed in the region of today's Gheorgheni in contrast to Ciuc- and Braşov-basin, where half of today's settlements had already existed. In this period the development of the region was due to wood cutting, conversion of timber, animal husbandry and cultivation in a lesser extent (Fig.1).

Villages with favourable geographical situation and easy of access had developed mor rapidly as the others, their population number increased. The economic and social role of the significant commercial centers was revalued, which were situated on main line of communications. These towns are Gheorgheni, Lăzarea, Ditrău etc.

During the reign of Joseph II, the administrative registration included 11 registered villages. Subcetate, the first permanent settlement of the northern part of the region, was established in 1750, due to marshland draining along the Mureş river and deforestation.

Gheorgheni had become market-town in 1607. In 1784 it was the most populous settlement of the region with its 2328 inhabitants. During the first national census (1784-1787) there were registered 44-1210 inhabitants in the villages of the region. The settlement system hadn't changed till 1806.

On the Lipszky J's map (1806) we can found one town and 10 villages in this region, which were written out in 1784. In Lenk's first place-name dictionary (1839) the number of Gheorgheni region's settlements were 23. In this dictionary can be found descriptions about villages from the Borsec-, Bilbor-basins, from the valley of Bistricioara- and Bicaz-creeks. In the north of Giurgeu-basin there were 5 new villages in this period.

Between 1806-1839 the increase of settlements were more significantly in Gheorgheni region, than in Ciuc- and Braşov-basin.

In 1850 the most populous settlements were Gheorgheni with 4217 inhabitants, Ditrău with 3988 persons and Remetea with 3041 dwellers. There were more than 2000 inhabitants in Lăzarea, Suseni and Ciumani and more than 1000 dwellers lived in Valea Strâmbă, Subcetate, Tulgheş, Dămuc and Bicaz.

The settlements of Giurgeu-basin, which were established in earlier periods, had more thousands inhabitants even then. Settlements, which came into being in 18th and 19th centuries, the number of population was below one thousand.

Between 1839-1873 the settlement systems of Gheorgheni region had increased. There were 30 settlements in this region then. In the district of Tulgheş 14 villages, in the district of Ditrău 8 villages, in the district of Gheorgheni 8 villages. In this period the greatest increase of settlements were in the drainage basin of the Bistricioara- and Bicaz-creek.

The natural vegetation was receded with the evaluation of settlement systems. In the end of the 19th century the construction of railway had a beneficial effect on the development of the economy, especially on the woodcutting, woodworking (wood-mill) industry. The expanding economy, the changing society, the railway, the extend of telecommunications influenced this area and the communities in different way.

The settlements, situated in the eastern margin of the Giurgeu-basin, were connected to national railway system. Between Borsec and Toplița a narrow-gauge railway had served the transport of mineral water and the strengthening foreign tourist

traffic. There were built then the recent predecessor of the number 12, 13B and 15 main roads. In Gheorgheni the role of economic- and society organization had streinghtened.

In 1900 Gheorgheni was the biggest town of the region with its 7028 inhabitants. Ditrău also was joined in the railway system, which resulted a population number increase: 6151 persons lived there in this time, meanwhile in Joseni 5811. In Remetea had 5000, Lăzarea, Suseni and Ciumani had more than 3000 dwellers. In the district of Tulgheş the name-giving village had 3000 inhabitants. In Bicaz community 6368 persons lived.

The establishment of today's settlement systems of Gheorgheni region wasn't finished at the beginning of 20th century in contrast to Ciuc- and Braşov-basin, where most of today's settlements had already existed. (Fig.2.)

In 1926 villages from Gheorgheni region were joined to neighbouring administrative units for the first time. Sărmaş and Subcetate became under the leadership of Toplița. The other settlements remained under the direction of the preceding administrative centres, inside Ciuc-county Gheorgheni and Tulgheş district (Împărțirea administrativă…1926).

In 1930 the most populous settlement was also Gheorgheni with 10355 persons, at the same time the population number of Toplița was 8314. Joseni, Ditrău and Remetea had around 6700 inhabitants.

In 1950 new administrative structures was established according to the new economic sector theories (Raionarea… 1950). The economic configuration determined the territorial devision of society; so the economic sectors became the new administrative territorial units: provinces-rayons-commune.

In the history of the region it was the greatest reorganization in the administration. Gheorgheni rayon became the eastern part of the Maros Region, where Târgu-Mureş was the chief town of the province.

The reorganization of 1956 brought little administrative change in this region (Raionarea… 1956). In the same time the number of villages increased in the region of Toplița.

After II. World War the extensive industrialisation of 1950 was related with the so called socialist cities and county towns, in contrast with Gheorgheni, to where industrialisation arrived lately, but it resulted significant changes. A lot of scattered settlements declared to villages, Toplița and Borsec became towns in the time. In this way it came into being the new aspect of today's settlement systems of Gheorgheni region. The centuries-old evaluation of settlement systems had finished then.

In 1968 due to reorganization, which are valid even today, provinces were reorganized to counties. The whole of former Gheorgheni rayon and the eastern part of Toplița rayon became part of Harghita-county since 1968 (Organizarea administrativa …1968) (Fig. 3.).

The economic and social processes, lasting from II. World War till 1990 led to the development of the towns and settlements with favourable facilities due to the extensive industrialisation.

After the events of 1989 a new politic, economic and social changes had started in Romania. These transformations took place mostly in cities and towns changed by the industrialisation (Gheorgheni, Toplița), in the touristic center (Borsec), which had become town in 1968 and in villages situated along main line of communications.

In small villages ageing, small economic productivity has become characteristic; a kind of social degradation can be observable in these settlements.

The greatest population number was registered in 1990 in whole Romania and in Harghita-county, too. Then Gheorgheni had got 23512; Topliţa 17781 and Borsec 3302 inhabitants (Anuarul statistic…1990). In 1992 the most densly populated villages were Remetea (6498 persons), Ditrău (6078) and Joseni (5406). The population number of Suseni, Ciumani was under 5000. There were living 2-3000 inhabitants in two villages, 1-2000 persons in three settlements. Villages with 500-1000 dwellers (9 villages in this region) were usual in this time. In 1960's there were esthablished 14 villages in the region of Topliţa, Sărmaş, Subcetate und Tulgheş. These settlements had less than 200 inhabitants.

In 1990's it was started a population decrease in Romania, which was felt mostly in cities and towns. In 1997 it was made a new region arrangement, according to that Harghita county was placed in the Central Region.

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ASPECTE ALE RELAȚIEI DINTRE SISTEMUL DE ASEZĂRI UMANE ŞI MEDIU ÎN REGIUNEA GHEORGHENI, ROMÂNIA, ÎN ULTIMELE 7 SECOLE.

(Rezumat)

Partea nordică a județului Harghita cuprinde depresiunile intramontane Gheorgheni, Borsec, Bilbor, respectiv munții înconjurători. Asemănător întregului lanț Carpatic, regiunea studiată este parte componentă a „zonei civilizației lemnului". Aşezările umane s-au format în funcție de condițiile geologice, morfologice, climatice, hidrologice şi biogeografice ale regiunii. Vetrele localităților se află pe fundul depresiunilor, pe piemonturi, la contactul depresiunii Giurgeului cu rama munților cristalini, sau pe văile principalelor ape curgătoare. Apariția şi dezvoltarea aşezărilor se leagă de fazele de locuire a regiunii. Păşunile, fânețele şi suprafețele arabile, respectiv satele şi oraşele s-au dezvoltat de-a lungul secolelor în detrimentul vegetației naturale formată mai ales din păduri de conifere.

Evaluarea sistemului de aşezări umane, administrației şi a mediului sunt ilustrate pe 15 harți realizate de mine. În această lucrare sunt publicate doar 3 din acestea.

Multitudinea de date referitoare la aşezări umane, regiuni mediu, unități administrative, poate reprezenta baza pentru organizarea microregiunilor în ultimii ani. In acelasi timp procesele care avut loc in secolele trecute pot fi identificate.

În anul 1990 s-a observat o descreştere a populației în România, care s-a simțit cel mai bine în oraşe.

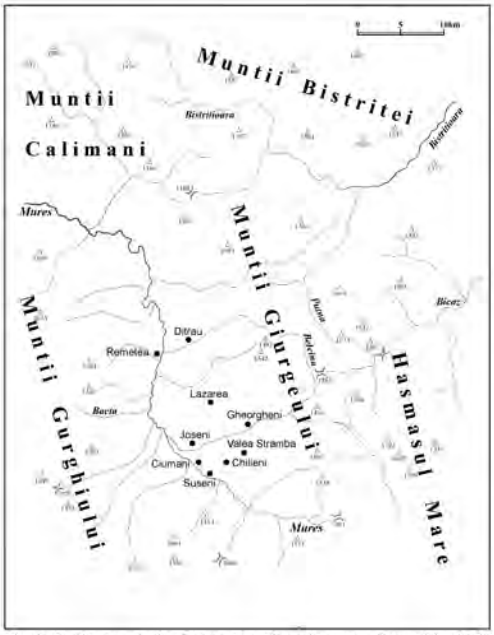

Fig.1. Settlements in Gheorgheni region mentioned in 1567
Localitati din zona Gheorgheni mentionate in 1567

Fig.2. Settlements in northern part of Ciuc county - 1921
Partea nordica a judetului Ciuc - 1921

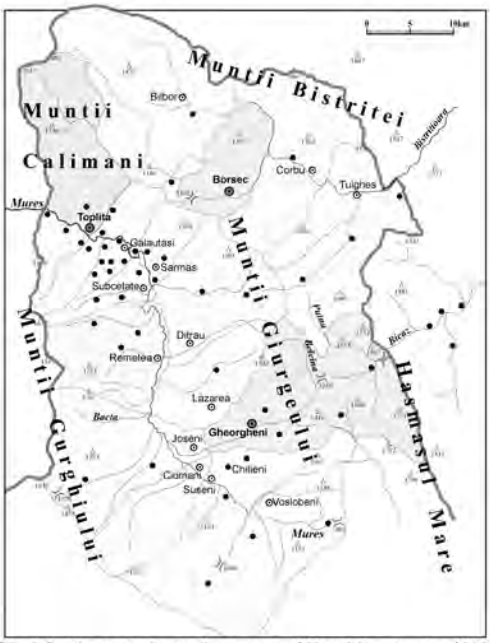

Fig.3.Settlements in northern part of Harghita county- 1968
Partea nordica a judetului Harghita - 1968

GAS MIGRATION IN THE GEOSPHERE: THE "GEOGAS" THEORY

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Abstract: Gas migration in the geosphere: the "geogas" theory.
Gas migration in the geosphere is a widespread process, that occur in numerous geological environments. The most important gases taken into account are CO_2, generally present in volcanic and geothermal areas, and CH_4, mainly related to hydrocarbon-prone areas. Difusion and groundwater flow were traditionally considered as the main mechanisms responsible for the gas migration. However, this approach failed to explain the behaviour of gases in particular situations, such as the long distance transport of radon, or the rapid variations of hydrocarbon anomalies in soil. The "geogas" integrative theory represents a contribution of the last decades, proposing a re-evaluation of several concepts of gas migration in the Earth's crust. Various mechanisms of gas migration are described in the present article. The importance of rapid advection and the capabilities of microbubble transport are highlighted.

Key words: *gas migration, geogas theory, advection, microbubbles*

INTRODUCTION

The mechanisms of gas migration in the subsurface can be considered as being due to diffusive or advective processes. For a long time most authors had considered diffusion and groundwater flow as the main mechanisms of Earth degassing, long-distance transport of hydrocarbons, trace gases and radionuclides. But since the 1970s new data on gas behaviour appeared in the literature and some authors re-assessed the effective role of diffusion and water transport in geological environments. Until recently, the scientific literature has been enriched by observations whose common theme is the difficulty in explaining long distance radon transport or rapid variations of anomalies of hydrocarbon concentrations in soil, as a result of diffusion. Etiope and Martinelli (2002) reviewed past and current theories of gas migration in the geosphere, and re-assessed the role of advection in comparison with diffusion. In particular, the phenomenon of "microbubble" flow, initially suggested in the 1980s by Swedish and Hungarian researchers to explain long-distance radon transport (Kristiansson and Malmqvist, 1982; Varhegyi et al., 1986) and by U.S. petroleum geologists to explain surface hydrocarbon anomalies (Price, 1986) was re-evaluated. This type of process was not properly and sufficiently considered up to now, although its existence has been confirmed by field observations and supported by theoretical models. The literature now suggests that all these experiences may be grouped into a single unified approach definable as the "geogas theory".

THE "GEOGAS" THEORY

The "geogas" theory includes the following six main features:

a- The widespread occurrence of a microflow of gas: The ascent of a microflow of gas through faults and fractures in the crust is a quite common phenomenon (Fig.1), playing an important role in the Earth's outgassing (Dikun et al., 1975; Morner and Etiope, 2001). This ascending microflow not only occurs in tectonically active areas (seismic, volcanic areas) but also in stable areas – sedimentary basins, shields, forelands (Baubron et al., 1991). Carbon dioxide is the main greenhouse gas released in volcanic and geothermal areas; CH_4, which has 21 times the global warming potential of CO_2 over a 100-year time frame, is mainly produced and released in sedimentary basins, particularly in hydrocarbon-prone areas.. Basically, almost all countries in the world have geological environments with CO_2 or CH_4 (or both) migration and emission sites.

b- Advecting multicomponent gas: This microflow regards advective movement of a mixture of naturally occurring gases (geogas), formed by carrier gases (CO_2, CH_4, N_2) which transport rare gases as He, Rn, a.o. (Malmqvist and Kristiansson, 1984; Durrance and Gregory, 1990; Etiope and Lombardi, 1995). The type of carrier gas depends on the geo-tectonic setting: CO_2 in volcanic-geothermal areas, CH_4 in sedimentary basins. Because a gas can move by advection, i.e. to be responsive to gravitative forces, it must have a sufficient amount of mass. In the subsurface rocks the amount of rare gases, such as Rn and He, is many orders of magnitude too small to form a macroscopic quantity of gas which can flow advectively. Thus such gases must be carried by a macroscopic flow of another gas which is moving upwards.
High Rn emissions are generally related to U-rich soils and bedrock; consequently radioprotection zoning should basically be focused on granitic and volcanic environments. Nevertheless, it is not rare to find locally, in different types of rocks, above fault zones, soil-gas Rn amounts much higher than the level imputable to U decay in the ground (Guerra and Etiope, 1999).

c - Rapid gas upflow: Numerous case histories produced evidence for long-distance transport of radon that cannot be explained by simple gas diffusion or groundwater flow (Fleischer et al., 1980 and references therein). In fact, as previously mentioned, in order for radon to reach the surface before decaying, it must be transported upwards at a rapid rate, which, in itself, is possible only if a rapidly ascending carrier gas exists. Experimental and theoretical data (Etiope and Martinelli, 2002) suggest vertical transport rates up to hundreds of meters per day, clearly greater than the values dictated by the diffusion mechanism alone. Gas migration at relatively high speed can be due to (Fig.1):

- pressure-driven continuous gas-phase flow through dry fractures;
- pressure-driven continuous gas-phase displacing water in saturated fractures;
- buoyancy of gas bubbles in aquifers and water-filled fractures.

d- The bubble flow: When the geogas microflow crosses groundwater, a bubble stream may form. Fault-linked bubble flows can take place in different geological environments; the bubble movement has been theoretically and experimentally recognized as a fast gas migration mechanism (Malmqvist and Kristiansson, 1985; Varhegyi et al., 1986). Microbubbles of colloidal size (radius below 1 □m) are considered by MacElvain (1969), Price (1986) and Klusman (1993) as the main migration mechanism for gaseous hydrocarbons. The equations describing the motion of bubbles in rocks are reviewed by Etiope and Martinelli (2002).

We can identify four main bubble flow patterns as possible circumstances occurring in natural rock fractures, depending on the gas flux and fracture size, in which the velocity of gas bubbles must be examined differently:

a) Bubbles with negligible fracture wall effect: classic equations of single bubble motion can be used assuming there is no perturbation on the bubble flow by the fracture walls. This condition can occur for microbubbles in relatively larger fractures and rock voids.

b) Bubbles rising along a typically narrow fracture whose walls influence the bubble rise (fracture width close to bubble diameter). The bubble velocity depends upon the ratio of bubble radius to half width of the fracture (see eq.28 in Etiope and Martinelli, 2002).

c) Long bubble trains and slugs. Increasing gas flux and/or reducing the fracture aperture, bubbles become elongated (slugs) forming a typical bubble-train flow.

d) Bubble plumes in larger rock voids. An additional upwelling fluid velocity should be considered (variable from 10 to 40 cm/s) as an effect of bubbling turbulence. In large joint systems, water-filled cavernous zones and sinkholes in karst environments, intense bubble plumes can rise without significant wall friction.

At higher gas pressures and fluxes, slugs can be replaced by connected gas streams driven by the pressure gradient. In particular, bubbles coalescencing with a following gas stream would occur if pressure-driven velocity is higher than buoyancy-driven velocity.

Bubble-trains and slug flow can be due to intermittent gas leakages through reservoir-cap rock systems, or be related to the transmission of pressure pulses created by crack propagation due to tectonic (seismic) stresses.

Continuous phase flow may exist only if a fracture is continuously invaded by large amounts of gas with pressure above hydrostatic plus capillary pressures (e.g., leakage from geothermal or hydrocarbon pressurized reservoirs). Any reduction of gas pressure or fracture width will interrupt the flow and slugs or trains of bubbles will form. As the bubble rise its radius increases and it can be occluded within the fracture. As bubbles occlude, they coalesce to again form longer slugs and then continuous phase gas columns.

e- Matter transport by geogas bubbles: The bubbles seem to be able to pick up and transport trace elements upwards for long distances (gaseous atoms as well as solid particles) (Etiope, 1998). This mechanism may be responsible, for example, for rapid and long-distance radionuclide (e.g., radon) and metal (e.g., gold) transport and for all other phenomena which are not accountable for by gas diffusion or water transport alone. This matter transport can take place by way of four types of physical mechanism (Etiope, 1998): 1. flotation (lifting of solid particles inside the bubble); 2. surface-active elements binding on the gas-water interface; 3. aerosol transport; 4. transport of volatile compounds dissolved in the carrier gas.

Flotation is a well-known physical process due to the fact that the specific surface energy is higher between water and gas than between solids and gas. Thus a microbubble stream crossing crushed rocks can lift fine particles and transport them upwards.

Transport of surface-active elements on a gas-water interface is due to the lower energy level provided by the interface itself than that occurring in solution. Many elements, mainly radionuclides, tend to attach to and concentrate on the bubble surface. Aerosol transport may occur by dispersion of solid and/or liquid particles induced by rapid movement of gas pockets through the rocks. There is a large number of elements, such as mercury, cadmium, arsenic and lead, that can form alkylated compounds through the

action of microorganisms. These compounds are quite volatile (and toxic) and are responsible for much of the dispersion of these elements in the geosphere and biosphere. If such compounds are formed in the fractures of the rocks, they may dissolve in the geogas and be transported to the surface.

f- Molecular fractionation of gaseous hydrocarbons during seepage to the surface

It is known that diffusion affects the composition of the natural gas inducing a molecular and isotopic fractionation (Prinzhofer and Pernaton, 1997). Gas seepage at the earth surface however cannot be explained by diffusion, but it is mainly due to rapid advection along fractures and faults. Nevertheless, seeping gas shows clear fractionations with respect to reservoir gas. A review of seepage data (Etiope and Feyzullaiev, 2007) suggests that this happens mainly where gas moves in a two-phase system (gas+water) by bubbles (microbubbles or slugs), like in mud volcanoes: due to a sort of "chromatographic effect", as pressure decreases (during gas ascent) both the amount and the molecular weight of the hydrocarbons carried in the gas phase of bubbles significantly decrease as function of their solubilities; this causes C2, C3, C4, C5… to exsolve progressively from the gas phase and be left behind in the sedimentary column. Accordingly, the surface seeps are poor of heavier hydrocarbons with respect to the original reservoir gas. This molecular fractionation is not observed in the "dry" seeps (only gas phase), which maintain their original (in the reservoir) ratio between methane and ethane+propane.

CONCLUDING REMARKS

On the basis of new observational data and theoretical models, the "geogas" theory proposes a re-evaluation of several concepts on gas migration and behaviour in the geosphere. The occurrence and abundance of carrier gases, such as CO_2 and CH_4 in many geological environments, and the capabilities of microbubble transport represent primary factors in controlling long-distance movements, behaviour and distribution of rare gases on the earth's surface. Caution in the interpretation and use of rare gas data in single discharge systems (e.g., Rn in groundwater), and analysis of more than one system (soil + exhalation flux + groundwater) in a given area are strongly recommended.

New field data and refined microbubble transport models are however requested to better evaluate the "geogas" phenomena in quantitative terms: the global non-volcanic C degassing, quantification of earthquake outgassing, CO_2-Rn or CH_4-Rn coupling in different environments, microbubble velocities in fractured media, radionuclides and solid matter transport by microbubbles, are all important prospects of future studies on gas geochemistry.

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Figure captions

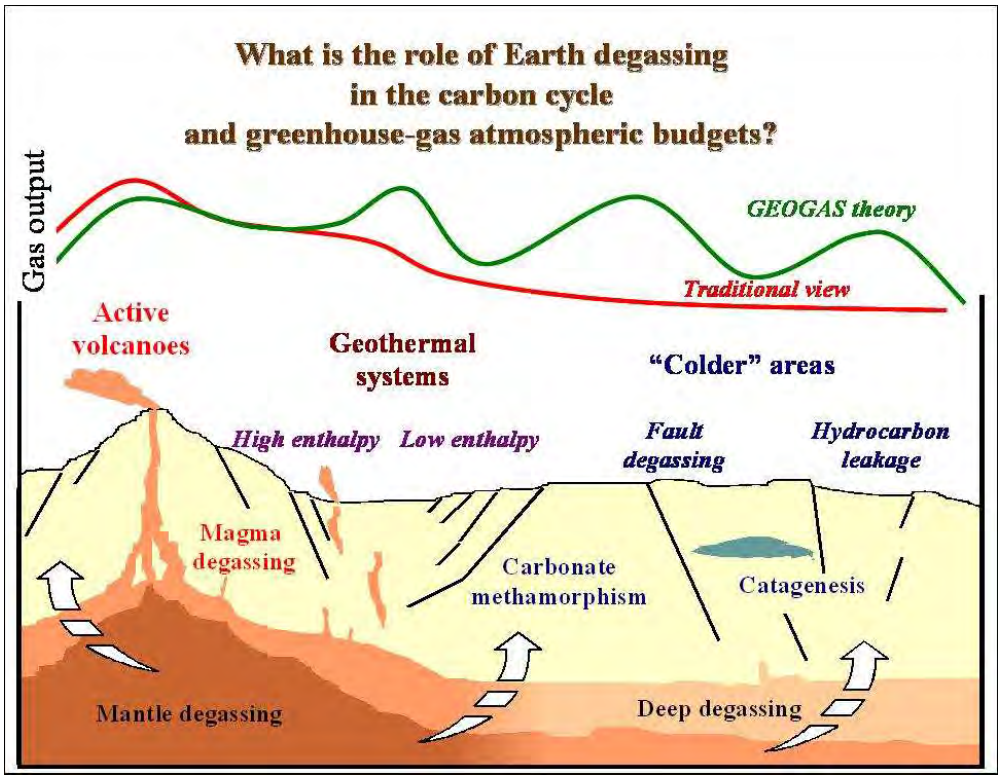

Fig. 1. *Sketch of greenhouse-gas emission from the solid Earth. CO2 is mainly released in volcanic and geothermal areas; CH4 is mainly produced and released in sedimentary basins (hydrocarbon-prone area).*

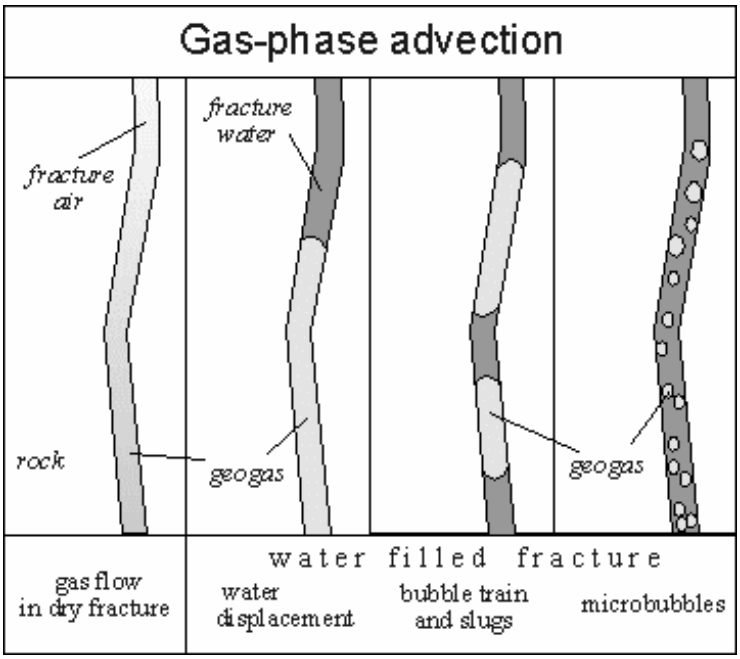

Fig. 2. *Schematic picture of gas-phase advection forms. For all forms the flow is controlled by permeability (fracture aperture for bubble flows) and pressure gradients, that may be induced by tectonic stresses, fracturing, variations of lithostatic loading, aquifer or fluid reservoir charge/discharge, local gas production, and barometric pumping near the surface (from Etiope and Martinelli, 2002)*

MIGRAREA GAZULUI ÎN GEOSFERĂ: TEORIA “GEOGAZ”

(Rezumat)

Pe baza noilor date experimentale si a modelelor teoretice, teoria "geogaz" propune o reevaluare a mai multor concepte privind comportamentul si migrarea gazului in geosfera. Aparitia si abundenta gazelor

purtatoare/transporatoare, precum CO_2 si CH_4 in multe medii geologice precum si capacitatea de transport a acestor microbule reprezinta principalii factori de control a deplasarilor pe distante mari, al comportamentului si a distributiei gazelor rare pe suprafata Terrei. Prudenta in interpretarea si folosirea datelor referitoare la gazele rare emanate intr-un singur sistem (de ex Rn in apa subterana) precum si analizarea a mai mult de un sistem (ex: sol + fluful de evapoare + apa subterana) intr-o zona data, este cu tarie recomandata.

Noile rezultate şi modelele de transport a microbulelor sunt necesare pentru o mai bună evaluare a fenomenului "Geogaz" în termeni cantitativi: emisiile de C non-vulcanice globale, cuantificarea emisiilor din timpul cutremurelor, CO_2-Rn sau CH_4-Rn în diferite medii, viteza microbulelor în mediile fracturate, radionuclizii şi materia solidă transportată de microbule, sunt toate luate la un loc perspective pentru studii viitoare în geochimia gazului.

PARTICULATE MATTER, HEAVY METALS AIR POLLUTION AND INTENSITY OF THE URBAN TRAFFIC. STUDY CASE - CLUJ-NAPOCA CITY

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Abstract: Particulate matter, heavy air pollution and intensity of the urban traffic. Study case – Cluj-Napoca city. An ambient air quality study was undertaken in Cluj-Napoca city from October 2004 to September 2005. The data were obtained from three urban monitoring sites, with different traffic volume. The purpose of the study was the monitoring of some air pollutants emissions caused by car traffic, especially the particulate matter and heavy metals.
The results showed that the highest PM 2.5 and heavy metals concentrations occurred in the area with the largest traffic volume in cold season for PM 2.5, respectively in summer for heavy metals.

Key words: *air, heavy metals, air pollution, urban atmosphere, particulate matter, PM2.5*

INTRODUCTION

Urbanization is a process of relative growth in a country's urban population accompanied by an even faster increase in the economic, political, and cultural importance of cities relative to rural areas. There is a worldwide trend toward urbanization.

Environmental pollution, especially air pollution is one of the consequences of the urbanization increase. The potential for serious consequences of exposure to high levels of ambient air pollution was made clear in the mid-20th century, when cities in Europe and the United States experienced episodes of air pollution, such as the infamous London Fog of 1952 and Donora Smog of 1948, which resulted in large numbers of excess deaths and hospital admissions. [1] Subsequent clean air legislation and other regulatory actions led to the reduction of ambient air pollution in many regions of the world, and particularly in the wealthy developed countries of North America and Europe.

EXPOSURE TO URBAN AIR POLLUTION FROM COMBUSTION SOURCES

Combustion of fossil fuels for transportation, power generation, and other human activities produces a complex mixture of pollutants comprising literally thousands of chemical constituents. The precise characteristics of the mixture in a given locale depend on the relative contributions of the different sources of pollution, such as vehicle traffic and power generation, and on the effects of the local geo-climatic factors.

Motor vehicle traffic is a major source of air pollution in the big cities. In half of them it is the single most important source. It is a major source of four of the six major air pollutants: carbon monoxide, nitrogen oxides, hydrocarbons and lead - and contributes to the SPM (Suspended Particulate Matter) concentration as well. The pollutant mixture also contains carcinogens such as benzo(a)pyrene, benzene and 1,3-butadiene. When petrol contains lead (Pb), as is still the case in many developing countries, this element is a common constituent of the pollution mix. [1]

A. Particulate Matter (PM) air pollution

Particulate matter consists of tiny particles in the atmosphere that can be solid or liquid (except for water or ice) and is produced by a variety of natural and manmade sources. These particles vary greatly in size, composition, and origin.

The amount of suspended particulate matter, usually measured in micrograms per cubic meter of air, is one of the most important indicators of the quality of the air that people breathe. According to the World Health Organization's air quality standards, the concentration of suspended particulates should be less than 90 $\mu g/m^3$. In many cities, however, this number is several times higher.

High concentrations of suspended particulates adversely affect human health, causing a wide range of respiratory diseases and exacerbating heart disease and other conditions.

These solid and liquid particles come in a wide range of size. **Total Particulate Matter (TPM)** are considered to be airborne particulate matter with an upper size limit of approximately 100 micrometers (μm) in aerodynamic equivalent diameter. Total Particulate Matter present in air are divided in two categories depending on the size of the particles:[4] [5]

- *Settle Particulates*: have more than 50 microns in diameter, this particulates tend to out of the air.
- *Suspended Particulates* : particulate diameter range from 0 – 50 microns:

- *PM 0.1* (ultra fine particles): particles up to 0.1 microns in diameter

- *PM 2.5* (fine particles): are particles up to 2.5 microns in diameter can enter lungs through nose. PM 2.5 contain many toxic organic compounds and heavy metals. Fine particles are mainly coming from activities like driving automobiles, burning plants (brush fires and forest fires or yard waste)

- *PM 10* (coarse particles): particles up to 10 microns in diameter, can enter lungs through mouth. Coarse particles are mainly produced by the mechanical break-up of even larger solid particles. Examples of coarse particles include dust, pollen, spores, fly ash, and plant and insect parts.

- *PM 10 – PM 50* – too large for respiratory system

The smaller particles are lighter and they stay in the air longer and travel farther. PM10 particles can stay in the air for minutes or hours while PM2.5 particles can stay in the air for days or weeks. PM10 particles can travel as little as a hundred yards or as much as 30 miles. PM2.5 particles go even farther; many hundreds of miles.[6]

A.1. Sources of Particulate Matter

Particulate matter can come from many sources. Generally, any activity which involves burning of materials or any dust generating activities are sources of PM.

Some sources are natural, such as volcanoes and water mist. Humans create huge quantities of particulate and many of these are regulated, such as smoke stacks at factories, power plants, and auto paint shops. However, there are many sources that are not regulated and our home is one of them.

PM may be classified as primary or secondary, depending on the compounds and processes involved during its formation. Some particles are directly emitted into the air from a variety of sources, such as vehicles, factories, construction sites, farming, unpaved roads, burning wood, and blowing sand and dust in desert environments. These particles are called "Primary" particles. Other particles may be formed in the air when

gases from burning fuels chemically react with sunlight and water vapor. These are the "Secondary" particles, and they can result from fuel combustion in motor vehicles, at oil fields and refineries.

Combustion of fossil fuels for transportation, power generation, and other human activities produces a complex mixture of pollutants comprising literally thousands of chemical constituents. Exposure to such mixtures is a ubiquitous feature of urban life.

All combustion processes produce particles, most of which are small enough to be inhaled into the lung either as primary emissions (such as diesel soot), or as secondary particles via atmospheric transformation (such as sulfate particles formed from the burning of fuel containing sulfur).[7]

A.2. Chemical composition

The chemical composition of particulate matter may vary within a broad range according to the sources of the particles, the conditions of their dispersion, location, time of year, and weather.

This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets.

Urban PM10 contains at least seven broad classes of chemicals: sulphates, nitrates, ammonia, elemental carbon, organic carbon, minerals and salts. Emissions from traffic typically result in particles composed of organic matter and nitrates, domestic heating and industrial activities in sulphates, building work results in mineral dust and agriculture in ammonium.[9]

B. Heavy metals air pollution

Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. To a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals (e.g. copper, selenium, zinc) are essential to maintain the metabolism of the human body. However, at higher concentrations they can lead to poisoning. Heavy metal poisoning could result, for instance, from drinking-water contamination (e.g. lead pipes), high ambient air concentrations near emission sources, or intake via the food chain.[4]

Heavy metals are dangerous because they tend to **bioaccumulate**.

EXPERIMENTAL DATA

In 2004 – 2005 in Cluj-Napoca was made a study, the purpose was the monitoring of the urban air pollution from Cluj-Napoca, caused by fine particulate matter (PM2.5) and heavy metals from airborne dust. The town is situated in a depression area, his microclimate disfavoring the particulate matter dispersion.

The monitoring network used for particulate matter and heavy metals determination was made from 3 areas from Cluj-Napoca with different traffic volume:

1_ P-ta Unirii – very intense traffic

2_Pavlov -V.Alecsandri crossing – intense traffic

3_1Decembrie1918-Petuniei crossing – medium traffic

Monitoring daily programming time was between the:

- 06.00-09.00 AM
- 02.00-05.00 PM
- 09.00 -00.00 PM
- 02.00-04.00 AM

For PM2.5 determination was used a MIE detector, witch allow the sample collecting by drawing tide variation. The particulate matter separation is made by specific sensors, and than the particulate matte rare x-ray sub sequential gravimetrical analyzed. MIE detector is made by a storage battery, a pDR-PU pump (for PM2.5 the pump debit was 4 L/min.) and a personalDataRam-1200 reading unit.

The results show that the highest fine particulate matter concentrations occurred at the main street with a large volume of traffic (1_P-ta Unirii and 2_Pavlov) (see figure 1.)

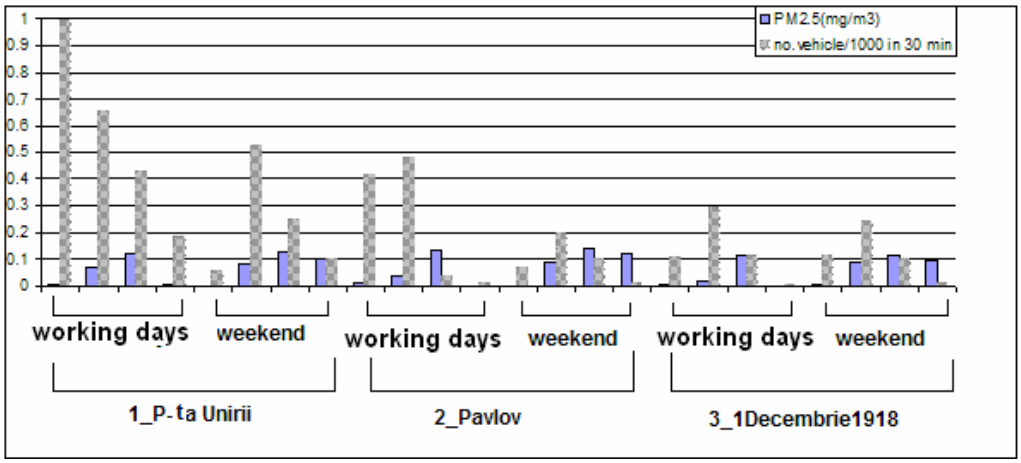

Fig.1. *Correlation between the traffic volume and the PM2.5 concentration (autumn 2004)*

Figure 2 summarizes the seasonal and daily average concentration of PM2.5 in tree areas from Cluj-Napoca, during October 2004 and September 2005:

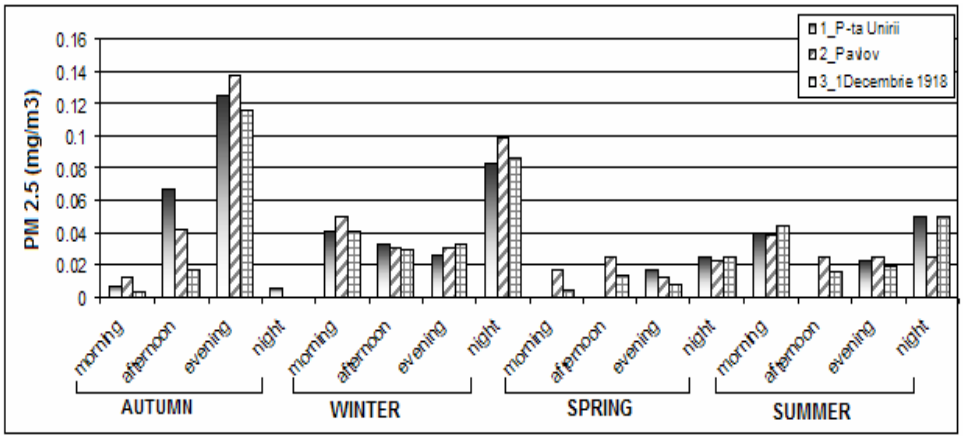

Fig. 2. *Seasonal and daily average concentration of PM2.5 in tree areas from Cluj-Napoca, during* October 2004 and September 2005

PM2.5 concentration was clearly higher during the cold season (autumn, winter) than during the warm months (spring, summer). Monthly averages PM2.5 concentrations are related to temperature, wind speed and relative humidity. In general there is a higher concentration of PM2.5 along with lower temperature and wind speed, and increasing relative humidity was noted. The particulate matter concentrations registered in spring and summer were lower, most probably because of the important quantity of precipitations from this period. Temperatures were lower during autumn and wintertime, so probably most of the particles become condensed instead of volatilizing.

The comparison of seasonal data points out that in the cold season the total number of particles is about two times greater than in the warm season, both on weekdays and on Sundays

Daily average PM2.5 concentration show that generally there is a higher concentration of PM2.5 in evening and night time.

The data evaluation shown that in each month the particulate matter concentrations were under the limit value for suspended particle (0.15 mg/m^3/month- STAS 12574/87).

In our study we determined the composition of dust from buildings and from outdoor in Cluj-Napoca too. It was determined 23 heavy metals; some of these metals have a small concentration below of detectable limit (Sr, Ru, Pb, Se, Ni, Ba, Tl, Sb, Cd). The metals which can be detected are: Mo, Zr, As, Hg, Zn, Cu, Co, Fe, Mn, Cr, Sn.

The method used was fluorescence with X ray, for this it was used a Niton XL700.

The determination of these heavy metals it was made in al four seasons of the year, in all places.

The most polluted intersection with heavy metals it was P-ta Unirii, the area with the most intense traffic, fig.3 and fig.4

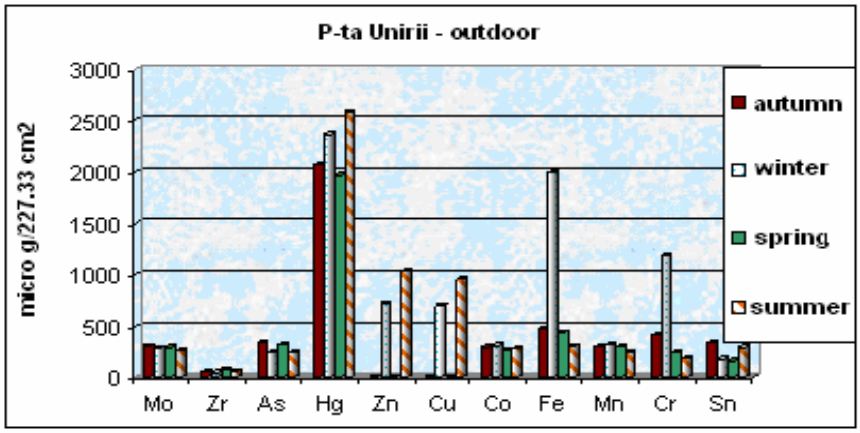

Fig. 3. *Heavy metals concentration in P-ța Unirii (outdoor)*

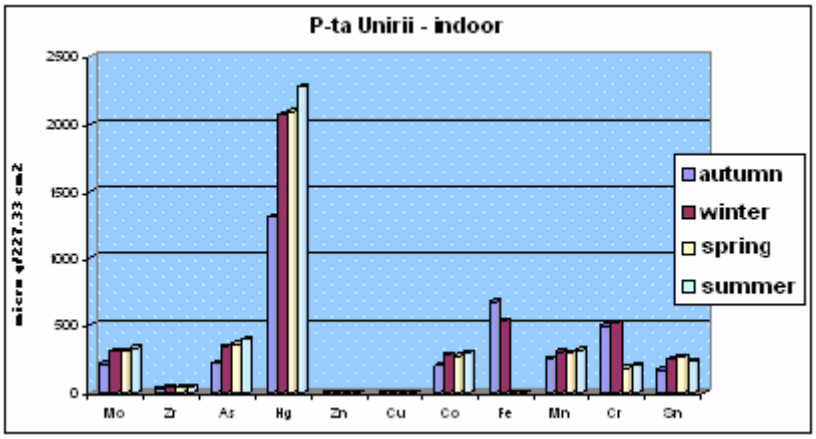

Fig. 4. *Heavy metals concentration in P-ța Unirii (indoor)*

The heavy metal with the biggest concentration in the studied areas is mercury, in all tree intersections. This have a big concentration in interior dust and also in exterior dust and the negative impact of this metal is determined by the chemical form of this.

The concentration of heavy metals is influenced by season. We observe that the concentration of heavy metals is bigger in summer, and this increase of concentration is influenced by the small number of precipitations.

The reality from our day is, that is impossible to not be expose to heavy metals daily, but the essential problem is, how much, in what concentration and the source of pollution.

The biotoxic effects of heavy metals refer to the harmful effect of heavy metal to the body when consumed above the bio-recommended limits.

Mercury is toxic and has no known functions in human biochemistry and physiology. Inorganic forms of mercury cause spontaneous abortion, congenital malformation. Poisoning by its organic forms, which include monomethyl and dimethylmercur presents gingivitis, stomatitis, neurological disorders, total damage to the brain and congenital malformations.

CONCLUSIONS

The results of this study showed that the highest fine particulate matter concentrations occurred at the main street with a large volume of traffic (1_P-ta Unirii and 2_Pavlov). The comparison of seasonal data points out that in the cold season the total number of particles is about two times greater than in the warm season, both on working days and on Sundays. Daily average $PM_{2.5}$ concentration show that generally there is a higher concentration of $PM_{2.5}$ in evening and night time. The data evaluation shown that in each month the particulate matter concentrations were under the limit value for suspended particle (0.15 mg/m^3/month- STAS 12574/87).

The most polluted intersection with heavy metals it was P-ta Unirii. The heavy metal with the biggest concentration in the studied areas is mercury, in all tree intersections. This have a big concentration in interior dust and also in exterior dust and the negative impact of this metal is determined by the chemical form of this.

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POLUAREA ATMOSFERICA CU PARTICULE MATERIALE, METALE GRELE SI INTENSITATEA TRAFICULUI URBAN. STUDIU DE CAZ - ORASUL CLUJ NAPOCA

(Rezumat)

In ultimii zece ani a crescut foarte mult numărul de autovehicule din parcul rutier clujean. Până in anul 1998, au fost importate autovehicule de mâna a doua, rulate, astfel încât vârsta medie a parcului auto a fost de circa 15 ani. Datorită reglemetărilor legislative introduse ulterior în vederea alinierii la normele impuse de Uniunea Europeană, această vârstă medie a scăzut la circa 10 ani (2003).

Vechimea traficului auto reflectă starea generală a traficului rutier, în special siguranța participanților la trafic, dar şi contribuția traficului în ceea ce priveşte poluarea urbană.

Din evaluarea datelor experimentale obținute a rezultat faptul că nivelele cele mai ridicate de PM-uri şi metale grele au fost atinse în intersecția cu cel mai intens trafic (Piața Unirii). Dintre toate metalele grele determinate mercurul atinge concentrațiile cele mai ridicate. În ceea ce priveste variația sezonieră a concentrației PM-urilor s-a observat că în sezonul rece nivelul acestor poluanți este aproximativ de două ori mai mare decât cel atins în sezonul cald.

ABOUT SOME PROBLEMS OF THE ORE MINING OBJECTS AND THEIR ENVIRONMENTAL IMPACTS

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Abstract: About some problems of the ore mining objects and their environmental impacts In this paper, after the definition of the ore mining objects, some geological factors of the mined materials, of the mine derived accumulations and the ways of pollution are examined. It is underlined, that the the ore mine products have a granular character, and the different types of interactions between the mining activity and the nature is analysed. The role in the economic and social development of the mining settlements and the positive or negative consequences of the historical and industrial ore mining is outlined. The author comments on the ways of reconciliation between mining activity and environmental protection, in light of the rising tendency of the metal prices . Finally, he calls attention to the historical and biological values of old (and as well, the recently closed) mining objects, which we don't want to make to disappear.

Key words: *Ore mining, Tailings, Dumps, Metallurgy, Mine water, Aerosols, Mine closing, Remediation, Historical values*

Among the factors, which influence our environment in the last decades, the mining activity has reached an outstanding importance. Everybody agree, that mining activity, either open-pit or the deep, underground excavations represent an irreversible process. This is due to the changes of the landscape, because the deposition, the pre-treatment and the processing of the mined materials, and on the long run the disturbance of the inner equilibrium of the Earth, will all affect, sooner or later, the basis of the human existence (Goude, 1990). This perception has lead to a comprehensive, scientifically argument survey of problems and thereafter, to taking the first steps in local, regional and global management of the recognized problems, but without spectacular results yet. The mining, as a basic human activity bear a millenary history, but it was only the 19-20th century, when following the industrial revolution it became an acute environmental problem (Fodor, 1996). Apart from the large scale lignite exploitation, which raises mostly geotechnical and hydrological problems in the Carpathian area(Anghel, Balázsi, 2005), the main environmental problems are caused by ore mining activities. The proximity effects and long-range influence of the ore mining on the environment, their quantitative determination, the experiments and the results of remediation works has constituted the subject of a great number of publications, symposia and conferences not to mention the monographies (as Down & Stocks, 1997, chapter III), nor the methodological treatises (e.g. Bennet & Doyle). Hereafter, because between the ore mining objects and the earth sciences there is a strong relationship, we formulate some remarks taking account of the geological point of view.

ORE MINING OBJECTS

In the followings, I discuss the mining objects, in which the activities of metallic ore extraction, preparation and/or processing are mainly pursued. The excavated geological rock material is a natural mixture containing one or more metallic and sterile minerals, which need, in each case, further procesing as a result of which the concentration of the utile components will increase by the application of different physical and chemical

processes, and one or more metal (or their useful compounds) and variable amount of sterile can be obtained.

Consequently, together with the ore, various components of the wall rock are carried to the surface. Thus, qualifying as ore mining objects, the surface of deep mines are characterized by their tailingl-banks, different preparatory facilities with sterile and ore dumps, storages of the products, metallurgic plants, ash and slag piles, inner transport routes and courtyard of the facilities. All of them can be characterised as open systems, in relation to their environment. Obviously, from geological and technological-organisational point of view, they group in metallogenetical units, metallogenetical districts or provinces, respectively in mining enterprises, mining trusts, mining and chemical holdings etc (fig. 1).

GEOLOGICAL AND ENVIRONMENTAL ASPECTS IN ORE MINING

The ore, as environmental risk factor

The mineral assemblages, which form the geological formations on the surface (or near the surface) are in equilibrium with the physical, chemical and biological factors, i.e. the transformation of the minerals needs a long (geological) time scale. The factors, which play the main role, are the climatic and biological ones.

If , a mineral or an assemblage of minerals, which has been formed under the condition of high temperature and pressure at the depth of the Earth. will be brought to the surface, it is forced to adapt oneself to the new condition, what results in structural, textural and mineralogical/chemical changes. The intensity of this transformations is determined by the difference between rock forming conditions at the surface and at depth, (including the pH and rh values, too). In this case, the climatic and biological factors play a secondary role. Due to above mentioned transformations, during a relatively short time (a few months or years) a great amount of, unnatural, stranger materials come into the environment, disturbing the millenary equilibrium between the local and regional natural factors.

From the chemical point of view, the industrial melts, scoria and cinder, formed at high temperature have a similarly behavior, then that of the igneous rocks and the related metallic ores.

The transformations of the ore bearing surface deposits have an exothermal character. This fact influences essentially the biological rehabilitation: an excessive hot „Saharian" microclimate is created, or, in the contrary, an „every green" island with luxuriant acidofil algae, moss and ferns and later, birch-tree os pine wood (Plate II, photo 2). The surface deposits emit or absorb certain bands of light radiation, by which they can easily be distinguish by remote sensing methods.

Mining granular deposits in the environment

The essence of the mining activity is cutting out, breaking and crushing of the mineral mass, until the dimensions of the grains permit their transport and their processing. The enriching of the metallic ores, i.e. the separation of the useful part of ore from the sterile one is possible only by reducing the grain size below the size of the mineral grains of the association. The so formed granular, more or less soft structure characterizes the different man-made deposits: the stemmings of the subterranean cavities, and ore piles, tailings (fig. 2) dumps on the surface, and, at the end of the metallurgic processes, the scoria and the cinder deposits, too.

The behavior of these granular mining deposits in the environment being more then thousands years old, is like some strange bodies. These objects, as man-made (anthropogenic) components of the relief (Balázsi, 2005) adjust themselves to the environment at mineral-, grain- and deposit body level.

At the level of the minerals, the components of the deposit follow the mainly chemical and subordinately, the physico-structural changes. In a previous study (Kalmár & Kuti, 2003) on a dump in Cisma-Băiuţ, the transformation were followed step by step.in time from the fresh andesite (with feldspars, pyroxene, amphibole and glassy groundmass) up to the clay minerals and silica.

At the level of the grains, the stratification and the formation of certain levels have begun in the initially chaotic, inhomogeneous aggregate (Plate 1, photo 1) by the action of the infiltrated water and of the gravitationally descendent grain movement, by which the stability of the dump increases. Note, that due to the mechanical and chemical processes, the sharp edges of the angular, sharp fragments wear down.

At the level of the deposit body, there are two adverse phenomenon: (i) under its own weight or the weight of the objects above it (buildings, depositories, roads etc., plate I, photo 3), the loose material is compacted. The degree of the compaction is significant in case of the fine grained dumps, in which the slam will be consolidated, by loosing an important part of the gravitational and capillary water, together with the soluble chemicals and alteration products; (ii) on the margins of the granular deposits, erosion processes start (plate. I., photo 3), which cause notable morphological changes on the site (Anghel, Balázsi, 2005) by spreading the mining material around of the deposit. The most serious disasters may be caused in the case of dumps , as e.g. the ill-famed cyanide outflow (plate I., photo 4) from Bozânta Mare (Baia Mare Task Force, 2000).

Subterranean and surface cavities

The sites of the excavated ore material and the sterile rock might be stemmed, i.e. filled by materials transported from the surface or from the other mining work, but rarely the cavities will be filled entirely by this operation , because the high costs of the stemming operations. Even if the cutting technology demands the application of the stemming floor, notable voids remain in the rock mass as a consequence of the compaction under own weight (fig. 3). At the surface, huge cavities and deep hollows gape, even where mining activity has not pursued for more than hundred years, (Faller, 1999).

The mining induced depressions, which have an endorheic character, form a local erosion base, and permit the infiltration of the rain water into the disturbed, fissured rock mass. In such areas, the rock crumbling and landslides are everyday events. The collapse of the subterranean cavities may cause damages in buildings and can produce shallow seismic movements (Fodor, 1996).

The ore mining and the water relations

A rather banal illustration of the aggression of mining against the nature is the red, dirty water which flow out from a crumbling gallery mouth (Plate II., photo 1). In reality, this is a diluted sulphuric acid with *ppm*-concentration of heavy metal ions (Damian & Damian, 2005), which originated from oxidation and leaching of some sulphuric minerals (mainly the fine dispersed pyrite and marcasite).The great tailings and dumps release an order of magnitude more toxic ions in surface or in subterranean water, then the main tailing of Roata-Cavnic (Kalmár, 2000) and the tailing-range of Secu valley, Baia Borşa.

For the leaching of heavy metals, and keeping them in solution , acid medium and the presence of inorganic and/or organic complex-forming compounds are necessary. The last ones are important mainly in the exfiltrations of the flotation dumps (Marigny et al., 2001).

There are different opinions about the extension of the mine related pollutions in water flows. While the Bozânta Mare cyanide outflows (Plate I.,photo 4) can be followed down to the Black Sea, the red water polluting Lăpuş river disappears after 16 km (in Lăpuş village) and the mine water carrying pollutants of Izvorul Rău I+II are not detectable at 6 km in Lunca Bradului rivulet (IPCM Baia Mare, 2001).

The data about the heavy metal pollution of the groundwater and the soil are contradictory, too. Thus, Cordoş et al (2004) have published their observations proving the general pollution of the groundwater below Baia Mare municipium, however, Licskó (1984) has demonstrated by systematic sampling, that downhill from the Recsk dump, the concentration of heavy metals sink under the background values It is interesting to mention, that a spring issued directly from the Mn-ore body (Cufoaia valley, Răzoare) contains less Mn, that the water of the Lăpuş river (Kalmár et al., 1986).

Smoke, dust and aerosols

Ore mining and mainly ore metallurgy have the clouds of (toxic),sulphur dioxide smoke as permanent companion, which fades the plants, carves the marble statues and wrecks the pulmonary cells. The wind carries the fine, sharp quartz grains of the quarries, tailings and dumps, which cause silicosis, whopping cough and other diseases. The most vile pollutants are the sub-micron sized lead (and lead-cadmium-thallium alloy) sphaerula and other aerosols (Cheresteşiu et al., 2000). All of these substances spread in the atmosphere, grace? abandoned mining works and the facilities of old, outdated metallurgical and chemical technology. Ejecting in the atmosphere, by a few hundred meters high chimney-stack produces, in fact, the extension of the polluted area (Baia Mare, Copşa Mică).

Note, that by the reactions of sulphur dioxide and of the microgranular pollution in the soilchanges are induced, which may be detected by geochemical and mineralogical methods (Cordoş et al., 2004).

THE ORE MINING, AS ECONOMIC AND SOCIAL FACTOR

On the Carpathian area, the mining activity goes on from prehistoric times. The first written documents, i.e. the *tabula cerrata* from Abrud and the Imperial reports on *Dacia Aurea* attest and well organized mining activity in II^{d} century A.D., which was continued more or less continuously during the Migration period (Anonymus, 1986). During the early Hungarian and Habsburg kingdom, until the discovery of America, the extracted gold and silver has satisfied the demandof the most part of Europe (Laugham, 1999).

A range of specialized settlements were formed, from Banska Kremnica to Rodna Veche, comprising the localities of Metaliferi Mts. and Banat in the inner part of the Carpathians, as a consequence of the historical mining activity) . In these communities, the majority of the population lived on mining and on services tied to it. There were formed the nuclei of the industrial enterprises, with the owners-burgeons and the working "class", i.e. the proletariat (Răducanu, 1952). Regarding the cultural aspects, the mining localities became the cradle of technical education (Mine High Schools from Banska Slimnica, Baia Mare and Brad), the research of the Earth sciences and the arts (e.g. the famous Painter School of Baia Mare).

Only the research of the last years casts light (Faller, 1999) on the environmental consequences of the historical mining,. Whereas, the majority of the old mine cavities and tailings have accommodated themselves in the actual relief, the wandering ore in the form of solid grains is present in the sediments of the main water flows, and according to certain opinions, the heavy metal ions, which were resulted from the historical mining (especially the As) could be identified in the water of the deep natural reservoirs (Upper Cretaceous, Paleogene, Pannonian) of the Great Hungarian Plain (Szederkényi, 1983).

The pressure on the environment has radically changed in the beginning of the XXth century, when the modern, mechanized mining technology was introduced (Woditska, 1896). In the second half of this century, the massive exploitation of the low-grade metallic ore was performed (Recsk, Baia Borşa, Şuior, Roşia, Deva, Moldova Nouă). New types of the metallic ore, as bauxite (Middle Mountains of Transdanubia, Pădurea Craiului), or the radioactive ones (Mecsek, Crucea, Ştei) were processed. The results was the disproportional increase of the mining labourers, to the detriment of their qualification and incomes, accompanied with huge environmental damages.

The political and structural changes of the 90^{s} affected both the environment state and the mining labourers. Gigantic tailings, dumps, abandoned mines and wreckage sites (Plate II., photo 2) remained without owners and hundred thousands of people languished in panel blocks of mining settlements (Plate II., photo 3).

ORE MINING AND ENVIRONMENT: WHAT IS THE GOLDEN MEAN?

Learning the lessons of the last 40-50 years, it is undoubted, that the ore mining and the preservation of the state of the environment are two, contradictory tasks. It is clear, that before the 90s, the mining activity in the East European countries has developed against the values of the nature, and together with the economic fall, the priorities of the environmental protection have determined the collapse of the ore mining.

Now, the question can be raised: could not both activities be reconciled. The answer to this question is so much the more actual, because in the last time, after a short recession and stagnancy, the current price of metals know a slow, but constant raise, so that the level of 1990 have exceeded in each case. It is not unfounded to suppose, that in the near future, the exploitation of certain abandoned ore deposits becomes profitable — if this will happen no in detriment of the environment.

Not all ore mines damage the environment

Some mine closings having in reality economic causes were justified by so called environmental studies. They were based on a small number of samples (rocks, soil, water, air, etc.), taken unsystematically and often tendentiously. Similarly, certain localities and/or sites were qualified as “top of the pollution” using a few, occasional sampling data. A deterrent example for this is the “analysis of the state” published by Cheresteşiu et al (2000) about Baia Mare, in which even the antisocial behaviour of some group of people and the juvenile delinquency is deduced from the bad state of the environment, Another negative example is the dump of Gyöngyösoroszi, which was qualified as “environmental dangerous object” using the results of a small number of analyses (Fügedi & Kuti, 2005). Now, the absolutely useless transport and deposition of the slurry is going on, which costs a few million euros.

This paper is not the negation of the mining pollution phenomena. But, in the case of the ore mining objects, the principle of the innocence should be vindicated either, similarly as in justice,: an object cannot be classified as polluted, without proves obtained

by adequate methods; thus, the remediation “in blind” is not recommended, because it may be absolutely thing of naught.

Mining objects: evaluation of ambient risks

A mining object, either an abandoned gallery or a few *ha* extended wreckage of a former flotation plant can be qualified from point of view of environment only by the use of adequate research method. Because of the extreme variety of tell sites, it is impossible (and useless) to prescribe an unified methodology, which will be applied mechanically, whether it good or not. But, it is very necessary to present a few, model-like, complex studies, with high scientific level, which serve as a guide for the treatment of similar objects.

The basic questions, which should be answered by research is (i) if, there are (were, will be) input and output-type material changes between the mining objects and their environment? (ii)?which are the consequences of these changes? and (iii) if these changes have negative consequences, which ways can they be ceased or diminished?. All these facts call for the detailed knowledge about the geological background and the structure and composition of the examined objects. It is? not possible to resolve an environmental problem without morphological, climatic and biologic data and — mainly in the case of metallic ores — the regional and local geochemical, background-values, both for geological formations and for the groundwater.

It is very important, not to avoid a harsh judgement on a settlement or on a region following subjective opinions, tendentious “revealing” newspaper reports, based on a few occasional samples. Nowadays, the modern remote sensing methods rapid and precise analytical methods, biological tests and suitable monitoring systems for determining the real situation are all available,, involving moderate material efforts.?

Not all waste is rubbish

The remains of the mining activity, which were not processed in metallurgical and/or chemical plants are considered as “waste” and treated consequently. But, much of this could be reused or recycled.

The majority of the tailings before 1950 are known only from reports and old maps, because they were processed due to their relative high metallic contents. During the last years, important mass of the old stemmings, the pillars and protection walls of the mines, as well some flotation dumps and the pavement of the mine courtyards (Săsar-Baia Mare, Brad, Zlatna) got in flotation plants, too.

Some tailings of transversal galleries, with fresh blocks of andesite (Cicârlău, Băița, Tunel Baia Sprie, Jereapăn) or dacite (Certeze, Roşia) were exploited for crushed stone products, or blocks for buildings (Plate II., photo 4). The material of tailings and scoria deposits (Ferneziu, Huta Certeze, Strâmbu, Reşița, Sasca Montana) were used as foundation of highways.

On the extended, consolidated tailings (Rudabánya, Baia Mare, Cavnic, Săcărâmb, Ocna de Fier) buildings, indeed dwellings were set up.

Certain laboratories and universities (Bucureşti, Budapest, Craiova, Cluj-Napoca, Debrecen, Iaşi, Miskolc, Oradea, Petroşani) experimented the use of the fine grained material of the flotation dumps in ceramics, silica bricks and cement industry (Felvinczy, 1978). or in agriculture (Fügedi & Kuti, 2005) Positive results were obtained in the processing (pelletisation) of the red bauxitic mud (Almásfüzitő, Oradea), with 55-60% iron

oxide. Now, the recycling of the steel concrete elements from demolition of the useless mining constructions is experimented (Baia Mare, Kaposvár).

It is important, that for encouraging this type of activities, the local, regional and state administration might ensure logistical and material support.

Mine closing: theory and reality

The mine — either open-pit or subsurface work — is a wound on the body of the nature, which will be healed by time more or less successfully, by physical and geological spontaneous processes (Kalmár & Kuti, 2003). Helping them, the Mine Closing Rules prescribe the operations to be performed for supporting or filling the cavities, for the prevention of the earth movements on the surface, for reduce the spilling mine water and for neutralise it. This expensive and highly professional works most be executed on the base of an engineering plans, which are verified and licensed by the competent authorities.

In wandering through Baia Mare mining district or through the Metaliferi Mts, and visiting the mines declared nominally as closed ones, we could see, at the most, the blasted gallery mouths, and the scratched tailing rests (Abrud, Valea Borcut-Baia Mare, Cicârlău). The mine water were gurgling, just as before the "closing" (Gal. Roşia and Gheorghe, Jereapăn; Ţibleş-Tomnatec, Plate II., photo 4), often through the functionless, but a few million worth facility of purification (Ilba, Ţibleş, Rodna Veche). It is not a literal hyperbole: one has to start from scratch: research and documentation, projects, licenses, field works and environmental rehabilitation. Another millions (in Euro!) from the pocket of the tributaries.

The ore mining objects, as cultural values

In present days, the enhanced interest on past events has resulted in the upgrading of the old industrial objects (among them, the ore mining ones), not only for the specialists, but also for the man of the street. Paradoxically, nowadays, the number of people, which need to be convinced has increased considerably, even when everybody has access — sitting in armchair — to all of the wunders of the World, appreciating the broad services of the media and the Internet. Thousands of tourists look up the historical or the recently closed mines, preparation plants, furnaces, as the iron ore mine from Rudabánya, the bauxite quarry from Gánt, the ore transfer courtyard of Tunel-Baia Sprie , the furnace rests of Podu Ruoii– Lăpuş or the Dognecea quarries and tailings. The world famous Mine Museum of Abrud, the old mine settlement of Săcărâmb, the Gold Museum from Brad and the Mineralogic one from Baia Mare are visited in all of seasons of the year, while the tailings of Börzsöny, Telkibánya, Herzsa, Tomnatec-Ţibleş, Valea Blaznei, Băişoara, Băiţa Bihor or Ocna de Fier swarm of the gatherers are seeking for minerals.

On the other hand, specific biotop has formed, from the pioneer vegetation on the ore mine tailings, in the cavity and walls of the quarries, on the dumps and in the courtyards of abandoned plants and furnaces as time went on up to the closed vegetation cover with corresponding fauna: worms, snails, arthropods, snakes, lizards and small mammals (Recsk, Telkibánya, Chiuzbaia, Jereapăn, Băiţa Criş). Their study, pointing out the kinds of adaptation is only in the beginning state.

Thus, it is not necessary — and in some cases might be pronouncedly harmful — the "rehabilitation" (i.e. to make to disappear totally, without marks) all of remnants of the ore mining. A group of scientist consisting of specialists in history of the industry,

biologists, geologists , mine specialists could discuss about historical, cultural or biological value of the past's heritage or it may be erased from the surface of the Earth.

CONCLUSION

The ore mining and related activities represent a high risk factor for the environment. From the geological point of view, the ore and the sterile wall rock, as natural formations become a pollutant, if they get in the Nature as stranger components and attempt to accommodate to the new, surface conditions. The results are the spreading of the products of the physical and chemical decomposition, with geomorphological, geochemical and biological consequences.

Whether the named object is pollutant or inoffensive, it can be decided only by an appropriate, scientifically proved measurements and tests. Although, the diversity of the ore mining objects need in all cases a particular treatment, certain high level model studies, which can be served as guidance for the similar situations are of general utity. The problems of the relation between the ore mining and the environment must be redefined, because knowing the tendency of the prices of the metals, it is possible, that in the near future some abandoned ore deposits will be profitable to be re-opened , inducing, thus, hard environmental problems (see Roşia Poieni). It is important to known, that some products of the past ore mining can be re-cycled as useful materials and certain objects can represent museum-like or biologically protected sites.

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Figure captions

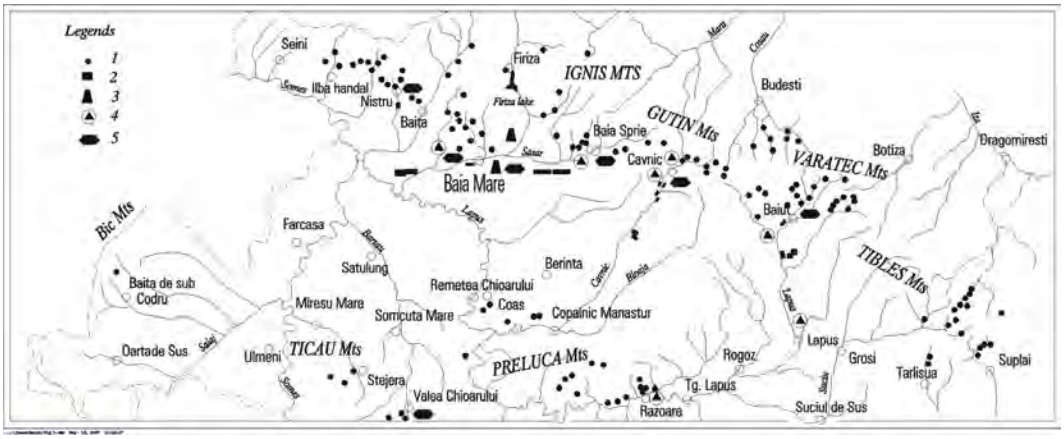

Fig. 1. *Baia Mare ore district. 1. The main tailings; 2. Dumps; 3. Furnaces and chemical plants; 4. Old metallurgical objects; 5. Flotations.*

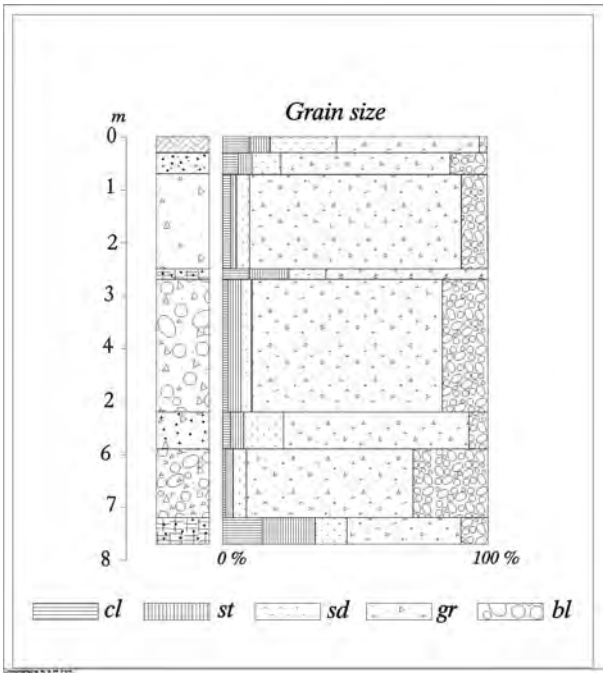

Fig. 2. *Granulometric structure of Cisma II tailing, cl. Clay; st. Silt; sd. Sand; gr. Gravel; bl. Blocks*.

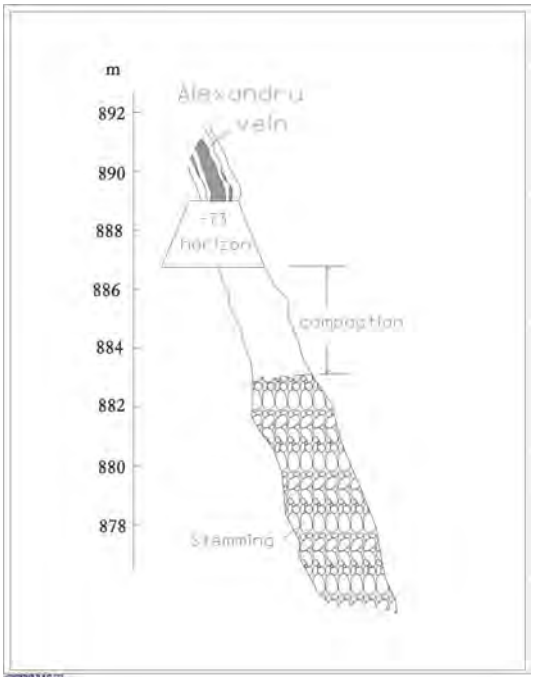

Fig. 3. *The cutter of Alexandru vein, V0227ratec-Băiuț, 16. panel, between horizons -73 and -160. The stemmed material was compacted approx. 4 m in the cutters' cavity.*

Plate captions

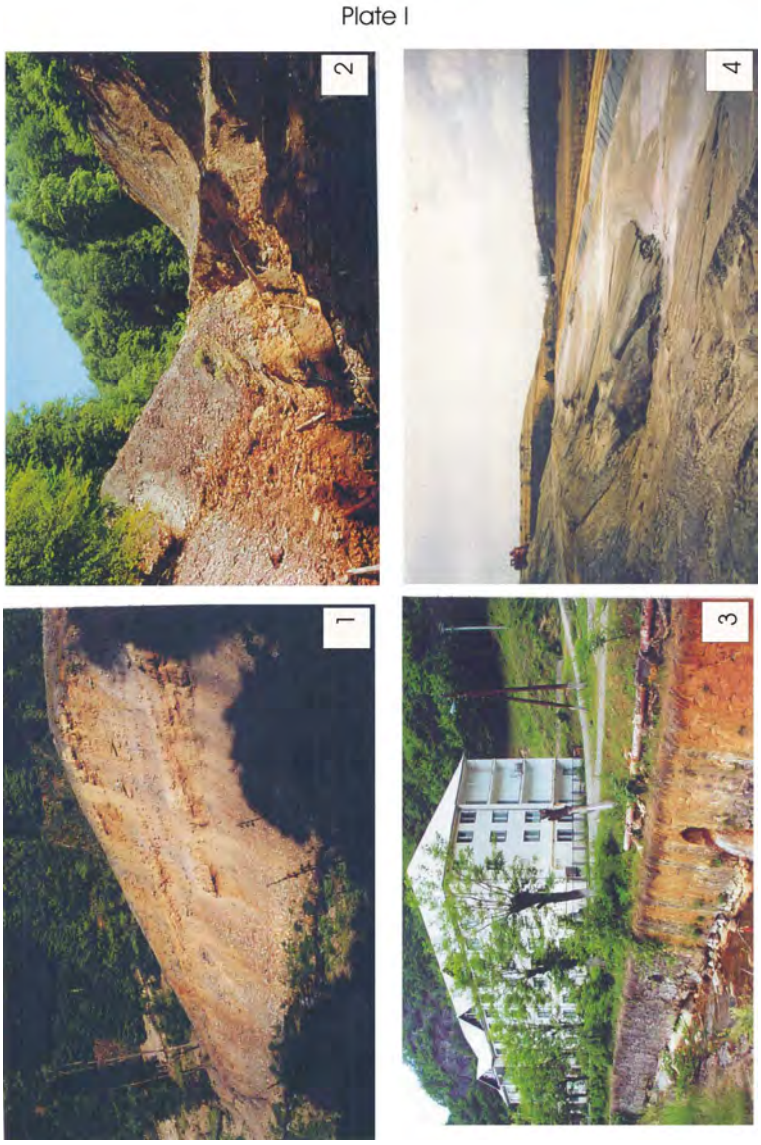

Plate I

Photo 1.*Stratified structure of Izvorul Rău tailing, Ţibleş*
Photo 2.*Deep erosion on the Cisma X tailing, Băiuţ*
Photo 3. *The Mine Hospital of Cavnic was built on the tailing Eristöl-Iosif*
Photo 4. *The site of the cyanide outflow, Bozânta Mare dump, January 30, 2000. Photo József Romok*.

Plate II

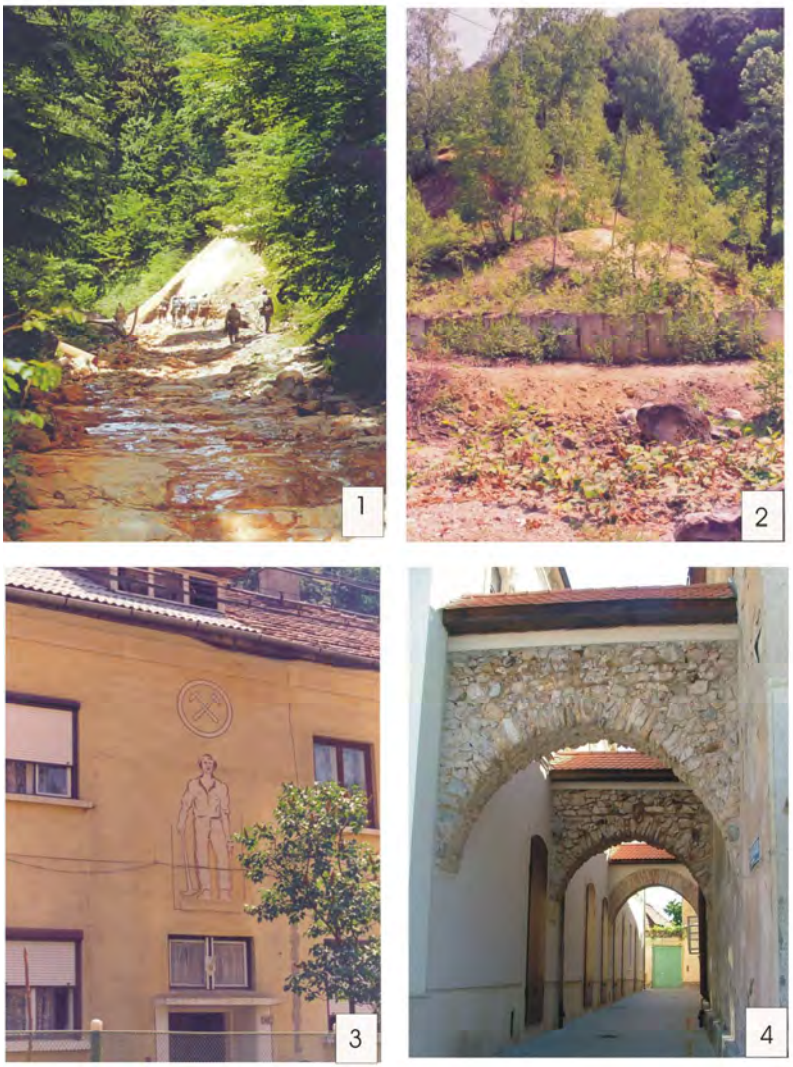

Plate II.

Photo 1. *Conciului vallewy, Băiuț downward to Hell gallery, with acidic mine water flow*.
Photo 2. *Napoleon tailing, Jereapăn, with young birch- tree forest*.
Photo 3. *Dwelling for mine labourers from Nistru (Maramureş).*
Photo 4. *Arcades of Elisabeth-passage of ancient centre of Baia Mare town, built in XVIth century, of andesite blocks and a few ore fragments (deep brown pieces). Photo Gábor Szurkos.*

PROBLEME LEGATE DE EXPLOATAREA CĂRBUNILOR ŞI IMPACTUL ASUPRA MEDIULUI

(Rezumat)

In lucrare se definesc obiectele miniere metalifere, ca rezultatul direct şi derivat al activităţii extracive şi metalurgice-chimice materializate în sânul naturii. Sunt prezentaţi factorii geologici prin care aceste acumulări intră în interacţiunre cu mediul înconjurător şi căile poluării, subliniind caracterul granular al diverselor materiale, cel de sistem deschis ale acumulărilor şi dezechilibrul cu condiţiile fizico-chimice de la suprafaţa Pământului. Rolul mineritului metalifer şi al rezultatul acestei activităţi pe plan social-istoric este în acelaş timp pozitiv şi negativ: pe de o parte au constituit sursă de existenţă pentru populaţia localităţilor miniere şi de acumularea primitivă a capitalului, iar pe de altă parte mineritul metalifer a fost sursa poluării istorice şi recente pentru arii extinse din bazinul carpatin. Abandonarea unor mine şi a utilităţilor la nivelul anilor 90 a avut consecinţe nefaste atât pe plan social, cât şi în mediul înconjurător. Nu întâmplător s-a creat impresia unei contradicţii ineluctabile între mineritul metalifer şi mediu. Cunoscând tendinţa actuală de creştere a preţurilor la metale (ceeace presupune reluarea activităţii la unele obiective abandonate) sunt analizate căile de reconciliere dintre activitatea minieră metaliferă şi prezervarea valorilor naturale. In final se atrage atenţia asupra valorilor culturale, istorice şi biologice a unor obiecte ale mineritului metalifer, care trebuiesc păstrate şi ingrijite pentru posteritate.

RESPIRATORY DISEASE TREATMENT IN THE THERAPEUTIC CAVE OF TAPOLCA, THE ROLE OF RADON

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Abstract: Respiratory disease treatment in the therapeutic cave of Tapolca, the role of radon. Cave therapy is often used as a way of additional therapy in curing chronic respiratory tract illnesses. High radon levels may generate in some of the caves. This study investigated whether the different radon concentration values had any effect on the FEV 1 values of the patients. In order to find it out the radon concentration inside the cave has been measured continuously for 3 years, and the FEV 1 data of 1824 patients have been processed for 8 years. It was stated that the radon concentration generated inside the cave is significantly different in summer and in winter (it is 17 times higher in summer). After the statistical analysis of the FEV 1 data it was found out that cave therapy has an expressly good influence on the FEV 1 values of the patients, however, there was no relationship found between the fluctuation of the FEV 1 data and that of the radon concentration values, which would be an important addition to research work investigating health effects of radon therapy.

Keywords: *cave therapy, radon, respiratory disease, therapeutic cave*.

INTRODUCTION

High radon concentration is often generated in underground air-spaces, i.e. in caves as well (Hakl et al.,1997; Kobal et al., 1986; Kobal et al., 1987; Jovanovic, 1996, Szerbin 1996). By the treatment of those suffering from pulmonary illnesses spending time in caves is recommended by several experts. Its favourable effect is partially considered to be that of radon. In Hungary, such treatments are also carried out in the Cave Hospital in Tapolca. However, high radon concentration causes significant radiation dose (Kavasi et al., 2003).

The changes in the radon concentration generated in the air-space of the great room of the cave hospital in Tapolca have been surveyed by continuous measurements for three years. A smaller room also used for treatments has been surveyed for one year using track detectors (changed monthly). Patients treated were examined at the beginning and after the completion of the treatment and also FEV1 (Forced Expiratory Volume in 1 s) values were measured.

During the study the changes in the FEV1 values back to 8 years of the treated patients were analyzed, and then it was inspected, whether there was a relationship between the efficiency of the treatment and the radon concentration in the cave.

METHODS

Measuring radon concentration

Continuous measurements of radon concentration have been carried out for several years. Dataqua semi-conductor detector radon-monitor was used as a measuring device, which recorded pressure and temperature values in every hour besides radon concentration. Calibration of the Dataqua radon monitor was carried out in a Genitron EV

03209 calibration chamber with gas mixture adjusted with Pylon RN 2000A radon emanation source.

Examining the effect of the treatment

Patients with illnesses of the respiratory organs are directed to the cave. The duration of treatment in the cave is usually three weeks, staying 3-4 hours a day in the cave.

Respiratory function inspections were carried out on those treated at the beginning and the end of the treatment. The inspection was carried out using a peak flow meter elaborated for asthma and allergy therapy follow-up, which gave the FEV1 value. FEV1 is the abbreviation for Forced Expiratory Volume per 1 second, i.e. the volume of the air exhaled in the first second of forced exhalation [cm^3].

During the study the relative changes of FEV1 values during the treatment were analyzed back to a period of 8 years.

Changes were calculated by the relation $\frac{FEV1(B) - FEV1(K)}{FEV1(K)}$, where FEV1(K) is the value measured at the beginning, and FEV1 (B) is the value measured at the end of the treatment. The causes of the change may be resting, the environment free of stress, special therapy, and spending time in the cave.

The cave is actually free of pollens, has a constant temperature, and its special air composition has an effect on the respiratory system of the patients. As a rather significant radon concentration is generated in the air-space of the cave during the summer months, it was inspected whether there is a relation between the efficiency of the treatment and radon concentration.

RESULTS AND DISSCUTIONS

The annual average of temperature in the cave is 13.9 ^oC (13.2-14.8), and that of pressure is 1004 kPa (997-1014), therefore it can be considered rather stable. The average radon concentration determined on the basis of the three year-long measurements is: 4.6 ± 0.12 kBq/m^3. The monthly distribution of the three year average radon concentration is shown on Figure 1.

As Figure 1 shows the radon concentration in winter months (December, January, February) is relatively low (average 0.66 kBq/m^3), while in the three hottest months (June, July, August) it is high (average 11.5 kBq/m^3). The average radon concentration in summer months is 17 times the average of that in winter months. So, if radon has a significant role in therapeutic effect, a significant difference has to be experienced in the efficiency of the treatment as well.

FEV1 date of a total of 1824 patients were inspected. By the statistical analysis of FEV1 values the effect of the treatment on the FEV1 values was inspected first. According to the Kormogolov-Smirnov test the spreading of the differences of FEV1 values is not totally normal, but rather similar to it. Therefore, Wilcoxon test and T-test were also carried out, and on the bases of both tests it can be stated that the changes in FEV1 values gave the expected result, that is the cave therapy has a positive effect on the FEV1 values of patients.

Thereafter the differences of FEV1 values were inspected related to radon concentration, by 70% of those treated the respiratory function bettered, while by 30% of them it became worse.

The distribution of the changes of the FEV1 value in % is shown on Figure 2.

In case of 507 persons (27%) the change in the FEV1 value was below 5%. This is such a low change, even taking the measurement errors into account, that this was qualified as “unchanged” during further analysis, and only relative differences over 5% were considered to be changes.

Values considered unchanged and the distribution of patients showing bettering and worsening in the different months are given in % in Figure 3.

The percentage of patients showing bettering (that is relative FEV1 increase greater than 5%) and the distribution of quarterly average of radon concentration are given in Figure 4.

According to quarterly data (representing sufficient number, i.e. 949 persons) it is apparent, that while the number of patients with bettered condition changed between 50.9-53.7%, that is within a narrow interval (average 51.7%), the quarterly average values of radon concentration have significant difference, namely between 0.66-11.53 kBq/m^3, i.e. the average radon concentration in summer months is 17 times the same in winter months.

If the presence of radon had a positive effect on the changes of FEV1 values of those treated, then it should have seasonal changes as well, but this was not found to be so.

Afterwards, such subclasses were tried to be found by introducing several parameters, where any kind of relation can be found. This way the connection between radon concentration, FEV1, age, and sex parameters were inspected, but neither by regression, correlation analysis, nor the established decision tree helped to achieve indicate a connection closer than chance relation.

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TRATAREA BOLILOR RESPIRATORII ÎN PEŞTERA TERAPEUTICĂ TAPOLCA, ROLUL RADONULUI

(Rezumat)

Concentrațiile medii ale radonului din lunile de iarnă şi vară (0,66 şi 11,5 kBq/m^3) în spitalul din peştera Tapolca au indicat o diferență 17 de ori. În acelaşi loc au fost examinate modificările valorilor, în cazul a 1824 de pacienți, măsurate prin inițierea şi finalizarea tratamentului.

Valoarea FEV1 a fost îmbunătățită cu 70% la cei tratați şi s-a agravat la 30% dintre aceştia, dar la 30,2% dintre pacienți, modificarea a fost sub 5%. O îmbunătățire mai mare decât această valoare a fost întâlnită la 50,7% dintre pacienți. Pe baza rezultatelor se poate afirma că îmbunătățirea valorii FEV1 la grupul supus inspecției nu este în corelație cu concentrația radonului din aerul peşterii.

Pe baza rezultatelor anterioare, doza de radiație, cu originile în radon a celor tratați este între 0,18 – 4,22 mSv, care, luând în considerare faptul că nu are efecte pozitive, poate fi considerată semnificativă.

De aceea trebuie acordată o atenție deosebită faptului că tratarea pacienților sub 18 ani nu trebuie realizată în perioada de vară.

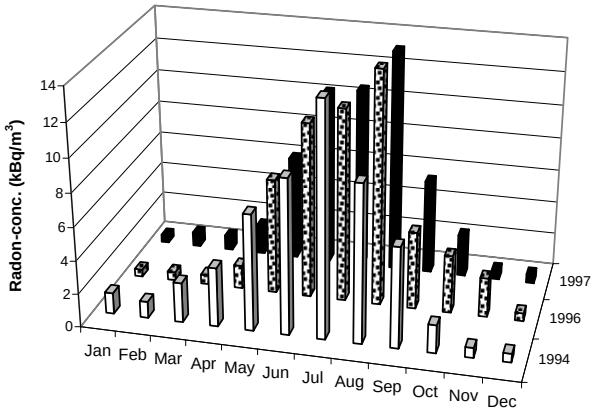

Fig. 1. *Monthly distribution of the radon concentration of 3 years*

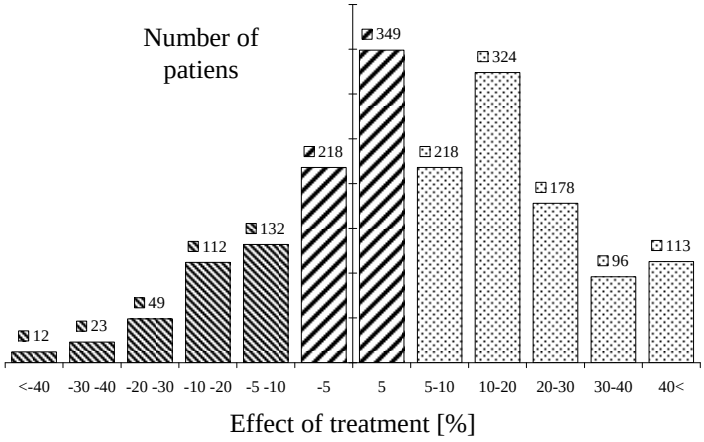

Fig. 2. *Distribution of FEV1 changes in %*

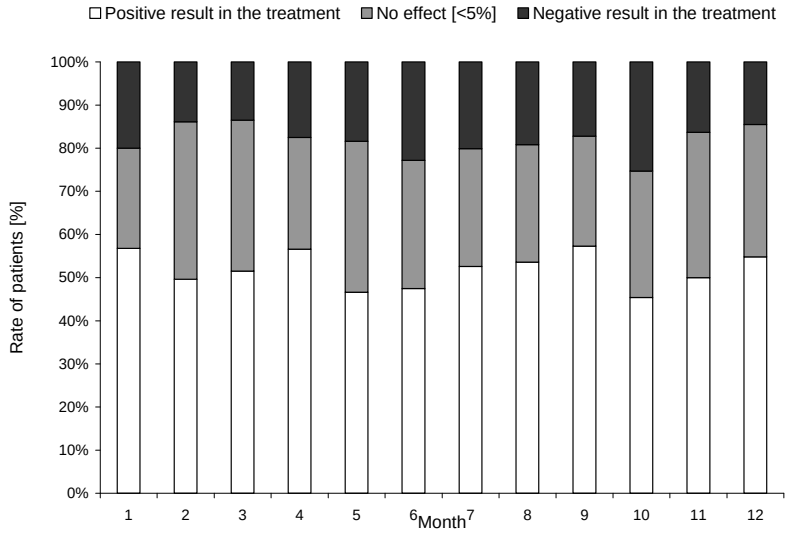

Fig. 3. *Distribution of patients with bettered, worsened, and unchanged conditions in the different months given in %*

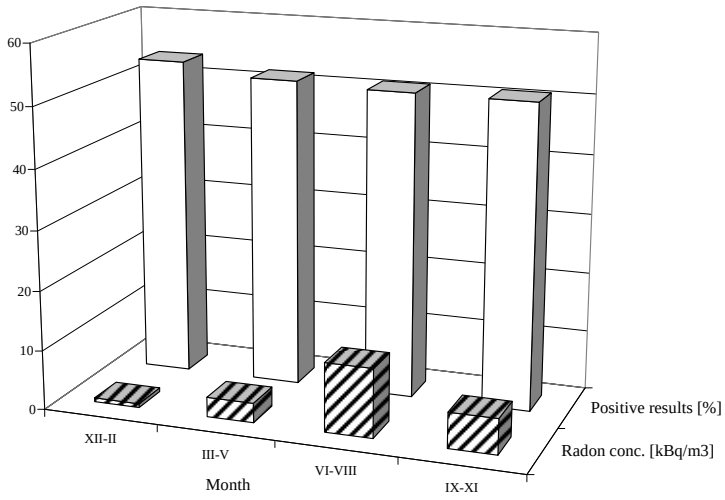

Fig. 4. *Relation between increased FEV1 values and radon concentration*

AGROGEOLOGICAL INVESTIGATION OF SOIL FERTILITY LIMITING FACTORS IN THE SOIL-PARENT ROCK-GROUNDWATER SYSTEM, IN HUNGARY

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Abstract: Agrogeological investigation of soil fertility limiting factors in the soil-parent rock-groundwater system, in Hungary. The most important characteristic of soil is its fertility. Capability of soil, like water management, nutriment accumulation and crumb structure belong also to soil fertility, since they can meet the needs of plants. These relationships have been examining in Hungary by modern agrogeology since the middle of the 1970s with this direction of the research and the method was worked out at the beginning of the 1980s.
Agrogeology search not just on the surface, but also on the near-surface formations, and finally survey on the connections in the soil-parent rock-groundwater system for the prognosis of changes caused by human activity (harmful or advantageous consequences). For the methodological research it is necessary to examine quite small areas (model areas) where one certain problem can be surveyed in details.
The agrogeological model areas are from a few hundred m^2 as far as 20-50 km^2 large territories chosen from different point of views (geology, pedology, agriculture, sylviculture, environmental protection, etc.). The sampled materials from the outcrops and from the boreholes, and also the water samples are analysed in the laboratory. For the agrogeological research of these areas the so called BFK-method was worked out beside the usual geological sample taking, samples are also taken at the A and C levels of the soil, the zone of the groundwater and the zone of the sediments permanently covered by the groundwater. The „special" samples are taken under more detailed analysis, than with the comparative evaluation of the results the agrogeological principles are established.
For the 33 model areas of Hungary, in this paper, grape chlorosis, alkalization, the geological factors of irrigation conditions, acidification vulnerability, risk to excess water ponds, erosion, deflation, and trace element relations are presented, in relation with the agrogeological methodology. In the future, agrogeological research will be continued in two directions: (i) the exploration of the most appropriate model area suited to different agrogeological problems and (ii) the regional agrogeology: the agrogeological interpretation and re-evaluation of the data of the countrywide geological and agrogeological (primary) maps. Thus, the agrogeological research answers to the most actual questions tied to the sustainable development in condition of the increased humanization of the environment and of the presummed climatic changes

Key words: *Agrogeology, Fertility, Soil–parent rock–groundwater system, Sampling, Surface sediments, Alkalization, Acidization, Erosion, Excess water, Trace elements, Loess.*

INTRODUCTION: CONSIDERATIONS ABOUT THE SOIL FERTILITY

The most important characteristic of a soil is its fertility. Soil fertility is determined by those soil characteristics and ongoing processes that are necessary to smaller or greater extent for assuring the optimal biological conditions of the cultivated plantations.

The concept of soil fertility includes the ability of soils to fulfill the needs of the vegetation, .e.g. its capabilities of water management, of nutrient accumulation and of forming stable crumby structure. The level of nutrient content and favorable pH values are also important. All these properties and characteristics are in strong correlations with each other, and primarily depend on the geological medium, where the given soil was formed. Agrogeology with a modern approach studies these connections; the way of this new discipline was drawn in Hungary in the mid -1970s, however, the research methods were developed in the early 1980s.

When searching for examples of agrogeological research from abroad, we find that

the term “agrogeology” itself is rather unusual and it covers something different as being used in the Hungarian nomenclature. Each of the research papers familiar to us report on research works, in which the aim has been the use of the geological information in soil melioration projects or the exploration and analysis of raw materials suitable for soil-melioration (Chesworth et al. 1989, van Straaten & Fernandes 1995, van Straaten 2002).

According to our concept, agrogeology studies those geological properties of near surface formations and geological processes taking place in them, that have primordial importance for agricultural production, influence the planting condition of the agricultural crop, provide information on the soil and parent rock constituents, on the location and quality of groundwater, on the salt content determined by groundwater movements, and on changes below the soil level due to man-made and natural processes on the surface (Kuti 1977). Therefore, agrogeology examines not only the surface but the whole complex of the near surface rock-formation, the relations of the components of the soil-parent rock-groundwater system, furthermore the changes of this system due to human interventions providing at the same time predictions of the beneficial or damaging consequences originating from these interventions.

Based on these claims, the most important tasks of agrogeology can be summarized as follows:

1. Detailed description and classification of agricultural landscapes, parts of landscapes for optimal land use, and for advancing the selection of the optimal crop types and structures;.
2. Study of the geological causes of several soil degradation processes (erosion, deflation, alkalization, acidification, draying out, etc.), assessment of risk of these processes, elaboration of proposals for prevention and mitigation of their impacts by geological methods.
3. Study of agrogeological and water relations characteristics of the soil-parent rock-ground water system in a given area
4. Study of the effects of land use of agriculture and silviculture on the soil-parent rock-groundwater system, the quantification, modeling and prediction of these effects, the prevention and mitigation of disadvantageous effects.
5. Study of the geological aspects of the drainage and irrigation and their effects on the geological environment.
6. Identification, study, and characterization of the parent rock type of the soil.

At the beginning, the modern agrogeological research in Hungary was based on former geological mapping results by re-evaluation of the geological mapping data from agricultural aspects, but soon we had to realize that it was not enough. For methodological research, it is necessary to examine small areas, where certain problems can be studied in detail. Therefore, we established an agrogeological reference area or model area system.

Agrogeological model areas are small territories (from a few hundred m2 to 20-50 km2) selected by various (geological, pedological agricultural, silvicultural, environmental etc.) considerations. They are explored by a rather dense network (with 50-500 m mesh size) of shallow depth drillholes with max. penetration of 10 m, and other surface sample-taking. All samples from the various surface rock formations, or from various excavations and boreholes, and as well the groundwater samples are analyzed in laboratories.

For the study of model areas, the BFK method was elaborated in the early 1980s.

The essence of this method is, that in addition to the usual geological sampling, samples from the upper and lower section of the soil, from the fresh parent rock, from the groundwater fluctuation zone, from the zone below the groundwater table and from the groundwater are taken, as well (Fig. 1.). These samples are then analyzed more thoroughly as usual, and deductions on various agrogeological rules will drawn by a comparative study of the investigation results (Bartha et al., 1987)

The method, that was employed originally for studying geochemical rules of loose sediments, revealed clearly, that for characterize an agricultural area, it is not sufficient to know the soil levels in the strict sense. It is necessary to study the entire near-surface rock formation including the groundwater flowing in it down to the zone of the standing groundwater level (but at least down to a depth of 10 m).

Since the early 1980s, 39 model areas have been established, where the agrogeological relations of alkalization, acidification, excess water risk, erosion, trace element relations, grape chlorosis were studied (Fig. 2.).

THE AGROGEOLOGICAL IMPORTANCE OF NEAR SURFACE, YOUNG, LOOSE FORMATIONS

The main characteristic of near surface, young, loose rock formations is, that the agrogeological processes take place practically in them. Even for the vegetation in highland areas built up by older, hard rock formations, it is fundamental the presence of near-surface, young, loose formations, as for their life conditions, primarily the sedimentary detritus (occasionally very thin) of the hard rocks, or gravitational sediments (replacement sediments) or settled dust provides the base.

Agricultural production is related mainly to plain and hilly areas made up of loose sediments, therefore formations of these areas are especially important for agrogeological research.

The soil forming rock is playing a basic role in soil formation. Physical, chemical and geological characteristics and mineral composition of its material determine the kind and quality of the soil being formed. At the same time, we cannot disregard the importance of other soil forming factors, such as vegetation, climate, topography, because due to these factors different soils can be formed even from the same geological formations. For example, on loess, brown forest soil and black soil (chernozem) can be formed. The rock type becomes exclusive determinant factor only in extreme soil forming conditions (e.g. barren rocky territories, karst areas, gravel fans), where other factors of the soil formation cannot work.

During our model area explorations, we found, that for agrogeological description of an area, it is not enough to examine the top 20-50 cm of the soil, but even the common practice of examining 1,5-2,0 meters is insufficient. It is necessary to analyze the complex of near surface formations down to the zone of standing water level, but maximum down to 10 meters depth (Bartha et al., 1987). As the agrogeological situation is different of those areas, where one type of sediment with great thickness appears in the whole sequence on one hand, and where different types of formations with varying thickness (thinner or thicker) settled in layers on top of each other.

For example, sandy, especially wind-blown sand areas, are not worth much for plantations, if covered with a sand layer of great thickness (over 10 meters) on the surface, even if the groundwater is relatively near the surface. Namely, the permeability of sand is good but its water retaining capacity (field capacity) is low, therefore its water relations characteristics are bad. But, when 2-5 meters below surface a silt (e.g. loess)

layer with good water retention can be found, than it has positive effects on the water relations of the sand layer above it. Similarly, a fossil soil layer at a depth of 3-5 meters below surface has positive effects on the surface sand. The fossil soil can improve the sand qualities in such an extent as if the soil were on the surface.

In the other hand, in clay- or silt areas, a water-bearing sand layer at a depth of 2-4 m below surface has positive effects on the water relations of surface formations. Occasionally, plants with deeper roots get their water supplies directly from this layer.

A watertight layer between the groundwater and the surface formation – for example, limy mud or fine grained sediments of a previous lake – has definitely negative impacts on the surface water relations. This layer namely isolates the surface layer from the groundwater, thus, blocking the nutrient uptake from the plants. Water relations in such areas depends on the climate. After melting of the winter precipitation, the snow above the water-resistant layer so-called hanging groundwater or pseudo-groundwater is formed, which feeds the plants in the spring, but as time goes by, the water disappears (plants use it or infiltrates in depth) and the plants' water supplies run short. In the case of monocarp plants (e.g. cereals), this does not cause problems, because these ripen by the end of spring or the beginning of summer. But in the case of fruit trees, serious problems may arise, if the young trees cannot get sufficient water.

In the mountainous, mountain foot areas, the composition and thickness of young, loose sediments settled on top of the older hard formations is essential for agrogeological aspects. Different agrogeological importance can be attributed to layer complexes in which a few centimeters or decimeters thin debris cover can be found or if a few meters of allogenic (autochthon) sediment accumulates, and even different if a wide layer of aeolian sediment, (loess) builds up. On the latter, there is a chance for the formation of good quality soil, and these formations can have good water management qualities as well. On the other hand, areas with thin regolith cover are useless for agricultural production.

CHLOROSIS

The thickness of the fine-grained sediment on the hard rock or the type of the parent rock can cause the yellowness of grape, chlorosis. For example, lithosoils with lime coatings on the Highland region of Balaton (Balaton-felvidék) have the risk of chlorosis as the hard rock is near the surface. Where a thicker sediment layer is above the limestone and, thus, its surface turns to soil, there is no risk of chlorosis (Fig. 3). There are also cases of chlorosis in areas where the autochthon weathering products of water-sealing shale's formed soil (Fig. 4).

ALKALIZATION

The formation of alkaline land depends on the geological structure of the given area, and on the geological processes that affect the area. Geological factors resulting in, or causing alkalization: the depth of the groundwater below surface, position of the groundwater table in relation to sea level, the chemical type of the groundwater and the whole solute material content, moreover the facies of the rock formation, grain size distribution in the zone of groundwater fluctuation and above the groundwater level.

During our mapping campaign, we found that alkalization is connected to a certain depth of groundwater. Over sodic areas, the groundwater usually can be found at a depth of around 1-2 meters (Kuti et. al. 1999). In areas of the Danube-Tisza Interfluves, where the level of groundwater had sank significantly, the decrease of the alkalization could be

observed.

The groundwater level above sea level determines the groundwater flow and determines its directions. According to this, it is obvious, that the groundwater flows from higher to lower areas (e.g. river valleys, flats).

At the same time, if we consider the generally accepted hydrogeological model that in elevated areas infiltration, while in low lands upwelling takes place, we also have to accept, that in these sodic lowland areas inflow is not only sideward but also from below. But this inflow determines also the water quality: i.e. it represents a continuous salt accumulation in these areas (Kuti 1989). These areas are characterized by groundwater arriving from different directions and getting stuck there, so basically a trap situation is created. The trapped water cannot flow away, its quantity only decreases by evaporation. At the same time, water and salt flow in continuously, therefore the concentration of salt increases, and so does the amount of the total dissolved material. Meanwhile, salts precipitate from the water. First, salts of magnesium, than those of calcium and finally the ones of sodium will precipitate, and the aggregate of these salts alkalinize (sodolize) the surface soil (Fig. 5).

Considering the total dissolved material content in groundwater, it is also obvious, that groundwater with elevated salt content are always located below the lower lying areas, as mentioned. There, the total dissolved material content can reach or even exceed 5 000mg/l, or in some cases even 10 000 mg/l. Indeed, in the Great Hungarian Plain, below some sodic flats, the total salt content in groundwater can exceed even 30 000 mg/l.

In these lower lying areas, the dominating anion in groundwater is usually sodium, and there waters are either sodium-bicarbonate or sodium-sulfate or occasionally sodium-chloride ones. These sodic, alkaline-type waters can be found in much greater areas, than that of the actual sodic ones.

Alkalization is a serious problem in those clayey or silty lowlands, where the groundwater level is situated usually between 1-2 meters below the surface.

This same process may take place below surface as well in the zone of groundwater fluctuation, where traps are formed due to sedimentological or structural reasons, where different sodium salts precipitate due to the fluctuation of groundwater.

GEOLOGICAL FACTORS OF IRRIGATION CONDITIONS

The geological foundation of the irrigableness of an area is determined by the facies of near-surface formations, the depth and flow of groundwater, its chemical type, the total dissolved material content, and the quantity of dissolved sodium ion in it (Kuti & Mikó 1989).

The basis for the classification of areas is the depth of groundwater below surface and the amount of all dissolved materials. Thus, the probability of the irrigation-induced alkalization processes is lower, when the groundwater table is deeper and the content in salts is smaller,

The probability of alkalization increases, if the groundwater is of sodic type or if the sodium content in it reaches 40 per cent equivalent.

The risk of alkalization decreases, if the groundwater flows fast. Thus, in sandy, gravel reservoirs with relative high relief energy, where the water can flow fast, the continuous leaching intensifies and the accumulation of the damaging sodium salts becomes more difficult. Contrary, in reservoir rocks built up by fine-grained sediments (silt, clay) and situated in flat, plain areas the lateral movement of the groundwater is

slow and the probability of salt accumulation increases.

Also, the type of near surface formations is one of the geological key factors, that influence the irrigation conditions of a given area (Kerék & Kuti 2003). Different sediments have various degree of the capillary ascension, that not only carries water near the surface, but with the water the salt content as well.

Capillary ascension is greater in silty rocks and lasts for shorter time. In clays, it is significantly smaller, slow and continuous. In sands, after a small, fast ascension, the capillary water level becomes practically constant. Therefore, the risk of alkalization is the highest in areas, where there is a clay or occasionally fine silt above the reservoir layers (Table 1). Especially, if thick reservoir layer can retain huge amounts of water and the water flow velocity is very small or zero. For example, see the Northern part of the Danube valley in the Great Hungarian Plain, in the region of Apajpuszta.

THE PREDICTION OF ACIDIFICATION VULNERABILITY USING THE CO_3-CONTENT

The increasing amounts of chemical fertilizers in intensively fertilized areas can cause the decrease of the calcium carbonate content of surface formation , which is equivalent to the acidification of the soil. By acidification, firstly, the calcium carbonate starts to dissolve, and after a considerable decrease in the carbonate content other buffer materials come to be modified, e.g. certain clay minerals.

For tracking the decrease in the carbonate content, we need to know the actual carbonate content in the soil and in the parent rock as well, and thus, the relation between these two data provides information on the past or future changes. For the determination of the decrease of carbonate content it is, though, sufficient to examine the surface formation and the soil, but for the clarification of the causes of the process, we need to examine the whole complex of the near-surface formations, because, only in this way can the soils with decreased carbonate content be discriminated from those formed in a geological medium with originally small carbonate content (Kerék, 2000, Kuti & Kerék 2006). For soil remediation in the first case, it is often enough, to cease the cause of the decrease of carbonate content, while in the latter case, often there is a need for a different method.

The determination of the quantity and the type of the carbonates (fast or slow dissolving) can usually be carried out quickly even for many samples, therefore, it can be usefully applied for the assessment of “acidification-risk” in larger areas. Carbonates in the soil can originate from the parent rock through transportation or from calcareous shells.

If we are looking for a relation between the acidification risk and the calcium carbonate content, it can be stated, that generally the more the carbonate the smaller the risk. The reason behind is, that more carbonate means greater buffer capacity and due to the continuous acid neutralization, there is no pH- value drop, or it occurs only much later. Meanwhile, however, the carbonate content constantly decreases as well, what, in some ways, counts as hidden acidification, even though the pH-value does not change.

EXCESS WATER RISK

Excess waters are called those waters, that cause inundations outside river floodplains, but still in plain areas (Pálfai 1988). They are caused by sudden and large amount of precipitation, the high level of groundwater, the water-sealing property of surface formations, or the specific morphological situation. The damaging effects of the

excess water ponds on the soil and vegetation depends on the durability of inundation: after exceeding a certain tolerance level, such changes occur, that, in addition to damaging the vegetation, have long lasting negative effects on soil fertility (Várallyay et al. 1981).

For predicting the risk of excess water ponds based on geological factors, it is fundamental to examine the hydrological permeability of near-surface formations, the depth of groundwater table below surface and the presence of water-sealing formations lying quite close to the surface in the area under investigation.

We consider those formations to be water-sealing, in which the fraction of grain-size below 0,02 mm is above 60%, such as clays, clayey silt, and fine silt. These formations form mainly in rivers, flood areas and sometimes in lakes. Similarly, we consider the surface- or near-surface lime muds, lime accumulation horizons and cemented sands, the buried soil-horizons and saliferous formations (Table 2).

Depending on whether the formations are on the surface or near the surface, they constitute greater or smaller excess water risk (Table 2). Namely, the sediments with low hydrological permeability will block or hinder infiltration of the surface precipitation into the soil, and the water will stay on the surface for shorter or longer period of time.

The closeness of the groundwater level to the surface raises the risk of excess water inundation. If it is at a depth of less then 1m, than it raises the excess water risk, significantly, if it is between 1-2 meters than does less significantly. Below 2 meters, the groundwater have little or no influence on the development of excess water From these all, it follows, that the excess water danger is the greatest in the lower, flat plains, or in the valleys between the hills.

EROSION

One of the most important factors determining soil fertility is erosion. Soil degradation is a complex process and can take place in natural circumstances as well, but often anthropogenic effects start, or accelerate the adverse changes. For far-seeing planning it is important to be able to predict the danger and scale of erosion in order to prevent the natural effects and stop the human activity causing erosion.

There are many factors taking part in the soil degradation caused by water. We need to emphasize the importance of the parent rock as the soil is formed on top of it. The influence of the parent rock on water erosion are different depending on various sedimentological conditions. In the case of clayey soil forming rock, the low hydrological permeability accelerates the soil erosion and the channel erosion can occur. The loess is exposed to greater erosion due to its loose structure. If, however, buried soil-horizon comes to the surface, it can greatly decrease the rate of the process, although the loess below it keeps degrading. Loess, therefore, need special attention, because it has the best physical and water relations properties for agriculture. Sand is less endangered, because has a good water absorbing capacity therefore surface run-off is low. Soils formed of different tuffs are less resistant against erosion.

The parent rock influence erosion not only through the soil formed on it, but also directly, through the relief features. Various parent rocks pertains to particular slope forms (e.g. slopes are arched on loess), which are determined by the physical and chemical characteristics of parent rocks, and this reacts to further erosion.

Out of the erosion- hazard factors, soil decay is influenced primarily by the relief, the precipitation conditions, and the grain size distribution of near-surface sediments. Relief context can be characterized by slope categories, while in case of the precipitation

conditions, we used the Bacsó-index for precipitation, and the characteristics of the near-surface formations were determined using the geological maps. Based on the data available for us, the erosion-risk value can be determined using the Farkas-formula:

$$E_v=(S_c \times P_i)+G_c \quad [1]$$

where E_v is the risk of erosion, S_c is the value of slope category, a P_i is the precipitation index, and G_c characterize the type and the grain–size distribution of the near-surface formations (Farkas 1987).

DEFLATION

The most important factor out of those ones effecting wind erosion (deflation) is the grain size distribution of the sediments, as deflation is generally found for sediments rougher than fine-grained silt, but finer than the medium-grained sand, i.e. with grain diameters between 0,02-0,5 mm. Below the lower limit of 0,02 mm grain diameter, grains of fine silts, clays, and fine silty clay sediments stick together, so the wind cannot grab and pick them up. Above the upper limit grains are too big for the wind to carry them. The wind can roll them on small distances, at the most. In areas of shifting sand (especially in the Danube-Tisza Interfluve) often the rough sand sediments settling on top of the sand dunes, accumulate on the surface as in “serir”, misleading inexperienced spectators, who looking at these formations often tend to think of gravel. Similar sediments can be formed in earlier periods of Pleistocene, because in the few, useful soil exposures in the Great Hungarian Plain, we could see a few millimeter (maximum 10 mm) wide, usually lime cemented sandstone pans.

As the grain-size grows, so decreases the strength holding them together and so grows the risk of deflation. In the formations with small amounts of fine grains (below 0,02 mm) or colloidal (clay, humus, iron hydroxides) materials, the grain cohesion decreases, therefore the chance of wind damaging impact increases. At the same time, in sandy sediments, if there is less, than 15% of the fraction of fine and colloidal grains, the wind can blow out these grains from the formations, and often carry them further, than sand.

The extent of deflation is influenced by the density and volume-weight as well. These depend on the mineralogical composition of these formations.

The density of the organic material of the surface formations, the humus, is small, therefore the wind with adequate strength can blow out lots of organic material from the loose, granular, rougher sediments. At the same time, it has basically no effect on the cohesive sediments, not even if the given sediment has a greater sand fraction.

In case organic material would bind the fine grains into crumbs in the given sediment, the formation would dry out, and the bound crumbs behave as sand grain, such that wind can grab and blow them out easily from the sediment.

Groundwater depth is also an important geological factor affecting deflation. Namely, humidity stick together the grains more strongly, and the wind cannot grab them. Even the wet sand can resist the damaging effects of wind, as long as it does not dry. At the same time, sand dries more easily, than fine sediment due to wind. Out of the sediments exposed to hazard of deflation, sand’s capillary rising is the smallest, so this quality further increases the chance of sand drying.

TRACE ELEMENT RELATIONS

“Those elements that are also needed by plants in a very small amount, but if they

are lacking it, various deficiency diseases set in appearing in the form of metabolic disturbances, are called micro-nutrients" (Zentay 1993). Similarly to the trace element deficiency, it can also be a problem, if they are in excess, because they can cause poisoning. The trace elements play an essential role in the growth of the plants and in the human and animal nutrition ((Metz, 1987; Pfannhauser, 1988).

Traditional investigations and nutrient-balance estimations only consider the top 20-50 centimeters of soil, even though the majority of cultivated plants have root depths of the dimension of meters. Therefore, we extended our primary investigations to the C-level of soil, finding, that the same laws are valid there as on the surface. The distribution of each micro-nutrients is uniform in the vertical segment. After this, we extended our explorations to the 10 meters complex of the near-surface rock formation and the groundwater accumulating in it, i.e. the soil-parent rock-groundwater system (Bartha et al. 1987).

In our examinations, we detected the boundary of constant groundwater coverage ("green line") using geochemical methods, and proved, that below it, the mobile micro-nutrient content radically changes. While, above the "green line" there is an extremely active, mobile life, below the line, everything calms down. Processes quiet down, settle and become constant. From this, we also established that exploring the top 20-50 centimeters of soil does not give useful information on the micro-nutrient content of near-surface formations. The soil can be deficient, over-saturated or normal referring to the trace element content, while the trace element content of the formations below it can be quite different. Therefore, if we want to determine the micro-element content and the nutrient supplies of an area by only surface sampling, we might "poison" our plants. From all of this, it follows, that layers need to be examined continuously down to the depth of root zone, or the zone under constant groundwater coverage (below the "green line").

CONCLUSIONS

In our study, we tried to give a brief overview of those agrogeological problems, that we are dealing with in our current model area research, but we are far from giving the full picture. It is obvious, however, that in order to find out the causes of the factors limiting or influencing soil fertility, and to solve the problems caused, to decrease the effects, it is not enough to examine the soil, but also we need to have appropriate information on the characteristics and interrelations of the soil-parent rock-ground water system in the given area, and the processes taking place in it. Only in this way can we provide valuable assistance to different agricultural and silvicultural activities.

In the future, agrogeological research needs are to be continued in two directions. One of the directions is the model (reference) area exploration, when we search for the most appropriate area suited to different problems, and by examining them we look for the causes of the agrogeological problems. The second direction is regional agrogeology, in which, we look for the problems and solution in a given area by agrogeological mapping, and by agrogeological interpretation and re-evaluation of the data of these maps.. As a result of the detailed examination of the model areas, we can elaborate the key of the appropriate countrywide agrogeological maps. The overall survey, on the other hand, raises the concrete questions, that we can be answered through the model area explorations.

Thus, the agrogeological research answers to the most actual questions tied to the sustainable development in condition of the increased humanization of the environment and of the presumed climatic changes.

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INVESTIGAREA AGROGEOLOGICĂ A FERTILITĂȚII SOLULUI, CU PRIVIRE LA FACTORII DIN SOL – ROCA MAMĂ ŞI SISTEMUL DE APĂ FREATICĂ, ÎN UNGARIA

(Rezumat)

Cercetări agrogeologice asupra factorilor limitativi ai fertilității în sistemul sol-roca parentală-apa freatică în Ungaria. Caracteristica cea mai importantă a solului este fertilitatea acestuia. Diversele atribute ale solului, ca de ex. retenția apei, acumularea substanțelor nutritive şi strucrura granulară a acestuia condiționează deasemenea fertilitatea, întrucât contribuie la satisfacerea necesităților plantelor . Relațile dintre aceşti factori sunt studiate de o nouă disciplină a ştiințelor Pământului, agrogeologia modernă, ale căror baze au fost puse în Ungaria în mijlocul anilor ’70, metodologia şi direcțiile cercetării fiind implementate la începutul anilor ’80.

Agrogeologia cercetează nu numai depozitele superficiale, dar şi stiva depozitelor necoezive din apropierea suprefeței terenului, urmărind legăturile dintre pătura de sol, roca parentală şi apa freatică cantonată în acestea, cu scopul de a prognostiza schimbările cauzate de activitatea umană, cu consecințe pozitive sau negative deopotrivă. Pentru studiile cu caracter metodologic, s-a considerat necesară instituirea unor arii model, pentru a se efectua cercetări detailate asupra uneia sau unor probleme specifice.

Ariile model sunt teritorii delimitate cu suprafețe de la câteva sute de m^2 la 20-50 km^2, care au fost alese pe baza unor criterii diverse, de natură geologică, pedologică, din domeniul agriculturii, silviculturii şi a protecției mediului. Probele provenite din aflorimente şi din forajele de max. 10 m adâncime, dispuse în rețea, sunt analizate pentru compoziția granulometrică, conținutul de carbonați şi pH. In afara acestora, conform metodei BFK, se iau probe din nivelele A şi C ale solului, din zona de oscilare a nivelului apei freatice, din zona permanent acoperită de apă şi din apa freatică proproi zisă. Pe aceste probe speciale se fac analize de elemente nutritive şi de elemente-urmă, ale căror comportament se studiază uzând metodele geochimice proprii problemelor agrogeologice.

Până în prezent, în Ungaria s-au deschis prin foraje 33 arii model din cuprinsul întregii țări, prelucrarea materialului fiind în curs. Pe aceste terenuri s-au studiat probleme legate de cloroza frunzelor de viță de vie, a alcalinizării sodice, a riscurilor irigării, a sensibilității la acidificare, ale bălțirilor, fenomenele de eroziune şi de deflație a păturii de sol şi caracteristicile mişcării elementelor-urmă. In lucrare se descriu detailat fiecare din acease probleme specifice cercetării agrogeologice.

In viitor, cercetările agrogeologice vor continua în două direcții principale: 1. Continuarea explorării datelor obținute din ariile model pentru anumite probleme specifice şi 2. Agrogeologia regională, constând din reinterpretarea datelor primare ale hărților (geologice şi agrogeologice) regionale şi naționale pentru elaborarea unor reprezentări tematice. Astfel, cercetarea agrogeologică va răspunde unor chestiuni de mare actualitate, legate de dezvoltartea suastainabilă în condițiile creşterii umanizării mediului şi a presupuselor schimbări climatice ale Pământului.

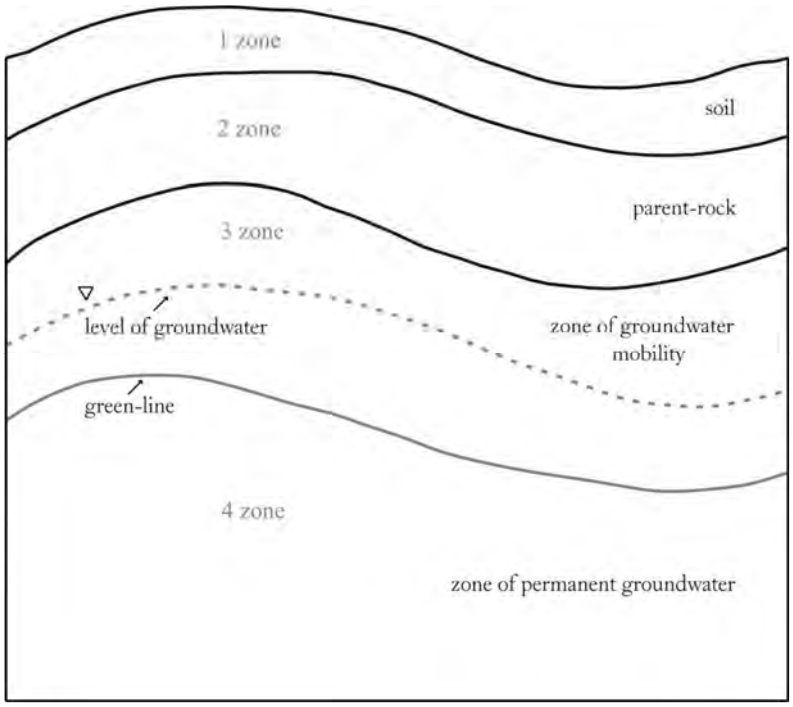

Fig. 1. *BFK levels. 1 zone: soil, 2 zone: parent-rock, 3 zone: zone of groundwater mobility, 4 zone: zone of permanent groundwater, 5: level of groundwater.*

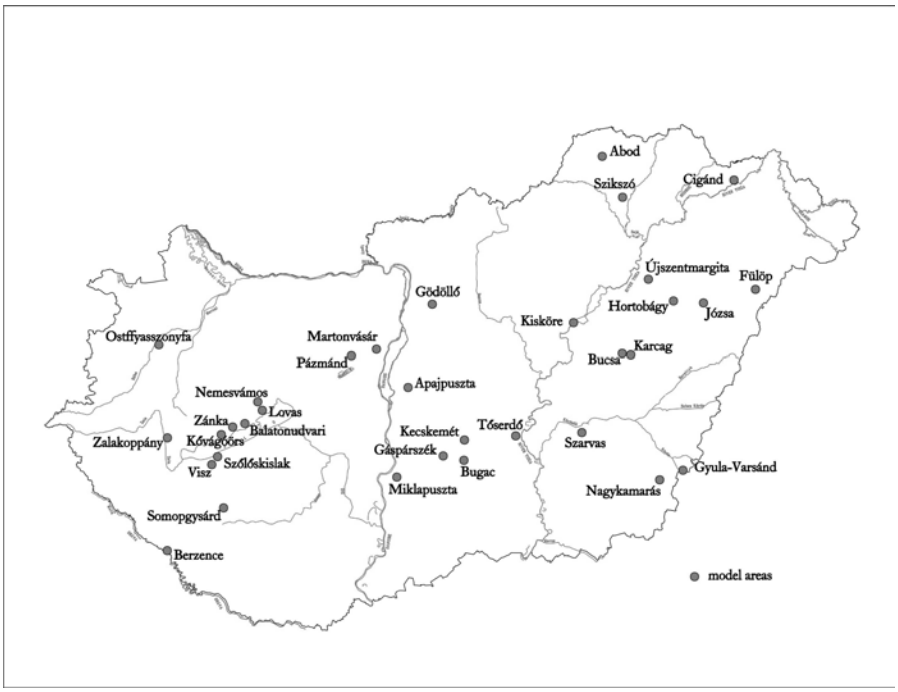

Fig. 2. *Model areas in Hungary*

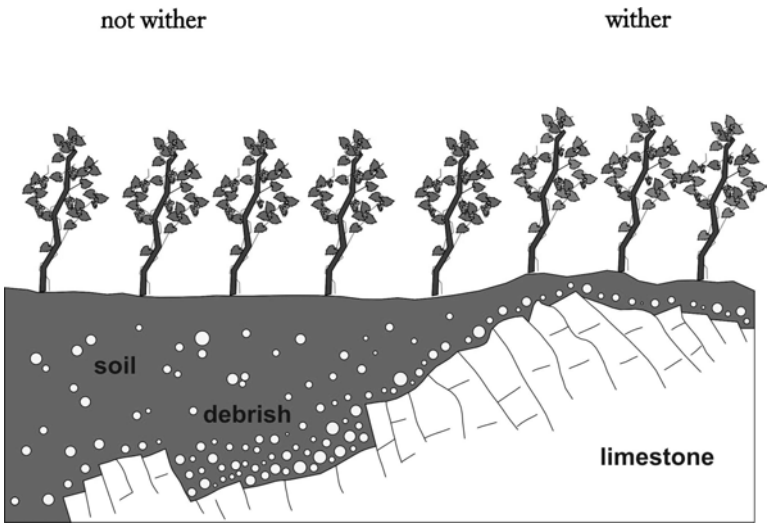

Fig. 3. *Chlorosis type 1 (Limestone basic rocks)*

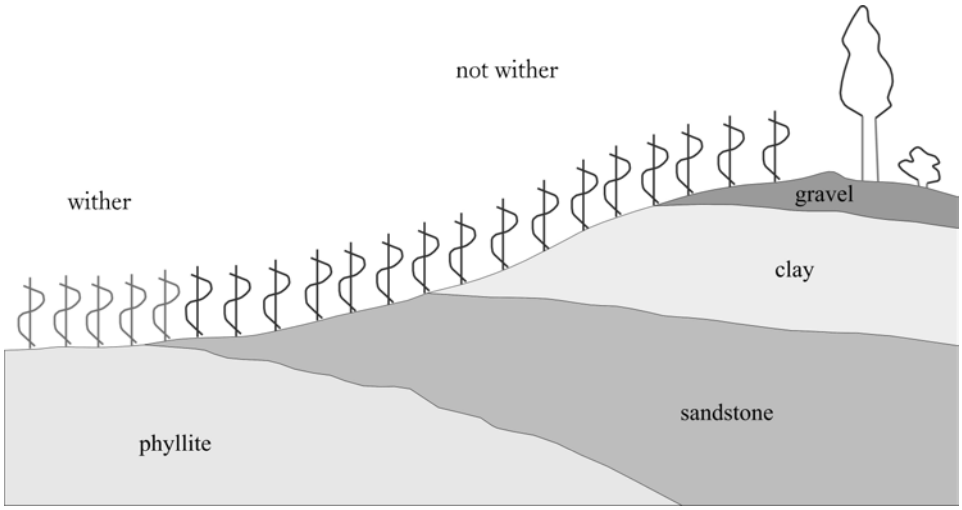

Fig 4. *Chlorosis type 2 (Sandstone basic rocks)*

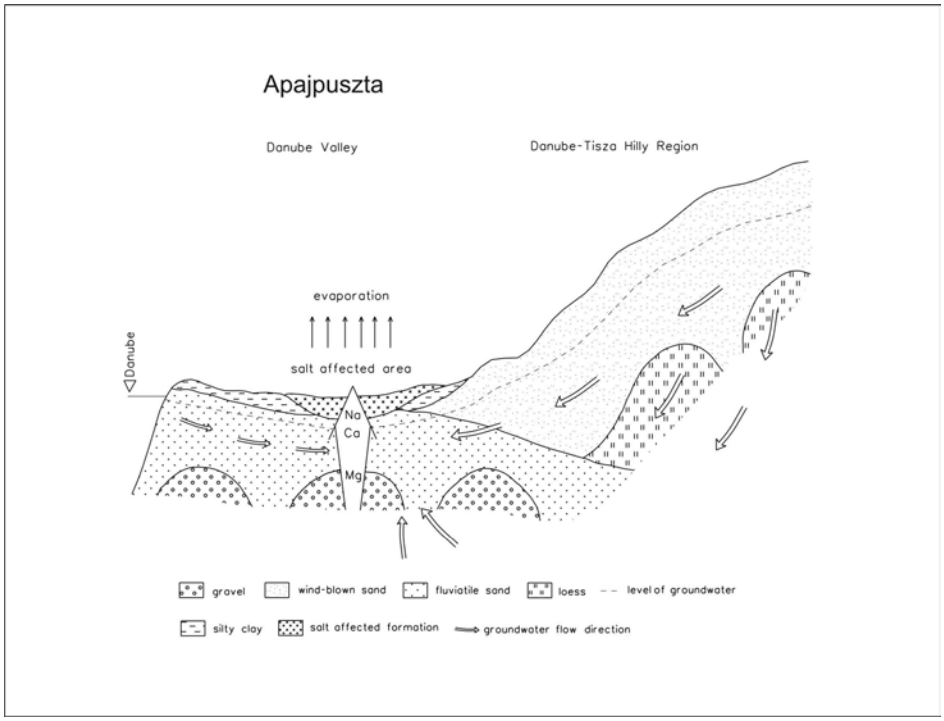

Fig. 5. *The sodification model of Danube Valley*

Table 1

Evaluation of irrigableness based on geology

	<500 mg/l			500-1000 mg/l			>1000 mg/l		
	sand	silt	clay	sand	silt	clay	sand	silt	clay
<1 m	B	A	A	A	A	A	A	A	A
1-2 m	C	A	B	B	A	B	A	A	A
2-4 m	C	B	C	C	B	C	B	B	B
>4 m	C	C	C	C	C	C	C	C	C

A: *not irrigable*, B: *irrigable with certain conditions*, C: *irrigable*

Table 2

Possibility of excess water inundation based on geological factors

	Presence of impermeable formations		
Depth of the groundwater (m)	On the surface	Near to the surface	Neither on the surface, nor near on the surface
<1	5	5	3
1-2	4	4	2
>2	4	3	1

1 = the smallest; 2 = small; 3 = medium; 4 = big; 5 = the biggest value of the risk

Table 3

Categories inducing and influencing erosion

Serial number of category	Slope angle % (S_c)	Index of precipitation (P_i)	Limits of grain composition (G_c)
1	0 - 5	< 20	Compact stone, boulder stone, pebble
2	5 - 15	20 - 30	coarse sand
3	15 - 25	30 - 40	clay, peaty earth, peat
4	>25	40 - 50	clayey silt
5	>25	50 - 60	silt, fine sand, silty sand
6	>25	60 - 70	sady silt
7	>25	<70	shallow tilth

Limits of erosion vulnerability:
Value of erosion vulnerability (E_v) = 0-5 → not vulnerable
Value of erosion vulnerability (E_v) = 6-10 → slightly vulnerable
Value of erosion vulnerability (E_v) = 11-20 → fairly vulnerable
Value of erosion vulnerability (E_v) = >21 → strongly vulnerable

METHODOLOGY OF DRAWING UP THE MAPS OF LANDSLIDE ZONING, DUE TO THE AGGRAVATING GEOHAZARDS FACTORS (METEOROLOGICAL, HYDROLOGICAL, ETC.) – FOR THE ROMANIAN TERRITORY, AT THE ADMINISTRATIVE AND REGIONAL LEVEL

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Abstract: Methodology of drawing up the maps of landslide zoning, due to the aggravating geohazards factors (meteorological, hydrological, etc.) – for the Romanian territory, at the administrative and regional level.

The spreading of the landslides in Romania, the severe damages resulted following the frequent reactivation due to the accompanying geohazards factors (such as meteorological, hydrological, etc.), justifies the preoccupation of the specialists and the local and national risk managers.

A brief estimation revealed that the lands affected by the active landslides in Romania occupy a surface of 115.000 ha [1].

The stability of the land generally depends by the triggering permanents factors, which are influencing the development of the landslides, represented by permanent and temporal factors. The permanent factors are represented by the geological, geomorphologic and structural conditions. The temporal factors are represented by the local geomorphologic factors, such as: climacteric, hydrologic, seismic, forestry, and anthropical factors.

In our country, the landslides and other forms of land movement or block fallings have a very large spreading and are connected with the lithologic substrata and linked with the climacteric regime. The most frequent types of landslides are linked with the network of erosion from the substrata, and the mudflows generally related with the surface erosion on an advance stage.

During the last recent years the severity of the extreme meteorological phenomena was significantly increased, as a result of the worsening of global warming, like the heavy rains which led to historical floods on the most part of the hydrographical basin from Romania, mostly during 2005. This dangerous meteorological phenomena reactivated a great number of landslides. Therefore, the risk managers from Romania, in order to urge the landslide inventory at the level of the whole country, recently released the hazard maps within the Law no 575/2001 regarding the "Plan of the national territory development, the Fifth section – Areas of natural hazards", which includes risk maps of Romania for the areas prone to natural hazards (floods, landslides and earthquakes), as well as the exact geographical and administrative localization of these areas, including the indication of the risk level of producing the specific hazards [2,3,4]. The paper presents the methodology for hazard zoning at the local and regional level, including the parameters used to draw down the thematic maps for inventory and representation of the active landslide over the whole territory.

Key words: *geohazards factors, landslides, meteorological phenomena*

ROMANIAN METHODOLOGY FOR LANDSLIDE REPRESENTATION

Until now, for the Romanian territory were made maps with landslides on small areas, for important objectives and only in the case when the landslide took place in different stages of evolution. The Law no. 575/2001 imposes elaboration of hazard maps to landsliding, in digital format, for the entire Romanian territory. This program is in the initial phase of development and the first maps have been made be made since the beginning of 2004.

According to the Law regarding the “Plan of the national territory development”, the Fifth section – Areas of natural risks” (no. 575/2001), which deals with “risk zones”, and includes the presentation of the zones prone to floods, landslides and earthquakes, is created the legislative frame for the delimitation of the areas prone to natural risks, also for prevention and attenuation of the effects, which are produced by the destructive natural phenomenon, like landslides, earthquakes and floods [3].

This law creates the legislative frame for the delimitation of the areas prone to natural risks, also for prevention and attenuation of the effects, which are produced by the destructive natural phenomenon, like landslides, earthquakes and floods.

Considering the common Order of Ministry of Agriculture, Forests, Waters and Environment and Ministry of Transportation, Constructions and Tourism: regarding the delimitation of the areas prone to natural risks (no. 62/N-19.0/288-1.955/1998), flooding risk areas from Romania concerning the rivers and torrents overflowing and the land sliding, are established, also upon the lessons learnt from disasters [4].

In the General Urban Planning (PUG’s), which is managed by local authorities, have to be indicated the areas exposed at natural risks, such us floods, landslides and earthquakes, where is forbidden to build, excepting the works that limit the effects of a potential natural disaster.

Mainly due to high impact, the landslide maps are very important for the safety of scientific research, regarding prevention measures for stopping the movement or the reactivation potential, which are for the interest for the stakeholders interested in the safety of their units and facilities.

According with the Law of Cadastre Law of Cadastre, no. 7/1996 (completed in 2004 by Governmental emergency Order no. 41) the public can consult the specialized cadastre maps (such us for landslides hazard) excepting the case of strategic units. Of course, general information is made public to inform population about hazards existence in their living area.

Regarding the representation of the landslide maps, the level of hazard may be rated qualitatively, for at least three different levels (low, medium and high):

- Phase 1 – qualitative – maps of landslide hazards of scales 1:50.000 ÷ 1:10.000
- Phase 2 – for details: detailed maps of landslides hazard, in areas of high probability of occurrence of landslides in the presence of vulnerable elements that would allow to estimate the risk; scales: 1:5000 ÷ 1:1000.

It has to be specified that in the Urban and Territorial Planning Plans, managed by the local authorities, the information regarding the natural hazards are represented detailed at scales ranging between 1:5,000 and 1:500, depending the size of the locality. Taking into account that natural hazards have generally a regional extension, is imposed an approach at the level of the county, which contains the all data from the local level, of the localities.

- Phase 3: In the emergency and response Plans of the Civil Protection, in case of Disasters, at the county level, are used maps at the scales 1:25,000 and 1:50,000. For the representations at the national level area used scales 1:1,000,000, 1:500,000 and 1:200,000, scales chosen according to the surface of Romania, which is 238,000 square km (Plate I).

LANDSLIDES MAPPING AT EUROPEAN LEVEL

The European Commission recommended the using of harmonized methods for representation of the hazards on maps, mainly on digital format, using GIS software, to

be able to compare, combine and ranking the priorities for all countries and regions taking into consideration. The most recent initiative was the elaboration of the landslide hazard map at the level of EU, by EPSON – European Spatial Planning Observation Network (Plate II.), based on several qualitative indices regarding the hazard occurrence probability.

Regarding the situation of elaboration the vulnerability and risk maps for hazards, in the last year in EU was underlined the necessity to create and implement a common methodology, with standards accepted by all Member states, leading towards the drawing of risk maps. The purpose of this action is the management of the risk at natural and technological hazards, determining an improved activity of prevention, efficient intervention in case of disasters and mitigation of their effects.

Regarding other projects implemented or under implementation, the following are the most important in the field of hazard risk mapping initiatives:

- European Initiative regarding the Risk Management at floods (under drafting), as a result of the Decision of the European Council and Parliament having the purpose the increasing protection against the hazards. As a result of the catastrophic floods from 2002, from the Centre Europe, in the Elba and Upper Danube River Basins, EU created the Solidarity Fond of European Union. This is a rapid specific assistance instrument in case of major disaster for the affected people, in order to rehabilitate the normal life conditions. European Commission proposes to develop and implement an Action

Program for prevention and protection against the floods. An important action in the frame of this common action program at the level of EU is towards an increased awareness and involvement of the pubic through the promoting and using the risk maps for the floods [http://www.europa.eu.int/comm/environment/water/index.html].

- The contribution of the General Directorate of Environment from the European Commission (DG-Env), in the field of drawing risk maps for natural and technological hazards, correlated with the Infrastructure for the Spatial Information in Europe, INSPIRE. The purpose of the activity, among others, is to identify the preliminary requests for a harmonised system for elaborating the risk maps from Europe, with reference at the Candidates Countries.

It is foreseen in the frame of the Project to be drawn up maps for zoning the natural risk (floods, severe storms, earthquakes, landslides, forest fires) and technological hazards (industrial accidents, transportation of dangerous goods, contaminated lands), which will meet the EU request regarding the prevention, combating and mitigation of the disaster at the national and transboundary level for the Candidates countries.

SOCIO-ECONOMIC IMPLICATIONS OF THE DISASTER

In order to prevent and attenuate the effects of natural disasters, as in the case of landslides and floods, it is necessary to be taken some measures to limit the socio-economic impact, which have to include:

- Delimitation of all the areas where building is prohibited, in the documentation of urbanism and planning (cf. PUG above).
- Obligation to carry out geological surveys, including laboratory and in situ geotechnical tests, in order to know the properties of the soil and bedrock of the populated areas and those with a socio-economic activity.
- Implementation of special building rules, which have to take into account the existence of natural hazards in the area [2].

- Measures for prevention and reduction of natural risks have also to be implemented. These have to include:
- Maintenance of the equipment and works for protection and mitigation of natural disasters.
- Control of the degree of land occupation and the completion of the specific land use and building plans.
- Information to the population regarding the potential risks specific to their respective inhabited area.
- Intense rainfall is one of the major landslide triggering and reactivation factors, and as such it must be duly forecast.

The lack of field studies, the absence of laboratory research, the lack of knowledge of the real situation from the point of view of stability and the characteristics of the usual ground parameters in the areas where it is intended to design and execute any type of works, can lead to landslides producing countless material damages and sometimes human losses (Fig. 1).

Fig. 1. *The landslide occurrence in generally related to the flood impact areas*

It has to be specified that in Romania, the technical coordination of the activity for the protection against the disasters related to the water factor, are realized by the National Romanian Administration A.N-A.R, through their directions organized by hydrographical basins, based on the operation Guidelines in case of floods and based of the Defence Plans against the floods and ice blockages, at the level of a hydrographical basin. The total length of the watercourses managed by A.N-A.R is approximately 78,905 km, which are included in the Protection Plans against the floods and ice blockages.

INDEMNITY ISSUES OF THE AFFECTED PEOPLES BY LANDSLIDES

Generally, any damage assessment is made in order to ensure compensation to the affected persons (and according with the law of the National System of Emergency Situations, the main aim of the defence activity after a disaster took place is to diminish the effects and to recover the damages). It has to be specified that the insurance companies have so far a weak involvement in the activities for preventing and reducing the effects produced by the landslides in high risk areas in Romania. The insurance companies are unwilling to insure goods and properties located in landslides-prone areas. The only financial resource for minimising the damages caused by the landslide caused by floods are the funds allocated by the State budget and external credits. Recently (in 2005) the Government took the initiative to launch a project on the elaboration of a normative act for the Obligatory Insurance of the Houses against natural disasters (including landslides) and fires. The new law of Obligatory Insurance of the Houses is foreseen to enter in force during 2007. Thus, the population will have the obligation to insure their houses. This way the acute problem of indemnity for affected people by floods, earthquakes and landslides will be solved (Fig. 2).

Fig. 2. *A faster recovery of the landslide affected areas is possible upon insurance*

PREVENTION MEASURES FOR MINIMISING THE LANDSLIDE VULNERABILITY

Due to increasing risk of extreme meteorological events recorded all over the world, due to possible global warming in the last decade, an increased risks from geohazards is presented in Romania, due o combined effect of slopes and particular geology of this area [5]. Therefore is possible that some areas will become more prone to landslides, for instance where slopes are covered by ground that is very porous and the rain can saturate it very quickly. If the areas prone to landslide will be inventoried, further

information to plan and avoid the danger areas, or put in place protection systems if economically viable, will increase the early warning capability for the people protection, limiting the possible disaster effects.

On the zones vulnerable at landslide near the transportation routes, are necessary supplementary works for limitation of the consequences of the landslide effects (soil erosion protection works by reforestation, torrents regulation protection works, etc.).

Is necessary the vulnerability reduction of the areas prone to landslides, especially the slopes zones, located in the vicinity of socio-economical activities, such as transportation routes, inhabited areas, plants, etc., by structural measures, including the reforestation which can improve the slope stability, by low investments compared to other measures (diverting the roads, expensive consolidation works, such as supplementary embankments, slope angle reduction, etc.) (Fig. 3).

Fig. 3. *Sometimes the reforestation is more feasible than other engineering works*

The intense rainfall is a major landslide triggering and reactivation factor, and such it must be duly forecasted.

The existence of field studies and the laboratory research for assessing the real situation regarding the land stability, and furthermore the mapping of the hazard vulnerability in the areas characterized by intense socio-economical activity, especially inhabited centers, can reduce the impact of the landslides.

INFORMATION TO THE PUBLIC FROM THE AREAS PRONE TO LANDSLIDE HAZARD

The continuously information of the public regarding the potential risk areas, the imminence of the landslides phenomena, their effects and the measures taken, is essential for a complete and successful actions for mitigation of the adverse situations due to landslides occurred nearby inhabited areas.

An efficient preparedness measure is dependable by the warnings issued by the authorities related to the evolution of the adverse hydro-meteorological phenomena, which often constitute the triggering factor for the landslide phenomena.

In order to ensure the mitigation of the disaster effects during the response phase, it is necessary the endowment at the level of the crisis unit from each municipality, with a special building fond designed for natural calamities or man-made catastrophes in order to assure the accommodation of the homeless people affected by the disasters (including landslide), from the inhabited areas.

The prompt information of the public regarding the possible effect of the natural hazards in the travel or inhabited area, due to the persistence of the dangerous hydro-meteorological phenomena, or regarding the presence of other triggering factors for natural hazards, lead to a more precautionary behavior of the population, and the limitation of the consequences in case of a natural disaster, particularly a landslide.

CONCLUSIONS

The inventory of the areas potentially to be affected by hazards, made during the initiative to build up a complete data base of landslide maps both at the regional and local level, will support the local development, allowing the promotion of protection projects of the population and the economical units, to comply with the increased safety requirements of the population and their owners.

A common methodology for realizing the multi-disasters maps, to be implemented at the level of the local community, will allow the unitary representation of the probability of producing for different disasters types, including their effects. This information will be available for all the factors involved in the activity for prevention and mitigation of the disaster effects at the local, county or regional level. Using a common methodology, harmonized for EU requests, will promote a better cooperation at the European level, leading to a unitary approach in the frame of common projects.

The insurance companies, being able to consult unitary information, according to their necessities, regarding the existence of the hazards at the level of a county, will be able to reorient their development strategies, establishing categories of primes according with the risk level from every region, assuring a better management of the funds, for the compensation of the affected persons by disasters. In this way the financial resources of the State will be efficiently allocated for supplementary measures for preventing disasters, not being used for direct compensation of the affected persons, as in the case of the major disasters.

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METODOLOGIA ÎNTOCMIRII UNOR HĂRȚI A ZONELOR CU ALUNECĂRI DE TEREN, DATORITĂ FACTORILOR GEOHAZARD INTENSIFICATORI (METEOROLOGICI, HIDROLOGICI ETC.) – PENTRU TERITORIUL ROMÂNIEI, LA NIVEL ADMINISTRATIV ŞI REGIONAL

(Rezumat)

În țara noastră, alunecările şi alte forme de deplasări de teren au o răspândire foarte largă şi sunt în legătură cu substratul litologic şi cu regimul climatic. Cele mai răspândite tipuri de alunecări şi surpări sunt legate de rețeaua de eroziune în adâncime, iar scurgerile noroioase de eroziunea de suprafață ajunsă în stadiu avansat.

In ultimii ani recrudescenta fenomenelor meteorologice extreme ca urmare a incalzirii globale, precum precipitatiile care au condus la viituri exceptionale pe o mare parte a bazinelor hidrografice din Romania, in special de-a lungul anului 2005, au condus la reactivarea a numeroase alunecari. Recent, in vederea urgentarii inventarierii alunecarilor de teren la nivelul intregii tari, factorii de decizie din Romania au finalizat identificarea şi delimitarea hazardurilor naturale (cutremure, alunecări de teren şi inundații), la nivelul intregii tari si la nivel de judete, avand ca baza de lucru pentru hărțile tematice hărțile topografice la scarile 1:25 000 şi 1:5 000.

Lucrarea prezinta succint metodologia de zonare la nivel adminstrativ local (judetean) si regional, cat si parametrii factorilor utilizați pentru obținerea reprezentarii pe harti tematice a factorului mediu de hazard – alunecări de teren, prin încadrarea impusă de legislatia nationala (Legea nr. 575/2001 privind aprobarea Planului de amenajare a teritoriului național – Secțiunea V-a – zone de risc natural). Deasemenea in lucrare este prezentat stadiul la nivel European si international in ceea ce priveste delimitarea zonelor de risc la alunecari, precum si masurile necesare de a se lua la nivel adminstrativ, regional sau local pentru reducerea vulnerabilitatii acestui tip de hazard natural asupra activitatilor economico-sociale a comunitatii.

Plate I. *Landslide types zoning at the administrative level in Romania*

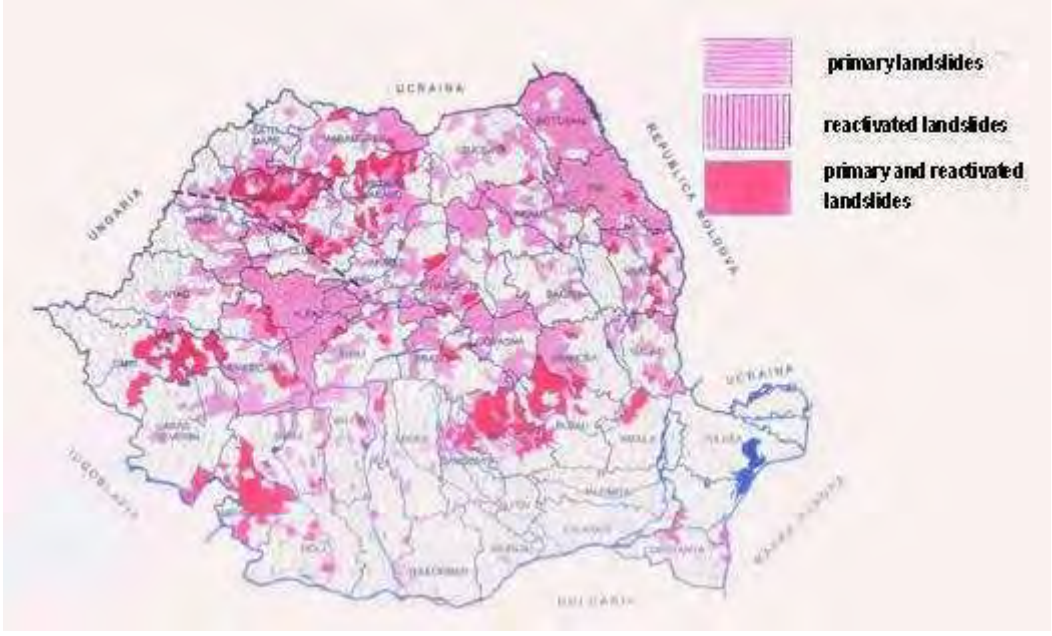
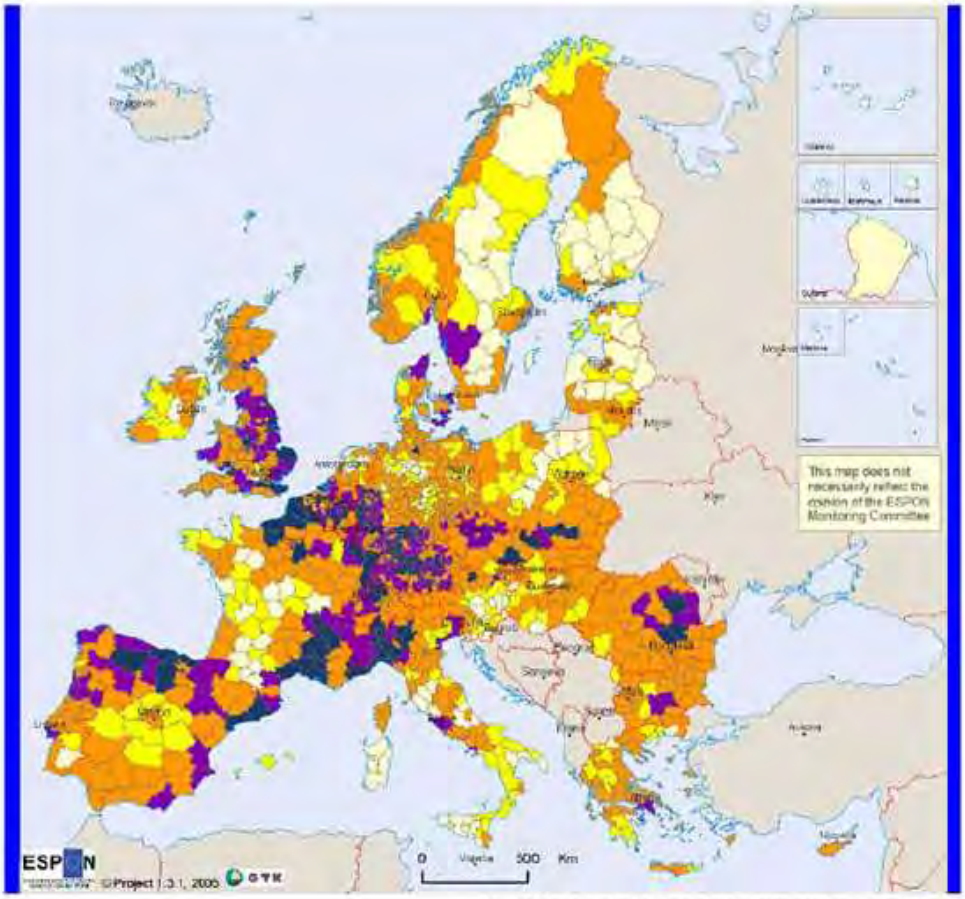


Plate II . *Probability occurrence map of the landslides at the administrative level in EU*



AUMENTO DEL RIESGO DE INUNDACIONES EN ESPAÑA: LA OCUPACIÓN DE TERRITORIOS DE RIESGO

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Abstract: The increase of flood risk in Spain: antropic occupation of risk lands. In the last twenty years there has taken place an increase of flood risk in many areas of the Spanish littoral. The growth of the real-estate park in the littoral areas has produced to itself, in occasions, on areas at flood risk and it in spite of the existence of legislation (soil, water) that, to priori, prevents the occupation of the above mentioned spaces. In the frame of the current hypothesis of climatic change, the question that studies this work is the increase of the vulnerability and exhibition, opposite to the idea of a possible increase of events of flood, which really do not demonstrate a trend to the rise in the last years.

Key words: flood risk, vulnerability, land management, soil and spatial planning legislation, occupation of riverbeds

La catástrofe de Biescas, en agosto de 1996, ocurrida en el contexto de del pensamiento ambiental denominado "cambio global", esto es, en plena efervescencia de la hipótesis de cambio climático por efecto invernadero y sus efectos derivados, inauguró un debate social sobre la posible repercusión de dicho "cambio" en el incremento de los propios episodios de lluvia torrencial con efecto de inundación y el mismo aumento de los fallecimientos vinculados a estos eventos.

Pero, realmente, ¿se producen más episodios de inundación durante los últimos años en España y, en relación con ello una mayor pérdida de vidas humanas?, o ¿se trata de un efecto relacionado con la mayor presencia de estas cuestiones ambientales en los medios de comunicación?.

Al analizar la hipótesis de trabajo señalada (¿más inundaciones o más riesgo?) nos damos cuenta de que estamos, en definitiva, ante dos posturas en el análisis del peligro de inundaciones manifestadas en España durante los últimos años. Por una parte, la postura que presenta "la naturaleza como problema", según la cual se estarían produciendo más episodios de inundación, que son fruto de la "imprevisibilidad", esto es, del azar de la propia naturaleza y ello traería como consecuencia la génesis de mayores desastres. En síntesis, la Naturaleza se presenta como algo perverso para el ser humano. Por otra, la postura que defiende el protagonismo del ser humano como "hacedor" del efectos catastróficos de los episodios de lluvia extraordinarios –que podemos denominar como postura "ético-territorial"- según la cual, en virtud del análisis de la realidad territorial de cada espacio geográfico a partir del trabajo de campo señalaría que el riesgo ante episodios de inundación se habría incrementado, sobremanera, en amplias zonas del territorio español en los últimos lustros merced a la plasmación territorial de actuaciones humanas poco acordes con los rasgos del medio y ello habría provocado un aumento de la vulnerabilidad de las poblaciones asentadas en territorios de riesgo (vid. cuadro adjunto).

Elaboración propia

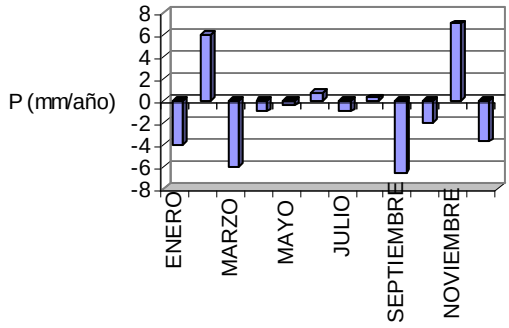
En primer lugar, debe señalarse la dificultad de confirmación, en su caso, del incremento de episodios de lluvia torrencial durante los últimos decenios en España. No se ha efectuado ningún análisis oficial, de escala estatal, sobre la cuestión, y son escasísimos los estudios regionales sobre el tema. Es preciso recordar la dificultad de obtener datos de intensidad horaria de las precipitaciones que son los realmente importantes en este caso. Las estaciones meteorológicas españolas, salvo las de 1º orden, no disponen de este instrumental y, en su defecto, se maneja la cifra de precipitación recogida en 24 horas sobre una localidad determinada. No obstante, pueden señalarse algunas referencias significativas sobre esta cuestión.

Así, por ejemplo, Quereda et alt. (2000) en su investigación sobre validación de los supuestos del cambio climático por efecto invernadero en las tierras del Levante y Sureste ibérico –las más castigadas de España por los episodios de inundación torrencial- , señala, de entrada, que no hay tendencias significativas sobre incremento o descenso de lluvias en dicho espacio geográfico[1]. Además, si se comparan los datos de precipitación mensual de los observatorios de Barcelona, Tortosa, Castellón, Valencia, Alicante, Murcia, Mahón, Palma, Gibraltar y San Fernando, registrados en el período 1961-94, en relación con los anotados en el período internacional 1931-60, se observa un ligero decrecimiento de precipitaciones en los meses de septiembre y octubre, lo que

[1] Vid. QUEREDA SALA, J.J. et alii (2000) "La evolución de las precipitaciones en la cuenca occidental del Mediterráneo: ¿tendencia o ciclos?, *Investigaciones Geográficas* nº 24, Instituto Universitario de Geografía, Universidad de Alicante, Alicante, pp. 17-35.

puede llevar a pensar que han sido menores los sucesos de torrencialidad pluviométrica desarrollados en este intervalo bimensual que, a efectos de potencialidad de génesis de episodios de lluvia torrencial, son los que ocupan lugar prioritario (vid. gráfico adjunto).

DIFERENCIAS MENSUALES DE PRECIPITACIÓN ENTRE LOS PERÍODOS 1961-94 y 1931-60 EN LA FACHADA MEDITERRÁNEA PENINSULAR



Fuente:Quereda et alii (2000)

De todos modos, debe señalarse que el desarrollo más o menos frecuente de episodios en un decenio no es significativo de las consecuencias en mayor o menor medida catastróficas que se asocian a esos eventos. Un solo episodio puede suponer efectos más desastrosos en un territorio que una relación más amplia de sucesos ocurridas en toda una década.

Así, pues, conviene, en esta cuestión recordar, desde la geografía, la necesidad de la consulta de los datos históricos (fuentes documentales, noticias de prensa escrita) para valorar, en su justa medida, el alcance de los episodios atmosféricos de rango extraordinario contemporáneos. Sólo a partir del estudio de datos históricos relativos a inundaciones (o sequías) en un determinado territorio, es posible situar en su punto exacto la frecuencia real de desarrollo de un peligro climático en dicho espacio geográfico.

Se puede concluir que en España, hasta el momento presente, no se observa ninguna tendencia al incremento de lluvias torrenciales con efectos de inundación durante los últimos años.

En relación a la segunda parte del supuesto señalado (el posible incremento de las víctimas causadas por los episodios de inundación) los resultados son más concluyentes.

En el último lustro de la década de 1990, se han producido varias inundaciones de efectos catastróficos en España que han sacudido a la opinión pública. En agosto de 1995, mueren 10 personas en Yebra y Almoguera (Guadalajara); en agosto de 1996, 87 personas perdieron la vida a consecuencia de la avenida torrencial del barranco de Arás

que destruye el camping Las Nieves en Biescas (Huesca); en septiembre de 1997, otras tres víctimas en la ciudad de Alicante; ese mismo año, en noviembre, 22 personas perdieron la vida al inundarse el barrio del Cerro de Reyes en Badajoz. Como se ha señalado, las inundaciones han producido en el decenio de los años noventa del siglo XX una media de 20 víctimas mortales anuales y unos 210 millones de euros (35.000 millones de pesetas) anuales, el 0,03 % del PIB, cubiertos en su mayor parte por el Consorcio de Compensación de Seguros, los Seguros Agrarios y las declaraciones de Zona Catastrófica. Ahora bien, desde la década de 1970, las víctimas por inundaciones no han dejado de disminuir, fruto probablemente de la disminución de infraviviendas y las cuantiosas inversiones en obra pública para su mitigación.

La inundaciones reseñadas, así como las inundaciones más severas a nivel humano de los últimos cuarenta años, la de septiembre de 1962 en la cuenca del Besós (Barcelona), con casi 800 muertos, la de octubre de 1973 en Granada-Almería-Murcia con casi 300, la de octubre de 1982 –pantanada de Tous- con 38 fallecidos, las inundaciones en el País Vasco de agosto de 1983 con 40 muertos, o los episodios ocurridos entre septiembre y noviembre de 1989 en la fachada mediterránea española con 42 muertos, tienen una característica común, la de ser *inundaciones-relámpago*, inundaciones torrenciales, en cuencas hidrográficas medianas y pequeñas.

En los últimos lustros se ha registrado un incremento en el volumen de pérdidas económicas vinculadas a los episodios atmosféricos de rango extraordinario. Realmente ello es así. Y no es, sino el reflejo del propio aumento del nivel de vida de las sociedades occidentales. En efecto, la mejora de las condiciones económicas de una sociedad conlleva prácticas “de riesgo”: necesidad de suelo para su urbanización en las ciudades, construcción de costosas infraestructuras, prácticas agrarias que buscan especiales condiciones del medio, entre otras.

El territorio se convierte en un escenario de actuaciones que, en la búsqueda del progreso colectivo, no valoran, en más ocasiones de las deseables, la exposición de personas, bienes y servicios al riesgo. De manera que no es necesario un aumento significativo del numero de episodios de lluvia torrencial o de temporales de viento, en su caso, para que se incrementen las pérdidas económicas con ocasión de su desarrollo en un territorio de riesgo.

En caso de las inundaciones resulta significativo al respecto. Y ello debido a la “litoralización” de la actividad económica y urbanística vivida en los últimos lustros en algunas áreas de la superficie terrestre. En este sentido, el litoral mediterráneo es uno de los ejemplos más llamativos.

El último informe sobre el estado del medio ambiente en territorio europeo, publicado por la Agencia Europea de Medio Ambiente (“*Señales medioambientales 2004*”), se pone de manifiesto que en la década de los años noventa del siglo XX la superficie edificada de Europa ha crecido un 22 %, y este hecho es muy evidente en algunos ejes de crecimiento económico europeo como el mediterráneo. El reciente informe de dicho organismo sobre “*El cambio climático y las inundaciones fluviales en Europa*”, hace constar la importancia de la acción humana en la génesis del riesgo de inundaciones en el territorio europeo; así, se indica que “la actividad humana también desempeña un papel, es decir, la deforestación en las regiones montañosas acelera el fenómeno de la escorrentía, lo que contribuye a un aumento del riesgo de inundación. Además, es probable que mediante el desarrollo urbanístico en lo que antes eran llanuras de inundación aumente la magnitud de las consecuencias negativas de los

episodios de inundación en determinadas zonas, contribuyendo al riesgo de inundaciones río abajo debido a la 'canalización' de los ríos". (EEA Briefing 01, 2005).

Tan sólo en el sector español del Arco Mediterráneo, en el período 1992-2000, se han construido más de un millón doscientas mil nuevas viviendas residenciales con lo que ello supone de ocupación, a veces, de terrenos poco aptos para la urbanización y necesidad de dotación ulterior de agua potable. Sirva también el dato de que, en el conjunto de España, durante el decenio de los años noventa seis de los diez municipios con mayor volumen de viviendas visadas en relación con la población censada en 1991 están situados en el litoral mediterráneo, correspondiendo los tres primeros lugares del *ranking* a las localidades de Torrevieja, Guardamar del Segura y Salou (Ministerio de Fomento, 2001). Además entre los 55 municipios con mayor número de viviendas visadas en el período 1992-2000 en relación con la población existente en ellos en 1991, un total de 38 son municipios situados en primera línea de costa. Y esto en muchas ocasiones ha tenido lugar a partir de la ocupación de áreas de poco adecuadas para la instalación de viviendas y población. El desconocimiento, en el mejor de los casos, o la imprudencia por afán de enriquecimiento, en más ocasiones de lo racionalmente creíble, supone implantación de usos (urbano, turístico, industrial) en el territorio, poco acordes con los rasgos que presenta su medio físico.

El ritmo experimentado por la construcción de viviendas residenciales en España ha sido espectacular. El parque de viviendas en 1991 se elevaba a 17,2 millones de unidades residenciales, casi tres millones más que en 1981 (14,7 mill.), después de crecer 3 y 4 millones de unidades respectivamente durante los años sesenta y setenta[2]. Pues bien, en 2001 el número de unidades de viviendas residencial en España suma 21 millones y rebasaba los 23 millones en 2005.

Tan sólo entre 1996 y 2005 se han visado 4.342.414 viviendas, lo que sitúa la cifra de nueva edificación en los valores más elevados del denominado " boom" de la vivienda vivido en España en la década de los años setenta. Y el ritmo se ha mantenido sin grandes alteraciones en estos primeros años del siglo actual. Antes al contrario, lo que parecían signos de desaceleración entre 2002 y 2003, en virtud de las cifras de visados de obra expedidos, se ha resuelto con un nuevo empuje del sector de la construcción en 2004 y 2005, con nuevas cifras que sitúan a España a la cabeza de Europa por este concepto. (vid. Figura 1.)

[2] Vid. TALTAVULL DE LA PAZ, P. (2001) *Economía de la Construcción*. Edit. Civitas, Madrid, 245 pp.

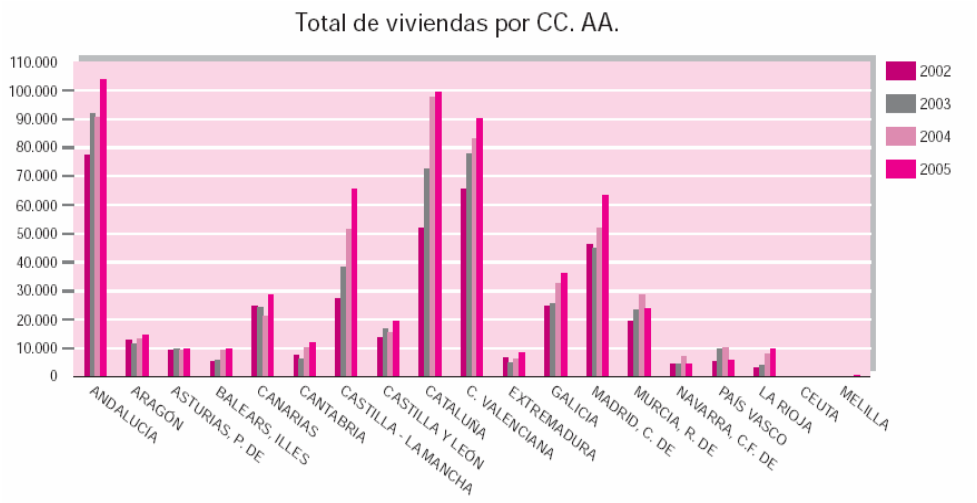


Fig. 1. *Edificación de viviendas en España (2000-2003). Fuente: Estadística de Edificación y Vivienda. Licencias municipales de obra (2000-2005). Ministerio de Fomento.*

En el conjunto del territorio nacional, al margen de la capital madrileña, el gran foco de actividad de la construcción residencial se ha situado en la fachada mediterránea, como se observa en el gráfico adjunto. Algunos datos resultan ilustrativos para explicar este proceso. De entrada, más del 50% de la nueva edificación residencial de la última década ha tenido ocasión en la fachada mediterránea española. Y en los últimos años, este porcentaje ha subido casi al 60% (vid. figura adjunta).

Resulta sorprendente la actividad de la construcción de viviendas residenciales en la provincia de Alicante durante los últimos años que se sitúa en el tercer puesto del ranking nacional tras las de Madrid y Barcelona, por encima de provincias de mayor entidad de población (población de derecho) como Valencia o Málaga, en la propia fachada mediterránea española, o de Sevilla. En esta provincia se mantienen ritmos de construcción de 12.000 nuevas viviendas de uso residencial al año.

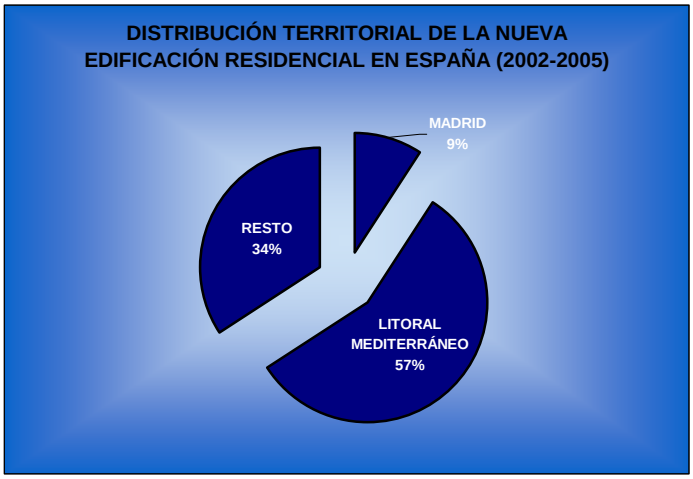


Fig. 2. *Visados de vivienda en España (2002-2005). Fuente: Anuario Estadístico 2005, Ministerio de Fomento*

Junto al litoral mediterráneo resulta muy destacada la actividad de la construcción de viviendas residenciales que se ha llevado en estos últimos años en el archipiélago canario, donde se mantienen ritmos de edificación de 8.000 nuevas viviendas al año, lo que sitúa a esta región en los primeros puestos del Estado por actividad edificatoria residencial. Ello puede explicar, entre otros factores, el aumento de la vulnerabilidad experimentado, asimismo, en las islas de Tenerife y Gran Canaria, donde se han ocupado laderas y abanicos aluviales de desembocadura de barrancos.

Y el ritmo de crecimiento inmobiliario no parece que vaya a reducirse en los próximos años. En relación con la demanda de viviendas para europeos la Asociación de Promotores Inmobiliarios de la provincia de Valencia maneja un estudio según el cual hay una demanda potencial de 800.000 familias alemanas que piensa finar su residencia en la zona litoral de la Comunidad Valenciana. Manejando una media optimista de 2 miembros por familia, estamos hablando de 1,6 millones de personas –sólo de un país europeo- que en los próximos años tendría previsto instalarse en el litoral valenciano. Con horizonte 2015 y a tenor del comportamiento que ha experimentado el sector de la construcción en los últimos años, es posible esperar un incremento de 1,8 millones de viviendas tan sólo en la franja litoral (primera y segunda línea) de la Comunidad Valenciana. Y el mayor dinamismo de la construcción urbano-turística se desplaza ahora a la región de Murcia y el litoral de Almería, que hasta hace unos años habían quedado un tanto al margen de este frenético proceso.

Entre las causas que ayudan a entender la magnitud del fenómeno está la propia liberalización del proceso urbanizador experimentado con la aprobación de la Ley estatal del Suelo de 1998 y de algunas leyes autonómicas del suelo en el ámbito mediterráneo, particularmente la polémica Ley Reguladora de la Actividad Urbanística de la Comunidad Valenciana (1994, derogada por Ley 16/2005, Urbanística Valenciana). La propia política de captación de fondos por parte de los Ayuntamientos a partir de los ingresos procedentes de las licencias de construcción se ha convertido en práctica, irracionalmente, regular en muchos municipios españoles. Este último proceso está llevando a la puesta en marcha de procesos de revisión del planeamiento municipal a fin

de “crear” suelo apto para la urbanización; en una visión cegada por el ingreso a corto plazo que ignora las repercusiones socio-territoriales y ambientales que ello va a tener a medio y largo plazo. En algunos municipios del litoral mediterráneo español (p.e. Torrevieja) la promoción de suelo para su urbanización ha agotado, prácticamente, este recurso en apenas 15 años.

La demanda de viviendas para residencia de inmigrantes europeos es creciente en el litoral mediterráneo español. Se trata de un grupo poblacional en aumento constante durante los últimos años que encuentra en las condiciones climáticas invernales de las tierras del mediterráneo español la justificación principal para la adquisición de viviendas cuyo precio resulta muy asequible en contrastes con los existentes en sus países de origen. Este aspecto reviste sumo interés para el tema de estudio que nos ocupa (riesgo de inundaciones), puesto que, en no pocas ocasiones, el comprador extranjero de una vivienda no es consciente –no tiene porque serlo- del peligro que supone la adquisición de unidades residenciales situadas junto a cauces de ramblas y barrancos ya que, de entrada, desconoce los rasgos del medio físico del territorio donde se ubica dicha vivienda. Se está, en definitiva, jugando, con mayor o menor intención, con el desconocimiento de los rasgos geográficos del territorio de acogida por parte del comprador europeo.

Y a ello se une otro factor de coyuntura económica cual es las condiciones ventajosas que ofrecen los prestamos hipotecarios en los cinco últimos años para los potenciales compradores. En efecto el tipo de interés medio para préstamos hipotecarios en España ha pasado del 16,6 % en diciembre de 1990 al 4,2 % a mediados de 2006, co valores mínimos del 3,19 en agosto de 2005. La vivienda se ha convertido, en los últimos lustros, en un objeto de inversión frente a depósitos a plazo y los propios fondos de inversión; y ello porque frente al reducido interés que se oferta en los últimos años para las imposiciones a plazo fijo y las fluctuaciones del propio mercado.

Como resultado de estos procesos de expansión del casalicio, la propia evolución urbana de una ciudad puede explicarse, en muchos casos, como la sucesiva integración en su callejero de cursos fluviales y, por ende, el incremento progresivo del riesgo de inundación, cuando no se han calculado los efectos que tal “invasión” puede suponer. En el litoral mediterráneo español proliferan los ejemplos de incorporación de cauces fluviales (rieras, ramblas, barrancos) al plano urbano. Ello eleva el grado de exposición de las poblaciones residentes y, en última instancia, la propia vulnerabilidad de las sociedades allí ubicadas. Por tanto, no es una cuestión de aumento de la peligrosidad –todavía no demostrado- sino de incremento de la vulnerabilidad y la exposición ante el peligro de las inundaciones que, -en este caso sí-, se ha convertido en la causa principal del aumento del riesgo frente a las inundaciones en España durante los últimos decenios. No es aventurado afirmar, sino todo lo contrario, que en conjunto del territorio español, y en especial, en las tres áreas señaladas (País Vasco, archipiélago canario y, sobre todo, litoral mediterráneo, el riesgo frente a las inundaciones es mayor a comienzos del siglo XXI que veinte años atrás.

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CREŞTEREA RISCULUI DE INUNDAȚII ÎN SPANIA: OCUPAREA ANTROPICĂ A TERITORIILOR CU RISC

(Rezumat)

În ultimii 20 de ani a avut loc o creştere a riscului de inundații în multe arii ale litoralului Spaniol. Creşterea parcului imobiliar de pe litoral s-a produs, în diferite ocazii, pe arii cu risc de inundații în ciuda existenței legislației (privind sol şi apă), care a priori împiedică ocuparea spațiilor amintite. În contextul ipotezei actuale a schimbărilor climatice, problema abordată în această lucrare este creşterea vulnerabilității şi a expunerii în fața pericolului de inundații.

Această idee este confundată cu cea a creşterii numărului de inundații, însă, tendință care nu este dovedită în ultimii ani.

Indiferent de ipoteza de pornire, se poate concluziona că în prezent, în aceşti ani de început ai secolului XXI, riscul de inundații pe teritoriul spaniol şi în special în ariile Pais, Vasco, Arhipelagul Canare, Litoralul mediteranean) este mai mare decât cu 20 de ani în urmă.

TECHNOLOGICAL RISKS MANAGEMENT IN THE CONTEXT OF POLLUTION PREVENTION – CASE STUDIES

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Abstract: Technological risks management in the context of pollution prevention – Case Studies. The main European regulations translated at national level in the member states and in almost all candidate countries regarding environmental security management are: Directive 96/61/EC (Integrated Pollution Prevention and Control - IPPC) and the Seveso II Directive (96/82/EC). The Seveso Directives have a complex character, concerning the assurance of prevention, preparedness, and emergency response, recovery and rehabilitation measures in the areas affected by a major industrial accident. The lessons learned have a major importance in improving the policies and measures for minimizing the consequences of similar major industrial accidents with possibility of occurrence in the future. Significant case studies have been chosen to emphasize the technological impact on the environment in Romania.

Key words: *risk assessment, technological disaster, Seveso, pollution prevention*

INTRODUCTION

The significance of promoting technological disasters' efforts at international, regional and national level has been recognized in South-East Europe and it represents a priority for the international organisations. Environmental safety in this area represents a major step in assuring and maintaining the stability in the region and in promoting sustainable development. For consolidating the community's coping capacity, measures and policies for disasters' prevention and reduction are needed. Thus, many training programmes and projects in the field of disaster prevention and emergency situations management are developed in this region. Some of these programmes are developed and implemented by the Disaster Preparedness and Prevention Initiative – DPPI, within the Stability Pact for South-East Europe (www.srv.se/templates/SRSA_Page____21080.aspx), in cooperation with several international organisations. These programmes are aimed at developing, disseminate and use the best available techniques, at learning from the previous lesson and at building connections between the academic field, researchers and experts.

Another initiative in the field of risk reduction and technological disaster prevention is the Environment and Security Initiative – ENVSEC within NATO (www.envsec.org). This initiative deals with the environmental issues that threaten the society's security, stability and wealthfare, human health or the sustainable development in the region.

Disaster management must be implemented by using the Action Plan for the period 2005 – 2015, established at the World Conference on Disaster Reduction, Hyogo, Japan, January 2005 (www.unisdr.org/wcdr). The major priority of this action plan represents the reduction of the disaster risk and of the associated vulnerability. There is a need to create joining mechanisms for programmes development, to implement the best practices and to learn based on previous experiences, by involving all the stakeholders.

The planned result is the significant reduction of losses caused by disasters, quantified in human lives, social, economic and environmental goods.

Within this framework, of risks prevention and reduction, a significant objective of the sustainable development strategy represents the technological risks reduction, in the context of global economy. The development of the processing industry uses the natural resources as raw materials and leads to the improvement of the other industries' infrastructure. The chemical industry plays a key role within the industrial activities through the numerous products produced. An important part of the population sees chemical processes as the causes for major environmental and human disaster, which does not correspond to reality.

Due to the operating conditions complexity, a possibility of major industrial accidents occurrence exists permanently. In the literature, the accidents from Seveso (1976), Flixborough (1974), Bhopal (1984), Baia-Mare (2000) are "classical", due to the major environmental and human impact. A person's existence and activity is permanently marked by the interaction between the environmental he lives and works. It is obvious that the technological impact on the environment represents one of the main issues the mankind is faced with. This solution for this problem must be found in the "sustainable growth and development" concept, as well as in the technological disasters' prevention and reduction.

SOME ASPECTS REGARDING TECHNOLOGICAL RISKS MANAGEMENT AT INTERNATIONAL LEVEL

The main European regulations implemented at national level within the member countries and within the majority of candidate countries regarding environmental safety management are the 96/61/EC Directive (Integrated Pollution Prevention and Control-IPPC) and the Seveso II Directive (96/82/EC - www.mahbsrv.jrc.it/Framework-Seveso2-LEG-EN.html). The mining industrial accidents have lead to the amendment of the Seveso II European Directive (96/82/EC) in 2003. By the continuous preoccupation of the decision factors the Seveso III Directive (2003/105/EC Directive - www.mahbsrv.jrc.it/Framework-Seveso2-Annex3.html) appeared. Seveso Directives have a complex character in what concerns the prevention, preparedness, and emergency response, recovery and rehabilitation actions in the regions affected by major industrial accidents.

At the level of the international organizations there are programmes dedicated to specific activities development. Such an important programme is Awareness and Preparedness for Emergencies at Local Level - APELL (www.uneptie.org/pc/apell**)**, developed by UNEP, in cooperation with other partners. The APELL Programme, which operates worldwide for 17 years under the aegis of UNEP, stipulates distinct support guidelines for actions involving authorities, economic agents, local communities and NGOs, to ensure environmental safety and promote sustainable development by: ► mitigation of the occurrence frequency of natural catastrophes and technological accidents affecting the environment; ►improving the individual capacities to ensure the environmental management and emergency response; ►initiating the risks mitigation measures and preparedness activities coordination regarding industrial risks; ►identifying risks and raising awareness within the industrialized communities; ►involving the authorities, from local level to developing intergovernmental relationships, regarding transboundary environmental risks; ►implementing the regional policies on community level and ensuring the information flow for all the stakeholders.

APELL is recognized as the main process or tool for achieving adequate awareness and preparedness. Disaster management must be considered also through

the Action Plan for the period 2005 – 2015, established by the World Conference with the topic of Disaster Reduction (18-22 January 2005, Hyogo, Kobe, Japan). This document served as work frame for the 6th meeting of Advisory Group for Environmental Emergencies - AGEE (www.ochaonline.un.org), which took place in Geneva, Switzerland. The major interest of this action framework is represented by disaster risk mitigation and of the associated vulnerabilities. It pursues the development of some participant mechanisms for the elaboration of programmes, the implementation of best available practices and learning based on previous experiences, by involving all the stakeholders.

The foreseen result of an efficient disaster management is substantial mitigation of the caused losses, quantified in human lives, social, economic and environmental assets. The strategic objectives include: ►integrating disaster risk mitigation in the policies and planning of sustainable development; ►developing and optimizing the hazard resistance abilities of institutions and mechanisms; ►the systematic incorporation of the risk reduction approaches in implementing the emergency preparedness, response and recovery programmes.

There have been outlined the action priorities for the factors involved (states, organizations, regional and international institutions, including the United Nations systems and the International Financial Institutions): **1.** Ensuring disaster risk reducing as a national and local priority that would benefit of a solid institutional basis for implementation; **2.** Identify, evaluate and monitor disaster risk and intensify early warning; **3.** Use knowledge, innovation and education in order to develop a safety and resistance culture at all levels; **4.** Risk factors mitigation; **5.** Optimizing disaster preparedness for an efficient response on all levels.

In order to achieve these objectives and act to attain the priorities proposed by this Action Plan, certain objectives have been identified to ensure their implementation and completion by the states, regional and international organizations involved, by a close cooperation with the civil society. Implementation of this Action Plan is to be assisted by the partners of International Strategy for Disaster Reduction – ISDR (International Strategy for Disaster Reduction, www.unisdr.org). There has been emphasized the need to implement a programme to enhance the capacities of nations and communities to deal with disasters - HFA (Building the Resilience of Nations and Communities to Disasters, www.eldis.org/static/DOC17574.htm).

The lessons learned from preceding incidents are very important in improving the policies and actions to diminish the consequences of similar future incidents. Accordingly, a special attention should be paid to the efficient dissemination, implementation and completion process of the lessons learned. In this context, APELL keeps disseminating information efficiently, offers useful tools for local level awareness and preparedness and supports the development of the prevention policies. Excellent examples are given by the coherent prevention policies in Central and South America, while the National APELL Center in India represents a model for other countries and regions. APELL is also an important tool for industrialized countries. An eloquent example is the Normandy region in France, where APELL is used for a better communication in the context of industrial and natural accident prevention, in compliance with the Seveso Directive.

At national level, the APELL programmes are implemented through workshops and seminars, which bring forth to the stakeholders the APELL issues. The first guide, APELL for Mining was launched in Romania in 2006 and the editing of other guides is expected in the future.

There are methodologies developed and implemented at European level, which Romania will also implement as a result of the Romanian adhesion process to the European Union. Thus, the specific regulation can also be found at national level and represent the basis for the entire environmental impact assessment study. The priorities in the legislation approaches are those related to the technological activities with a major accident potential, involving dangerous substances (Government Decision no 95/2003, Seveso II Directive equivalent).

In Romania, The Seveso II Directive was translated by Governmental Decision 95/2003, brought into practice in August 2003. The Seveso II Directive establishes two risks classes (major and minor) for the industrial units which use or store dangerous substances. In Romania, there are 333 industrial establishments which are covered by this directive (245 in the major risk category and 88 in the minor risk category) (Fig. 1).

The main national regulations used in the field of technological risks management are: GD 918/2002 regarding the framework procedure for environmental impact assessment and for approving the public or private projects' lists covered by this procedure; Ministry Ordinance MO 860/2002 for the approval of the procedure for environmental impact assessment and for environmental permit issuance (with MO 210/2004); MO 863/2002 regarding the approval of methodological guides for the steps in the framework procedure for the environmental impact assessment; Emergency Government Ordinance 152/10.11.2005 regarding the pollution prevention, mitigation and integrated control.

Risk assessment methodology

The following questions are important in risk assessment studies:

- Which are the weaknesses in the security system? What does not work?
- Which are the prevention actions that could control the risk?
- In which ways are these actions monitored?
- How should the outputs be used for results and trends assessment, with the aim to determine whether the company does the things that should be done, it does them well and achieves the objectives and targets?

Thus, reference indicators to be used at different levels are needed. It is obvious that the risk can not be reduced to zero. Due to this fact, the limit which people can endure is very important.

Accident prevention thorough risk analysis implies a specific activity starting from the design stage, by applying qualitative and quantitative techniques and methods based on existing data and systematic, creative and imaginative actions.

Qualitative analysis has as main objective establishing the possible hazards and eases the events' ranking in risk order and represents the first step in risk quantitative assessment studies.

Hazard identification techniques (qualitative analysis) – for finding the hazards in the process – and the hazard assessment techniques (quantitative analysis) – are often mixed.

The following general components can be summarized:

- For hazard identification: their presence; observing the process; check lists; Hazard and Operability Study (Hazop).
- For hazard assessment: their presence; previous experience; practice codes, Hazard Analysis (Hazan).

The applying order, from qualitative to quantitative analysis is obvious. Which are the main differences between these techniques?

Table 1

Differences between Hazop and Hazan (Ozunu, 2000)

HAZOP	HAZAN
Identifies hazards Preferred technique for each project Qualitative Team work Also named “What if?”	Hazards assessment Selective technique: is used especially to systems exposed to major accidents Quantitative Realized by one or two experts Also called: -Risk analysis -Risk assessment -Risk probabilistic assessment -Quantitative risk assessment

CASE STUDIES

Ocnele Mari

Salt exploitation by the dissolution method in the Ocnele Mari region can lead in time to the occurrence of a major disaster. This is highlighted by the signs similar to those which preceded the event in September 2001, which occurred also in other residential areas of the Ocnele Mari town, where the wells are also located immediately near the houses.

Main types of risks identified in this perimeter are:

- **Risk of chemical pollution with isolating fluid and brine**, due to the wells loss of containment and to the pipes for the transport of the technological fluids in the wells field.
- **Risk of dissolution holes collapse** with the overflow of significant brine quantities, exploited in the well field.
- **The landslide risk in the well fields II and III Ţeica**, where the existing collapse cone and the relief energy represent, together with the lithologic structure of the slope, determinant factors in developing instabilities.

There are exposed directly or indirectly to risks of collapse and chemical pollution: population, as well as its mobile and real assets; the productive capacities: industrial platforms, electrical plant; roads; natural environment: agricultural lands, water courses.

The collapse in September 2001 had a major destructive effect upon population of the Ocnele Mari town and upon human settlements in the sectors close to the II Ţeica well field. In the influence area of the collapse cone there were 113 households which are at present decommissioned and the inhabitants were relocated.

In case of the other well field, for several structures situated within the limits of the wells field and in their area of influence, there are signalled damage phenomena due to vertical (compaction) of horizontal (local landslides) displacements.

The grouped location of the wells within the fields has lead to the impossibility of controlling the dissolution process. Thus, it is not possible to accomplish the designed dimensions for the dissolution holes and the elements of the resistance structures (pillars

and cave floors). Under the conditions of some complex stratigraphical structures and the advanced degree of deposit (faults), the ecologic impact phenomena have occurred under the form of brine springs both to the surface and in the aquifer structures from the salt roof.

For the prevention and mitigation of negative effects that the impact of solution salt exploitation activities have within the Ocnele Mari wells field, it is recommended a monitoring programme and a set of prevention measures, presented within the Disaster Prevention Plan, as follows:

- monitoring of the production parameters;
- monitoring of environmental factors, in general and of the human settlements in particular. In this respect, it is recommended the monitoring of the damaged structures. In case the micro-seismic monitoring of the controlled collapse process of the SOCON cave has good results, it is recommended that this monitoring system is established also for the other well fields;
- monitoring of the convergence of dissolution holes and of its effects upon the surface by an appropriate markers system.

Baia – Mare

The Maramureş mining basin is one of the main mining areas in Romania, where the exploitation activities of the useful mineral substances and the metals processing techniques dates back to hundreds of years and have evolved together with the changes which marked the development of the human community in this region.

The most frequently used method for the opening of metalliferous deposits was that of the coast galleries. The opening with combined methods, which is the coast gallery and blind pit is the practical generalized method, as it meets the advantages of the coast gallery advantages and allows the opening of in depth deposits. The Şuior deposit was open by coast galleries located at different levels, with separated surface precincts. The ores resulting from the mining activities are sent to the concentration stage, which, in the analyzed areas is performed by flotation; the cyanide method is the basis of gold extraction since 1889 and is applied both to low gold content ores and to the golden concentrates resulting from flotation.

The method was applied at SC Transgold Baia Mare, which used for the extraction of gold the Meda Tailings Dump. There are three stages which are considered to be sensitive in this process: ● transport of NaCN to the processing plant location; ● transport of the cyanide solution by pipes; ● storage of the residual cyanide solutions in open tailings dams.

The residual waters resulting from the process, with a high content of cyanides and heavy metals are transported by pipes to the Aurul dam.

The pollutants specific to the studied areas are in all the three aggregation states:

- - gaseous state: sulphur gases (SO_2 şi SO_3 in particular);
- - solid state: suspended powders (compounds of Pb, Cu, Zn, Cd, Mn, Fe), particulate matters, tailings grains resulting from the mining areas;
- - liquid state: soluble compounds of heavy metals.

The mining industry in the Maramureş region generates a significant pollution quantity emitted into the air, water and soil, as well as large quantities of tailings stockpiled in dumps and dams, as well as in water mines. In the neighbourhood of the Baia Mare municipality there are situated numerous tailings dumps and dams, which provide the polluting elements.

The technologic accident with cyanide in Baia Mare

On the 30.01.2000, at 22.00 hours has occurred a breach in the tailings dam of the tailings resulting from the gold extraction. The pond belonged to the Company Aurul S.A. from Baia Mare.

There were discharged approximately 100.000 m^3 of water containing cyanide (approx. 100 t) and suspension material, for 11 hours, contaminating rivers, flora and fauna with cyanide and heavy metals from the contaminated rivers.

Disaster management plans of the former Aurul Co. before and after the accident

Before the accident, the disaster management plan of Aurul Co. Baia-Mare (including awareness and preparedness) was a short version not in Seveso Directives II context. There were: no safety studies; no safety training; no third party control on safety; insufficient attention to safety design.

The DMP after the accident (2002), entitled "*The plan of prevention and mitigation of accidental pollution for Aurul plant and Aurul dam",* considers important issues:

- a general introduction about the enterprise, production, and technology.
- a prevention plan for accidental pollution by
  - identification of industrial water sources
  - outlining actions to be taken
  - nominating a team to take charge of accidental pollution
- a compilation of a list of critical hazard zones
- the importance of describing the type of pollution
- tabling measures for prevention including aims, responsibilities and terms
- the provision of equipment lists
- the provision of adequate training programs
- outlining the chain of command including details of responsibilities
- listing stakeholders to facilitate a co-ordinated response
- a list of water resources outside the pollution hazard zone.

There is a framework plan of pollution prevention for 2001 which includes pollution mitigation, a list of restricted areas, and annexes (plant layout/plant site, piping layout/Săsar tailings dam piping, piping layout/overall plan).

Among the shortcomings of the DMP (2002) are: missing safety studies; missing satey training; missing safety reports (the risk assessment using a formal failure mode and effects methodologies such as HAZard and OPerability studies (HAZOP); an absence of failure scenarios for site-specific circumstances, such as: a release of hydrogen cyanide gas from cyanide storage or process facilities, transportation accidents, fires hazards and explosions, pipe and tank ruptures, power outages, pump failures.

From the accident was learnt:

- *From a legal perspective*, mining companies in Romania, in particular Aurul, must improve their DMP in the context of a new major accident prevention policy (MAPP) if they are to comply with new EU legislation; should sign the Cyanide Management Code; should consider the right-to-know of the public and the community.
- *From a technical perspective*, Aurul should consider an improved safety design (e.g. closed loop of CN wastewater circuit and no assumptions of extreme meteorological conditions in dam design); safety audit by a third party.

- *From the public health perspective*, Aurul should consider to support a local hospital in expertise in disaster medicine by networking within the International Poison Control Network

The most important effect of this incident was the reconsidering at the level of European Union Directorates involved, of the Seveso II Directive provisions amended by the introduction of some aspects specific to dams and mining activities, generating the newest regulations in the field, the Seveso III Directive.

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*** Ministry Ordinance 863/2002 regarding the approval of methodological guides for the steps in the framework procedure for the environmental impact assessment;

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MANAGEMENTUL RISCURILOR TEHNOLOGICE ÎN CONTEXTUL PREVENIRII POLUĂRII – STUDII DE CAZ

(Rezumat)

Dezvoltarea industriei şi intensificarea producţiei au condus inevitabil la creşterea cantităţilor de materiale şi substanţe periculoase folosite, fapt ce a avut ca şi consecinţe producerea unor accidente tehnologice majore.

Mai multe evenimente petrecute într-un interval scurt de timp au subliniat necesitatea dezvoltării de măsurii pentru situaţii de urgenţă legate de siguranţa amplasamentelor industriale. Pe plan internaţional, organizaţiile cu ce activează în acest domeniu dezvoltă proiecte de optimizare a managementului riscurilor tehnologice şi de prevenire a accidentelor industriale. Primele măsuri au fost destinate dezvoltării de programe prin intermediul cărora guvernele, în strânsă cooperare cu industria, să lucreze cu liderii locali pentru identificarea hazardurilor potenţiale ce ameninţă comunităţile şi să pregătească acţiuni care să răspundă şi să controleze urgenţele ce au impact asupra sănătăţii populaţiei, securităţii si mediului.

Principalele reglementări europene transpuse la nivel naţional în statele mebre şi în aproape toate ţările candidate referitoare la managementul securităţii de mediu sunt: Directiva 96/61/EC (Prevenirea şi Controlul Integrat al Poluării - IPPC) şi Directiva Seveso II (96/82/EC). Directivele Seveso au un caracter complex şi se referă la asigurarea măsurilor de prevenire, pregătire, răspuns la urgenţă, recuperare şi reabilitare în zonele afectate de producerea unui accident industrial major. În acest cadru sunt reglementate unitar activităţile legate de producţia, depozitarea, transportul, utilizarea sau deversarea unor substanţe periculoase, în vederea limitării consecinţelor pentru om şi mediu.

Lecţiile învăţate au o importanţă majoră în îmbunătăţirea politicilor şi măsurilor de reducere a consecinţelor unui accident similar cu probabilitate de producere în viitor. Provocarea majoră pentru industriile care prezintă risc tehnologic este reprezentată de crearea unei culturi de învăţare din lecţiile anterioare, dar şi de extragerea a cât mai multe informaţii din accidentele care se produc. Studiile de caz au fost alese pentru a accentua impactul tehnologic asupra mediului în România.

Figure captions

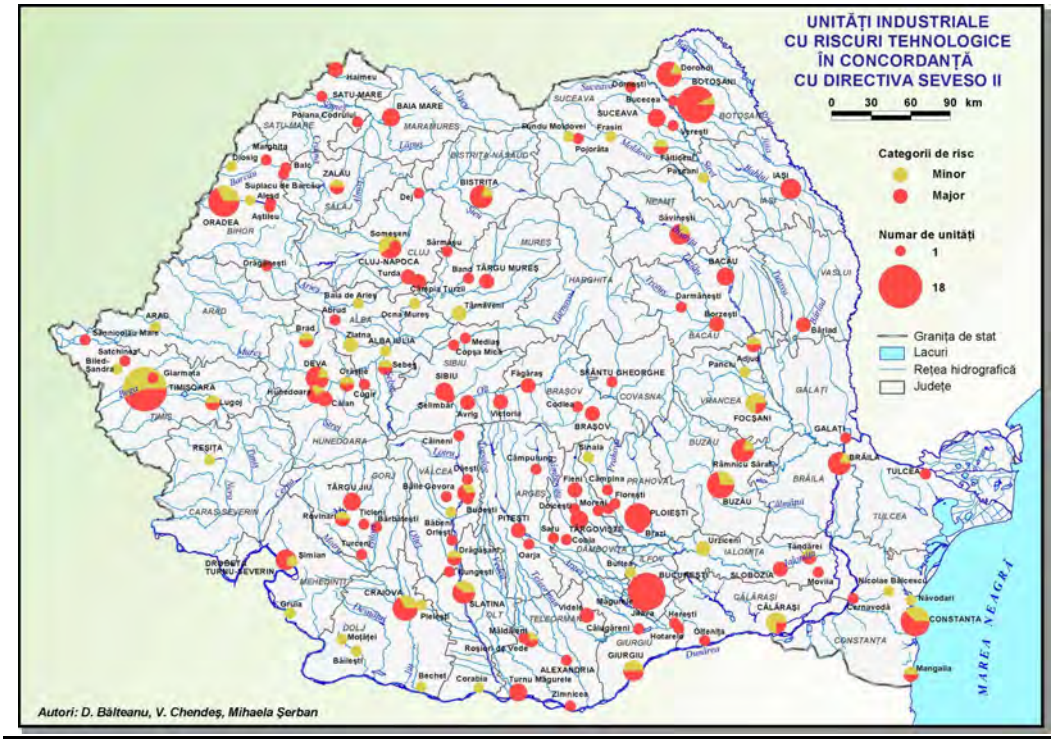

Fig. 1. *Industrial installations according to Seveso II Directive (Authors: D. Balteanu, V. Chendes, Mihaela Serban)*

Fig. 2. *Lake resulting from the collapse in Ocnele Mari (July 2004)*

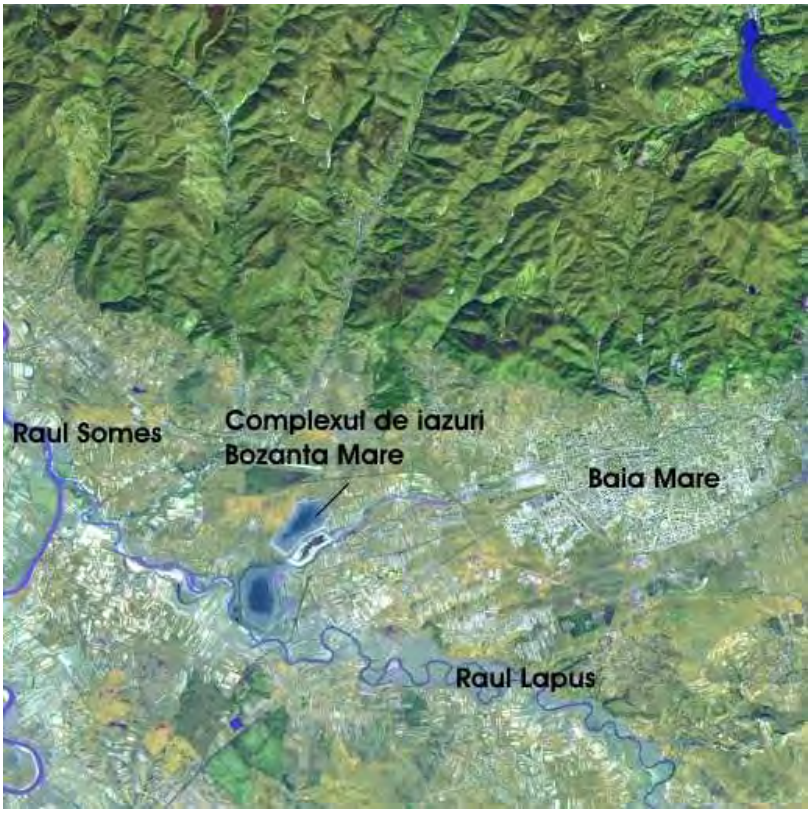

Fig. 3. *The dam complex in Bozânta Mare*

THE INVASIVE POTENTIAL OF THE EXOTIC GUPPYFISH (*POECILIA RETICULATA* PETERS 1859) IN TEMPERATE ZONE

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Abstract. **The invasive potential of the exotic guppyfish (*Poecilia reticulata* Peters 1859) in temperate zone.** The paper describes the guppyfish and treats the invasive potential of species in the temperate zone. The study is important due to production perspective of cryoresistant guppy strain as objective of research project CEEX 140/2006. Creation of the cryoresistant guppy strain has no invasive potential in the temperate zone, excepting thermal waters where the problem became serious in the last years. The contrast between the invasive potential of guppy in thermal waters and its incapacity of survival in the other waters indicate that guppy is euribiont from all points of view excepting coldwater tolerance.

Key words: *guppyfish, Poecilia reticulata, cryoresistant, temperate zone.*

DESCRIPTION OF THE SPECIES

Poecilia reticulata, the popular and widespread guppyfish, has been brought for the first time in Europe in 1860 by Robert John Lechmere Guppy (Bud 2002).

Origin and Distribution. The species originates from South America: Venezuela, Barbados, Trinidad, Northern Brazil and Guyanas. It was widely introduced and established elsewhere, mainly for mosquito control. Several countries report adverse ecological impact after introduction. Africa: feral populations reported from the coastal reaches of Natal rivers from Durban southwards, as well as in the Kuruman Eye and Otjikoto Lake in Namibia (www.fishbase.org). Europe: in countries having warm climate, or having thermal waters: Hungary, Romania (Băile Felix, Băile 1 Mai; Mag et al. 2005).

Taxonomy of Guppyfish. Family: Poeciliidae (Poeciliids); subfamily: Poeciliinae; order: Cyprinodontiformes (rivulines, killifishes and livebearers); class: Actinopterygii (ray-finned fishes).

Morphology. Dorsal spines (total): 0 - 0; dorsal soft rays (total): 7 - 8; anal spines: 0; anal soft rays: 8 – 10 (www.fishbase.org).

Biology and Environment. They occur in warm springs, their effluents, weedy ditches and canals. Found in various habitats, ranging from highly turbid water in ponds, canals and ditches at low elevations to pristine mountain streams at high elevations. Has a wide salinity range but requires fairly warm temperatures (23-24℃) and quiet vegetated water for survival. They feed on zooplankton, small insects, and detritus. Guppy is a benthopelagic, non-migratory, freshwater, brackish fish. pH range: 7 – 8; dH range: 9 – 19. Climate: tropical, 18 – 28℃; 14℃N - 2℃N, 67℃W - 52℃W. High, minimum population doubling time less than 15 months (tm=0.16-0.25; Fec=20-100 (20-40 in the wild) with multiple spawning per year). Female reaches 5 cm SL. Males mature at 2 months and females at 3 months of age. Not in IUCN Red List (www.fishbase.org).

Reproduction. The guppyfish is a species of livebearers with an internal fertilization of the eggs. In the case of this species, matings are not associated with

oviposition sites and they can occur at any place and any time. Embrionary development takes place into female's organism, being an ovoviviparous fish. Guppy males are smaller than guppy females and more colorful, the sexual dimorphism being observed at one-month age. The male's anal fin is turned into a copulatory organ (gonopodium) by modification of the third, fourth and fifth rays. This helps the male to introduce the sperm into the female's genital pore through a false and short accuplation, which makes the female to spawn for many times (even 6-7 times), every 4 weeks. After the accuplation, female stocks the sperms into *receptaculum seminis* for 5-6 months. Because of this particularity of reproduction, survival of a single female after unfavorable season can save the existence of the population. In this way, the nature substitutes the male when this is absent.

Importance of the Guppyfish. The guppyfish is a species of economical and commercial interest, having such an importance for the aquarium market, as also a model organism (physiology, endocrinology, carcinogenesis studies), in ecology (especially in behavioral ecology and sexual selection), ecotoxicology (as bioindicator), phylogeny (study of speciation phenomena, evolution of sex chromosomes in vertebrates, etc) and genetics research.

Guppy Genetics. Guppy males exhibit many various elaborate secondary sexual characters; several have been shown to be attractive to females: conspicuous coloration, especially bright orange and black spots, large caudal fins, large body size, and high courtship display rate (Farr 1980, Bischoff et al. 1985, Reynolds & Gross 1992, Nicoletto 1993, Endler & Houde 1995, Brooks & Endler 2001, Lindholm & Breden 2002). Color patterns, caudal fin size and shape, courtship rates, and a composite measure of attractiveness are primarily sex-linked in guppy. Both quantitative genetic and pedigree analyses indicate that most of the attractive male traits are not exclusively Y-linked (Winge 1927, Kirpichnikov 1981, Lindholm & Breden 2002). Many of these traits recombine between X and Y chromosomes, denoting a partial homology between the two guppy sex chromosomes.

In 2001, Traut & Winking found some cytological and molecular differentiation between the X and Y chromosomes in *Poecilia reticulata.* Only a half of the Y chromosome pairs with homologous regions of the X in synaptonemal complexes. Furthermore, the orientation of the chromosomes allowed for recombination in only 2 of 49 synaptonemal complexes observed. This fact indicates the fact that recombination is also greatly reduced in the pairing, homologous region. Comparative genomic hybridization reveals a large part of the nonpairing region of the Y chromosome that comprises male specific repetitive DNA. There is structural variation among Y chromosomes in this region (Traut & Winking 2001, Lindholm & Breden 2002). This fact agrees with results from an in situ hybridization study showing that Y chromosomes, but not X chromosomes, of some domesticated guppies carry large numbers of simple repetitive sequences (Nanda et al. 1990, Lindholm & Breden 2002). The X chromosome may have a region homologous to that of the nonrecombining region of the Y, but so far no genes have been shown to be exclusively linked to it. Two genes for color patterns that are on the X but are not known to recombine to the Y: *Lineatus* (Winge 1927, 1934) and *Nigrocaudatus* I (Nybelin 1947) are candidates for such a region.

There are a lot of patterns that can be both X and Y linked in guppy populations. In general, male X-linked traits exclusively express in males, but a few of them can express in both male and female organism. Of course, their expression is weak in females and their intensity cannot be compared with the fully expression of these traits in

guppy males. This is the situation of some phenotypic sexually selected traits as: *Nigrocaudatus* I (Nybelin 1947), *Nigrocaudatus* II (Dzwillo 1959, Nayudu 1979), *Flavus* (Winge & Ditlevsen 1947, Nayudu 1979), *Pigmentiert caudalis* (Dzwillo 1959, Schroder 1969, Nayudu 1979), red tail (Fernando & Phang 1990, Khoo et al. 1999), blue tail (Fernando & Phang 1990, Phang & Fernando 1991), green tail (Phang et al. 1989, Phang & Fernando 1991), variegated tail (Khoo et al. 1999), black caudal peduncle (Khoo et al 1999) and black tail (Petrescu & Mag 2006).

The autosomes, have many fewer genes for pigmentation and fin morphology. These autosomal genes which express, as well, in female are: blond, golden (Goodrich et al. 1944), blue (Dzwillo 1959), albino (Haskins & Haskins 1948), kalymma (Schroder 1969), suppressor (Schroder 1969) and elongated (Horn 1972). The Y-linked traits express in males only (as long as female has no Y chromosome).

A few described Y-linked traits are: *Maculatus* red (Schmidt 1920, Winge 1922, 1927, 1934, Winge & Ditlevsen 1938, 1947, Haskins & Haskins 1951, Haskins et al. 1970), *Oculatus* (Schmidt 1920, Winge 1927), *Armatus* (Blacher 1927, 1928, Winge 1927, Haskins et al. 1970), *Pauper* (Winge 1927, 1934, Winge & Ditlevsen 1938, 1947, Haskins et al. 1970), *Sanguineus* (Winge 1927), *Iridescens* (Winge 1922, Blacher 1928, Winge & Ditlevsen 1947, Dzwillo 1959), *Aureus* (Winge 1927), *Variabilis* (Winge 1927), *Ferrugineus* (Winge 1927), *Bimaculatus* (Blacher 1927, 1928), *Reticulatus*, *Trimaculatus*, *Viridis* (Natali & Natali 1931, apud Lindholm & Breden 2002), *Bipunctatus* (Natali & Natali 1931, apud Lindholm & Breden 2002, Kirpichnikov 1935), *Doppelschwert*, *Filigran* (Dzwillo 1959). Beside these, there are a few quantitative traits which are encoded by poligenes. These Y-linked quantitative traits are: black area, fuzzy black area, iridescent area, mean brightness, brightness contrast, mean chroma (Brooks & Endler 2001), attractiveness (Brooks 2000), tail area (Brooks & Endler 2001), courtship (Farr 1980).

Cryoresistant Gene in the Guppy. There are coldwater fish species and tropical fishes, the guppy being one of the latter. However, the guppy has the ability to survive in cooler waters that would certainly kill most tropical fishes. In their paper „Detection of a low temperature-resistant gene in guppy (*Poecilia reticulata*), with reference to sex-linked inheritance", Fujio et al., (1990) reported an X-linked gene, responsible of low water-temperature resistance in guppy. In 2006, in the paper: „Effect of temperature on sex ratio in guppy *Poecilia reticulata* (Peters 1860)", Karayucel et. al., 2006 emitted the hypothesis that the same gene is involved in high water-temperature resistance of guppy. In that moment the above mentioned gene becomes a very important one, especially for guppyculture, and generally for aquaculture because of extrapolation possibility of these studies to many cases of economical and commercial important species.

In a CEEX (Research of Excelence) project (Petrescu-Mag et. al., 140/2006) intend to test a number of 150-175 random primers, and to identify markers associated to low temperature resistance. The next step of this research is obtaining of a homozygote strain of guppy for that locus, and this will be possible because of gene's X-linkage. Crossing homo- or heterozygote cryoresistant females with hemizygote males for that locus eliminates the problem of dominance of the RAPD markers. Monitoring of cryoresistant gene is facilitated by the presence of an X-linked *Nigrocaudatus* II gene that can be used as color marker gene (Mag et al., 2006). One hundred of homozygote individuals will be tested with previous identified genetic markers and then will be exposed to controlled increasing values of temperature. The tested stock will be compared with a control stock for obtaining conclusive results as regards involving of the cryoresistant gene in heat resistance too. The breeding programme of the research team

is based on ♂Red Blond X ♀Half Black-Black crossing, followed by a backcross of F_1 females with the Red Blond males (see Fig. 1).

THE AIM OF THE STUDY

The aim of the present research is to describe the guppyfish and to establish the invasive potential of species in the temperate zone. The study is important due to production perspective of cryoresistant guppy strain as objective of research project CEEX 140/2006.

MATERIAL AND METHOD

Two varieties of guppy have been used as genitors in order to create the cryoresistant guppy strain: Half-Black Black and Red Blond.

The Half-Black Black variety is characterized by black color of the second body half. Sometimes ¾ of the body present a strong black expression and any other color pattern is physiological delayed in that region. Dorsal, pectoral and caudal fins are black. The gene responsible of half-black trait - *Nigrocaudatus* II - is found in our case in X-linked form. Strains which possess that gene in Y-linked form can be easily identified because of their high mortality and low growth rate. There is, also, in the guppy a less frequent variant of *Nigrocaudatus* gene which is X-linked and not known in Y-linked form - *Nigrocaudatus* I. *Nigrocaudatus* genes are dominant and express in both males and females.

Red Blond is a pure red variety, melanic pigments being much reduced in the skin and present in the eyes only. Blond character is encoded by an autosomal mutation, red color of the skin is determined by polygenes (orange area) and red tail character is determined by a major sex-linked gene. The Red Blond female has no red body coloration, and the red tail character presents a weak expression.

The two guppy varieties were exposed to decreasing values of temperature (1˚C each two days). The experiment began with 25˚C and ended to 9˚C. The 8 lots were bred in tanks of 100 liters volume, and 7.1 pH. The feed was administered 2-3 times a day, *ad libitum.* The 8 fish lots were: 3 Red Blond male lots, 3 Half-Black Black female lots, 1 Red Blond female lot, and 1 Half-Black Black male lot.

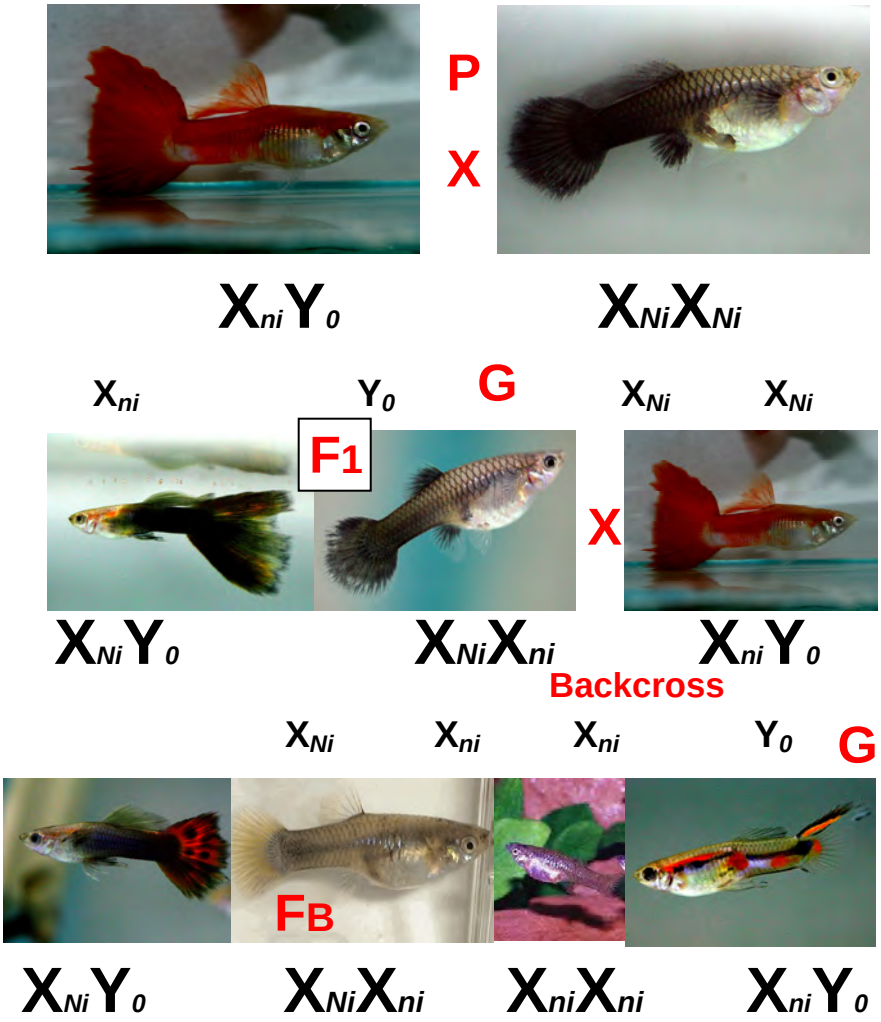

Fig. 1. *Scheme of the breeding programe in the project CEEX 140/2006*

RESULTS AND DISCUSSION

Each lot presented a lethargic behavior beginning with 14˚C, and mortality began to increase around 12˚C, especially in the male lots (table 1). Difference of mortality between the two genders indicates a accentuate resistance of females and a low tolerance of males to coldwater. The relation is simple: let's consider R the frequency of cryoresistant gene in the genophond. The male is hemizygote - XY, and its chance to inherit the cryoresistant gene is R. Then female, according to statistic calculus, has a probability of $2R\text{-}R^2$, where 2 represent its number of X chromosomes, and R^2 is

probability of an individual to inherit two X chromosomes bearing the cryoresistant gene. Taking in account the fact that 0<R<1, it is easy to understand that $2R-R^2<R$. In other words, probability of male to inherit the cryoresistant gene is lower than that of female, excepting situation when R=1 (100%).

Table 1

Number of lost individuals on Red Blond and Half-Black lots depending on water temperature

Lot/Temperature (˚C)	20-25	15-20	12-15	10-12	9-10
Lot 1 Red Blond ♂	0	0	0	2	15
Lot 2 Red Blond ♂	0	0	0	1	21
Lot 3 Red Blond ♂	0	0	0	3	58
Red Blond ♀	0	0	0	0	15
Lot 1 Half-Black Black ♀	0	0	0	0	3
Lot 2 Half-Black Black ♀	0	0	0	1	7
Lot 3 Half-Black Black ♀	0	0	0	0	12
Half-Black Black ♂	0	0	0	0	32

Short exposure (1 hour) of guppy to lower temperature, under those presented in the table 1, indicates a tolerance to 6-7˚C. However, it is improbable survival of this species in the winter when water temperature became smaller than 5˚C. After our opinion and experience, forming of self sustaining population requires at least 16-18˚C in the case of guppy. Creation of the cryoresistant guppy strain has no invasive potential in the temperate zone, excepting thermal waters where the problem became serious in the last years. The contrast between the invasive potential of guppy in thermal waters and its incapacity of survival in the other waters indicate that guppy is euribiont from all points of view excepting coldwater tolerance.

CONCLUSIONS

Guppy presented a lethargic behavior beginning with 14˚C, and mortality began to increase around 12˚C, especially in the male lots. Difference of mortality between the two genders indicates a accentuate resistance of females and a low tolerance of males to coldwater. The result is due to the fact that probability of male which is hemizygote to inherit the cryoresistant gene is lower than that of female which has two X chromosomes.

Exposure of 1 hour long to lower temperature (under 9˚C) indicates a tolerance of guppy to 6-7˚C. However, it is improbable survival of this species in the winter when water temperature became smaller than 5˚C. After our opinion and experience, forming of self sustaining population requires at least 16-18˚C in the case of guppy. Creation of the cryoresistant guppy strain has no invasive potential in the temperate zone, excepting thermal waters where the problem became serious in the last years. The contrast between the invasive potential of guppy in thermal waters and its incapacity of survival in the other waters indicate that guppy is euribiont from all points of view excepting coldwater tolerance.

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POTENȚIALUL INVAZIV AL PEŞTELUI EXOTIC GUPPY (*POECILIA RETICULATA* PETERS 1859) ÎN ZONA TEMPERATĂ

(Rezumat)

Lucrarea descrie peştele exotic guppy (*Poecilia reticulata*) şi tratează problema potențialului invaziv al speciei în zona temperată. Studiul este important în perspectiva creării liniei criorezistente de guppy în scop economic şi comercial în cadrul proiectului CEEX 140/2006 finanțat de către Ministerul Educației şi Cercetării, monitorizat de către Centrul Național de Management Programe Biotech. Indivizii posesori ai genei pentru rezistență la temperaturi scăzute manifestă letargie începând cu 14˚C, iar mortalitatea creşte începând cu 12˚C. Expunerile scurte la frig arată că ei rezistă până la 6-7˚C, timp de o oră. Crearea liniei prin programul de ameliorare genetică nu prezintă pericol invaziv în zona temperată, cu excepția apelor termale unde guppy crează probleme în ultimii ani. Contrastul dintre potențialul invaziv al speciei în apele termale şi incapacitatea lui de supraviețuire peste sezonul rece în restul apelor din zona temperată demonstrează faptul că guppy este un euribiont din toate punctele de vedere cu excepția toleranței la temperaturi foarte scăzute.

AGRICULTURA URBANA Y PERIURBANA, ELEMENTO DE DURABILIDAD DE LOS SISTEMAS PRODUCTIVOS. EL IMPACTO POSITIVO Y NEGATIVO SOBRE EL MEDIO AMBIENTE

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Abstract: The urban and peri-urban agriculture, as a key element for the sustainability of the productive systems. The positive and negative impact on the environment. The urban and peri-urban agriculture (UPA) refers to small areas within cities, such as vacant lots, gardens, verges, balconies and containers, that are used for growing crops and raising small livestock or milk cows for own-consumption or sale in neighbourhood markets. UPA is estimated to involve 800 million urban residents worldwide in income-earning and/or food-producing activities. Besides the positives aspects presented in the paper the agricultural production systems in urban and peri-urban areas can pose risks to public health and the environment. Food security depends upon the level and stability of the cost of food access as well as on the variety and quality of food available to all the consumers.

Key words: *Urban and peri-urban agriculture (UPA), sustainability, environment, food security*.

La alimentación es un derecho humano básico y la seguridad alimentaria garantiza el acceso oportuno y suficiente de alimentos, que cubran las necesidades fisiológicas y culturales de la población. Unido al este derecho se encuentra otro, el que tiene las naciones libres e independientes: de mantener y desarrollar su propia capacidad para producir en sus territorios, de manera autónoma los alimentos que consumen sus pueblos, respetando su diversidad productiva y cultural; este derecho lo concebimos como la construcción de la soberanía alimentaria.

La dificíl situación socioeconómicas y los altos niveles de desocupación que existen en el tercer mundo, epecialmente, se traducen en problemas alimentarios graves para grandes sectores de la población. La soberanía alimentaria requiere del uso sostenible de los recursos naturales y del trabajo de las personas. La sostenibilidad a largo plazo exige de un cambio en el uso de los insumos y de la finalidad de la producción. Es necesario romper con la dependencia de los agroquímicos y de los monocultivos y sobre todo con los modelos de producción intensivos industrializados, que desdeñan el aprovechamiento de los recursos locales. De esta forma la Agricultura Urbana y Periurbana (AUP) tiene un importante papel que cumplir dentro de una estrategia de combate a la pobreza garantizando acceso a los alimentos a las poblaciones de menores ingresos, al reducir el precio de los mismos y acercar espacialmente la producción al consumo, generación de empleo atacando la desocupación, con la consecuente acceso a un ingreso permanente y de calidad, así como, una contribución en el saneamiento de espacios recuperando y favoreciendo un metabolismo menos lineal de la ciudad.

La agricultura urbana y periurbana se lleva a cabo dentro de los límites o en los alrededores de las ciudades de todo el mundo e incluye los productos de las actividades agropecuarias, pesqueras y forestales, así como los servicios ecológicos que proporcionan. Con frecuencia, en una sola ciudad y cerca de ella existen múltiples sistemas agrícolas y hortícolas. AUP se refiere a pequeñas superficies (por ejemplo, solares, huertos, márgenes, terrazas, recipientes) situadas dentro de una ciudad y

destinadas a la producción de cultivos y la cría de ganado menor o vacas lecheras para el consumo propio o para la venta en mercados de los alrededores (Comité de Agricultura de la FAO, 1999) .

Desde el punto de vista de la clasificación general de los ecosistemas, podemos incluir la AUP en la categoria de bioecosistemas y dentro de esta categoria en los ecosistemas antropogenas (vease cuadro1).

Cuadro1

Los principales ecosistemas terrestres según el grado de artificialización, Fuente: adaptado segun I. Puia et al., *Agroecologie şi Ecodezvoltare*, Editura AcademicPres, 2001, Cluj-Napoca, p.239.

BioEcositemas	-Se caracteriza por la dominación de los componentes naturales y de los procesos biologicos.
1.Ecosistemas naturales	-Sin la influencia humana directa, son capaces de autoregulación.
2.Ecosistemas “casi” naturales	-Similares con el número 1, pero. Se cambian si existe la influencia humana. Capaces de autoregulación.
3.Ecosistemas seminaturales	-Resultan de la utilización humana de los tipos número 1 y 2, pero no son creadas con intención. Cambian si la intervención humana cesa. Capacidad limitada de autoregulación. Es necesario la gestión.
4.Ecosistemas antropogenas	-Son creados intencionalmente por el hombre. Dependen en totalidad de la gestión o manejo y del control humano.

Se estima que unos 800 millones de habitantes de ciudades de todo el mundo participan en actividades relacionadas con la AUP que generan ingresos y producen alimentos, en general en países subdesarrollados (por ejemplo, la superficie de Montevideo es de 528,7 km^2, de los cuales el 36,4% están urbanizados y el 63,6% corresponde a suelo rural, con unas 35.000 hectáreas potencialmente agrícolas (Scarlatto, 2001). Además, en el espacio urbano existen muchos barrios con áreas públicas libres o abandonadas y viviendas que cuentan con potenciales superficies para el desarrollo de huertas familiares, asi que podemos considerar AUP como una «válvula de seguridad alimentaria» decisiva para los hogares urbanos pobres (Mougeot, 2000). Al cultivar sus propios alimentos, las ciudades reducen sus déficit alimentarios y obtienen una importante cantidad de frutas, hortalizas y productos de origen animal (huevos, lácteos, carne). Se estima que estas formas de producción proporcionan aproximadamente el 15% de los alimentos consumidos en las zonas urbanas del mundo y es probable que este porcentaje se duplique en las próximas décadas. Las ciudades con sectores agrícolas urbanos más avanzados, han pasado a autoabastecerse de alimentos frescos y algunas incluso exportan excedentes al extranjero.

Este tipo de agricultura constituye una fuente de ingresos para los hogares. Sin embargo, la gran mayoría de los agricultores urbanos son pobres y cultivan alimentos básicamente para su propia subsistencia y en pequeñas parcelas que por lo general no son de su propiedad. En África, estos sistemas productivos han mejorado el estado nutricional de las familias, medido por el consumo de calorías y proteínas, la calidad de la comida o las tasas de crecimiento de los niños. (Mougeot, 2000; Red Águila).

La agricultura urbana podrá ser, junto con otras políticas sociales, una alternativa para alcanzar la seguridad alimentaria y una contribución hacia la sostenibilidad social, económica y ecológica. Se presenta a continuación un breve análisis de la contribución de experiencias del área metropolitana de Montevideo en el logro de esos objetivos.

AUP y el medio ambiente

→ *Aspectos positivos:*

Elementos que AUP aporta a la sostenibilidad ecológica (Bellenda, 2005; Penso Sanchez, 2007):

Una gran parte de la basura de la ciudad es orgánica, y gran parte de ella se convierte en una fuente de contaminación de las mismas. La agricultura urbana puede ayudar a reducir la contaminación ambiental reciclando los desechos sólidos y líquidos a través del proceso de producción agrícola. La agricultura urbana también desempeña un papel en el reverdecimiento de la ciudad, ayuda a mejorar el microclima, reduce la erosión, reduce el ruido, y desempeña un papel en el mantenimiento de la biodiversidad.

Las siguientes medidas pueden aplicarse para aumentar los impactos ambientales positivos de la agricultura urbana y prevenir los efectos negativos sobre el medio ambiente urbano:

- Promoción de una reutilización segura de desechos orgánicos urbanos y aguas servidas por medio del establecimiento de instalaciones de bajo costo para la recolección y clasificación de desechos orgánicos “cerca de la fuente”;
- Producción de compost o biogas (y estimulación de investigación aplicada sobre tecnologías de compostaje y digestión);
- Inversiones en sistemas de recolección y almacenamiento de aguas lluvias para sistemas de irrigación de pequeña escala con el fin de ahorrar agua y así reducir la demanda de agua tratada;
- Introducción de precios preferenciales para aguas servidas;
- Educación de los agricultores sobre el manipuleo adecuado de desechos y las aguas residuales.
- Se producen alimentos sin la incorporación de agrotóxicos;
- Al incorporar productos de origen animal (cría de gallinas, conejos, caracoles), se genera el reciclado de excedentes de la huerta para los animales, y del estiércol de los animales para la huerta, logrando sistemas agroecológicos.

→ *Aspectos negativos* (Comité de Agricultura de la FAO, 1999)*:*

-Las aguas residuales recicladas y tratadas constituyen la fuente de agua más viable para la agricultura urbana y periurbana. La FAO ha estimado que los efluentes de aguas residuales de origen doméstico, sometidos a un tratamiento adecuado con miras a su reutilización agrícola, podrían aportar todo el nitrógeno y gran parte del fósforo y el potasio normalmente necesarios para la producción agrícola. A veces se utilizan como fertilizantes desechos líquidos sin tratar (purines de cerdos, aguas de inodoro) o desechos semitratados. Con frecuencia se emplea estiércol sin tratar de pollos y ganado

vacuno para aumentar la fertilidad y mejorar la estructura del suelo. Estas prácticas entrañan cierto riesgo para la salud, pero cuando se aplican correctamente es posible reducir al mínimo ese riesgo.

- El principal peligro de la utilización de aguas residuales es la contaminación de los alimentos con microorganismos patógenos y la aparición de enfermedades transmitidas por el agua. El uso de aguas negras no tratadas o tratadas de modo inadecuado con fines de riego lleva asociado un alto riesgo de infección con helmintos y un riesgo entre medio y bajo de infección con bacterias entéricas y virus. En general, la información disponible indica que los efectos negativos sobre la salud sólo constituyen un problema cuando se utilizan para el riego aguas residuales brutas o insuficientemente tratadas.

- Otro caso de riesgo para la calidad del agua es el que plantea la acuicultura intensiva en zonas periurbanas. La intensificación implica una mayor utilización de agua para recirculación, piensos comerciales y medicamentos (antibióticos, bacteriostáticos). El exceso de nutrientes y materia orgánica favorece una proliferación de microorganismos que da lugar a la eutrofización al reducir el oxígeno disuelto en los sistemas hídricos.

Elementos que aporta la AUP a la sostenibilidad socioeconómica:

- Cambios en la alimentación (Bellenda, 2005).

• Permite la obtención de alimentos sanos, frescos y confiables; mantener algunas hortalizas en la dieta que no se podían consumir por su costo, e incorporar nuevas;
• Mejora la calidad de vida;

- Incorporación de valores y conocimientos: fortalecimiento del capital social;

• Promueve la solidaridad, la honestidad, la conciencia comunitaria y combate el individualismo;
• Facilita el aprendizaje creativo y permite rescatar conocimientos, cultura popular y técnicas del pasado;
• Propicia la educación y los aprendizajes múltiples;
• Implica un cambio cultural que se diferencia de la sociedad de consumo;
• Permite aprovechar el tiempo ocioso, dignificándolo;
• Aporta a la mejora de la autoestima, a sentirse útiles y potencia la capacidad de hacer con otros.

- Mejora en el desempeño económico de las familias;

• Reduce el gasto en alimentación;
• Permite el trueque de alimentos con otros vecinos o pequeños comerciantes;
• Permite ingresos complementarios a través de la venta de excedentes.

En lo correspondiente a la alimentación familiar, se indica que una huerta de 60 m^2 es capaz de suministrar las hortalizas frescas necesarias para una familia de dos adultos y tres niños. Otro posible indicador de sostenibilidad está en el análisis de lo que aportan los productos de la huerta (en volumen) a la alimentación familiar. El 35% de los vecinos declaran que la huerta les aporta más del 50% de sus alimentos diarios, lo cual es de gran relevancia. En cuanto al destino de lo producido, el autoconsumo resulta el principal, ya que el 62% de los emprendimientos así lo define.

Los móviles que motivan a los vecinos a realizar una huerta familiar o comunitaria se presentan en el cuadro 2. De este cuadro se desprende que la búsqueda de la sostenibilidad mediante el desarrollo de emprendimientos productivos de alimentos,

que contribuyan a la seguridad alimentaria de las familias, es una motivación explícita y conciente de buena parte de los vecinos participantes.

Cuadro 2

Razones que motivan a los vecinos a la realización de las huertas, Fuente*:* Primer Censo de Emprendimientos Productivos y Agricultores Urbanos vinculados al PPAOC y PAU-IMMM. 2005.

	PORCENTAJE DE VECINOS
Gratificación y crecimiento personal	**28,7%**
Sustento ecónomico	**40,6%**
Proyecto alternativo	**12,9%**
Aprovechamiento de recursos	**6,9%**
Integración social	**10,9%**

La agricultura urbana aumenta la cohesión social en los barrios y que une a las personas. Las medidas de política pueden fomentar desarrollo social dentro de las comunidades, estimulando la inclusión de la agricultura urbana en proyectos de regeneración urbana que vinculan a la agricultura urbana con actividades educativas y de desarrollo comunitario. Las tierras abandonadas y degradadas pueden ser transformadas en huertos comunitarios y contribuir a aumentar la autoestima o la seguridad en los barrios. La agricultura urbana es un instrumento cuya promoción por parte de las autoridades urbanas puede facilitar la integración social dentro de la trama socioeconómica de la ciudad, creando acceso a terrenos municipales, líneas de crédito y asesoría técnica (Penso Sanchez, 2007).

En lo que concierne la AUP en Rumania, no hemos encontrado ninguna fuente oficial. De todos modos, tenemos que hacer algunas clarificaciones: antes de 1989 una gran parte de la población urbana practicaba este tipo de agricultura, debido al sistema de colectivismo, que no permitia la existencia de la propiedad privada (con unas exepciones) sobre los terrenos, etapa caracterizada por la falta tremenda de recursos alimentarios. Hoy dia la AUP es menos practicada, como consequencia de la reconstitución/constitución del derecho de la propriedad sobre los solares de la zonas urbana y del aumento increible de sus precios en los ultimos diez años. En la zona periurbana de Cluj-Napoca podemos constatar un aumento considerable de la producción vegetal entre 1960 y 1998 (los mas recientes datos que disponemos, vease cuadro 3).

Cuadro 3

*Producción agricola vegetal promedio (t/ha)***,** Fuente: adaptado segun I. Rotar et al., *Considerații privind spațiul agricol periurban,* 2002.

Años/Tipo de cultura	1960	1980	1990	1998
Trigo	1,70	2,88	2,49	3,84
Maiz	1,29	0,50	2,39	2,95
Patatas	6,47	8,71	15,09	15,33
Legumbres	3,84	7,85	7,25	9,81

Como consequencia que muchas ciudades de Asia, Africa y America Latin, probablemente, duplicarán sus poblaciones dentro de una década y que el número de consumidores urbanos de bajos ingresos también aumenta, la seguridad alimentaria de éstos depende no solamente de sus ingresos sino también del nivel y estabilidad del costo de acceso a los alimentos, así como de la variedad y calidad de los alimentos de que dispongan. Queda mucho por investigar en torno de la sostenibilidad de los sistemas productivos. No obstante, podemos extraer algunos conclusiones (Bellenda, 2005):

- → Estos sistemas productivos contribuyen al desarrollo sostenible de las familias que llevan adelante la experiencia.
- → Sus efectos pueden aportar en la mejora y conservación del medio ambiente de algunos barrios y espacios de las zonas peri/urbanas.
- → Es posible desarrollar estrategias hacia los agricultores urbanos que contribuyan a la búsqueda de la sostenibilidad, implementando políticas públicas al respecto.
- → Las huertas urbanas, de autoconsumo o de venta de excedentes, pueden convertirse en unidades económicas basadas fundamentalmente en el trabajo y no en el aporte de insumos externos; son sostenibles en un modelo económico solidario, privilegiando relaciones más integradoras de la sociedad.

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AGRICULTURA URBANĂ ŞI PERIURBANĂ, ELEMENT AL DURABILITĂŢII SISTEMELOR DE PRODUCŢIE. ASPECTE POZITIVE ŞI NEGATIVE ASUPRA MEDIULUI ÎNCONJURĂTOR

(Rezumat)

Situaţia socioeconomică precară şi rata ridicată a şomajului care există, mai ales, în ţările din lumea a treia, se traduc prin grave probleme alimentare pentru majoritatea acestui segment al populaţiei.

Suveranitatea alimentară impune folosirea durabilă a resurselor naturale şi a forţei de muncă. Sustenabilitatea pe termen lung necesită schimbarea metodelor de producţie şi a finalităţii acesteia. Este necesar să ne detaşăm de chimicalele utilizate în agricultură şi de monoculturi, dar mai degraba de modele de producţie intensive care dăunează resurselor locale. În această direcţie, AUP are de îndeplinit un rol important în strategia de combatere a sărăciei. Ea garantează accesul la alimente pentru populaţia săracă, reduce preţul acestor produse, generează locuri de muncă şi îşi aduce contribuţia la curăţarea spaţiilor astfel recuperate.

Agricultura Urbană şi Periurbană (AUP) se referă la acel tip de agricultură practicată pe suprafeţe mici (de exemplu pe spaţiile disponibile: mici grădini, terenuri, balcoane) situate in zona peri/urbană şi care este dedicată cultivării de plante şi creşterii de animale mici, dar şi a vacilor de lapte, producţie destinată consumului propriu sau comercializării în pieţele din împrejurimi. Se estimează că în jur de 800 milioane de locuitori, mai ales din statele subdezvoltate, participă la activităţi legate de AUP. Alături de aspectele pozitive prezentate în lucrare, sitemul agricol de producţie din zona peri/urbană poate genera riscuri considerabile pentru sănătatea publică şi mediul înconjurător.

AUP este un instrument, a cărui promovare din partea autorităţilor urbane poate facilita integrarea socială în cadrul zonelor urbane, facilitând accesul la terenuri municipale, linii de credit şi consultanţă tehnică.

În ceea ce priveşte AUP în România, nu am găsit nici o sursă oficială în acest sens. Cu toate acestea, se impun câteva clarificări: înainte de 1989, o mare parte a populaţiei urbane practica acest tip de agricultură. Acest lucru se datora sistemului colectivist care nu permitea (cu mici excepţii) existenţa proprietăţii private asupra terenurilor; etapa amintită s-a caracterizat printr-o acută lipsă de produse alimentare. În prezent, AUP este tot mai puţin practicată, ca urmare a reconstituirii/constituirii dreptului de proprietate asupra terenurilor şi a creşterii incredibile a preţurilor terenurilor din ultimii zece ani.

RADON: CANCER Y SITUACION EN ESPAÑA

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Abstract: Radon: cancer and situation in Spain. Radon represents most of the total dose received by population from natural sources of radiation. In Spain, exposure to radon is responsible of 50% of the dose to natural sources of radiation received by the population, and supposes more than 40% of the total dose coming from all sources. In this paper, a short review of the radon issue is performed. Behind the Spanish situation concerning radon, its role as one of the most important lung cancer risk factor is presented. Finally, a brief description of the international recommendations and regulations is provided.

Key words: *radon, lung cancer, risk*

INTRODUCCION

El radón se encuentra en cantidades significativas en el suelo (Quindós, 1995). En España, la exposición al radón es responsable del 50 % de la dosis debida a fuentes naturales de radiación recibida por la población, y supone más de un 40 % del total (Fig. 1). Las primeras campañas de medida de radón fueron llevadas a cabo hace más de veinte años y, paralelamente se construyó un mapa de radiación gamma externa, MARNA (Fig. 2), encontrándose en algunas zonas una buena correlación entre ambos conjuntos de datos (Quindós et al., 2005). Una parte de esta relación puede explicarse a partir de la geología de la península ibérica (Fig. 3).

La evidencia documental que data del siglo XVI indica que la exposición a niveles elevados de radón era probablemente la causa del exceso de muertes debido a cáncer de pulmón de los mineros de algunas minas de Europa Central, tales como las minas de plata en Alemania y Bohemia (Lubin et al., 1994). Inicialmente los científicos pensaban que la radiación natural no suponía un riesgo significativo para la salud de la población en la mayor parte de nuestros países. Sin embargo, ese punto de vista comenzó a cambiar a mediados del siglo XX. El cambio fue dramático en los años 70 y 80 cuando se descubrió que el interior de algunas casas en un número de países tenía niveles de radón en concentraciones elevadas. Entonces, en 1984, el asunto atrajo la atención nacional en los Estados Unidos cuando un trabajador de la construcción puso en marcha un monitor de radiación al entrar a la estación de Generación Nuclear de Limerick en Pensilvania. La planta no estaba generando todavía productos de fisión, esto hizo pensar que su casa era la fuente de contaminación. En estos momentos se entiende que en áreas donde el nivel natural de radón es alto, la baja presión del aire dentro de las casas trae como consecuencia un flujo hacia el interior de aire rico en radón a través de las grietas en las losas del piso o en las paredes de los sótanos (Darby, 2005).

Estudios epidemiológicos fueron realizados a la población general en respuesta a la necesidad de información sobre los riesgos de la exposición en interiores. Los primeros estudios fueron en gran parte ecológicos en diseño y los resultados variados. Estudios de control de casos de cáncer de pulmón se implementaron en los Estados Unidos, Europa y otras partes. Algunos de estos primeros estudios no medían realmente el radón en interiores, utilizando medidas sustituibles como es el tipo de construcción de la casa, por estas razones los datos obtenidos no podían proveer estimaciones

cuantitativas del riesgo. Estudios más sofisticados con muestras más amplias se llevaron a cabo a mediados y finales de los años 80. Algunos de estos estudios sugerían una asociación entre los niveles elevados de radón en las viviendas, otros no, incluyendo el estudio que llevó a cabo Salud Canadá en Winnipeg. Estos estudios en conjunto no pudieron aportar evidencia concluyente del elevado riesgo de cáncer de pulmón (Brand et al., 2005).

A finales de los 80 el IV Comité de Efectos biológicos de la Radiación Ionizante (BEIR) revisó los estudios de control de casos publicados y planificados. Inmediatamente se evidenciaron las limitaciones potenciales del tamaño de la muestra y los posibles niveles de margen de error en las medidas. Se propuso agrupar estudios individuales y se convenció a agencias financiadoras como el Departamento de Energía y la Comisión para las Comunidades Europeas para que apoyaran la planificación de grupos eventuales de estudios globales de control de casos relacionados con la exposición al radón en interiores y el cáncer de pulmón.

La incertidumbre acerca del radón y el cáncer de pulmón en los estudios de control de casos iniciales ha sido reducida por muchos de los avances científicos. En estos momentos se acepta que decenas de miles de muertes cada año por cáncer de pulmón están relacionadas con la exposición al radón. La solidez de los datos y los análisis apuntan a una necesidad de acción. Para reducir el riesgo de cáncer de pulmón por la exposición al radón las autoridades nacionales deben establecer métodos y medidas que, con una sólida base científica, contribuyan a desarrollar políticas de salud válidas.

WHO (Organización Mundial de la Salud) tuvo la previsión de trabajar en el desarrollo de las directrices. En 1996 publicó un informe que contenía diferentes conclusiones y recomendaciones encaminadas a comprender científicamente el riesgo del radón. Mas recientemente a través de un proyecto internacional muestra la necesidad que tienen los países de actuar en las áreas de control de riesgos y comunicación de riesgos (Zielinski et al., 2006).

BASES CIENTÍFICAS PARA EL ESTABLECIMIENTO DEL RIESGO DEL RADÓN

El cáncer de pulmón continúa siendo uno de los de mayor incidencia en países desarrollados. En Europa se encuentra en cuarto lugar tras tumores de mama, próstata y colon y recto con una incidencia de 71.8 y 21.7 por cada 100000 habitantes para hombres y mujeres, respectivamente. La mortalidad por cada 100000 habitantes es de 62.4 en hombres y 18.4 en mujeres, siendo la situación española similar con 67.2 en hombres y 8.9 en mujeres (Ferlay et al., 2006).

En los últimos 15 años investigadores de todo el mundo se han reunido regularmente para establecer un marco de trabajo común y un ambiente de colaboración. Los estudios en Norteamérica y Europa han sido agrupados para producir análisis combinados de los diferentes estudios, pero han arrojado esencialmente los mismos resultados.

El proyecto norteamericano de agrupación agregó información de siete estudios sobre la exposición al radón en el sector residencial, para un total de 3.662 casos y 4.966 controles. Esto permitió un examen más detallado del radón, del riesgo de cáncer de pulmón y sus modificadores potenciales que los hechos con anterioridad. Todos los estudios utilizaron detectores a largo plazo alfa-track para establecer las concentraciones de radón en el sector residencial. Las probabilidades (Odd Ratios) de cáncer de pulmón

se incrementaron con la concentración de radón en este sector de estudio. La OR estimada después de una exposición al radón con una concentración de 100 Bq/m^3 en un tiempo ventana de exposición de 5 a 30 años antes de la fecha índice fue de 1,11 (95 % intervalo de confianza = 1,00 – 1,28). Esta estimación es compatible con la de 1,12 (1,02 – 1,25) pronosticada por la extrapolación de la tendencia descendiente de datos de la minería. No había evidencias de la heterogeneidad de los efectos de radón en los estudios. No había heterogeneidad aparente en la asociación por sexo, nivel educacional, tipo de respuesta (personal o enviada), o tabaquismo, aunque había algunas evidencias de la relación entre la disminución del riesgo de cáncer de pulmón asociado al radón con la edad (Field et al. 2006).

El grupo de colaboración europeo extrajo información de estudios existentes que satisface cierto criterio – un total de 13 estudios que incluyen 7.148 casos de cáncer de pulmón y 14.208 controles. La concentración media de radón para los 13 estudios de nueve países es considerablemente mayor que la media en los análisis combinados norteamericanos y similar a los de la agrupación china. La medida media de concentración de radón en las viviendas de las personas del grupo de control era de 97 Bq/m^3, con 11 % de las medidas mayor que 200 y 4 % mayor que 400 Bq/m^3. La probabilidad (O.R) de cáncer de pulmón era de 1,08 (con 95 % intervalo de confianza 1,03 – 1,16) por 100 Bq/m^3 de incremento en el radón medido (Darby et al., 2006), (Barros-Dios et al., 2002).

El exceso proporcionado de riesgo no difiere significativamente con el estudio, la edad, el sexo o el tabaquismo. En ausencia de otras causas de muerte, los riesgos absolutos de cáncer de pulmón a la edad de 75 años a concentraciones usuales de radón de 10, 100 y 400 Bq/m^3 serán de 0,4 %, 0,5 % y 0,7 % respectivamente, para los no fumadores y cerca de 25 veces mayor (10 %, 12 % y 16%) para los fumadores. De forma colectiva pero no por separado los estudios europeos muestran el peligro del radón en el sector residencial especialmente para los fumadores o aquellos que abandonaron el hábito recientemente.

Los resultados de estos estudios conjuntos muestran una evidencia consistente de la asociación entre el radón en el sector residencial y el riesgo de cáncer de pulmón, un resultado pronosticado por la extrapolación de los resultados de estudios ocupacionales realizados a mineros expuestos al radón en el interior de las minas y consistente con los resultados tóxicos que arrojan los estudios in vitro de animales (Samet, 2006).

MEDIOAMBIENTE REGULATORIO ACTUAL

La comisión internacional para la protección radiológica (ICRP) (ICRP, 1991), estableció en 1991 que la mejor opción de un nivel de acción para las viviendas traería consigo la necesidad de un significativo pero posible trabajo para remediar esta situación. En 1993 recomendó un nivel óptimo en el radón de 200-600 Bq/m^3, el cual corresponde a dosis anuales efectivas de 3 a 10 milisieverts (mSv). Esta Comisión en sus nuevas recomendaciones refrendadas en su ultima reunión el pasado mes de Marzo en Essen, Alemania, no ha hecho sino reafirmarse en el mismo criterio, en cierta medida en contra de las sugerencias derivadas de múltiples investigadores que sugerían un descenso en los mencionados limites.

La EPA considera que el método más efectivo y económico es la despresurización compartida. Esto cuesta una promedio de US $ 1.200 por casa. La auto-evaluación por un inspector profesional puede constar muy poco, unos US $ 350. Las características de

resistencia al radón en las nuevas casas pueden adicionar de US $ 350 a 500 al coste de las mismas.

La EPA no depende de la regulación sino de la voluntad de acción, de la educación pública y de la asociación de un amplio rango de organizaciones, los gobiernos, ONGs, los educadores, los empleados de bienes raíces y de la industria de servicios del radón. Considera que la mejor oportunidad para examinar el radón son las transacciones de bienes raíces y los mayores obstáculos para la aceptación pública son la complacencia y los gastos para mitigar el problema.

La Acción Concertada ERRICCA-2 (European Radon Research and Industry Collaboration Concerted Action, Contract No: FIRI-CT-2001-20142),encuadrada dentro del Fifth Framework Programme de la Unión Europea representa el mayor esfuerzo realizado hasta el momento presente en la labor de conseguir que investigadores y profesionales unan sus esfuerzos para tratar de minimizar el impacto negativo que el gas radón tiene en nuestra salud, reuniendo a representantes de mas de 20 países procedentes del campo científico e industrial.

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RADON: CANCERUL ŞI SITUAȚIA DIN SPANIA

(Rezumat)

Radonul reprezintă marea parte din doza totală primită de populație din surse naturale de radiație. În Spania, expunerea la radon este responsabilă de 50% din doza primită de populație provenită din surse naturale şi presupune mai mult de 40% din doza totală care provine din toate sursele. În această lucrare, se realizează o scurtă trecere în revistă a aspectelor legate de radon. În spatele situației legate de radon din Spania, este prezentat rolul radonului ca unul dintre cei mai importanți factori de risc care generează cancer pulmonar. În final, este oferită o scurtă descriere a recomandărilor şi reglementărilor internaționale.

Leyendas de figuras:

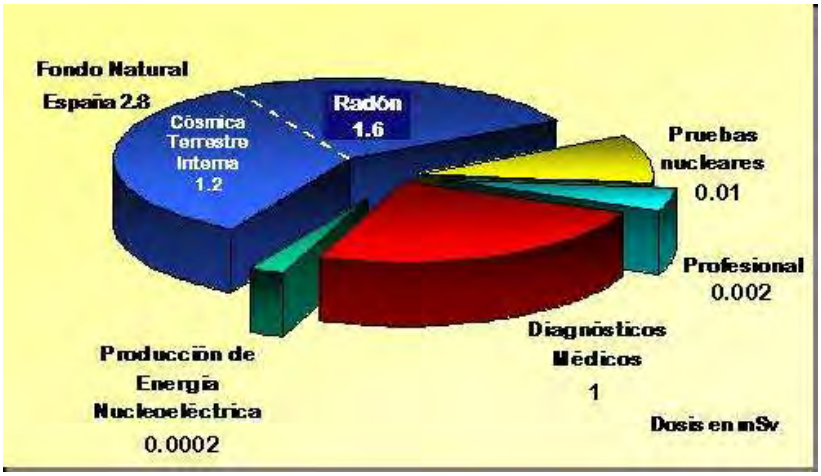

Fig. 1. *Dosis anual de radiación recibida por la población española por diferentes causas*

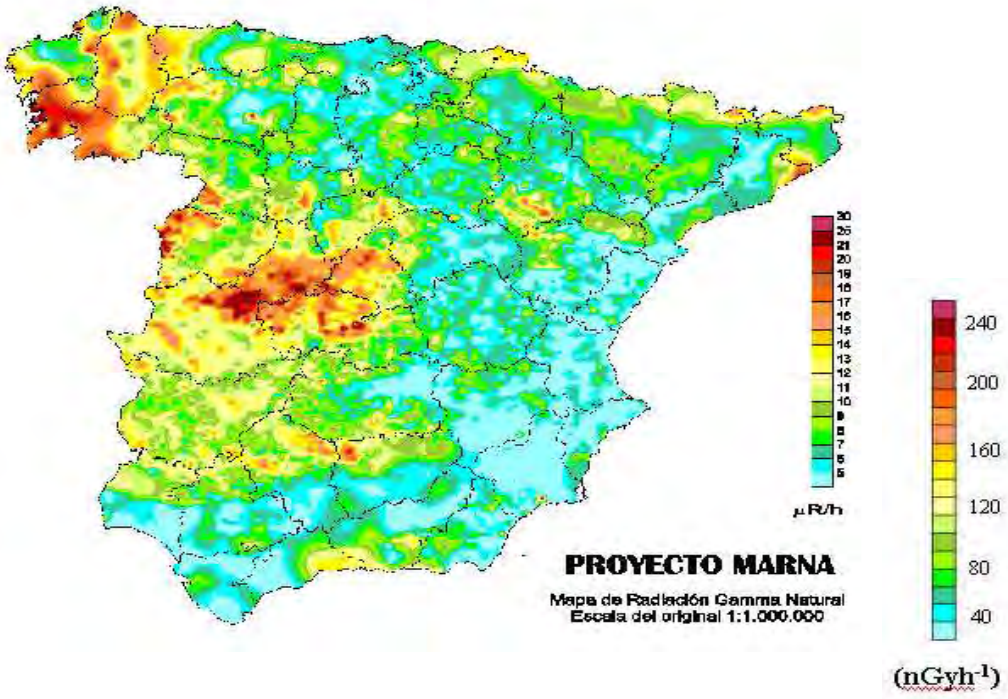

Fig. 2. *Mapa de radiación gamma externa obtenido en el proyecto MARNA*

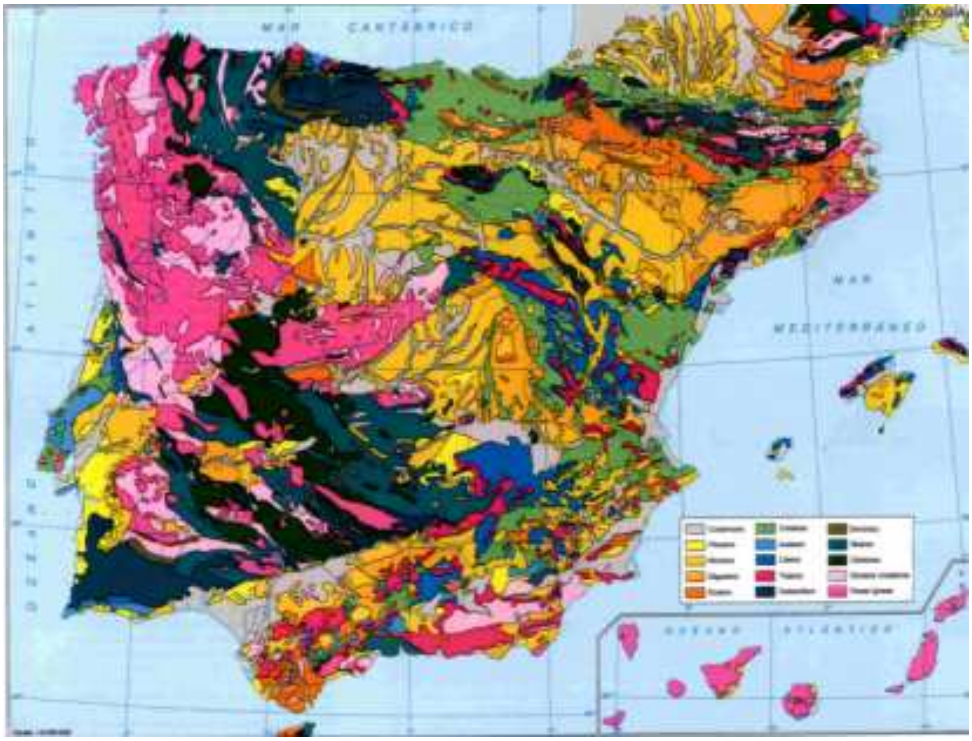

Fig. 3. *Mapa geológico de España*

HYDROGEOLOGICAL CONSIDERATIONS IN COPSA MICA – AXENTE SEVER – SEICA MARE AREA (DOWNSTREAM OF THE VISA VALLEY), SIBIU COUNTY

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Abstract. Hydrogeological consideration in Copsa Mica – Axente Server – Seica Mare area (downstream of the Visa Valley), Sibiu County. The Transylvanian Depression is known as an adverse region from the point of view of drinkable groundwater. Hydrogeological research showed that the most important aquifer is the one situated in the Pannonian deposits, which have a wide spreading south from the Mures River.The study area is situated along the Visa Valley on the left bank of the Tarnava Mare River. The paper presents several lithological, hydrogeological and hydrochemical considerations regarding Quaternary and Pannonian deposits which develop in the area, with direct implications concerning the possibilities that these aquifers represent water supply sources for the localities and economical objectives from the area.

Key words: *phreatic aquifer, deep aquifer, drinkability*

INTRODUCTION

From the point of view of drinkable groundwater, the Transylvanian Depression is characterized by a relatively low potential. This fact is due to the fact that, on one hand, in the lithological composition of the deposits that make up the filling of the depression predominate the pelitic deposits, and on the other hand, the presence in deep of saltipher deposits and gas domes. This last aspect determines the existence of salted water at different stratigraphic levels (Badenian, Sarmatian, Pannonian).

Hydrogeological research made in the Transylvanian Depression showed that the most important aquifer from the region is the aquifer situated in the Pannonian deposits, but which presents, from one area to another, lithological, hydrogeological and hydrochemical particularities

The Copsa mica – Axente Sever – Seica Mare area is situated in the central-southern part of the Transylvanian Depression, developing along the Visa Valley, left bank tributary of the Tarnava Mare river, area in which the Pannonian deposits are well developed.

South from Seica Mare it outcrops, on a small area, Sarmatian deposits (Volhynian - Lower Basarabian)

GEOMORPHOLOGICAL CONSIDERATIONS

From the geomorphological point of view, the study area belongs to the Tarnavelor Plateau, integrating part of the Transylvanian Plateau (Badea et.al.1971).

As a result of erosion, the entire Tarnavelor Area has the general appearance of a wavy, hilly plateau, compartmented in ribbons oriented in the same direction with hilly massifs or groups of hills and peaks, generally well delimited.

Erosion also created, along the valleys, three distinct terraces, according to some geographers, four and according to others, two on the Taranava Mare Valley and the Visa Valley.

From the hydrographical point of view, the study area belongs to the Tarnava Mare catchment, the main water course, along which the Copsa Mica, Axente Sever and Seica

Mare localities are located, being the Visa Valley. This mainly runs towards SW – NE and meets Tarnava Mare River at the Copsa Mica town.

GENERAL GEOLOGICAL CONSIDERATIONS

In the ensemble structure of the Transylvania Depression we can notice the crystalline basement, with the Pre-Neozoic sedimentary cover and the Neogene and Quaternary filling deposits. The Transylvania Depression started to evolve as a inter-mountain accumulation basin at the end of the Cretaceous, after the Laramic tectogenetic stage. The Paleogene transgression didn't involve the whole region, a part of it evolving as immerse area until the Middle Miocene, reason for which the Paleogene deposits are more developed in the northwestern part of the depression (Mutihac,1990).

The Badenian was the beginning of a new sedimentation cycle, disposing transgresively over older deposits or over the crystalline basement. During the Badenian, it also started the subsequent magmatic activity within the Oriental Carpathians and the Southern Apuseni Mountains. This activity determined the accumulation, at certain stratigraphic levels, of the pyroclastic material. A characteristic of the Badenian deposits is given by the presence of the Salt Formation, which is under the form of a megabreccia with salt and gypsum (Mutihac,1990).

The Sarmatian deposits are disposed in a continuity of sedimentation over the Badenian and are composed of an alternance constituted of clays, marls, sands, sometimes with intercalations of dolomitic limestones and tuffs.

The Pannonian has an extensive development in the central and southern part of the Transylvania Depression. It must be said that, in this paper, Pannonian is considered in *sensu largo*, representing, in the Pannonian Basin, the equivalent of the Upper Basarabian - Pontian interval from the Dacic Basin. Generally, in the succession of the Pannonian deposits, two lithological complexes are recognized, a basal one made of marls and clays and another upper, made of sandstones and sands with gravels.

In the eastern part of the Transylvania Depression volcanic-sedimentary deposits from the Neogene are developed.

The Quaternary is represented by alluvial, deluvial and coluvial deposits from the feet of the Fagaras Mountains and by flood plains and terrace deposits of the main rivers in the region (Fig.1).

HYDROGEOLOGICAL AND HYDROCHEMICAL CONSIDERATIONS

In the study area two aquifers are developing: the phreatic aquifer, localized in the alluvial deposits of meadow and terrace, of Quaternary age, of the Visei and Tarnava Mare Valleys and the depth aquifer, localized in the porous-permeable horizons of the Pannonian deposits .

There is no information regarding the aquifer situated in the Sarmatian deposits that outcrop south from Seica Mare.

The Phreatic Aquifer

The meadow deposits (Holocene) and terrace (Middle Pleistocene) are little extended, on both sides of the Visa Valley, being made of an alternance of mean coarse sands with sparse gravel, siltic sands, clays with calcareous concretions, with intercalations of sandy clays. In the upper part of the succession the siltic sandy-argillaceous deposits predominate.

In the right slope of the Visa Valley, on the area situated between it and the Vorumlac Valley, there were preserved, suspended, terrace remnants, attributed to the Middle Pleistocene, made up of gravels and sands (Răileanu et.al. 1968).

The alluvial deposits of the Tarnava Mare meadow and terrace have a variable granulometry. Thus, downstream Medias (approximately 10 km NW of Copsa Mica) the sands predominate, while upstream Mediaş the gravels and boulders in sand mass predominate. Locally there are intercalations of clays and sandy clays with lenticular development.

Characteristic is the fact that, on certain sectors, the alluvial deposits are colmated, in a variable proportion, with fine muddy argillaceous material, deposited during floods.

The phreatic aquifer is locally exploited through wells, the hydrostatic level being situated, in the Axente Sever area, at relatively great depths, between 4.73 – 10.26 m.

From the information obtained from the locals, it results that the drop in the hydrostatic level in these wells, or even their drying-out, was determined by the excavations of ballast in the Tarnava Mare riverbed, downstream Copsa Mica, made many years ago. The drop in the Tarnava Mare level lead to the drop in the Visa River level and implicitly to the drop in the hydrostatic level of the phreatic aquifer localized in its alluvial deposits.

Currently a part of the dried-out wells are used by their owners as septic tanks, for the discharge of used water or even water from the toilets, with unfavorable effects from the point of view of the pollution of the phreatic aquifer.

The phreatic aquifer situated in the suspended terrace remnants discharge through some slope springs, situated at the contact point between the alluvial deposits and the subjacent Pannonian deposits. The springs are catched through drains and collected into reservoirs, in the Axente Sever area, the total catched discharge being of 1l/sec.

From the qualitative point of view, the water catched from springs, at Axente Sever and Seica Mare, is generally drinkable, with local exceeding of drinkability standards at sulphates and phosphates, at the same time noticing high values of total hardness, between 24 German degrees at Axente Sever and 32.5 German degrees at Seica Mare. The same qualitative aspects also characterizes the phreatic aquifer from the meadow and terrace of the Visa Valley.

The quality of the phreatic aquifer from the Tarnava Mare valley and terrace is strongly affected by anthropogenic activity in the area of Copsa Mica, recording exceeding in drinkability standards at organic substances, sulphates and ammonium.

The Depth Aquifer

The depth aquifer is localized in the porous-permeable horizons, predominantly sandy of the Pannonian.

For the development in depth of the Pannonian information is known from the geophysical diagraphs of great depth wells (over 1000 m) executed for the prospecting and exploring of gas yielding structures in the region.

The analysis of the geophysical diagraphs, corroborated with petrographic and paleontological data, determines the Pannonian – Sarmatian boundary, for the Axente Sever area, at a depth of approximately 300 m, as well as the existence, at different depths, of the porous-permeable horizons, susceptible to contain groundwater.

In the study area there were executed several hydrogeological research and exploitation wells (Fig. 2, Fig. 3), thus the Pannonian aquifer being known in the area until the depth of 250 m.

From the lithological point of view, the Pannonian deposits are predominantly made of clays and marls, sometimes sandy or siltic, to which it is added sand intercalations, predominantly fine, seldom average, locally argillaceous or siltic. Subordinately there are thin intercalations of sandstones and coaly clays (F2 Agarbiciu). Only one well (F1 Agarbiciu) intercepted an intercalation of small gravel with average sands, localized in the upper part of the lithological succession.

From the analysis of the lithological columns of the hydrogeological wells executed in the study area, we notice a variation of facies both on the horizontal and vertical (fig.3).

It is noticed that the frequency and the thickness of the porous-permeable intervals increases from South to North (from Seica Mare to Axente Sever) and decreases with depth.

The vertical distribution of porous-permeable horizons suggests the existence in the Agarbiciu-Axente Sever area of three aquifer complexes, developed as follows: an upper aquifer complex (I), which develops between 15 – 60 m (emphasized by wells F1 Agarbiciu, F2 Agarbiciu and H13P Axente Sever), a middle aquifer complex (II), between 80 – 120 m (H13P Axente Sever) and a lower aquifer complex (III) emphasized between 180 -210 m (H13P Axente Sever)

The lithological succession crossed by H8P Seica Mare well shows a relatively uniform distribution in depth of sandy intercalations, noticing altogether the small thickness (frequently between 0.5 – 1 m) and their fine granulometry (fine, argillaceous sands).

The existence of several aquifer complexes is suggested by the depth of the piezometric level. If in F1 Agarbiciu well, which opened the upper aquifer complex (I), the piezometric level is ascensional, being situated at the depth of 12 m, in the H!3P Axente Sever well, which opened the middle and lower aquifer complexes, the piezometric level is artesian, at the execution of the well, the piezometric level was + 8.5 m towards south, at Seica Mare, the piezometric level was, at the execution of the well, strongly artesian, of 11.45 m.

The F2 Agarbiciu well cannot offer information regarding the hydrogeological characteristics of the Pannonian aquifer, because this one opened both this aquifer and the aquifer localized in the Quaternary deposits.

In the case of H8P Seica Mare well, the free flow discharge was of 0.2 l/sec, and during pumping it reached 0.45 l/sec for a drawdown of 110 m. The values of the hydrogeological parameters (transmisivity T = 0.285 m2/day, hydraulic conductivity K = 0.016 m/day) shows a negligible potential of the Pannonian aquifer from that area.

In the case of F1 Agarbiciu well, which opened the upper aquifer complex, it was obtained a yield of 2 l/sec for a slope of 8 m.

The free flow discharge of the H13P Axente Sever was of 0.6 l/sec, and during pumping it reached a discharge of 3 l/sec, for a drawdown of 12.4 m. The values of the hydrogeological parameters (T = 0,578 – 1,186 m^2/day, K = 0,0275 – 0,056 m/day) indicates an aquifer with a very weak potential (the upper and middle aquifer complexes).

From the qualitative point of view, in the Agarbiciu – Axente Sever area, water is drinkable, while in the Seica Mare area, it has a high degree of mineralization of 3280.59 mg/l.

CONCLUSIONS

Hydrogeological research made in the Transylvanian Depression, known as a region deficitary in drinkable groundwater, showed that the most important aquifer is the one localized in the Pannonian deposits.

The Copsa Mica – Axente Sever – Seica Mare area is situated in the central-southern part of the Transylvanian Depression, along the Visa Valley, left bank tributary of the Tarnava Mare River, in which the Pannonian deposits are largely developed. Comparatively to these, the Quaternary alluvial deposits occupy a small area, on both sides of the Visa Valley, as well as on the Visa-Vorumlac interfluve from the western bank of the valley.

The phreatic aquifer, situated in the suspended terrace remnants on the Visa – Vorumlac interfluve, is discharged through springs and is catched through drains. The phreatic aquifer localized in the meadow and terrace of the Visa River is exploited on a local level through wells. A part of these wells were transformed in septic tanks by the owners, because they dried out, as a result of the drop in the water level on the Visa Valley.

From the qualitative point of view, the phreatic aquifer is generally drinkable, with local exceedings of the maximum admitted concentration in accordance with the law regarding drinkable water quality at sulphates and phosphates indicators, both at Axente Sever and Seica Mare localities.

The depth aquifer is localized in Pannonian deposits, being known through wells until the depth of 250 m.

The Pannonian deposits, predominantly pelitic, are characterized by a variation in facies both on horizontal and vertical. This facial variation consists in the increase of frequency and thickness of porous-permeable horizons from south to north and their diminishing from top to bottom.

The wells made in the area emphasized the existence of three aquifer complexes within the Pannonian deposits, situated approximately in depth intervals of 15 – 60 m, 80 – 120 m and 180 – 210 m.

Except the upper complex in which the piezometric level is ascensional, the other two complexes are characterized by a strongly artesian piezometric level.

The determined hydrogeological parameters on the basis of experimental pumping have small values, characterising an aquifer with negligeable potential in the Seica Mare area and a very weak potential in the Axente Sever area.

The yields obtained are 2-3 l/sec in the Axente Sever area, where the water is drinkable, and 0.45 l/sec in the Seica Mare area, where the water has a high degree of mineralization.

From the facts presented above, two areas are emerging, Axente Sever, favourable from the point of view of water supply, and Seica Mare, unfavourable from the same point of view, in which the Pannonian deposits have different lithologic and hydrogeologic, quantitative and qualitative characteristics.

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CONSIDERAȚII HIDROGEOLOGICE ÎN ARIA COPŞA MICĂ - AXENTE SERVER – SEICA MARE, JUDEȚUL SIBIU

(Rezumat)

Depresiunea Transilvaniei este cunoscută ca o regiune nefavorabilă din punct de vedere al apei potabile subterane. Cercetările hiodrogeologice au demonstrat că cel mai important acvifer este situate în depozitele Pannoniene, acesta având o răspândire limitată la sud de râul Mureş. Aria studiată este situată de-a lungul Văii Visa, pe bancul stâng al râului Târnava Mare.

Lucrarea prezintă câteva considerații litologice, hidrogeologice şi hidrochimice cu privire la depozitele Cuaternare şi Pannoniene care se dezvoltă în această arie, cu implicații directe asupra resurselor de apă pentru localitățile înconjurătoare şi obiectivelor economice din această arie

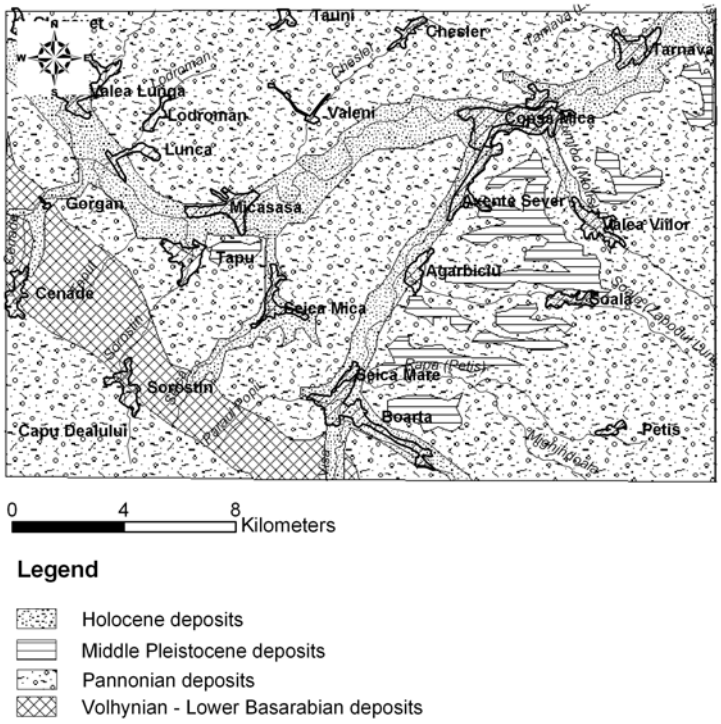

Fig. 1 Geological map of Copsa Mica - Axente Sever - Seica Mare, Sibiu county

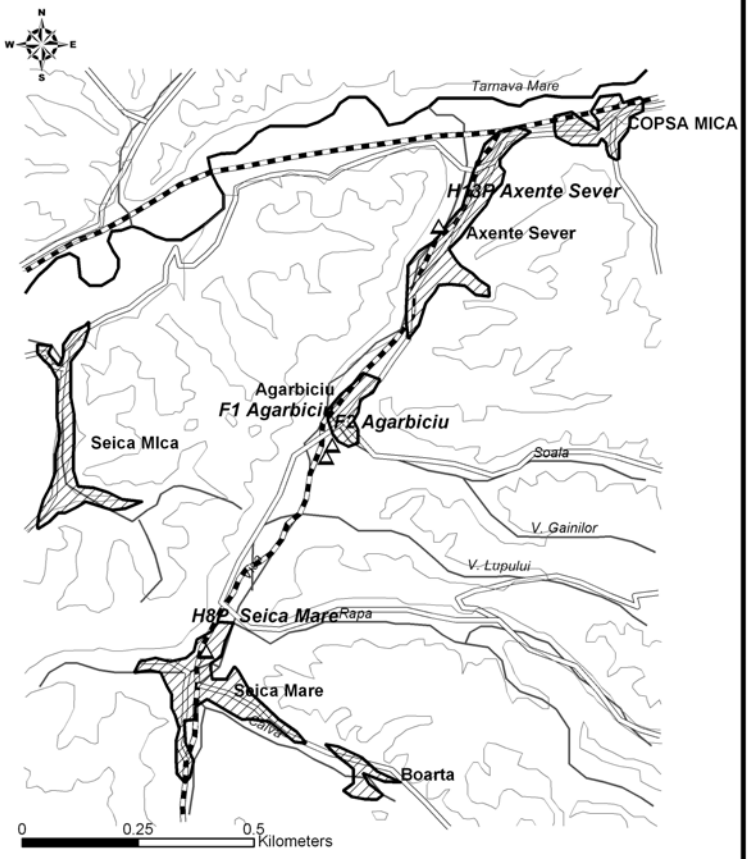

Fig.2 The map with the location of some hydrogeological wells from Copsa Mica - Axente Sever - Seica Mare, Sibiu county

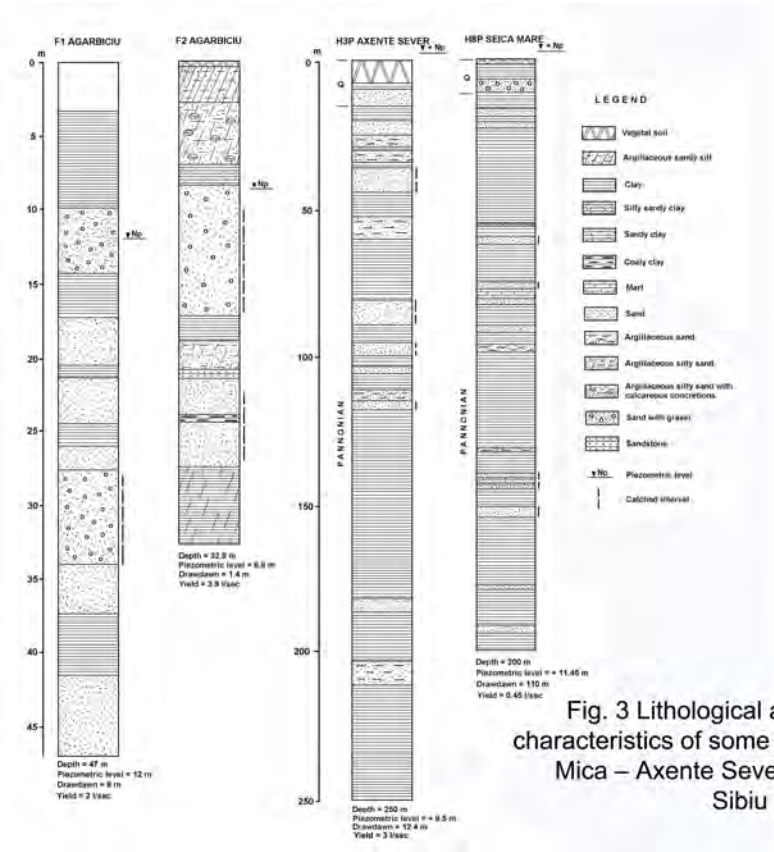

Fig. 3 Lithological and hydrogeological characteristics of some wells executed in Copsa Mica – Axente Sever – Seica Mare area, Sibiu county

L'HYDROGÈNE, VECTEUR ÉNERGÉTIQUE DE L'AVENIR ?

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Abstract Hidrogenul, vector energetic pentru viitor ?Higdrogenul cunoaşte un interes special ca potențial vector energetic. Numeroase publicații cu caracter ştiințific evidențiază calitățile sale care pot să-l relanseze pe piața energiei. Lucrarea evidențiază aceste calități ale hidrogenului, dar şi defectele posibile.

Key words : *hydrogen, energetic vector, combustible.*

L'ÉLÉMENT HYDROGÈNE

De masse moléculaire 2, il est le plus léger des éléments. La molécule étant non polaire et très peu polarisable, l'hydrogène est très peu soluble et difficilement condensable. Il s'agit d'un gaz dont le point d'ébullition est 14 K (-259℃), donc très coûteux à liquéfier. Bien que très abondant dans l'univers (89 % des tous les atomes), il est très rare sur terre car sa faible masse porte sa vitesse quadratique moyenne au-delà de la vitesse de libération de la terre. C'est ainsi que, dans l'air, on n'en trouve que des traces de l'ordre de 0,5 ppm (part par million, soit 0,5 millionième en volume !). A la surface du globe, il se trouve majoritairement lié à l'oxygène sous forme d'eau et donc certainement pas à l'état élémentaire, comme le prétendent indûment certains articles de presse. Les dérivés du pétrole et le méthane contiennent en proportions appréciables.

L'HYDROGÈNE EN TANT QUE COMBUSTIBLE

L'enthalpie molaire de combustion de l'hydrogène vaut :

- 286 kJ/mol si l'eau produite est condensée (PCS : pouvoir calorifique supérieur),
- 242 kJ/mol si l'eau formée reste à l'état de vapeur (PCI : pouvoir calorifique inférieur).

Nous retiendrons cette dernière valeur étant donné que, dans la majorité des techniques de combustion, l'eau est émise sous forme de vapeur.

A ce stade, il est intéressant de comparer le contenu énergétique de différents combustibles de manière à apprécier leurs qualités et leurs défauts. Le tableau ci-dessous donne l'énergie massique dégagée lors de la combustion de ces substances. La troisième colonne fournit le volume correspondant à 1 kg de quelques unes de ces substances.

Combustible	Energie massique (PCI en MJ/kg)	Remarques
Bois	14	
Charbons	20-30	
Dérivés liquides du pétrole		
Méthane[a]	42-44	1 kg ~ 1,3 L
Hydrogène[b]	55	1 kg = 1400 L
	124	1 kg = 11200 L

[a] Principal constituant du gaz naturel.
[b] Doit être synthétisé.

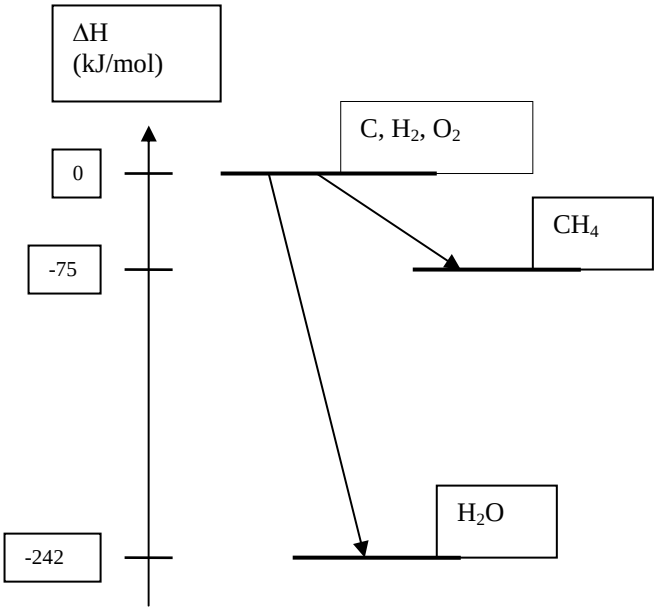
Une première remarque s'impose : les combustibles fluides sont beaucoup plus faciles à manutentionner, à transporter et à stocker que les combustibles solides. Deuxième remarque, les liquides sont beaucoup plus denses que les gaz : la densité énergétique par unité de volume est manifestement la plus élevée pour les dérivés du pétrole et ceci explique que ces combustibles liquides sont pratiquement irremplaçables comme source d'énergie pour les transports, en particulier pour les véhicules automobiles … qui doivent évidemment emporter leur réserve d'énergie ! Stocker le méthane, et surtout l'hydrogène, pour le transport automobile est une solution coûteuse qui impose l'utilisation de réservoirs particulièrement encombrants et lourds, solution qui nuit à l'économie énergétique du véhicule ainsi équipé.

LA SYNTHÈSE DE L'HYDROGÈNE

Nous l'avons dit, l'hydrogène ne se trouve pas à l'état libre sur terre: il n'est présent que sous forme combinée. Répétons que, à la surface de la terre, les molécules renfermant de l'hydrogène sont, en tout premier lieu, l'eau et, en moindre quantité, les hydrocarbures (HC), en ce compris le méthane (CH_4). Le problème de la synthèse de H_2 est donc d'extraire cet hydrogène des molécules d'eau et d'HC par un procédé qui ne soit pas trop gaspilleur d'énergie. De ce point de vue, trop souvent passé sous silence, il importe de bien situer les deux types de molécules hydrogénées sur une échelle d'énergie. Nous reportons ci-dessous un diagramme qui situe le niveau d'enthalpie de l'eau et du méthane (un HC idéal !). Dans ce diagramme, le niveau zéro est, par convention, attribué aux éléments constitutifs des molécules considérées (H_2 et $C_{graphite}$ pour le méthane ; H_2 et O_2 pour l'eau). Les molécules H_2O et CH_4 sont alors reportées au niveau (négatif) correspondant à l'énergie ΔH_f *qui se dégage* lors de leur *formation* (au départ des éléments). Soit donc les réactions de formation :

pour l'eau : $H_2 + \frac{1}{2} O_2 \rightarrow H_2O \quad \Delta H_f = -242$ kJ/mol

pour le méthane $C_{graph.} + 2\ H_2 \rightarrow CH_4 \quad \Delta H_f = -75$ kJ/mol



La réaction de synthèse de l'hydrogène qui consiste à reformer les éléments au départ de H_2O ou de CH_4 est évidemment l'*inverse* des réactions de formation reportées ci-dessus :

à partir de l'eau : $H_2O \rightarrow H_2 + \frac{1}{2} O_2$ $\Delta H = + 242$ kJ/mol

à partir du methane : $CH_4 \rightarrow C_{graph.} + 2 H_2$ $\Delta H = + 75$ kJ/mol

Les énergies *à fournir* pour ces opérations sont donc, *au minimum*, égales à celles qui se dégagent lors de la formation de ces molécules.

Manifestement, il est plus difficile, plus "énergivore" de sortir l'hydrogène de son "puits de potentiel" H_2O que de CH_4 ! Voyons d'abord quelles sont les méthodes les plus faciles pour synthétiser l'hydrogène, à savoir, à partir d'hydrocarbures. Dans un premier stade, la réaction de l'eau avec le carbone nous servira pour comprendre la réaction de synthèse de l'hydrogène à partir du méthane.

LE VAPOREFORMAGE DU CHARBON

Il s'agit d'une réaction dont le principe est connu de longue date : elle produit ce que l'on a longtemps appelé le « gaz à l'eau » ou « gaz de ville » : elle se réalise sur du charbon, en première approximation, considérons que celui-ci n'est constitué que de carbone:

Etape 1. $C + H_2O_{(g)} \rightarrow CO + H_2$ $\Delta H_1 = + 132,5$ kJ

La réaction est endothermique : elle exige donc un apport d'énergie thermique qui sera éventuellement fournie par l'oxydation en CO_2 d'une partie du carbone investi dans le processus. Ce CO_2 va évidemment diluer le gaz de synthèse et en réduire le contenu calorifique. Par ailleurs, la présence de CO dans les produits rend le gaz de ville très toxique. Il est indésirable pour des raisons de sécurité, mais aussi parce que, dans certaines applications novatrices, il perturbe gravement le fonctionnement des catalyseurs, par exemple, dans la pile à combustible proposée pour alimenter en électricité le moteur automobile. On préfère donc poursuivre l'opération en faisant réagir le monoxyde, à nouveau avec l'eau :

Etape 2: $CO + H_2O \rightarrow CO_2 + H_2$ $\Delta H = - 40$ kJ

L'exothermicité importante de l'oxydation du monoxyde en dioxyde ($\Delta H = - 283$ kJ) compense l'endothermicité de la décomposition de la molécule d'eau ($\Delta H = + 243$ kJ). En fin de compte, la réaction globale se représente par:

Etapes (1 + 2) $C + 2 H_2O \rightarrow CO_2 + 2 H_2$ $\Delta H_{glob.} = + 93$ kJ

qui doit donc être alimentée par un apport d'énergie.

LE VAPOREFORMAGE DU MÉTHANE

Le méthane (CH_4) est, par atome de carbone, l'hydrocarbure le plus chargé en hydrogène (H/C = 4). Son vaporeformage fournit les meilleurs rendements en hydrogène dans la panoplie des hydrocarbures existants. En reprenant strictement le schéma des réactions présentées pour le charbon, nous avons:

$CH_4 + H_2O \rightarrow CO + \mathbf{3}\, H_2$ $\Delta H = + 207$ kJ

Et, pour le « shift » à l'eau,

$CO + H_2O \rightarrow CO_2 + H_2$ $\Delta H = - 40$ kJ

Au total donc :

$CH_4 + 2 H_2O \rightarrow CO_2 + \mathbf{4}\, H_2$ $\Delta H = + 165$ kJ

On produit ainsi **quatre** molécules d'hydrogène au départ d'**une** seule molécule de CH_4 et de trois molécules d'eau. Cette production s'accompagne de la formation d'**une** molécule de dioxyde de carbone. *En théorie* donc, on peut espérer synthétiser 8 g d'hydrogène (4 moles) moyennant production de 44 g de CO_2 (1 mole): soit dans un rapport massique $CO_2/H_2 = 11/2$. En pratique industrielle, on atteint un rapport de 11/1, qu'il faut comparer à ce que peuvent donner les fractions lourdes du pétrole, à savoir, un rapport de 15/1. L'énergie à fournir pour le déroulement de la réaction amène le rendement énergétique du vaporeformage du méthane à 70 %. Les 30 % de perte sont le prix à payer pour cette synthèse qui, bien entendu, aboutit à fournir un combustible exempt de carbone (H_2) et donc susceptible de brûler sans (trop) polluer … si l'on excepte la production de CO_2 lors de la synthèse de H_2.

La mise au point de la synthèse de l'ammoniac par Haber et Bosch propulsa l'hydrogène parmi les éléments les plus importants de l'industrie chimique. Dès 1913, date de la première réalisation de synthèse industrielle de NH_3, l'hydrogène était produit majoritairement par vaporeformage du charbon. Quelques pays dans le monde, favorisés par leur orographie, se permettaient de produire l'hydrogène par électrolyse de l'eau[1]. Cependant, le coût énergétique de l'électrolyse la fait actuellement régresser au second plan, loin derrière le vaporeformage du méthane qui se révèle beaucoup plus compétitif, aux dépens, bien sûr, d'une réserve d'énergie fossile !

L'ÉLECTROLYSE DE L'EAU

La réaction qui se déroule dans la cellule d'électrolyse est très simple dans son écriture : elle est dissociée en deux étapes qui se déroulent au contact de deux électrodes appelées anode et cathode, alimentées par un générateur d'électricité (courant continu) :

à la cathode : $2\ H^+ + 2\ e^- \rightarrow H_2$

à l'anode : $2\ OH^- \rightarrow 2\ e^- + ½\ O_2 + H_2O$

Les électrons sont donc transférés de l'anode à la cathode via un circuit externe alimenté par une source d'énergie électrique. Celle-ci active les deux demi réactions sous courant continu à un potentiel *minimum* de 1,8 volts et sur des électrodes de *platine*.

Si elle est réalisée sur de l'eau épurée, l'électrolyse fournit un hydrogène très pur, d'un grand intérêt dans quelques applications bien ciblées, dans l'industrie, en laboratoire, ou pour l'hydrogénation des huiles végétales en margarine. Le coût énergétique, bien sûr, est à la mesure de la qualité du gaz produit : il se monte à une dépense comprise entre 4 et 5,2 kWh d'électricité par m^3 d'hydrogène produit. Pour les besoins de la discussion, nous prendrons en compte une valeur moyenne (optimiste) de 4,6 kWh/m^3. Il vaut évidemment la peine de mesurer tout l'impact de cette dépense d'énergie et du dégagement de CO_2 qu'elle peut impliquer lors de la production de l'énergie électrique. Et, de ce point de vue, il faut bien se rendre compte que, d'un pays à l'autre, les conclusions que l'on peut émettre sur la validité de la méthode peuvent être fort différentes suivant le mode de production de l'électricité. La situation la plus favorable, bien évidemment, se rencontre dans les pays à forte pénétration d'énergie hydraulique, nucléaire ou renouvelable (géothermie).

[1] Ce fut le cas de la Norvège qui attira la convoitise des Nazis car un des sous-produits de l'électrolyse de l'hydrogène, l' « eau lourde », se révélait un excellent modérateur de neutrons dans les réacteurs nucléaires.

Nous allons déduire un facteur d'émission de CO_2 si l'électrolyse devait être appliquée sur une large échelle en Europe. Les hypothèses sous-jacentes sont les suivantes :

* rendement de la production d'électricité : 33 à 40 %,
* consommation d'énergie électrique : 4,6 kWh par m^3 d'hydrogène produit,
* facteur d'émission moyen de CO_2 en Europe pour la production d'électricité : 389 g_{CO2}/hWh

Si on considère le m^3 d'hydrogène à pression et température normales (PTN : 0°C et 101.300 Pa, soit 1 m^3 = 44,64 moles = 89,3 g), l'énergie électrique à fournir à l'eau liquide pour obtenir l'hydrogène se monte ainsi à 10.586 kJ par m^3. Malheureusement, de l'énergie est gaspillée sous forme de chaleur durant l'opération et, nous l'avons dit, il faut compter sur environ 4,6 kWh pour électrolyser la quantité d'eau liquide requise, c'est à dire avec un rendement réel de 64 %. Il y a peu de commentaires à ajouter, sinon que, au départ de, disons, 40.000 à 50.000 kJ d'énergie thermique fournie par des combustibles classiques, on produit un peu moins de 13.000 kJ d'énergie chimique sous forme de H_2 !

Le point sensible du débat porte évidemment sur les quantités de CO_2 qu'il faut consentir à émettre pour produire l'hydrogène. Trop de publications assurent que l'utilisation d'hydrogène, en tant que vecteur énergétique (« source d'énergie » est à bannir), se fait sans émission de GES. C'est *faux* dans la majorité des cas puisque, en définitive, le bilan dépend du processus par lequel l'hydrogène aura été synthétisé. Les facteurs d'émission des différentes voies de synthèse, exprimés en kg de CO_2 déversés dans l'air, par kg de H_2 produit sont les suivants :

par vaporeformage (VR) du méthane, 11 kg
par VR de fractions lourdes du pétrole 15 kg et
par électrolyse de l'eau, l'émission moyenne *théorique* en UE est de 20 kg.

Ce dernier chiffre est effectivement tout théorique car il ne tient pas compte des exigences pratiques dans la mise en œuvre de l'électrolyse (compression des gaz, d'épuration de l'eau …), en définitive, une émission moyenne de **30 kg de CO_2** par kg d'hydrogène est plus conforme à la réalité industrielle.

CONCLUSIONS

Le vaporeformage du gaz naturel se révèle la technique de synthèse la plus économique et, bien entendu, cet argument, à lui seul, explique la disproportion qui se marque dans le choix actuel de la filière de production de H_2 à l'échelle mondiale : 4 % par électrolyse – 96 % par reformage du méthane. On comprend aisément le choix des industriels. Bien entendu, il existe des situations favorables à l'électrolyse : c'est vrai pour des régions gratifiées d'un parc important de centrales nucléaires ou d'une hydroélectrocité abondante et, dans ces cas-là bien sûr, il faut revoir les facteurs d'émission au cas par cas. Nous avons déjà relevé l'exemple de la Norvège. On comprendra aisément que des pays comme la Suède, l'Islande et le Canada s'activent à mener des recherches intensives sur l'utilisation de l'hydrogène comme vecteur énergétique ! Mais de là à préconiser une généralisation de l'hydrogène en tant que combustible "propre", il y a un pas que l'auteur se refuse à franchir. D'autres techniques de synthèse font l'objet d'études intensives : citons, par exemple, la décomposition thermique de l'eau à des températures de l'ordre de 1000°C. L'hydrogène et l'oxygène formés à ces températures doivent être séparés par diffusion préférentielle de H_2 à travers des membranes métalliques (Pd). Un réacteur nucléaire refroidi par un gaz inerte

pourrait fournir l'énergie nécessaire. Ces recherches n'en sont encore qu'au stade de la recherche. Il faut espérer un aboutissement proche !

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HIDROGENUL, VECTOR ENERGETIC PENTRU VIITOR ?

(Rezumat)

Higdrogenul cunoaşte un interes special ca potențial vector energetic. Numeroase publicații cu caracter ştiințific evidențiază calitățile sale care pot să-l relanseze pe piața energiei. Lucrarea evidențiază aceste calități ale hidrogenului, dar şi defectele posibile.

In prezent produccția de hidrogen la scară mondială se repartizează astfel : 4% prin electroliză şi 96 % prin cracarea metanului. Alte tehnici de obținere a hidrogenului fac obiectul unor studii intense ; este menşționată de exemplu descompunerea termică a apei la temperaturi de 1000 0 C. Hidrogenul şi oxigenul rezultat la aceste temperaturi trebuie să fie separați prin difuziune preferențială prin traversarea de membrane metalice (Pd). O astfel de descompunere ar putea avea loc prin răcirea miezului reactorului nuclear. Astfel de cercetări nu sunt decât în stadiu experimental. Se speră la o finalizare curândă a acestor cercetări, care se doresc cu rezultate practice pozitive.

AN EVOLUTIONARY GEOGRAPHY OF ENVIRONMENTAL AND SOCIAL JUSTICE

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Abstract An evolutionary geography of environmental and social justice. The first part of the paper builds on evolutionary biology and psychoanalysis to outline a model of human nature which maintains that humans are a species with inborn potential for both good and evil. Based on this model, the second part explains the central role played by envy in signaling inequality within and between the environments we create around us. The third part of the paper explains why environmental and social justice cannot exist without envy and delineates seven societal strategies for dealing with envy. The conclusion will pull the threads of the paper together, to suggest that a biologically-informed geography provides novel and deeper insights on the causes and consequences of egalitarian sentiments and policies.

Key words: *micro-geographies, evolutionary biology, inequality, envy, environmental and social justice, individual and group differences*

INTRODUCTION

> *The appeal to justice is often a mask for envy. (John Rawls, 1973: 540)*
> *How relaxed are we about seeing our sense of justice based on envy? It seems we are now accustomed to God being dead, but would be reluctant to admit that social justice is dead. (John Forrester, 1998: 146)*

One of the greatest things that Freud taught us is the fact that we are motivated to see reality through rosy glasses. Bare reality is too cruel and harsh for humans to endure. We are more selfish than we would like to accept. We are closer to animals than we are willing to concede. Freud praised the courage of those people who had the ability to take off their rosy glasses and confront reality as it is. At first glance, it might look like the scientific community is made of such people. However, upon closer examination, it becomes apparent that there is a significant amount of residual positive delusions even among the most respectable scientists. Although our job is to find and disseminate the naked truth, the actual scientific practice remains more ideological than we would like to believe (Simandan, 2002, 2005a, 2005b). Very often we embellish the truth, by presenting only the acceptable parts of it. At other times, we stay away from finding the truth, because our intuition tells us that what we are likely to discover will be dangerous knowledge. And because of that, we avoid digging deep enough and content ourselves with shallow investigations. At the heart of this coward attitude is fear. There is the fear that one will be stigmatized by colleagues and by the media for making outrageously unpleasant claims. And, then, there is also the fear about the negative consequences for social well-being of widely disseminating dangerous truths. The first type of fear is selfish and petty. The second type is an expression of responsibility and wisdom. But both types keep us further away from the task society pays us to do: the pursuit of the truth (Johnston & Sidaway, 2004). It might be the case that society does not benefit as much as we think it does from being told pleasant lies. It might be that true wisdom cannot

follow from lack of intellectual honesty. These latter doubts about what we do as scientists pushed me to write this paper. It may feel like a cold shower, but cold showers have several positive effects. Chief among them is the fact that the improved circulation makes the body more alive. And if this is so, there is the corresponding chance that this paper will enliven the body of geographical theory in unforeseen ways.

The argument I want to put forward is that the emotion of envy is at the very heart of the human geographies we create around us. Envy is the emotion through which those who lost at the genetic lottery enhance their chances of reproductive success. Two mechanisms are responsible for this beneficial effect of an otherwise destructive emotion. The first of them is the creation of extra-friction for those who won too much at the genetic lottery. This extra-friction takes the form of progressive levels of taxation, anti-monopoly laws, and requirements such as monogamy. More stringently, I make the case that our stubborn delusion with the idea that all humans are equal results directly from the passion of envy. By framing all observed human inequalities as unfair, the deceptive idea of equality among humans creates a positive feedback loop that relentlessly increases both the intensity and the legitimacy of individual and collective envy. The political commitment for social justice is the translation into the moral and public sphere of the idea of equality among humans. In its turn, the commitment to social justice yields a set of practices such as redistribution, and the valuation of humility, tact and generosity, which have (a) the advantages of giving reparatory satisfaction to the envious and of keeping under tight control the risk of an upsurge in envy, and (b) the disadvantage of undermining excellence. Nevertheless, this disadvantage is partly overcome by the second beneficial mechanism of envy, namely the drive to emulate those we envy, and thus to keep intact our opportunities to spread our genes. The truly dark side of envy comes from the fact that although it enhances the reproductive fitness of those who lost at the genetic lottery, it is antithetical to what humans most want: happiness.

Although some philosophers such as Bertrand Russell have indeed noticed that “envy is the basis of democracy” (Russell, 1989: 64), my argument draws primarily on psychoanalytical theory and evolutionary biology. In the first part of the paper, I explain the complementarity of these two bodies of theory and the ways in which they enable us to move beyond the positive illusions of the “standard model of social science” (Cosmides & Tooby, 2006), for a dispassionate and honest consideration of the dark side of human nature. The second part of the paper traces the micro-geography of envy and unravels its intricate relation with the practice of social comparison and the Darwinian struggle for reproductive success. This analysis will then lead, in the third part of the paper, to an understanding of the ideal and practice of social justice as an envy-mediated adaptive solution to the collective problem of the unfairness of the genetic lottery. Finally, the conclusion will dwell on how the taking into account of envy requires the anxiety-inducing habit of telling the truth as it is, but ultimately pays off dividends by enhancing the honesty of geographical scholarship (Johnston & Sidaway, 2004) in a number of significant ways.

PSYCHOANALYTICAL AND EVOLUTIONARY REAPPRAISALS OF HUMAN NATURE

Passions which work havoc in private life work havoc in public life also. (Bertrand Russell, 1989: 71)

The social sciences have entertained the idea that all humans are equal, as part of a broader conception of human nature that is now being referred to as the standard social science model of human nature (Buss, 1999; Cosmides & Tooby, 2006). The origins of this model reach back to the work of Jean Jacques Rousseau and his romantic idea that humans are born good, but lose their goodness because of the process of socialization (Rousseau, 1762/1979). What psychoanalysis and evolutionary theory have in common is their departure from the standard social science model and their agreement on a number of significant tenets about what makes us human. In what follows, I will mention these tenets and explain the conflict between them and the idealistic conceptualization of human nature in the social sciences.

The standard model assumes that humans are born with no genetic predispositions and that their brain is a blank slate or *tabula rasa*. This assumption entails the claim that at birth all people are equal and that later differences between people are the result of the play of social forces (Pinker, 2002). In other words, humans are 100% socially determined. If somebody becomes wealthy, it is not because she was born smart, but because she grew up in a privileged family, who provided her with the intellectual and social resources that allowed her to succeed. Conversely, somebody who ends up in jail is the passive victim of a set of social factors such as disorganized family, socialization in the wrong peer group, or lack of job opportunities, and not a psychopath born with an excessive amount of aggressive tendencies (Pérusse & Gendreau, 2005). Both psychoanalysis and evolutionary theory reject this assumption and argue that individuals are born unequal. Their particular biological endowment explains a large part of their way of navigating life. However, there is a difference of emphasis on this point between psychoanalysis and evolutionary theory. Traditional Freudian psychoanalysis admitted a role to biological predispositions, but argued that the family environment exerts a massive influence on the child (Freud, 1940). A child born in a normal, healthy family will have a different fate from a child born in a disorganized family. As he studied adults troubled by mental diseases, Freud sought to explain their malfunctioning by exploring their memories of their early childhood. Thus, an obsessional adult was usually explained in terms of a too severe toilet training in childhood, and a hysterical person was normally explained by recourse to some real or imagined sexual abuse in her early years. However, a careful reading of Freud makes it very clear that he admitted that these explanations were provisional and speculative and that certain biological predispositions might actually be the ultimate cause of disease (Freud, 1940). What we do know now from the field of behavioral genetics (Plomin, 2004, Harris, 2006) is that we are born unequal and predisposed towards particular preferences and behaviors. All facets of personality as well as one's level of intelligence are at least 50% heritable. What is even more damaging to the standard model of the human in the social sciences is the fact that the heritability of intelligence and personality increases as we grow older. The older we get, the more free we become to do what we actually want (i.e. what our genes predispose us to prefer). If in childhood our true genetic penchants were distorted and controlled by parental pressure, later on these social pressures stop exerting their

influence and the share of genetic influence increases steadily until one's late adulthood (Plomin, 2004). Not only that we are born unequal and with different genetic predispositions, but as time goes by and genes with late onset start expressing themselves, we grow closer and closer to our true DNA.

The second point of departure from the social science model and the most important for our subsequent discussion of envy refers to the fact that both psychoanalysis and evolutionary theory dismiss *the myth of the Noble Savage* (Pinker, 2002). People are not born all good and become evil because of unhealthy social forces operating on them. People are born with potential for good and evil. We are essentially selfish beasts interested in improving our lot in life (Freud, 1930/1989). We know now that there are genes for aggression (Pérusse & Gendreau, 2005) and that Freud was right in saying that the task of society is to tame this potential for aggression by sublimating it into socially acceptable things such as ambition, humor, and competition. In his mature theory of human nature, Freud (1940) captured the complex interplay of good and evil in our psychic life by postulating the existence of two dialectically opposed drives: Eros, or the life drive (our tendency to bond, to love, to cooperate, to empathize, etc) and Thanatos, or the death drive (our aggressive tendency, including emotions such as envy, jealousy, resentment, scorn, hatred, and anger; Raulet, 1998). If in its early days (Darwin, 1872/1998), evolutionary theory took a primarily negative view of human nature, more recently researchers in the field (Buss, 1999; Cosmides & Tooby, 2006) admit that we are born with potential for both good and evil, and that both of these potentials have adaptive value. The admission of an evil side to human nature demolishes the hopes of the social sciences in general and of Marxist theorists in particular about the creation of a peaceful utopian world, where everybody is equal and fraternity reigns. Society will always be a precarious achievement and the prospects of violence, war, aggression, and conflict will always lurk just below the appearance of harmony and civilization (Raulet, 1998; Di Chiarra, 2004).

Thirdly, both evolutionary theory and psychoanalysis dismiss the assumption of *the mind/brain dualism and the illusion of conscious free will* and replace these comforting myths with a courageous emphasis on the fact that we are driven by brain processes beyond our conscious awareness (Wegner, 2002). The standard social science model embraces the Cartesian notion of a mind based on, but distinct from, the brain. In metaphorical language, the model conceives some sort of homunculus inside the brain, some sort of driver who has the power to control the brain. That homunculus is "us" – our sense of self-awareness, our experience of consciousness, our experiencing of qualia (e.g. the conscious experience of the redness of red when we see red). Until recently, the social sciences were able to get away with this theoretical model. Although Freud went at great lengths to explain the fact that we are driven by unconscious forces, his arguments have not radically challenged the standard model because for decades it has been easy to dismiss them as mere speculations. It is the swift progress of neuroscience and experimental psychology beginning with the early 1990ies that has vindicated Freud's initial insights (Wegner, 2002). As evolutionary theorists, neuroscientists, experimental psychologists, and philosophers of the mind make sense of the ongoing stream of information from brain research, a very clear fact emerges: there can be no such thing as a mind independent from the brain, or a homunculus able to direct the function of the brain. There is nothing but the brain. The subjective feeling of conscious will and the feeling that there is a homunculus or driver directing our thought are just properties of the brain (Pinker, 2002). The moral implications of these findings remain to be fully spelled

out, but at the very least they compel a reassessment of the question of individual responsibility.

The fourth point of departure from the standard model refers to *the centrality of sexuality* in both the psychoanalytical and the evolutionary theorizing of human nature. Writing in the first decades of the 20th century, Freud scandalized public opinion by claiming that even our most refined and noble activities are nothing but sublimations of sexual energy. The human beast derives the greatest gratification from the direct satisfaction of her sexual urge, but because civilization is incompatible with boundless sexual expression, the human beast is tamed to express her libido in indirect ways, such as literature, art, science, caring, sports, and friendship (Freud, 1930/1989). It is true that the specifics of Freud's theory, and especially his focus on the oedipal triangle, have not found robust support in recent research (Harris, 2006). Nevertheless, the underlying idea of the centrality of sexuality to what makes us human has been powerful enough to resist the test of time. It is on this fundamental idea that psychoanalysis and evolutionary theory agree. At the level of specifics, the two schools of thought part company, but this should not detract from understanding their mutually reinforcing power to dismantle the edifice of the standard model.

The fifth element on which evolutionary theory and psychoanalysis meet each other refers to the stipulation of the *inherent conflictual nature of our mental life*. Freud believed that our activities are the result of the fight between three psychic instances (Freud, 1940): the id (the unbridled natural beast in us, driven solely by the pleasure principle), the super-ego (the moral conscience implanted in us by parents and society), and the ego (the arbiter of the fight between the id and the super-ego, guided in its decisions by the reality principle). Evolutionary theorists suggest that our behaviors are the consequence of the interplay of several inborn modules, such as the language module, the novelty module, the relationship module, the socialization module, and the status module (Buss, 1999; Harris, 2006). Both theories undermine the standard model of the human in the social sciences by pointing out that we do not have unitary minds and that the mind is not some general purpose device. The emphasis on conflict between instances (Freud) or modules (evolutionary theory) suggests that we are forever condemned to be tormented by our inner struggles and that, therefore, happiness will always remain elusive to the members of our species (Haidt, 2006).

The sixth and final point of departure from the standard social science model consists in the rejection of the fact that we stand somehow above ordinary nature and the courageous acceptance of our *animality*. The social order is just a specific type of the animal order. Human nature is just an example of animal nature. There is no massive discontinuity between civilization and nature (Whatmore, 2002), and the fact that we share 98.5% of our genes with the chimpanzee (Pinker, 2002) gives a brutal quantitative understanding of this state of affairs. As evolutionary theorist Satoshi Kanazawa (2004) suggests, the implications of accepting our animality are unsettling, but ultimately progressive. The social sciences must accept the fact that they are branches of biology. Human geography must redefine itself as a component of biogeography. Social scientists and human geographers need to acquire biological literacy. We are not born *tabula rasa*, but with genetic predispositions. We are not noble savages, but animals who struggle with one another to spread their genes. We do not control ourselves, but are driven by largely unconscious biological urges. Sexuality is not one among the many components of life, but the central component from which all the others derive. We are not programmed to be blissfully happy, but to struggle continually to better our chances of

reproductive success. We are not apart from the animal kingdom, but a part of it. Against this theoretical background, we can now move on to the next section, to consider the origin and development of envy, and to understand why is it that "the instability of social status in the modern world, and the equalitarian doctrine of democracy and socialism, have greatly extended the range of envy" (Russell, 1989: 70).

THE MICRO-GEOGRAPHIES OF ENVY

> *I have myself seen jealousy in a baby and know what it means. He was not old enough to talk, but whenever he saw his foster-brother at the breast, he would grow pale with envy…surely it cannot be called innocence, when the milk flows in such abundance from its source, to object to a rival desperately in need and depending for his life on this one form of nourishment? Such faults are not small or unimportant…(St. Augustine, in Forrester, 1998: 133-134).*

We all have a little devil in us. In Christianity, the theorization of our dark side took the form of the doctrine of the original sin. The opening quote of this section captures the essence of the micro-geographies of envy. Although the elder sibling has just been fed, he nevertheless feels envy when he sees his younger sibling being nourished. They are brothers, there is plenty of milk available, and there is no reason to conceive this primal scene as a zero-sum game, where one's win is another one's loss. But there is no place for reason at that early stage in life, nor is it much place for it later on (Pinker, 2002). We are driven by our passions, good or bad (Thrift, 2003, Simandan, 2006a). Psychoanalysts ranging from Sigmund Freud (1921/2004) to Melanie Klein (1957/1997) have paid particular attention to the fate of the passions in the early years of human life. In analyzing the micro-geography of the mother with two children, Freud observes that humans are not born social animals. They become social animals because of social constraints imposed upon them (Freud, 1921/2004). The first, genuinely natural, reaction of the older sibling is to grow pale with envy at the sight of the nourishment of his brother. Because this reaction is totally unjustified and because the older sibling knows that his parents love his younger brother as well, he unconsciously transforms the original feeling of envy into its very opposite: brotherly love. This way he can deal with the original energetic load of the affect of envy without risking the rejection of his parents. In psychoanalysis, the transformation of one emotion into its very opposite because of social pressures goes under the name of reaction formation (Freud, 1940). Thus, excessive cleanliness is a reaction to unconscious passion for dirt, generosity is a reaction to unconscious selfishness, and fraternity (or social sentiment or team spirit) is a reaction against envy. The fact that envy is natural and comes before positive social sentiments such as fraternity raises several questions from the point of view of evolutionary theory. If evolution has endowed us with those emotions useful for the struggle for survival and reproduction, and envy is part of that natural endowment, what is the usefulness of envy? Furthermore, if Freud was right in seeing the feeling of fraternity and community as a reaction formation to envy, why is it that the process of conversion is never fully complete? Why do we still consciously feel envy later on in life, instead of always transforming it into fraternity and love? The following remarks (Greene, 2000: 405) will help us in answering these intriguing questions:

> The human animal has a hard time dealing with feelings of inferiority. In the face of superior skill, talent, or power, we are often disturbed and ill at ease; this is because most of us have an inflated sense of ourselves, and when we meet people who surpass us they make it clear to us that we are in fact mediocre, or at least not as brilliant as we had thought. This disturbance in our self-image cannot last long without stirring up ugly emotions. At first we feel envy: If only we had the quality or skill of the superior person, we would be happy. But envy brings us neither comfort nor any closer to equality. Nor we can admit to feeling it, for it is frowned upon socially – to show envy is to admit to feeling inferior…So it goes underground. We disguise it in many ways, like finding grounds to criticize the person who makes us feel it: he may be smarter than I am, we say, but he has no morals or conscience. Or he may have more power, but that's because he cheats. If we do not slander him, perhaps we praise him excessively – another of envy's disguises.

The clue in this quote is inferiority. We become aware of our inferiority through the experiencing of envy (Schoeck, 1987; Smith, 2004). The feeling of envy is the tool provided by evolution to alert us to the situations in which others are better than we are. Although humans have to cooperate in order to defend themselves against the ravages of nature or of competing tribes (nations), they also have to compete *within* each group for reproductive success. Reproductive success in human communities is mediated by status (Buss, 1999; Kanazawa, 2004). If one is rich or smart or strong, one has status, and thus becomes an attraction for the females who are motivated to mate with males who are able to provide enough resources for child rearing.

When we feel envy, we know that we are loosing status because somebody else is winning status.

This emotion triggers a call to action to prevent our further loss of status, and thus the loss of chances to spread our genes. The action we may take is of two kinds. On the one hand, we can try to improve our reputation by emulating our competitors and proving that we are as good as or even better than they are. If Harry's neighbor, Mr. Jones, buys an expansive car, Harry can use his envy to propel him to save money and buy an even better car. On the other hand, we can create extra-friction to slow the social ascension of our competitors. Thus, Harry can go at night and scratch with a stone Mr. Jones' new car. However, as Krebs and Denton (2005: 642) remind us in their new theory of morality, "people may use moral judgments for immoral purposes". Thus, rather than scratching Mr. Jones' car, Harry can be more devious and ruin his reputation by subtly spreading the gossip that Mr. Jones is cheating on his wife with another man and that this other man is the one who actually paid for the car.

Whichever of the two kinds of action one takes, the result is likely to improve one's relative social standing and hence one's chances of reproductive success. But there is more than meets the eye. People learn as they grow up that too much success will attract the enmity of the others and the very fear of the "Evil's Eye" moderates their desire for success. This moderating effect operates through self-regulation at two levels. The first is conscious, and consists in either the concealment of one's success, or in the setting of goals below one's potential. Because "envy…consists in seeing things never in themselves, but only in their relations" (Russell, 1989: 68), by concealing his success, Mr. Jones does not allow Harry to infer his inferior relation to Mr. Jones, and thus to experience envy. Instead of buying a car that would stir his envy, he could buy a cottage

and never tell him about it. Alternatively, he might conceal his success from Harry by leaving that poor neighborhood and moving into an area where Mr. Jones' level of success is matched by the whole neighborhood. The downside of this alternative resides in Mr. Jones' being deprived of the subjective pleasure of knowing and showing that he is the best in the whole neighborhood. Evolution endowed us with experiencing positive emotions for those things that enhance our reproductive success and the blissful experience of standing out from the crowd is a case in point. The other route one can choose at the conscious level is the deliberate setting of one's goals below one's true potential. To give an example, if Mr. Jones is much better at basketball than Harry, he could opt to win at a moderate difference in order to prevent him from experiencing envy and humiliation. Although Mr. Jones has the possibility to score many points, he lets Harry save face and thus preserves his friendship. In other words, evolution instilled in us the required mechanisms for balancing two equally important tasks: the task to stand out and the task to fit in (Harris, 2006). Those who are tall poppies and want to grow even taller risk being excluded, and thus loosing any chance for reproductive success (it takes two to have a baby). By moderating their ambitions, they sacrifice some improvement in status for the acceptance of their community.

But I suggested before that this moderation operates at two levels, really. So far, the focus has been on the conscious level. The second level of analysis concerns the unconscious. The psychoanalytical literature (Di Chiarra, 2004) has paid attention to the fact that very often achievement of success is followed by the worsening of mental well-being. The reason is the unconscious fear of the Evil's Eye and the secret belief that one's success will soon be lost because at bottom it has been undeserved. The media fuel this process of self-sabotage by feeding the eye with images of people who starve, who are at war, who have been hit by misfortune, and by bathing the ear with an egalitarian discourse that looks down on selfishness and egocentrism and praises generosity and selflessness. Freud was naïve to imagine that the guilty conscience comes solely from early childhood; the present discourses that surround us are equally responsible for the sense of guilt of the wealthy. Although these egalitarian discourses undermine the happiness of the wealthy, they are useful for collective well-being by pushing those well-off towards charity and volunteering (i.e. acts of undoing the sin of their success).

In several of the examples given as I traced the micro-geographies of envy, the chief concern has been with how the successful (Mr. Jones) deals with the actual or potential envy of the looser (Harry). But before moving to the next section to discuss the dialectic of envy and social justice at the societal level, we need to pay attention to how the envious himself experiences envy. How about Harry' feelings? Why does he go so far so as to scratch his neighbor's marvelous car and to spread vicious gossips about him? Where does all that destructive passion come from? John Forrester (1998: 135) provides us with a very clear answer:

> The awareness of the object envied and the awareness of one's own failure, one's own emptiness, go hand in hand; they are inseparable. Envy…the most 'sociable' of the passions…reveals one's fundamental failure in relation to the world, at the very moment where it reveals the causally linked success of another.

The person most dear to each of us is ourselves. Freud uses the concept of "primary narcissism" to emphasize this natural egocentricity and to make the point that all other forms of love (erotic love, love for one's friends, parental love, and love for one's

profession) are the result of the projection of some of our initial libido onto an external object. One's child, one's lover, and one's hobby are all love-objects, i.e. external items that have been narcisistically invested by the subject. That investment is fragile. In Freudian terminology, if I lose my interest in something, I am withdrawing my libido from that item back into myself (Freud, 1940). When Harry sees his neighbor win, his narcissism is wounded. When our narcissism is wounded, we reveal our dark side (Di Chiarra, 2004). We regress to a more primitive self that is concerned with the reassertion of our narcissism, no matter what. The dark passions of envy, hatred, fury, and anger give us the energy to fight back and to reassert our self-esteem, but the price to pay for that increase in energy is the clouding of our better judgment and the uncovering of our antisocial self (Smith, 2004). These latter processes explain why Harry, an otherwise nice neighbor, lowers himself so much so as to scratch Mr. Jones' car without any trace of guilt. When Mr. Jones bought the car, he wounded Harry and lowered his reproductive chances by implicitly telling everybody that he is a better male than Harry. When Harry scratches Mr. Jones' car, he merely *reciprocates* what Mr. Jones did to him. In his eyes, he feels good about himself because vengeance – one of the passions through which envy keeps us equal – has adaptive value and we feel good when we do things that increase our chances for life and reproduction (eating, mating, winning, etc).

The evolutionary fact that whenever we win, we force our competitors to lose would prevent the emergence of peaceful communities. Everybody would be at war with everybody else (Raulet, 1998). By the introduction of the norms of social justice within each community, a relatively peaceful collective life and a sense of place (Thrift, 1999) become possible. However, our destructive tendencies (the death drive) do not disappear because of a mere commitment to social justice and egalitarianism. The safest way to deal with aggressive drives for any given community is to direct them outside that community in the form of hatred, envy, or fury against a common external enemy. As I am going to show next, from the local to the global, envy requires social justice, and social justice requires envy. We are not born to want to be equal, but we are born to want to have nobody better off than ourselves.

SEVEN SOCIAL STRATEGIES AGAINST ENVY

> *What is subsequently found to operate in society as community spirit…undeniably springs from an original envy. No one should seek to stand out; all should be and possess the same. The implied meaning of social justice is that a person denies himself much in order that others, too, shall have to deny themselves as much. (Freud, 1921/2004: 75)*

In the preceding sections, I outlined several strategies that the envious and the envied use in order to cope with this shameful emotion. Each strategy may work in some contexts, and fail in other contexts. When we move up the scale of geographical analysis from the individual to the level of communities and societies, it becomes apparent that the aforementioned strategies involve some limitations and some trade-offs. In what follows, I propose seven strategies through which societies deal with envy and explain their broader implications for social and economic life.

The first strategy is the social offering of *multiple avenues for standing out*. Given the fact that people are born with different gifts and passions, it stands to reason that the

most effective way to tame envy is to allow each person to shine at what she does best and to make it clear through a reward system that the thing at which she stands out is socially valued. One can excel in intellectual endeavors, in music, sports, drama, painting, beauty, empathy and generosity, sexual prowess, industriousness, business talent, political acumen, bravery, or sense of humor. The individual who is socially appreciated for being above average in a given domain may be less likely to feel envy towards those good at other things, by over-valuing the domain of her excellence and de-valuing the other domains. Thus, somebody who is unanimously seen as the bravest kid in the neighborhood is also inclined to consider bravery the most important thing in the world and to look down at what he sees as others' "trivial" strengths in music or humor. The phenomena of over-valuation and de-valuation become amplified through the process of assortative mating. People good at sports will tend to make friends with other people good at sports and nerds will tend to befriend other nerds. Thus, their private acts of over-valuation resonate with the views of their group and this virtuous circle of prejudiced agreement reassures them of their superiority. The problem with the first strategy is that very often the genetic lottery operates according to the "feast or famine" principle (Plomin, 2004). Those who are smart tend also to be more beautiful (Kanazawa & Kovar, 2004, Luxen & Buunk, 2006) and to have a heightened sense of humor (Jensen, 1998). Conversely, there are individuals affected by an unusually high load of damaging mutations, which have pervasive negative consequences for their chances to live a fulfilling life (Leroi, 2003). As Judith Rich Harris explains (2006: 246):

> Humans have many ways of finding something to be good at but the limits put on them by their genes and their environment make some choices impractical, and some individuals are constrained to pick from a smaller menu than others.

A further limitation of the first strategy comes from the objective fact that not all gifts and talents have the same amount of social significance. No matter how we try to hide it, general intelligence tops the list of socially significant assets because it makes a difference across the board of human activities and because the most desirable jobs in any society require a level of mental ability that only a small minority of individuals can reach (Jensen, 1998, Gottfredson, 2006, 2007). Because of this state of affairs "…the sorting out of individuals according to their ability is very nearly the most delicate and difficult process our society has to face" (Gardner, 1984: 84).

The second strategy for dealing with envy is, as suggested in the story of Harry and Mr. Jones, the *deliberate concealment* of inequality in wealth and well being. This strategy creates uneven urban geographies, with neighborhoods for those less intelligent or less wealthy (intelligence and wealth tend to be positively correlated, for both individuals, e.g. Jensen, 1998, Strenze, 2007, and nations, e.g. Whetzel & McDaniel, 2006, Hunt & Wittman, 2007, Rindermann, 2007), and gated communities for the very smart and/or very wealthy (Davis, 1990; see also Simandan, 2006b). Because envy is a passion of the sight (you are not envious if you do not see another's assets), this urban segregation prevents the explosion of envy and contributes to social peace. Writing on this point almost half a century ago, sociologist Michael Young (1961: 124) observes, in an unacceptably demeaning language, the benefit of concealing differences:

If…the stupid are kept together, they are not reminded at every turn of their inferiority. By the standards of the group in which they move and have their being they are, indeed, not stupid; here they are amongst their equals; they can even, in a modest way, shine in the display of their more commendable attributes. When they are amongst their equals, the great society does not press harshly upon them, nor resentments linger.

They have the respect of their fellows in their own intelligence grade. This class solidarity, provided it is not coloured with a rebellious ideology, can be…a most valuable aid to the cohesion of society.

The limits of this strategy have become apparent with the spread of the modern media, since the early decades of the 20th century. Modern media fosters a general trend towards increased social transparency (cf. Barnett, 2003). Even if Harry lives in a different neighborhood than Mr. Jones, he might still experience envy because he can watch at his TV the luxurious lifestyle that people in other neighborhoods enjoy. We live increasingly in a world where there is no place to hide and this puts a severe limit on all territorial strategies of segregation. While they might still work for securing the short-term peace of wealthy neighborhoods, they certainly fail to prevent the upsurge in envy among the destitute that are now forced by the media to keep aware of their inferiority.

The third strategy of envy prevention is a more radical form of concealment. Instead of hiding one's success, *one hides one's true potential*. The best way to prevent envy is by hiding one's success, and the best way to hide one's success is by not becoming a success in the first place. We can easily imagine a very bright teenager anxious to be accepted by her peers and to be desirable for potential mates. For her, the success brought by excellent grades would actually signify the failure to be accepted in the group and the failure to find a partner. If her hierarchy of values prioritizes social participation and erotic love above the cold loneliness of professional achievement, she may choose to hide her true intellect. Playing dumb would help her attract men and maintain friends. Karen Horney was the psychoanalyst who uncovered and deplored the pervasiveness of this typical female strategy in the first half of the last century (Horney, 1967). While the feminist movement has encouraged enormously the liberation of women from the curse of this strategy, the sad fact of deeply seated social prejudices remains. Even in our present day, highly successful professional women are less likely to find a partner, even if they are actively looking for one (McDowell, 2005). Moreover, the envy caused by women's success in the workplace may be one of the unacknowledged causes of the obstacles males place for them on the career ladder. Ultimately, hiding one's true potential is a loss for the respective individual and a loss for society at large.

If one takes a broad view of the history and geography of political regimes (Rawls, 1973), one can detect that a four strategy that mitigates envy is the organization of society along the ideological lines of a *hereditarian "natural order"*. If Harry had been born in 18th century England, he wouldn't have felt envy towards Mr. Jones because his parents would have educated him to see Mr. Jones as a different kind of human being: somebody chosen by the grace of God, somebody with blue blood, somebody above the ordinary masses. This ideological indoctrination could have ensured a relatively peaceful social order for a long period of time, because it would have ruled out the very idea of vertical social mobility and the very concept of equality between all people. Be that as it may, but the problem with this strategy against the envy of the masses is the relentless operation of the genetic phenomenon called regression to the mean (Plomin, 2004). Regression to the mean tells us that the children of two dumb parents tend also to be dumb, but less dumb than their parents. Conversely, the children of two intelligent parents, tend to be intelligent as well, but less intelligent than their parents. What this means is that as generations of people unfold in time, the smart and the dumb tend to be distributed across the tight lineages of the alleged hereditarian natural order. It may well be that Mr. Jones' grandfather was very smart and thus was knighted by the monarch, but chances are that Mr. Jones himself is much less sharp than his grandfather. And if

our Harry happens to be smart, he can notice that the whole talk about the aristocrats being superior to him is simply dust in one's eyes. By finding other smart people born in the inferior classes, Harry could start a revolution that would overthrow the empty ideology of a natural order. We owe the revolutions of the Enlightenment to the smart Harries of the time.

The fifth strategy against envy is somehow paradoxical, because it uses the very passion of envy to fight against its otherwise destructive effects. A *meritocracy* is a system that purports to give equal chances to all the envious to *emulate* the envied and to do at least as well as they do (Young, 1961). Instead of hiding the envied, a meritocracy displays them in their full glory to stimulate the envious to put more effort to succeed (Schoeck, 1987). The general message "If they did it, you can do it too" is full of optimism and naïveté. The consequences are of a mixed kind. On one hand, the view of others' success and the belief that one can do it too if one just tries hard enough, makes many people try harder than they would have tried otherwise. This effort certainly benefits society, and, to some extent, it also benefits the individual concerned. On the other hand, by providing equal chances of success for all, a meritocracy crushes psychologically those who fail because they have absolutely no means for saving face. They are the only ones to blame for their failure and it might well be that the upsurge in depression in the last decades in the advanced capitalist world (Peterson & Seligman, 2004; Haidt, 2006) is causally linked with this peculiar way of distributing blame. The moral dilemma of meritocracy resides in its discourse of equal opportunities. While it is laudable that it tries to give equal chances to all the citizens and that it cultivates collective optimism, it is ultimately vicious because it obliterates the fact that the genetic lottery does not give us equal chances at all (Rawls, 1973). Not everybody can become a Pavarotti, Einstein, or Picasso. A meritocracy merely gives a chance to win to those who have already won at the genetic lottery. As time goes by, the cleavage between the envied wealthy and the envious poor grows larger and the meritocratic system becomes increasingly threatened by the consequences of its own lies.

The sixth strategy of dealing with envy is the *distraction of the attention* from the internal cleavages of a given community towards a real or fabricated *external enemy* (Spears & Leach, 2004). Given that humans have the potential for both positive (Eros) and negative (Thanatos) affects, a leader can enhance love and peacefulness within her community by channeling all hatred, envy, and fury on an outside enemy. In Freud's own words (1930/1989: 72), "It is always possible to bind together a considerable number of people in love, so long as there are other people left over to receive the manifestations of their aggressiveness". The problem with this strategy is that it works well only in the short-term. At bottom, this strategy consists in the mere procrastination of a solution to the real problem of wider social inequality and envy. When the enemy disappears or becomes harmless, the buried social conflicts of the community emerge with renewed force and press for a radical resolution.

Finally, the seventh strategy for handling the destructiveness of envy is the *institutional creation of extra-friction* for those who threaten to become enviable. This strategy relies on loudly declaring the falsehood that all people are equal and on arranging the societal mechanisms in such a way so as to make that falsehood seem true. The genetic lottery creates a minority of people that could be called "natural aristocracy" or "the lucky lot". Included in this group are the individuals endowed with an excellent constellation of genes for intelligence, ambition, and likeability. If left to compete in a truly free market, they would easily grab most of the resources available and thus win

the competition for spreading their genes to the detriment of the rest of us. The only problem with the lucky lot is that they are always a small minority (Jensen, 1998; Rawls, 1973). The average Joes can prevent the lucky lot from grabbing all resources by the institution of a democratic regime: regardless of wealth and ability, every person has the right to one and only one vote. By mathematical necessity, a democracy allows the average Joes to control the lucky lot through the means of the state. The business of the modern welfare state is to arrange reality in such a way so as to make it seem that all people are indeed equal. The state does its job by using ideological state apparatuses (especially the school system) to indoctrinate all people with the idea that all humans are born equal, as well as by the creation of extra-friction for the lucky lot. Extra-friction begins with the introduction in the school system of the principle of lockstep progression (Gardner, 1984). No matter how intelligent one is, one has to progress from one grade to another just like everybody else. If all pupils graduate from high-school at the same age, we obliterate the fact that some people learn twenty times faster than other people (Jensen, 1998) and we keep alive the illusion of equality. Extra-friction continues in the workplace by the introduction of collective agreements, of the principle of progression through the ranks based on requisite experience (and not on sheer performance), by the progressive taxation of income, and by the creation of anti-monopoly laws.

Finally, and of direct relevance for an evolutionary perspective on envy and inequality, extra-friction is introduced in the civil system by the institution of monogamy. No matter how wealthy one becomes, one has the right to spread his genes only with one wife at the time. This institution makes sure that, even if the extra-friction imposed on the lucky lot in the school system and the workplace has failed to stop them from becoming enviable, they would still not get an unfair amount of reproductive advantage. In essence, the genetic lottery has given too much to a tiny minority of people and the job of a modern society is to undo that unfair distribution by putting extra-burdens on the shoulders of that privileged minority. Social justice is the antidote to genetic injustice and thus plays a significant role in the geography of evolutionary struggle.

CONCLUSION

> *Without envy, not only would there be no need for a judicial apparatus; there would be no desire for justice. (Forrester, 1998: 132; emphasis in original).*
>
> *Envy is itself a terrible obstacle to happiness. (Russell, 1989: 67)*

Envy, I have tried to show, is the dark passion that saves us from death. If it were not for envy, we would not care that the lucky lot grabs all the resources and eliminates our opportunity to spread our genes. The visceral experience of envy mobilizes our bodies to fight for our reproductive survival. We may try to emulate the envied and this means that Bertrand Russell (1989: 66) was only partly correct in asserting that “if this passion is allowed to run riot it becomes fatal to all excellence”. By fostering emulation, envy can foster excellence, a point well exploited by the meritocratic strategy. We may try to create extra-friction for the envied, either at the individual level (Harry scratching Mr. Jones’ new car with a stone) or at the collective level (the scholastic lockstep, progressive taxation, monogamy). At first glance, this second route is pathetic, but one needs pathos if one wants to remain alive (cf. Thrift, 2003). After casually noticing that “modest

people…are particularly prone to envy" (1989: 69), Bertrand Russell (1989: 70-71) puts the finger on what he finds unacceptable about envy-based social justice:

While it is true that envy is the chief motive force leading to justice as between different classes, different nations, and different sexes, it is at the same time true that the kind of justice to be expected as a result of envy is likely to be the worst possible kind, namely that which consists rather in diminishing the pleasures of the fortunate than in increasing those of the unfortunate.

His remarks miss the very logic of social justice. In order to increase the pleasures of the unfortunate, one must diminish the pleasures of the fortunate, because we are wired to experience envy (displeasure) whenever we see that others are better off than we are. Evolution endowed us with this mechanism to save us from death (lack of offspring) and we should stop being ashamed to admit that we experience envy. Ideals of social justice spring from envy and do the great job of compensating for the unfairness of the genetic lottery. Although "people…attempt to foster their interests by invoking self-serving principles of equity" (Krebs & Denton, 2005: 642), there is nothing wrong with taking this route in the big scheme of the struggle for survival (Cosmides & Tooby, 2006). If there is a true problem with envy, then that problem has to do with what we feel we most want: to be happy. Evolution saved us from death by endowing us with the possibility for envy, but the gift comes with a price: envy causes unhappiness (Peterson & Seligman, 2004). And that unhappiness pushes us into acting and striving to better our stand in life. If those committed to social justice think that this ideal will make people happy, they are wrong. Social justice helps our genes, not ourselves.

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O GEOGRAFIE EVOLUȚIONISTĂ A JUSTIȚIEI ENVIRONMENTALE ŞI SOCIALE

(Rezumat)

Pornind de la premisele majore ale biologiei evolutioniste si psihanalizei, prima parte a articolului dezvolta un model teoretic al naturii umane al carui principiu esential rezida in afirmatia ca specia noastra are un potential innascut atat pentru a face bine cat si pentru a face rau. Pe baza acestui model, partea a doua explica rolul central jucat de invidie in semnalarea inechitatii atat in interiorul unui aceluiasi mediu inconjurator, cat si intre medii inconjuratoare diferite. Partea a treia a articolului explica motivele pentru care justitia environmentala si sociala nu poate fi conceputa daca fenomenul invidiei umane este ignorat si prezinta un numar de sapte strategii prin care comunitatile umane din toate timpurile si toate regiunile geografice au incercat sa solutioneze problema invidiei. In concluzia articolului, liniile directoare ale argumentului vor fi combinate spre a sugera ca o geografie atenta la dezvoltarile din stiintele biologice poate sa ofere explicatii noi si penetrante ale cauzelor si consecintelor sentimentelor si politicilor publice care propovaduiesc idealul egalitatii sociale si environmentale.

RADIOACTIVITY OF COALS, COAL SLAGS, AND THE RADIATION DOSE ORIGINATING FROM THEIR USE - THE HUNGARIAN SITUATION

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Abstract: Radioactivity of coals, coal slags, and the radiation dose originating from their use - the Hungarian situation. The average concentration of ^{238}U, ^{232}Th and ^{40}K in coal is usually low (estimated to be 20, 20 and 50 Bq/kg, respectively), but it can varied by more than two orders of magnitude. In the combustion process, the radionuclide concentration of the remaining fly ash and bottom ash became 5-10 times higher than the original coal's was, and the natural radionuclides can discharged to the atmosphere. The utilization of slag (bottom ash), fly ash may mean another significant route of the effective dose of the population.
Significant increase in the dose effect was caused also by using slags as filling-insulating materials in Hungary. The values of estimated annual gamma dose contribution where 0.5-3 mSv/year. The committed effective dose originating from radon in these flats was 4.6 mSv/year - 15.2 mSv/year in two town. The estimated annual effective dose contribution in some cases was close to or in excess of the occupational limit of 20 mSv/y for annual average dose.

Key words: *natural radioactivity; radon; waste management; coal-ash; building materials; radiation dose.*

INTRODUCTION

Naturally occurring radionuclides of terrestrial origin is the major source of radiation exposure of public. These primordial radionuclides are present, in more or less extent, almost everywhere. Where their presence is significant the material contains them are called naturally occurring radioactive material (NORM).

When NORM are used as industrial row-material the processing frequently can results in waste materials enhanced in these radionuclides referred to as technologically enhanced naturally occurring radioactive material (TENORM).

The world average of natural background radiation is 2.4 mSv/year. There are some areas where it is much higher due to the terrestrial background radiation and cosmic radiation.

It is estimated that about 65% of individuals have exposures between 1 and 3 mSv/year about 25% of the population have exposures (UNSCEAR, 2000). less than 1 mSv/year, and 10% have exposures greater than 3 mSv.

Outdoor gamma dose caused by radionuclides of terrestrial origin are actually determined by the concentration of ^{40}K and that of ^{226}Ra, ^{232}Th and their daughter elements located in the soil and in materials surrounding us. Average concentration values in soil (UNSCEAR, 2000) are: ^{226}Ra: 32 Bq/kg, ^{232}Th: 45 Bq/kg, ^{40}K: 420 Bq/kg - , and in building materials (UNSCEAR, 1993): - ^{226}Ra: 50 Bq/kg, ^{232}Th: 50 Bq/kg, ^{40}K: 500 Bq/kg.

Due to the geometry within the buildings and the higher average radionuclide concentration of natural origin of building materials, the effective dose is usually higher (84 nGy/h) than outdoors (59 nGy/h). Taking this and the dwelling time into consideration the resulting worldwide average of the annual effective dose is 0.48 mSv with the results for individual countries being generally within the 0.3-0.6 mSv range(UNSCEAR, 2000).

From the aspect of both environment protection and economy the industrial usage, mainly including building industry usage of by-products generated during mining and processing gain a more and more important role.

For the most part, this does not present any radiological hazards (Hewamanna et al., 2001; Kumar et al., 1999) but it can be significant in case of using materials, rocks with elevated NORM or TENORM content (Yu et al., 2000; Tzortzis et al., 2003).

RADIOACTIVITY OF THE COALS, AND COAL SLAG (FLAY ASH AND BOTTOM ASH)

Coals

U and Th contents often exceed by several times or even by an order of magnitude the characteristic world average referred to coals. The world average is claimed to be 1-5 ppm and 1-7 ppm for U and Th, respectively (Eisenbud, 1995; Kóbor, 2002).

The average concentration of ^{238}U, ^{232}Th and ^{40}K in coal is estimated to be 20, 20 and 50 Bq/kg, respectively, based on analysis of coal samples from 15 countries, with a variation of more than two orders of magnitude (UNSCEAR, 2000).

The theory of Breger (Breger, 1974) may give an explanation on the high uranium-content of coal, according to which uranium enters coal bed from ground water as the soluble sodium uranyl dicarbonate ($Na_2[UO_2(CO_3)_2]$) or the sodium uranyl tricarbonate ($Na_3[UO_2(CO_3)_3]$) complex. Breger also suggests that this slightly acidic environment of the coal decomposes theses complexes, and the uranium quickly becomes absorbed by the coal with subsequent reduction to uraninite (UO_2). If sufficient silica is present in solution, the mineral coffinite ($U(SiO_4)_{1-x}–(OH)_{4x}$) is formed instead of uraninite.

Hungary belongs to countries, where the activity of coals (the concentration of uranium) is specifically high, the Hungarian coals proved to represent higher radioactivity than the usual value: the Cretaceous coal of Ajka, the deposits of Kisgyón, certain deposits in the Tatabánya coal basin and the Liassic coal of the Mecsek Mts (Kóbor, 2002; Bodrogi, 1959).

The radionuclide concentrations (Bódizs Komley, 1993) of coal samples originated from Hungary are summarized in Table 1.

Fly ash and bottom ash

Almost 40% of coal-mining is burnt in power-plants. In the combustion process, most of the mineral matter in the coal is fused into a vitrified ash, worldwide production of coal ash (Reijnders, 2005) is estimated to exceed 550 10^6 tons/yr. A portion of the heavier ash, together with incompletely burned organic matter, drops to the bottom of the furnace as bottom ash or slag. The lighter fly ash together with the hot flue gases and any volatilised mineral compounds to the stock, where most is collected while the rest is released to the atmosphere. The combustion of the coal in coal-fired power plant leads to an increase of the natural radionuclides, and non-combustible elements, with enrichment factors for the ashes of 5–10 times (Beck, 1989).

Radionuclide concentration values of some ashes mentioned in literature are summarized in Table 2. It can be seen that radionuclide concentration values vary within wide limits.

The activities of natural radionuclides discharged to the atmosphere from a power plant depend on the activity concentration in coal, the construction of furnace, the temperature of combustion, the partitioning between slag and fly ash, the efficiency of the

filtering system etc. So marked differences should therefore be expected between the activities discharged per unit energy produced from different power plants.

The main pathways through which the populations living around coal-fired power plants are exposed to enhanced levels of natural radionuclides are inhalation during the cloud passage and external irradiation and ingestion following deposition of activity on the ground (Papp, 1998).

Another major use of coal is domestic cooking and heating. Not enough information in the literature on the environmental discharges of natural radionuclides from this source. However, there are no dust separators on the chimney in this case, so both fly ash and bottom ash get into the environment.

The utilization of slag (bottom ash), fly ash may mean another significant route of the effective dose of the population.

In Hungary, the coals mined in neighborhoods of Ajka, Tatabánya, Várpalota, Pécs towns contains radionuclides considerably higher than the world average. There are coal-fired power plants in these locations as well; therefore fly ash, bottom ash (coal-slag) waste hips can be found in great quantity. In the burning process the radionuclide concentration of the remaining fly ash and bottom ash became 5-10 times higher than the original coal's was. The radionuclide concentrations of the fly ash and bottom ash can see in the Table 3.

These waste hips are not recultivated. The radiation exposure of the critical group is mainly due to the radon exhalation and the dust migration.

Intensive environmental study was executed only in the neighborhood of Ajka town. The power plant emitted 1 Mt fly ash across its chimney during its duration. 80% of the emitted fly ash deposited within a radius of 20 km. Within a radius of 5 km the 0-5 cm soil layer contained 6 times higher ^{226}Ra concentration (355 Bq/kg) than the soil layers on the further. The main reason is that the inhabitants put the bottom ash (coal-slag) comes from the home stoves to the backyard. The plants (ex. potato, parsley) cultivated in this district contain 5-25 times more ^{226}Ra than the control samples from the other part of the country. The ^{226}Ra concentration of the egg (raw egg) was 2 Bq/kg.

Estimated dose contribution from food:125 μSv/y, from dust 8.4 μSv/y,from external gamma dose (in the open air) 53 μSv/y (Papp, 1998)

BUILDING INDUSTRY USE OF FLY ASH AND BOTTOM ASH (SLAG)

Large quantities of coal ash (fly ash and bottom ash or slag combined) are produced each year through out the world. It can be estimated that about 5% of the total ash production from coal-burning power stations is used for constructing dwellings (this represents about 15 million tons per year).

Coal ash is used in a variety of applications. The use of fly ash and the manufacture of cement and concrete are well-known. Fly ash, bottom ash are most widely used by the production of concrete bricks and blocks (Yazici, 2007a; Yazici, 2007b; Skodras et al., 2007). Favourable results were also gained by the production of special, e.g. dam concrete by using 50% fly ash (Gao et al., 2007).

Fly ash-based light-weight building materials are also being produced (Wu Sun, 2007). By the production of Hong Kong light weight concrete pulverised fuel ash (Yu et al, 2000) is used as an additive.

A special method of use is spread in Hungary. Bottom ash (slag) generated in power-plants or other furnaces, stoves were used as a filling-insulation material directly, without any additives (Somlai et al., 1998), as it is shown on Fig.1. This was primarily

justified by the relatively small volume and weight, and the good heat-insulating capacity due to high pore volume, and of course cheapness.

Despite the fact that the production of building blocks from the slag of coals mined in the Transdanubian region was inhibited (Somlai et al., 1997b), the use of the slag for this purpose, i.e. as a filling-insulating material, was continued (Somlai et al., 1997c).

Gamma dose in buildings, in case of using ash

The average ^{226}Ra, ^{232}Th radionuclide concentration of coals (UNSCEAR, 2000) (^{226}Ra 10-25 Bq/m^3, ^{232}Th 10-25 Bq/m^3) is lower than the radionuclide concentration of the soil, but during burning this results in a 5-10 times higher value within slag. The use of these materials in a high quantity may result in an increase of dose.

Penfold et. al. found out that the highest dose rate for a critical group in the United Kingdom was 250 μSv came from the use of fly ash in building materials (Penfold et al., 1998). Measurements in the former Czechoslovakia gave values approaching 1000 nGy/h in houses with outside walls containing coal slag (Thomas et al., 1993).

Significant increase in the dose effect was caused also by using slags as filling-insulating materials in Hungary.

The averages and minimum-maximum values of the dose rate measured in a height of 1 m, and the estimated annual dose contribution are presented in the Table 4.

Slag was also built in public buildings using the mentioned method, values of 500-900 nGy/h were measured in nursery-schools and schools (Somlai et al., 1997a).

Radon in buildings, in case of using ash

There are conflicting views on the impact of the use of fly ash on the dose from inhalation of radon decay products. According to some investigators, the indoor dose originating from radon should be higher in a house with fly ash concrete than in a house built with ordinary concrete (Blaton-Albicka Pensko, 1981) according to other investigators the indoor dose should be lower (Kovler et al., 2005a; Kovler et al., 2005b; Stranden, 1983) while another group concluded that there should not be any significant change (Lught Scholten, 1985; Ulbak et al., 1984).

The UNSCEAR 1988. report assumed, that the use of fly ash in building materials does not result in any additional dose due to the inhalation of radon decay products.

However, in case of the building method applied in Hungary, according to the surveys a significant increase of radiation dose originating from radon may be expectable.

The results of the measurements performed by nuclear track detectors (CR-39) and the estimated effective doses due to radon are presented in Table 5.

It should be emphasized that these results does not represent the typical radon concentration of the dwellings of this three towns. These data are restricted in numbers and the measurements focused on flats where use of slag-as-building-material was known or supposed.

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Table 1.

Radionuclide concentrations of coal samples from Hungary

Origin of coal samples	Average radionuclide concentrations (Bq/kg)		
	^{238}U	^{232}Th	^{40}K
Ajka	140-480	12-35	56-190
Tata	100-140	30	162-270
Dorog	40	36	194
Pécs	175	127	560
Oroszlány	99	24	163
Komló	150	97	384
Borsod	38-52	32-62	190-264
Visonta	20	15	80

Table 2.

Average radionuclide concentration of fly ash and slag

Sample and reference	^{238}U	^{226}Ra	^{232}Th	^{40}K
Fly and bottom ash (UNSCEAR, 2000)	200			
Fly dust				
	400		200	
Coal ash (UNSCEAR, 1993)		150	150	400
Coal flay ash typical (EC, 112)		180	100	650
maximum		1100	300	1500
Fly ash (Shukla et al., 2005)	81-206		110-305	208-515
Fly ash (Karangelos et al., 2004)		904	53	454
Bottom ash		662	44	405
Fly ash (Bem et al., 2002)		54-119	48-92	449-758
Bottom ash		33-91	28-77	307-607
Fly ash (Kumar et al., 1999)		45	40	88

Table 3.

Radionuclide concentrations of ash samples originated from the coal-fired power plants of the four towns.

Place of origin (town)	Average radionuclide concentrations (min.-max.) [Bq /kg]		
	^{40}K	^{232}Th	^{226}Ra
Ajka	198 (45-386)	42 (16-81)	1962 (578-2893)
Tatabánya	352 (257-468)	83 (50-119)	1912 (843-2407)
Várpalota	273 (227-333)	40 (37-48)	298 (160-523)
Pécs	780 (666-883)	231 (174-263)	296 (222-386)

Table 4.

Dose rate (min-max) and estimated annual effective dose in the flats

Town	Number of rooms examined	Dose rate in rooms (nGy /h)		Effective dose in rooms (mSv /y)	
		average	min-max	average	min-max
Ajka	47	321	151-633	**1.57**	0.74-3.10
Tatabánya	198	265	110-602	**1.30**	0.54-2.95
Várpalota	85	132	110-225	**0.65**	0.54-1.10

Table 5.

The radon concentrations in the three towns measured by nuclear track detectors

Town	Number of rooms monitored	Radon conc. (Bq /m^3)	Estimated effective dose (mSv /y)
Ajka	8	887 (547-1310)	**15.2** (9.4-22.5)
Tatabánya	35	268 (36-678)	**4.6** (0.6-11.7)
Várpalota	28	128 (29-338)	**2.2** (0.5-5.8)

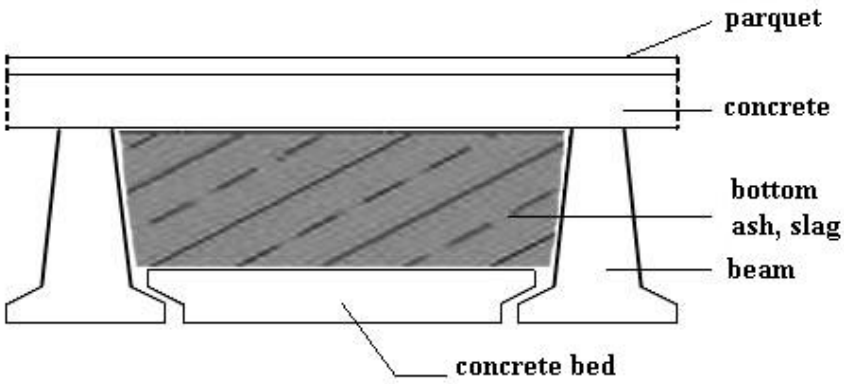

Fig. 1. *Utilisation of the slag*

RADIOACTIVITATEA CĂRBUNILOR, ZGUREI DE CĂRBUNI ŞI DOZA DE RADIAȚIE CARE REZULTĂ DIN UTILIZAREA LOR – SITUAȚIA UNGARIEI

(Rezumat)

Concentrația medie de ^{238}U, ^{232}Th şi ^{40}K în cărbuni este estimată la 20, 20 şi respectiv 50 Bq/kg.

În procesul de ardere, concentrația de radionucleelor din cenuşa zburătoare rămasă şi cenuşa de la bază a devenit de 5-10 ori mai mare decât cea a cărbunilor originali. Expunerea grupului critic la radiație se datorează în principal exhalației radonului, migrației prafului şi utilizării acestor materiale ca materiale de construcție.

Cenuşa de cărbuni (cenuşa zburătoare şi cea depusă sau zgura) generată în cantități uriaşe în timpul arderii cărbunilor este utilizată în câteva locuri şi în diverse maniere prin lucrări de construcții în lume.

Supravegherile realizate în diverse țări indică rezultate diferite. există câteva locuri unde doza gamma a celor care locuiesc in astfel de clădiri este semnificativă sau chiar mai mică, corelată cu utilizarea pe plan local a materialelor de construcție. Aceasta se determină prin radioactivitatea cărbunilor şi a cenuşii generate în timpul arderii. Totuşi, în anumite cazuri, se preconizează o doză semnificativă a radiației, de câțiva mSv anual. De aceea, supravegherea radiologică anterioară a cenuşii utilizate şi a materialului de construcție produs din aceasta, precum şi clasificarea ei reprezintă o sarcină esențială.

Gradul dozei de radiație care provine din radon este de asemenea contradictoriu în aceste cazuri. În anumite cazuri, radonul nu poate fi emis din materialele de construcție, iar în unele situații au fost raportate valori ridicate ale concentrației de radon, fapt care poate duce la o doză de radiație de 15 mSv/an. Luând toate acestea în considerare, se poate afirma că în cazul utilizării materialelor din cenuşă menționate, valorile emanației şi exhalațiilor de radon trebuie de asemenea supravegheate.

THE FLOODS OF THE INNER RIVERS IN ROMANIA (2000-2006) AND THE NEGOTIATIONS FOCUSED ON SOLVING THEIR CONSEQUENCES

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Abstract: The floods of the inner rivers in Romania (2000-2006) and the negotiations focused on solving their consequences. The flood of the last decades increased significantly in many countries of the world, including Romania. Among catastrophic floods occurred on inner rivers in Romania, we can mention those produced in May-June 1970, December 1995-January 1996, April and July 1932, July 1975, April – September 2005 etc., which affected wide lands, causing great damages. The economic, social, environmental etc consequences of these natural disasters and the awareness of the high probability of their return, generated negotiation processes that led to the creation of strategies, action plans etc focused on the prevention and reduction of flood risk effects. In 2005 and 2006, the National Strategy on the Flooding Risk Management on short, medium and long term was created.

Key words: flood, flood risk, overflow, hydrographic basins, damages, Romania, negotiations

INTRODUCTION

Floods represent the most widely spread natural hazard on Terra, with numerous human losses and material damages of great proportions. Each year, all over the world more than 20.000 victims are registered, and 100 million persons are more or less affected by this phenomenon.

The last decade of the last century and the first one of the 21st century can be characterized all over the world by an increase in the floods' intensity and frequency (the floods with a return period of 1-100 have now almost yearly apparitions). The floods' increase in intensity has been related (by the majority of the experts) to environmental change, and their frequency was connected to global warming.

THE NATURE OF FLOODS AND INDUCED HAZARDS

The factors which trigger floods' occurrence and manifestation are numerous and they can be grouped in two big genetic categories: natural (geomorphologic, geologic, climate, hydric and biotic) and anthropogenic (urbanisation, accidental damages of hydrotechnical constructions, bottomed or sub-dimensioned drainage and sewerage networks, deforestation, improper fulfilment of certain agrotechnical works etc.). The control factors have also been classified as it follows: temporary or transitory and permanent. Flood's nature involves a series of characteristics of the generating factors. Thus, the nature of fluvial floods depends on their magnitude, length, intensity and frequency.

Among the characteristics of the floods for evaluating the hazard the most important are: length, intensity, magnitude, frequency of occurrence and the return period. The relation between the floods' magnitude and the probability of occurrence has a regional singularity and depends on the climate conditions and on morpho-metric characteristics of the river.

Flood risk involves the probability notions and the return period (average number of years between floods with similar magnitude).

During the last decades, one can notice an increase in floods frequency and intensity, determined by an increase in the number of torrential rains. The flood risk has also increased because many houses with their annexes, as well as economic objectives were built too close to the water, because they were built on improper foundation and were made out of very poor quality materials; we can also mention improper functioning of the information flow for warning – alarming the population (especially in the rural area), as well as the fact that public administration and population is not well informed on the responsibilities and measures to be taken on crisis situation generated by floods.

Types of floods and their mechanisms

Floods can be classified according to various criteria. According to length, there are: sudden floods, short-term and long-term floods. According to the area they affect, floods can be local, when they occur on small area and regional when they occur on wide areas in large basins. Depending on the occurrence causes, floods can be natural, accidental and caused by human activities (Şelărescu, Podani, 1993).

Natural floods include more types: riparian or fluvial and coastal.

Slow fluvial floods are specific to great rivers in the hilly plain area, which developed wide slope basins. These floods are the result of slow increase in the water level because of long rainfalls, snow melting or simultaneous production of the two phenomena and processes. The period of time between the beginning of the rain and increase in the water level usually leaves enough time for taking measures and necessary dispositions for preventing the population.

Among catastrophic floods occurred on the inner rivers in our country, we can mention those produced in May-June 1970, December 1995-January 1996, April and July 1932, July 1975, April – September 2005 etc., which affected wide lands, causing great damages.

In association with these floods, there have been great flows (ten, even hundred times stronger then the average of many years). Thus, during the floods of May-June 1970, on Someş and Mureş rivers, in certain sections, quantities and volumes with historical frequencies, of 0,5-0,2%, were registered.

The floods on December 22, 1995 – January 5, 1996 had mixed origin: abundant rainfalls, added to rainfalls originating from sudden melting of snow. Rivers' maximum flows had assurances lower than 10% (Arieşul in Câmpeni, 1-1,5%; Someşul Mare in Nepos, Beclean and Salva, 2 %; Crişul Negru in Beiuş, Tinca and Zerind, 3-6%).

Rapid floods occur under special conditions: local intense rainfalls with stormy character. They are characterised by a very rapid water speed and a very fast water level growth, which make the warning and evacuation of population difficult, and the risks caused are also very high.

Torrential floods occur suddenly and are of short duration, about an hour. They are the so-called "flash-floods", which are extremely dangerous. Because of the speed the flow increase occurs, the time for informing the population which could be affected is very short. The force of the water stream and the solid material transported can cause significant disasters to houses and agricultural lands. Torrential floods are very destructive, as they bring along significant quantities of mud and rocks.

Accidental floods can be caused by burst or damage of dams or other hydrotechnical buildings, wrong manoeuvre at hydrotechnical constructions, land slides, etc.

Floods by urban flow are the consequence of torrential floods which affect the urban areas and which are not absorbed by the superficial sewerage network from the underground. Similar floods occurred in many towns on the Black Sea's shore (Constanța, Techirgiol, Agigea, Mangalia, etc.) as a consequence of exceptional rainfalls on August 28, 2004 (Cheval and collab., 2006).

Floods and vulnerability

Vulnerability represents one of the three components of the risk concept (degree of danger, vulnerability, and exposure) and is necessary to be known in order to evaluate the hazard. The floods' impact is variable and it depends on the phenomenon's characteristics and also on the degree of vulnerability, which is generated by a series of social and economic factors. Vulnerability changes in time and space.

At national level, different degrees of vulnerability to floods for the period 1992-2004 have been determined. A very high vulnerability is specific to the counties in the North (Suceava, Maramureş), North-West (Sălaj, Bistrița-Năsăud, Cluj), Centre (Mureş, Alba), East and South-West of the country (Arad, Hunedoara, Timiş, Caraş-Severin and Mehedinți). High vulnerability is characteristic to the counties: Satu Mare, Bihor, Sibiu and Dâmbovița. High vulnerability has been evaluated for a series of counties in the centre and East of the country, and a smaller one for the counties in the South-East of the country (Fig. 1).

The number of counties included at different degrees of vulnerability, as well as the average and total damages caused are showed in Table no. 1.

Vulnerability can be modified by a series of actions: community's training through special programs; improvement of the forecast and warning systems; land-use planning etc.

Flood effects and their perception

Floods with regular character, caused by periodical overflows, bring not only benefits, but also losses. This duality has begun to appear just lately. The Chinese equivalent for risk is "weijji" which describes well this duality: "weij" means good luck, while "ji" indicates danger.

The negative effects caused by floods have an economic, social and ecological nature. The extent of the damages caused by floods (direct and indirect) depends on their type and characteristics (especially their size, length, the affected area). The effects caused by floods are often temporary, but they can be quite long other times.

The damages caused by the floods in Romania have been evaluated at 29.581 ROL. The values of damages are different from year to year, the highest ones being registered in 1995 (Fig. 1).

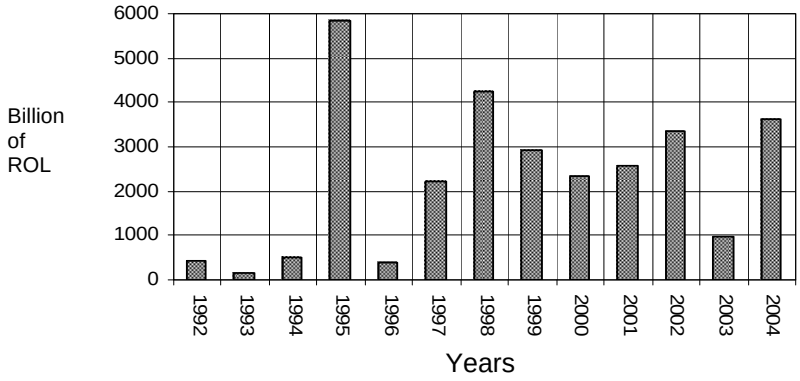

Fig. 1. *Damages caused by floods during 1992-2004*

The floods have many positive effects. Thus, a high fertility of the plains situated along the great rivers (Eufrat, Gange, Nil, Tigru, etc.) favoured the development of several prosperous civilisations in these areas. At the same time, these rivers have drawn the population's attention through other positive activities (fishing, shipping, production of thermoelectric energy). Valleys have formed important routes for the road and railway transport and terrains favourable to the development of settlements. The pressure put upon the major bed management has negatively influenced the development of its functions: storage, flow regulation and assurance of great water supplies. With a view to a long-lasting development of these territories, the mentioned functions have to be maintained and rehabilitated.

The social and economic advantages of the inhabitation and use of the flood plains are sometimes exceeded by disadvantages, flood danger and its negative effects. Living along rivers is natural for people, as well as living with the risk of flood, fact which has created a distinct perception of floods. Floods have even different names in order to make a difference between the good and the bad ones. For example, the farmers in Bangladesh carefully distinguish the little useful flood (barsha) from the devastating one (bonna). Distinction between the two is made according to the level of rivers.

A deep awareness of danger does not stop people living in those areas. In such situations, one uses the notion of acceptable risk. Part of the population is not aware of the dangers, and another one is intransigent when it comes to such events.

In some countries (Bangladesh), floods still represent a natural and fundamental component of the agricultural and ecologic systems, as they supply the base for recovering the cultures, aquatic life and human life.

Though the negative effects caused by floods are very well known, the good aspects related to their action have just recently been understood. Floods ensure fundamental habitats for fish, water birds and wild life, and they help to maintain a wider variety of plants and animals. Overflow also supplies fertile soils with nutrients and transports alluvial deposits necessary for maintaining a deltaic and costal equilibrium.

Related to rivers and floods, a new policy begins to be applied; it foresees the retreat of certain economic functions in the river areas and the removal of traditional measures of flood fighting.

CASE STUDIES ON CERTAIN FLOODS THAT TOOK PLACE BETWEEIN 2000-2006 AND THE NEGOCIATIONS CARRIED ON TO SOLVE THEIR CONSEQUENCES

Floods of 2005, caused by the overflow of the inner rivers

There are few cases when the floods lasted so long and extended on such wide areas, as in 2005. The most important floods took place during April and September, when there were significant floods on most of the rivers, some of them with historical flows (Table 1).

Table 1

Maximum flows registred on the rivers from the main hidrografic basins

Hidrographic basin	Maximum flow (m^3/s) registred in:	
	Observation period	Years 2005
Someş-Tisa	3342-May1970; 2090-April 1934; 1565-March 1934; 1344-December 1995.	-
Crişuri	890-July 1932; 750-December 1995; 576-June 1970; 538 May 1983.	-
Mureş	2321-July 1970; 2230-July 1975; 2154-April 1932; 1729-June 1913.	-
Banat	1500-May 1912; 1420-May 1906; 1100-May 1970; 930-March.	1250 April
Jiu	2000-October 1972; 1950-January 1950 1028-May 1957; 1316-June 1961.	-
Olt	2580-June 1948; 2138-July 1975; 1900-September 1914; 1715-May 1970.	-
Argeş-Vedea	2000-July 1941; 1700-July 1975, 1960-July 1979; 1200-October 1972.	2000 June
Ialomiţa-Buzău	2100-July 1975; 1330-July 1940; 1330-May 1984; 1250-July 1971.	1331-September
Siret	3186-May 1970; 2858-July 1969; 2700-June 1988; 2550-May 1971.	5500 –July (Rec.) 4650-July (Registred.)
Prut	1780-June 1988; 1780-August 1979; 1540-july 1978; 1400-July 1982.	2800-August
Dobrogea-seaside	758-June 1985	-

The causes that generated most of the floods have been the pluvial or pluvio-nival flows.

In Bega, Timiş, Bârzava, Moraviţa, Caraş, Nera and Cerna basins, flows have been generated by rains (the quantities registered between 14-22 of April had high values: between 80-220 mm) and by the water originated from snow melting in the alpine area (Ţarcu's height, 126 cm and Semenic, 26 cm). The flow was tremendous. Thus, on Timiş river, on Şag section, the flow has been of 770 million m^3 comparing to 250 million m^3, registered in 2000.

As to the rivers in Banat, there have been registered the highest rates in the entire series of observations taken from most of the hydrometric stations; the effects were dam overflows on Timiş river, downstream Lugoj and Bârzava in Gătaia area. Timiş river joining Bega river by Topolovăț hydrotechnical point registered the biggest transit of flow during the observation period. Dams were loaded in excess for an extremely long period of time (more than 20 days). Phenomena of compression and infiltrations usually appear in 5 days at maximum.

The territories affected by the floods in April 2005 were not similar to the ones in 1850 (the greatest ones), 1912 and April 2005, which were also catastrophic. The effects produced by floods were disastrous. 35.000 hectares of land have been flooded; hundreds of houses have been partially or completely destroyed leading to the evacuation of 2.500 persons, only in Timiş County. There were great damages, evaluated at 406.069 RON (approx. 135.000 euro) in Timiş county and 363.209,8 RON (120.000 euro) in Caraş-Severin county.

In Timiş-Bega basin, the 26 non-permanent bodies of water have accumulated 100 million m^3 of water, leading this way to a decrease in flow levels. In the permanent bodies of water from Surduc, Văliug, Trei Ape, Secu, Poiana Mărului and Gozna, 40 millions m^3 have been accumulated, decreasing the water volume originated from snow bed.

In order to evacuate the water from flooded areas in Timiş, help was needed from Hungary, Germany, France and Finland. 16 Hungarian pumps have been used, 24 submersible pumps from Germany, 8 pumps from Finland, 2 pumps from France, as well as 8 pumps from S.C. AVERSA S.A.

During June 8-14, the rains fallen in the inferior basins of Olt and Argeş-Vedea, which reached very high values in some places (150-200 mm), have generated floods in the mentioned areas during June 8-18.

In July, all over the country (31 counties), it rained considerably giving rise to quite big floods, especially on the rivers from Crişuri, Mureş, Olt, Vedea, Argeş, Ialomița, Buzău, Bistrița basins. In the hydrographic basins Trotuş, Putna, Rm. Sărat, on Siret inferior flow and on certain branches of Bistrița, the floods had historical values, with a probability of happening of less than 1%. Shower rains have been registered in the intervals July 1-19, July 23-24 and July 27-28. Considerable quantities (over 100 mm) have been registered in certain areas from Dobrogea and in the west and south of Moldova (even more than 150 mm in certain area from Bacău, Vrancea, Galați counties).

In the basins of Trotuş river, floods reached exceptional values, the maximum quantity registered at Vrânceni hydrometric station was 2.800 m^3/s (possibility of increase with 0,5%), and the floods volume on this section has been the biggest of all existent measurements. Due to deposition of soil from flow appeared in time, dams' transportation capacity diminished from 3.600 m^3/s to 3.000-3.200, negatively influencing the flood effect.

On Putna and Rm. Sărat rivers, there are registrations of the greatest floods ever (1.323 m^3/s at Botârlău hydrometric station corresponds to a probability rate of 2,5 %).

On the inferior section of Siret, at the Lungoci hydrometric station, the quantity of flood has been evaluated at 4.650 m^3/s, respectively a rate of increase of 0,5%. The floods on July 8-17 have been considered catastrophic.

In August, there have been frequent increases of flows on most rivers, with exceedings of flood levels in the rivers from the basins: Someş, Moldova, Jiu, Olt, Argeş, Vedea, Prahova, Prut, Siret, Ialomița and in some rivers from Dobrogea.

In September, important floods have been produced in the basin of Ialomița river, which have led to floods downstream Adâncata and Coşereni localities; several villages were isolated and many households and wide agricultural areas were flooded.

The rains in September 19-24 in hydrographic basins Argeş, Vedea, Buzău, Ialomița and Dobrogea-coast summed up values of more than 200 mm in the Eastern basin of Southern Dobrogea and the Central part of the Romanian Plain, and 140-200 mm in the basin of Argeş and upper and middle Ialomița, Central and West of South Dobrogea's plateau.

Floods' effect in the hydrographic basins Ialomița and Argeş-Vedea during September 17-29 has been diminished by a decrease in floods through accumulation lakes. For example, in the upper basin of Prahova river, there have been decreases of 24 million m^3 in Paltinu and Mâneciu accumulations. In order to decrease the level of floods on Ialomița and Prahova rivers, Dridu dam has been used to its maximum capacity.

During September 21-22, on the Black Sea coast, during a few hours, considerable rains have fallen (Mangalia, 165 mm, Biruința, 222 mm), which led to important flows on hydrologically unmonitored courses, on slopes, flooding streets, householding, houses and social-economic objectives of certain localities (Agigea, Eforie, Techirghiol, Tuzla, Costineşti, 23 August). Similarly, the many rains fallen in the hydrographic basin of Colentina river, upstream Buftea locality, lead to an increase in the volume of Bucharest lakes. Historical floods were registered on Ialomița and Cricovul Sărat rivers that month.

2005 floods have affected many territories in the South-West (Timiş and Caraş-Severin counties), South (Olt, Teleorman, Ialomița and Călăraşi counties, and partially in Giurgiu, Ilfov, Dâmbovița, Prahova), South-East (East of Constanța county) and East of the country (Suceava, Botoşani, Bacău and Vrancea counties, and partially Iaşi, Neamț, Galați, Buzău and Brăila counties).

Dangerous floods and meteorological phenomena occurred in 2005 affecting 1.734 localities, the total value of damages being estimated at about 5.975.201,5 thousand RON (approx 2.000.000 euro); 76 persons died; 93.976 houses and householding annexes have been destroyed; 1.063 social and economic objectives, and more than 656.392 hectares of agricultural land have been seriously affected.

Torrential floods

During the last century, many torrential floods have drawn our attention, but only those that affected certain areas from Transylvania Sub-Carpathians (affluents from the right of Târnava Mare on the section Vrădeşti-Cristuru Secuiesc) and Someş plains (the basin of Ilişua river), territories characterized by a favourable exposure to ocean advection of air masses, to the restoration of air fronts and the movement of air masses in front of Oriental Carpathians will be studied in this paper.

On affluents from the right of Târnava Mare from the Sub-Carpathian sector, as well as in other regions of Romania (Prahova and Ialomița, Moldova counties, the basin of Tur river), catastrophic floods have been registered, generated by the torrential rains on August 23, 2005.

Floods on the Feernic, Seiche (Şoş), Busjac, Cireşeni, Bată, Tăieturii rivers had an extraordinary size and intensity giving rise to important damages. These floods had a "flash flood" character, as they were formed in little hydrographic basins (less than 100 km^2), on a high hilly region, partly covered in forests and with steep slopes of flow. Floods have occurred after high intensity rains (more than 100 mm for 2 hours) and they were characterized by a very rapid increase in levels, high flow speed and considerable

transportation of alluvial deposits and floats (Konecsny, Măteuț, 2006). The water level in the streets reached 4-5 m at Lupeni (Feernic), 4 m in Sâmbăteni quarter of Odorheiu-Secuiesc (p. Seiche), 1,5 m in Tămaşu (p. Balo), 2 m in Hoghia (p. Cireşeni), 2,5 m in Aluniş (p. Kovacsi). The water speed has been very high, it could not be measured, but according to engineering evaluations, it reached 5 m/s (Bálint, 2005) in some places.

The local rainfalls' intensity, which gave rise to the flood on the 23rd of August 2005, has been emphasized by historical values of the specific flow, calculated for Şimoneşti section, on Feernic river (2.538 l/s km^2). As the biggest quantities of rainfalls have fallen on the superior valley section (between Lupeni and Morăreni and upstream), one can suppose that, on these lands, the values of a specific maximum flow have been even higher (2.800-3.000 l/s km^2). This exceptionally great value has been registered in a few hydrographic basins with a reception surface of 100 - 200 km^2.

The region affected by floods included two towns (Odorheiu-Secuiesc and Cristuru-Secuiesc) and 6 communes made up of 54 villages, with a population of 73.700 inhabitants. More important damages have been registered in 25 localities (Odorheiu-Secuiesc, Mugeni, Tămaşu, Ulcani, Polonița, Porumbenii Mari, Feliceni, Tăureni, Aluniş, Dejuțiu, Dealu, Hoghia, Dobeni, Avrămeşti, Secuieni, Zetea, Sâncraiu, Băile Seiche, Lupeni, Bulgăreni, Bisericani, Morăreni, Şimoneşti, Rugăneşti, Cobăteşti).

Sixteen persons died, and total damages have been evaluated to 800 billion ROL (approx 2.600.000 euro); 1978 houses have been flooded (27 of them completely destroyed) and different road categories damaged: national (14 km), county (53 km), commune (58 km) and forest (52 km). Floods destroyed 37 bridges and 62 air bridges. The railway traffic on the section Odorheiu-Secuiesc – Sighişoara has been stopped. Many wells (942) have been filled with mud.

Beside the infrastructure damages, considerable damages have been registered in the agricultural field, too. Thus, 48 cows, 19 horses, 132 pigs, 2.615 birds, 325 rabbits and 187 bee families died. The overflow destroyed arable fields (20 hectares of wheat and rye, 217 hectares of corn, 62 hectares of oats, 35 hectares of potatoes and 12 hectares of vegetables), pastures and meadows (1.360 hectares).

The hydrotechnical protection system on Târnava Mare river functioned properly, while local protecting systems on affluents could not avoid catastrophic situations and diminish material damages.

The exceptional flood occurred on June 20-21, 2006 in the hydrographic basin of Ilişua river (affluent on right side of Someşul Mare river) had a pluvial genesis. The causing rainfalls were spread irregularly, between 20 mm in the lower basin and over 120 mm in the upper one. The highflood generated by strong rainfalls, determined by intensified convective nucleus, which moved slowly to south is included in the category of the fast ones (flash floods), characterized by a concentration and sudden increase of flows. The highest flow of the high flood formed, calculated in a section from the middle of basin with a surface of 160 km^2 has been of 280 m^3/s, which corresponds to an occurrence probability of 0,7-0,8 % (Fetea and collab., 2006).

Flood effects have been disastrous and they materialized in human losses (10 deaths and 3 disappearances), significant material damages registered in the 16 flooded localities, destruction of many houses and householding annexes, agricultural lands, cultures, bridges, footbridges and hydrotechnical constructions.

Environmental impact has been materialized by increase in turbidity on the water flow in basin (the quantity of alluviums evaluated at the hydrometric station Cristeştii Ciceului was of 24.380 kg/s), destruction of specific vegetation especially in the plain

areas, degradation of scenery and the quality of underground water, temporary creation of the environments favourable to transmitting catching diseases as a consequence of water storage for a long period of time.

Accidental floods

Accidental floods with extremely serious effects occurred in the counties Olt and Teleorman, being caused by damage of little ill-used dams. In order to deal with such situation, the emergency decree no. 138/October 2005 has been released, regarding safe exploitation of the accumulations with piscicultural, pleasure and local use, from the categories of C and D importance.

Environmental negotiations that lead to the elaboration of strategies for preventing and reducing the floods effects

Two concepts regarding floods management have been created in time. The first one, very old, is based on a deviation of the phenomenon or on the protection of inhabited areas and on activities regarding damage avoidance. It uses structural measures. In order to directly minimize the damages caused, they bring changes in the environment. The second concept appeared in USA in the second half of the last century and uses non-structural measures, which allow an adaptation of human activity to the flood danger conditions. The two concepts have to complement each other, instead of being used individually.

After the floods of 2005 in Romania, a negotiation process focused on flood risk management started between environmental and administrative local, regional and central institutions. The result was the elaboration of the National Strategy on the Flood Risk Management on long and medium term; this was related to the projects of land management and approved by Governmental Decision no. 1854/22.12.2005. The National Strategy on the Flood Risk Management promotes the measures for the prevention, protection and diminishing the effects of floods. Among the prevention measures it is mentioned the necessity to improve the land management and to promote the adequate use of landscape, agricultural and forest lands.

The efficiency of the negotiation's outcomes depends on the capacity of the negotiators to foresee the risks and to find the appropriate solutions to be applied for prevention and impact reduction. This capacity is linked to the negotiators' experience and their field of expertise. This is why a wide rage of participants that would cover all the issues related to flood risk management – economic, social, environmental, technical etc – is welcomed.

The short term strategy of the Ministry of Environmental and Sustainable Development has foreseen a series of measures related to: the preparation of prefects and mayors on their attributions in case of floods, the modernisation (enforcing DESWAT project) and the checking of the way the hydrometeorology informational flow functions in order to warn-alarm the population, the counselling, completing and updating the plans for fighting against floods, the elaboration of strategies regarding the improvement of protection against floods and the reduction of flood risk in many hydrographic basins: Siret, Timiş (Matra-Flex program, financed by Netherlands' Government) etc., the financial program for designing natural hazard maps regarding floods, etc.

In 2006, started the elaboration of National Strategy on the Flooding Risk Management on long term, supported through a PHARE project. The same project was also used for: the elaboration of the methodologies for designing the flood hazard and

risk maps, the evaluation of the direct damages caused by floods, the delimitation of the areas where can be created controlled floods, alongside dammed sections of rivers, the elaboration of maps of flood risk on Trotuş river and on the inferior section of Siret river, the elaboration of a guide for informing the population on the flood risk, the implementation of feasibility studies for the management of the rivers: Trotuş, upper Buzau and middle Putna.

Along with the National Strategy on the Flooding Risk Management, other strategies, reports, action plans etc related to flood risk management were prepared and will still be elaborated in the future. As the impact of our own actions on the environment, translated in various negative effects like floods, desertification, drought etc, has increased beyond the capacity of the environment to self-recover, both the reduction of human pressure on Earth and the protection against existing and future negative effects are needed. All these efforts need intense negotiations (environmental social etc), because they are carried on by and they affect many parties, with various interest, points of view, expectations, resources etc.

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INUNDAREA UNOR RÂURI INTERIOARE DIN ROMÂNIA (2000-2006) ŞI NEGOCIERILE AXATE PE MINIMIZAREA CONSECINŢELOR LOR

(Rezumat)

Inundaţiile reprezintă unul dintre riscurile naturale cele mai însemnate din România, iar în ultimii ani frecvenţa şi intensitatea lor s-au mărit considerabil. Dintre inundaţiile catastrofale produse de râurile interioare din ţara noastră menţionăm pe cele produse în mai-iunie 1970, decembrie 1995-ianuarie 1996, aprilie şi iulie1932, iulie 1975, aprilie-septembrie 2005 etc., care au afectat teritorii extinse din suprafaţa ţării, producând pagube mari. În intervalul1992-2004 pagubele provocate de inundaţiile din România au fost evaluate la 29.581 miliarde lei vechi. Unul dintre anii cei mai nefaşti din acest punct de vedere a fost 2005, datoritã duratei şi arealului extinse afectate de inundaţii. Cele mai importante inundaţii au avut loc în intervalul aprilie-septembrie, când s-au produs viituri însemnate pe majoritatea râurilor, unele cu debite istorice. De exemplu, pe râul Timiş, în secţiunea Şag, volumul viiturii a fost de 770 mil. m^3. Pe sectorul inferior al Siretului, la staţia hidrometrică Lungoci vârful viiturii a avut un debit estimat la 4.650 m^3/s, respectiv o probabilitate de depăşire de 0,5%. Inundaţiile produse în perioada 8-17 iulie au fost considerate catastrofale.

Aceste dezastre naturale au impulsionat procesul de negociere între autorităţile centrale, locale, specialişti etc. concentrat pe găsirea unor soluţii de reducere a efectelor inundaţiilor produse şi de diminuare a impactului celor viitoare. Unele dintre rezultatele cele mai importante ale acestor negocieri au fost Strategia Naţionalã de Management al Riscului la Inundaţii pe termen scurt şi mediu (2005), precum şi cea pe termen lung (2006).

Tabel 2

Vulnerability degree to floods (1992-2004).

Vulnerability degree	No of counties	Damages (bil. lei)	
		average	total
Very high	12	>70	> 750
High	4	50-70	455-750
Average	11	30-50	250-450
Low	12	<30	<250

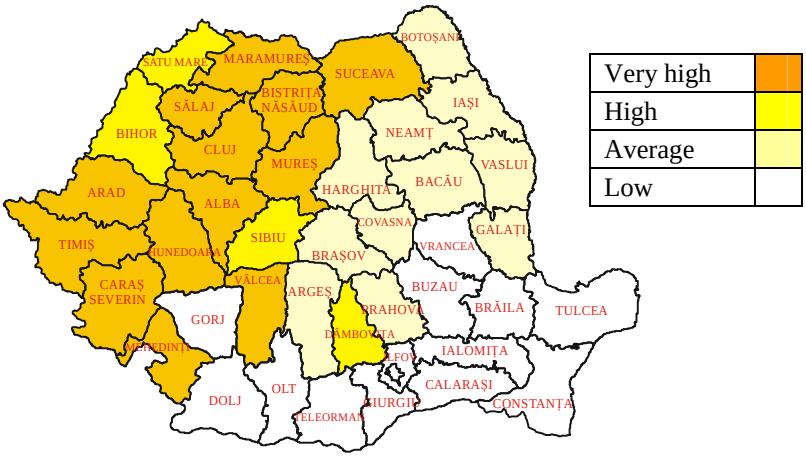

Fig. 2. *Vulnerability degree to floods (1992-2004) on county level*

PERSONALIZED E-LEARNING IN A RE-USABLE WAY: A PROPOSED GIS SYSTEM DESIGN - APPLICATIONS IN ARCHITECTURE

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Abstract Personalized E-Learning in a Re-usable Way: A Proposed GIS System Design - Applications in Architecture. The rapid advances in learning technologies, computer modeling, multimedia and spatial sciences, as well as the availability of many powerful graphics PCs and workstations, make 3-d modeling-based methods for personalized e-learning with GIS (spatial) functionality feasible. *Personalized GIS e-learning* is a new term in engineering, environment and architecture education, related to the development of learning educational units (3-d learning objects) with re-usable spatial functionality, and introduced to literature for the first time within this paper. In particular, for university education courses in GIS and CAAD (reagarding spatial information systems, architectures, monuments, cultural heritage sites, etc.), such a e-learning methodolgy must be able to derive spatial, pictorial, geometric, spatial, topological, learning and semantic information from the target object (a 3-d model) or scene (a 3-d landscape environment) or procedure (a 3-d simulation approach to a phenomenon), in such a way that it can be directly used for e-learning purposes regarding the spatial topology, the history, the architecture, the structure and the temporal (time-based) 3-D geometry of the projected object, scene or procedure. This paper is about the system design of such a e-learning method. For this purpose, the requirements, objectives and pedagogical extensions are presented and discussed. Finaly, a practical project is used to demonstrate the functionality and the performance of the proposed methodology in architecture.

Key words: *e-learning documentation, spatial functionality, digital photography, GIS, historical living systems.*

INTRODUCTION

The rapid advances in digital imaging sensors and scanners, off-the-shelf haptic devices, computer modeling software and the availability of many powerful graphics PCs and workstations make a method for *personalized GIS e-learning* with 3-D modeling or 2-D drafting functionality feasible (Kalay, 2006). *Personalized GIS e-learning* is a new term in informatics, engineering and architecture, related to digital documentation with e-learning functionality, and introduced to literature for the first time within this paper.

The proposed term *personalized GIS e-learning* is defined as a digital documentation procedure with e-learning functionality based on metric and non-metric (qualitative) data, and spatial and 3-D modeling semantic information (please see next Section).

In particular, for the historical living systems (i.e. monuments, churches, basilicas, archaeological sites, etc.), such a methodolgy must be able to derive pictorial, geometric, spatial, topological, learning and semantic information from the *target architectural object* (historical living system), in such a way that it can be directly used for e-learning purposes regarding the history, the architecture, the structure and the temporal (time-based) 3-D geometry of the projected historical living system.

Improvements and new developments in the fields of sensor technology and computer modeling allow the acquisition of digital images in video-realtime, without developing and digitizing a photographic film (Streilein, 1996; Kazakeviciute *et al.*, 2005).

Such a system -which is well described by André Streilein from the ETH Zurich- for digital photogrammetry and architectural design consists of two sub-systems: a sub-system for the digital photogrammetric station and a sub-system for the CAAD (Streilein, 1996; Streilein *et al.*, 1992). In this domain the aim of a method for *e-learning documentation* is to make the photogrammetric data acquisition and processing easier and faster, to create a three-dimensional geometric and semantic object description, and to allow CAAD/multimedia data integration, haptic rendering, visua1ization and architectural processing in an easy and user-friendly way (Vladoiu, 2004; Weber, 2004).

Therefore, such a method must be capable to acquire imagery with sufficient resolution, process the data with a big level of automation, and pass the results to a data structure useful for 3-D CAAD modeling (Hirschberg *et al.*, 1996). This can be achieved using solid-state sensors and manual, semi-automatic or automatic measurement techniques. Also, for environmental management purposes, the current status of a relative methodology for such a system is described by L. Dimen *et al.* (2005) and a relative method is being developed in a joint project of the ATEI of Thessaloniki in co-operation with the "1 Decembrie 1918" University of Alba Iulia.

With the constant progress of multimedia technology and network bandwidth, the traditional teaching environment that based on text and pictures, will be integrated with media streams, 3-D modeling, intelligent agents, virtual reality, haptic rendering and spatial objects (scienses) as described by A. Styliadis *et al.* (2006) for the GIS case, by Engeli *et al.* (1996) for the intelligent agents, and by Silva *et al.* (2002) for the insertion of 3-D architectural objects in photography. For this reason, in this paper, the proposed methodology shows and demonstrates an architecture (3-D model) that can support these new, rich in e-learning functionality, environments.

Recently, more and more systems come up that use any CAAD and semantic information available prior the measurement process. Such a system is the modelling-and-rendering system developed at the University at Berkeley by Debevec *et al.* in 1996. This system uses a rough object description in order to guide a stereo matching technique for the digital reconstruction of the primary object details with relative accuracy better than 10^{-3}.

Another similar system (a CAAD system named "NAOS"), dealing with 3-D geometry (with relative 10^{-3} accuracy as well) and qualitative information for CAAD documentation, was developed in 1997 at the Aristotle University of Thessaloniki, School of Surveying Engineering and at the ATEI of Thessaloniki, Greece (Styliadis, 1997).

Also, very interested is the work at the University of Helsinki from H. Haggren and S. Mattila (1997) dealing for 3-D indoor modeling development based on videography data. In particular, in this work a functional 3-D model of indoor scenes is built first and the measurements of the geometry based on video images are performed thereafter.

Finally, an interested CAAD system under development exists at the University of Delft (Frank van den Heuvel, 2003), which makes use of a priori geometric object information in the form of parameterized object models with image lines as the main type of observations.

On the other hand, e-learning is a process that needs quite amount of mental and body strength. In order to promote the e-learning efficiency, it is important to improve the

learning environment and this is the case of the proposed methodology (e-learning with CAAD functionality).

Apart from traditional design, the media stream or the virtual reality, can stimulate learner even more, reinforce the learner's motivation, attention and mentality. Some systems adopt different technology and implemented similar environment also demonstrate satisfactory results. However, they need to spend a lot of money and time to achieve that, such as VRML (Virtual Reality Modeling Language) it can establishes a virtual 3-D scene with walk-through functionality in the scene by a simple parameter, but while controlling the behaviors of the 3-D objects that enhance photorealism -such as the materials, the lights, the object scale, etc. - a script procedure must be writen in the complicated VRML markup language. Evenmore, the VRML modeling relative inaccuracy is greater than 10^{-3} and so, this is not acceptable for *e-learning documentation* applications.

The proposed method is based on a virtual learning environmental architecture that integrates synchronous, asynchronous and co-operative characteristics.

The paper is structured as follows: In Section 2 (*Personalized GIS e-Learning: Term Formulation*) the new term *Personalized e-learning* is introduced and described. In Section 3 (*Personalized GIS e-Learning: The System Design - Learning Requirements*) an overview of the proposed *personalized e-learning* methodology is given. The Section 4 (*Personalized GIS e-Learning: The Main Streams*) presents the main sub-systems outline design of the proposed e-learning methodology. Finaly, in Section 5 (*Personalized GIS e-Learning: An Application in Architecture*) a practical 3-d model based application is presented and its e-learning functionality is discussed.

PERSONALIZED GIS E-LEARNING: TERM FORMULATION

Personalized GIS e-learning is a new term in engineering and architecture, related to digital (geometric- and semantic-based) learning with re-usable spatial functionality, and introduced to literature for the first time within this paper.

The proposed term *personalized GIS e-learning* is defined as a digital documentation procedure with e-learning re-usable spatial functionality based on metric and non-metric (qualitative) data, and spatial 3-d modeling semantic information. At the 'heart' of this *e-learning* is the 3-d model (vector format) of the object (which could be any architecture, building, monument, etc.) or the process (environmental polution, weather forecast, water flood estimation, etc.) being described (Dimen, 2005).

The objectives of the *personalized GIS e-learning* are:

- to facilitate and encourage the collaboration and the critical awareness between the design students, scientists and professionals (architects, designers, engineers and so on).
- to design virtual spaces using different representation methods and techniques for haptic rendering regarding architectures, landscapes and urban design.
- to communicate through 3-D model-based multimedia data in ways traditional CAAD, photography and video does not support.
- to support access to prior understandings regarding the 'pathology' (nature) and the characteristics of the described object or process.
- to allow ideas exchange and to support design autonomy.
- to test the efficiency of the various sub-systems involved in design and construction processes for the Architecture, Engineering and Construction (AEC) community.

- to promote self-directed reusable learning exercises which lead to a critical awareness of the learning process and the learner's empirical background.

Similarly, the pedagogical profits are:

- the establishment, through this documentation, of a new *reality* in education and design practice, whereby the accepted realism and the level of the 3-D modeling accuracy (or inaccuracy), of the object or the process, are not so necessary to communicate performative and reusable educational and design concepts (Martin *et al.*, 2004).
- the real-time collaborative and reusable interactivity.
- the feedback (learning domain 3-D ontologies for semantic CAAD descriptions).
- the ability to develop manual, semi-automatic or automatic reusable CAAD learning tools that could support architectural, photogrammetric, art, historical or archaeological training and education.

The pedagogical strategy of the *personalized GIS e-learning* is based on encouraging and facilitating the communication and ideas exchange between the personnel involved in the design, implementation and spatial analysis process. Finaly, active role, interaction, group work and design autonomy are the characteristics of the proposed *personalized GIS e-learning*.

PERSONALIZED GIS E-LEARNING: THE SYSTEM DESIGN - LEARNING REQUIREMENTS

The structure and the processing steps for the proposed *personalized GIS e-learning* method are shown in Fig. 1. In this figure, the relation among the 3-d learning objects with modeling functionality and the available learners' (engineers, GIS personnel, architects) profiles are presented in connection with the geometric, topologic and thematic spatial data.

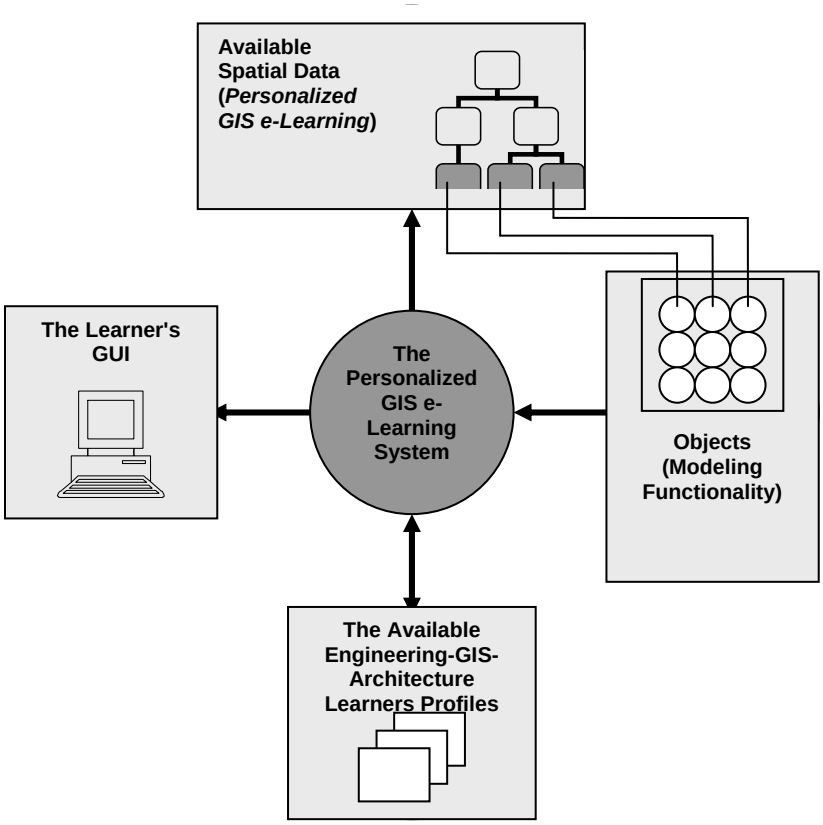

Fig. 1. *The Proposed GIS System Design (Personalized GIS e-Learning).*

On designing the proposed methodology for the e-learning documentation, the statistical analysis results from an e-learning course in CAAD and the VRlab research project at the ATEI of Thessaloniki are examined (Tsakiris *et al.*, 2005). So, according to students suggestion, the functional specifications for a 3-D based e-learning system are defined as follows:

- 3-D map video processing
- 2-D image processing
- Archive or historical photography, rich in geometric regularities and properties (i.e. clues, like: planarity, parallelism, orthogonality, symmetry, perpendicularity, topology, etc.), processing (Styliadis *et al.*, 2003)
- Item-by-item 3-D modeling functionality in an e-learning CAAD environment
- Haptic rendering of the resulting virtual representations of both the 3-D maps (models) and 2-D images (drawings)
- GUI with drag-n-drop functionality
- Multimedia functionality
- Learning functionality incorporating historical and semantic data

- Force-field haptic rendering functionality
- Virtual Reality functionality
- Noting- and shared-board functionality
- Non-stop study functionality

Actually, what the learner needs is a synchronism and adaptive e-learning system which can interact in real-time with the teacher in class (Wu, 2002). In this domain an asynchronous system can let learner to study in his free time by adapting learning object selection (based on discrete and reusable 3-D modeling items) in intelligent learning systems (Karampiperis *et al.*, 2004).

Also, such as system can let learners discuss with each other through media stream. Besides, they also need 3-D virtual environment with haptic rendering functionality, which can increase learner's interest and attention.

PERSONALIZED GIS E-LEARNING: THE MAIN STREAMS

After defining its functional specifications the main sub-systems (streams) of the re-usable e-learning system are defined as follows:

- *Media Stream Services:* This is the server sub-system; for which a number of media stream servers are needed (e.g. a system or central server). These servers can provide data (photography, imagery, history, architecture, modeling) for learners on real-time. These servers can also store material in repository (i.e. material palettes) which then can be searched by researchers or learners (e.g. students in architecture, art, history, etc.).

- *Virtual Learning Environment for 3-D Visualization:* This is the client sub-system; which includes a user interface based on 3-D graphics, haptic equipment and virtual reality tools (Petrovic, 1996). It is the stage for the learner and it includes virtual and resource classroom, chat room, etc. This e-learning sub-system provides chatting functionality on a learner-to-learner or learner-to-teacher basis. After the learner's logon to the system, he can control the learning process on focusing: (i) on particular 3-D modeling and rendering methods supporting e-learning functionality, e.g. haptic rendering, phong shading rendering (Fig. 2) or phong rendering; and (ii) on particular details of the historical living system using a GUI input device like the keyboard, the light-pen or the mouse. Evenmore, using this stream the learner can also communicate on-line with other learners (e-students).

- *Web Portal:* This e-learning stream provides the learner with additional information and operates as an integration platform for the entire e-learning documentation. This stream mainly includes the system's operation manual, monument's relevant documents and teaching materials, monument's architecture, history, archive (historic) photography, digital imagery, etc.

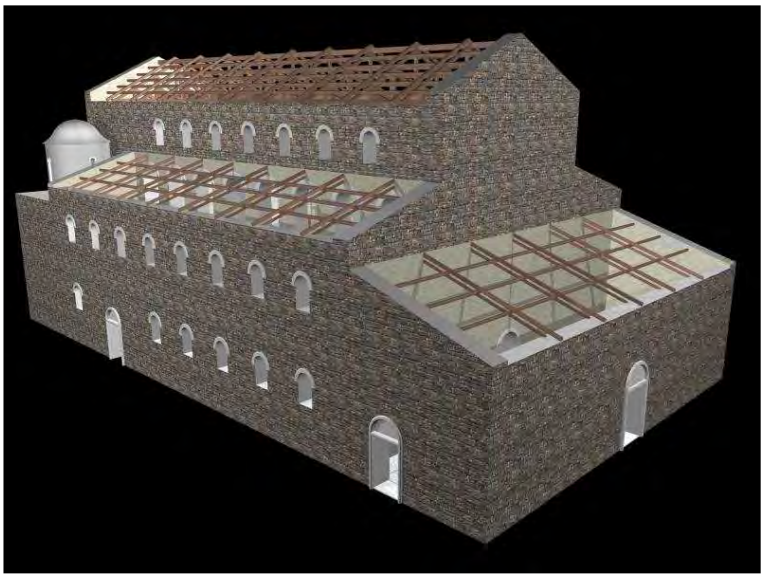

Fig. 2. *3-D modeling of Aghios Achilleios basilica.*

PERSONALIZED GIS E-LEARNING: AN APPLICATION IN ARCHITECTURE

Beyond the thirsty coasts of Greece lies a lush heartland where a coachload of sunburnt tourists are a rarer sight than a flock of pink-backed pelicans. This is Macedonia, a land of legendary battles and untamed landscapes, more familiar for the news headlines it attracts than for its startling natural beauty.

Nestled, among Macedonia's verdant mountains, are the twin cool lakes of Prespa (North-West Greece). Declared as a National Park in 1974; these twin lakes provide a sanctuary for over 280 species of birds and the largest pelican breeding ground in the world. Though stranded on the edge of Greece, Prespa lies at the 'heart' of the Balkans. Straddling Greece, Albania and the Former Yugoslavian Republic of Macedonia (FYROM), these lakes are a smooth expanse of serenity caught in the crossfire of shifting borders. Locals are an unusual stew of immigrants and refugees from Pondos and Asia Minor, and nomadic Vlachs; many still speak their native dialects. But as with most of rural Greece, Prespa's population is dwindling.

At the turn of the century, there were 12,000 inhabitants and 21 villages. Now, only 1,200 locals and 12 villages are left; they survive now, as then, by fishing and farming. Until 1969, locals carried special ID cards and foreign visitors required a visa. Even today, tourism is just a slow trickle in this watery wonderland.

The Aghios Achilleios basilica, in lakes Prespes, was chosen to demonstrate the functionality and efficiency of the proposed method. Actually, the Aghios Achilleios basilica is located at the Aghios Achilleios island on the minor Prespes lake.

The monument is a three-aisled, wooden-roofed basilica with a narthex and domes over the parabemata (Fig. 3). It was founded in ca. 986-990 by tsar Samuel of Bulgaria. Initially, it was the cathedral of Samuel's short lived empire and later, until the middle of the 15th century, was an episcopal church.

A tomb covered with a relief tombstone is preserved in the south arm of the cruciform diaconicon; tradition say that the relics of Aghios Achilleios were kept in this tomb. Along the south wall of the south aisle, four other graves are preserved, in which important persons of the church or the local community were buried.

Fig. 3. *The Aghios Achilleios basilica at the twin lakes Prespes.*

The few fragments of the wall paintings belong to two different layers and have been removed from the building. They are now on display in the exhibition of Byzantine and post-Byzantine art, in the Byzantine Museum of Florina. Today, only a part of the super-structure of the building is preserved, especially on the east side.

It stands to a privileged and dominating position, nearly 20 metres above the lake of Prespes at the isle of Aghios Achilleios. The monument is about 22 m in length, 16 m in width and 6 m in height. A detailed discussion about the history, architectural design and construction of this basilica is given by Prof. Emeritus of Architecture Nikolaos Moutsopoulos (1999). The monument has been under restoration since 1987, and the wall masonry will be rebuilt as long as there is available evidence of its construction.

The result of the photogrammetric processing was a 3-D geometric and semantic object description, which was passed automatically via Java-MDL programming (Java and C++ coding) to the MicroStation Masterpiece CAAD system.

This system is able to pre-process the data and store it in data structures adapted to architectural purposes; allowing, as well, data transformation into other representations in an easy way.

For the *personalized GIS e-learning*, the task of the learner is the creative finding of new modeling solutions (point or parallel perspective) as well as to evaluate the current modeling accuracy, for both the point and the parallel perspective projections, in connection with the imagery processing equipment and technique used. More for 3-D reconstruction from perspective images could be found in (Yang *et al.*, 2005).

The *e-learning documentation* is important for documentation and visualization purposes, and for complex simulations, manipulations and analysis of the target architectural object. This could be used in e-learning courses about architecture, archaeology and art history, in preservation of historical monuments and sites, in regional and local planning, as well as in renovations, reconstructions and reverse engineering projects.

Figure 4 shows the top view of an architectural drawing regarding the east part of the Aghios Achilleios basilica, and Figures 5 and 6 illustrate two haptic rendering perspective views of the photogrammetric generated CAAD model of the same monument. It is important to note that haptic interaction and rendering is especially important to e-learning students and populations with disabilities, such as the visually impaired, because tactile interpretation is one of the most important modalities they can use to perceive the world and to appreciate the monuments and the cultural heritage.

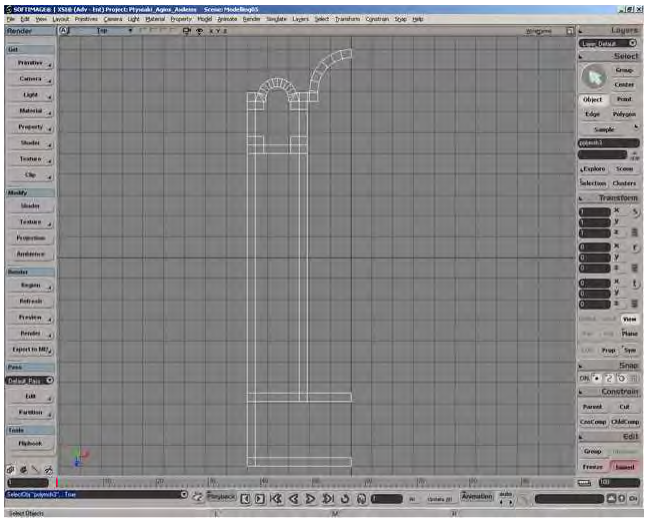

Fig. 4. *A top view of the east part of Aghios Achilleios basilica (architectural drawing)*.

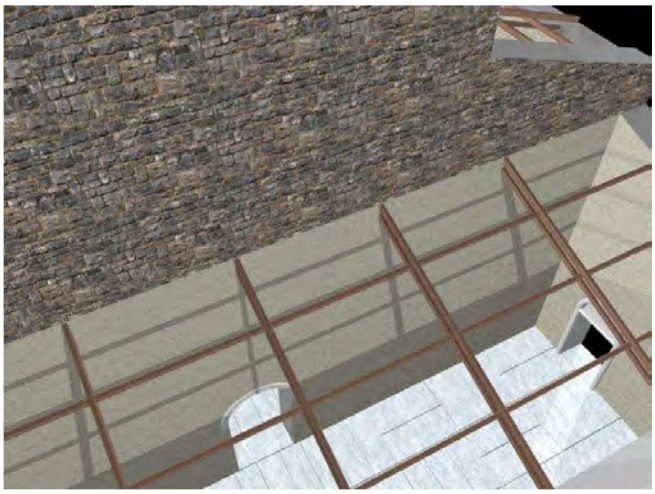

Fig. 5. *Phong haptic rendering: A point-perspective view of the Aghios Achilleios basilica* CAAD Model (haptic representation based on digital low-resolution Canon CI-10 imagery).

Fig. 6. *Phong haptic rendering: A parallel-perspective view of the Aghios Achilleios basilica CAAD Model (haptic representation based on digital low-resolution Canon CI-10 imagery).*

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ÎNVĂȚARE PERSONALIZATĂ ÎNTR-O MANIERĂ REUTILIZABILĂ: PROIECTUL PROPUS AL UNUI SISTEM GIS – APLICAȚII ÎN ARHITECTURĂ

(Rezumat)

Un sistem GIS este un sistem folosit pentru modelarea informatiei, proceselor si structurilor, care reflecta lumea reala, inclusiv evenimentele trecute, pentru a putea intelege, analiza si gestiona resurse si facilitati.

Un sistem GIS poate fi descris ca un sistem de corporatie in gestiunea bazelor de date care, in general, prezinta datele in mod interactiv utilizatorilor, intr-o forma grafica care poate fi usor interogata si analizata.

In general, datele dintr-un sistem GIS pot fi impartite in date de adancime si de suprafata, corespunzand unei harti de baza si, respectiv,obiectelor din lumea reala care sunt reprezentate in sistem.

Pentru a incepe sa lucrati cu un sistem GIS este necesara o baza de date adecvata (o reprezentare a hartii de baza care sa acopere intreaga suprafata a sistemului) care este obtinuta in urma achizitiei de date.

Cele mai mari costuri pentru o organizatie care decide implementarea unui sistem GIS este conversia datelor, hardware-ul si software-ul necesar si implementarea sistemului cu particularitatile care apar, dar aceste costuri sunt amortizate in timp prin eficienta muncii si abilitatea de a lua decizii in timp real.

REDUCTION OF CHLORIDES AND RESIDUE TO 105 ºC FROM THE WASTE WATER RESULTED FROM TEXTILE INDUSTRY BY USING THE ELECTROCHEMICAL TREATMENT

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Abstract: Reduction of chlorides and residue to 105 ºC from the waste water resulted from textile industry by using the electrochemical treatment. The wastewater resulted from Textiles presents a great variety of compositions, because of the technologies used in the production. This is the reason of using diverse methods to treat them.

This work outlines studies and tests used to correct the qualitative paremeters of wastewater resulted from Textiles especially when reducing the chlorides and residue to 105ºC using chemical and electrochemical methods.

The tests effected in case of electrochemical treatment were realised by using an electrochemical treatment cell with iron and aluminium electrodes.

In this way, the natrium chloride is transformed in iron chloride, insoluble in water. Using coagulants and flocculants the iron chlorides were precipited.

It was used a range of treatment in case of some wastewater with different characteristics, to obtain the best results from quantitative and economic point of view.

Also, it was effected tests using chemical and electrochemical treatment and then the results were compared and evidentiated the advantages of the last one.

Key words: *Waste water, chemical treatment, electrochemical treatment, coagulants, floculants, chlorides, residue to 105ºC.*

INTRODUCTION

Residual water from Textiles presents a great variety in composition and amount. According to the technologies we used, especially in the last phases of the procedures which involved the dyeing and rinse of the materials, the wastewater consists a large quantity of pollution because of using a large scale of dyestuff (colouring matter) .

The values of qualitative wastewater parameters must be reduced before to discharge them into the municipal severage system or in the river and in this way, the environment is protected.

The main indicators of wastewater from textile industry analyzed before and after the treatment are: pH, suspended solids, BOD, COD that represent the chemical oxygen demand in mg/l for the oxidation of the mineral salts and of the organic substances , dissolved salts and color.

In the last period it was enough a preliminary treatment , now the values of the wastewater parameters must be in accordance with the NTPA 002/2002 to be discharged in the municipal sewerage system and NTPA 001/2002 to be discharged in the river. In the Textiles there exist a lot of difficulties to treat the wastewater to the standard values. So, it is necessary to look for new methods to treat this kind of wastewater.

The usual techniques of purifying the wastewater from dyeing factories or generally, from the textile industry are: physical, chemical and biological or a combination of these methods.

Good results were obtained using the electrochemical method to reduce the wastewater parameters in textile industry. So, for example the effectiveness of this method we can bring to mind the reducing of color with 90%, BOD with 50-70%, COD

with 50-70%, heavy metals with 80%, TTS with 80%. Also, after the electrochemical treatment we obtained a significant decrease of the ions of sodium, chlorine and sulfate.

This work outlines the studies and the tests which were used to correct the quantitative perameters of wastewater resulted from a textile factory. The wastewater from the textile factory dealt with in the first case presents a great variety of composition, because of the technologies used in production, especially chlorides and residue to 105ºC (case A and B paremeters values are higher than the values allowed in NTPA002/2002).

To reduce the specified parameters we can use some methods like :

- Reverse osmosis. This method presents the disadvantage of obtaining a secondary wastewater which is very rich in disolved salts. Also the membranes of the equipment cannot be used in case of concentrated wastewater .
- The filter with ion – exchange resin. This method presents a disadvantage because of the technology of regeneration realised with some other salts . In this way the paremeter residue to 105 ºC increases.
- The chemical treatment. In case of the chemical treatment it can be used the usual coaulants, floculants and polymers.
- The electrochemical treatment. In this case the natrium chloride precipitates with the other salts existing in the studied wastewater. The precipitate must be retained in the first basin .

Tabel 1

The wastewater parameters compared with NTPA 002/2002

Parameter	**U/M**	**Realised max.**		**NTPA 002/2002**
		Case A	**CaseB**	
Temperature	ºC	40	40	40
pH		6,5-8,5	7,5-9,5	6,5-8,5
Rezidue to 105 ºC	mg/l	5860	3139	2500
Chloride	mg/l	4600	2360	2000

Material and methods

In the first step the wastewater was analised after the wastewater treatment plant and before to be discharged in the river . The wastewater was sampled in two different periods in which the water had different concentration of chlorine and to residue to 105 ºC too .

The first category of samples was marked with A and it was sampled in a period in which the wastewater from the dyeing factory has a high concentration (June 2006). So, the control- sample has for chlorides a value from 4600 mg/l and to residue to 105ºC - 5860mg/l (Table no.1).

The second category of samples was marked with B and was sampled in a period in which the wastewater from the dyeing factory was deluted because of the technologies used in this period (July 2006). So, the control- sample in case of chlorine has a value to 2360mg/l and to residue to 105ºC to 3139 mg/l.(Table no.1)

Table 2

The treatment with coagulants and floculants used in case of wastewater from textile industrry (Variants of treatment)

No.	Sample	Treatment					
		Coagulant			Floculant		
		NALCO	Conc %	quant ml.	NALCO	Conc %	quant ml.
	M	-	-	-	-	-	-
	1	71225	0,5	5,0	7152	0,5	1,0
	2	71225	0,5	10,0	7152	0,5	
	3	71225	0,5	15,0	7152	0,5	
	4	71225	0,5	15,0	7152	0,5	2,0
	5	71225	0,5	5,0	7752-cationic	0,5	1,0
		Aluminium sulphate	0,5	40,0	-	-	-
	6	71225	0,5	5,0	7752-cationic	0,5	1,0
		Aluminium sulphate	0,5	50,0	-	-	-
	7	71225	0,5	5,0	7752-cationic	0,5	1,0
		Aluminium sulphate	0,5	60,0	-	-	-
	8	71225 Aluminium sulphate	0,5	5,0	7752-cationic	0,5	2,0
		Aluminium sulphate	0,5	50,0	-	-	-

In these cases the values of perameters chloride and residue to 105ºC present high values , higher than the values allowed in NTPA 002/2002 (Table no 1.) . We tested

more variants with chemical treatment and more variants with combinations of chemical and electrochemical treatmant to obtained a decrease of the studied parameters.

CHEMICAL TREATMENT

The physico-chemical experiments were carried out in a Jar –Test apparatus .

The tests were performed using coagulants 71225 from NALCO and Al2(SO4)3, and 7752 –cationic floculant from NALCO. Table no. 2 shows the quantities of coagulants and floculants added to treat the wastewater in the two studied cases. (The coagulant concentration varied between 5,0 and 15,0 ml -0,5%and aluminium sulphate 40-60 ml -0,5%. The floculant concentration varied betveen 1,0-2,0 -0,5%).

The procedure consisted in introducing 500 ml of the sample in the jars, the coagulant was added and rapidly mixed during 4,5 minutes. (2) Then the flocolant was introduced in the jars for an additional time of 15 minutes.

The coagulant and floculant concentrations were studied .

Using the chemical treatment was obtained a decrease of the chlorine and of the residue to105ºC parameters but not enough to realised the values alowed in NTPA 002/2002.

Table no. 3 shows some results we had obtained and which are representative for this part of our experiments.

Table 3

Values of wastewater from textile industry after the chemical treatment with coagulant and floculant substances

No.	Sample	U/M	Parameter			
			Chloride		Rezidue to 105 ºC	
			A	**B**	**A**	**B**
1	M	mg/l	4.600	2.360	5.860	3.139
2	9	mg/l	3.700	1.890	5.460	2.930
3	10	mg/l	3.706	1.910	5.320	2.783
4	11	mg/l	3.836	1.978	5.520	3.008
5	12	mg/l	3.990	1.996	5.300	2.800

In case of sample 9, using the treatment with aluminium sulphate and coagulant 71225 for coagulation and cationic floculant 7752 for floculation we obtained a decrease of chlorine concentration with 19,56% in the samples in the first category (caseA) and 19,91% in the samples in the second category.(case B).

In case of sample 10,we can see a decrease with 19,43% of chloride values (case A) and with19,06% in case B.

In case of sample 11,we can see a decrease with 16,60% of chloride values (case A) and with16,18% in case B.

In case of sample 11, we can see a decrease with 13,26% of chloride values (case A) and with15,42% in case B.

In case of sample 9, using the treatment with aluminium sulphate and coagulant 71225 for coagulation and cationic floculant 7752 for floculation we obtained a decrease

of the parameter residue to 105ºC concentration with 6,82% to the samples in the first category (caseA) and 6,65% to the samples in the second category,case B (Fig.no.1).

In case of sample 10, we can see a decrease with 9,21% of residue to 105 ºC values (case A) and with11,34% in case B (Fig.no.1).

In case of sample 11, we can see a decrease with 5,80% of residue to 105 ºC values (case A) and with 7,96% in case B, (Fig.no.1).

In case of sample 12, we can see a decrease with 9,55% of residue to 105 ºC values (case A) and with 10,79% in case B, (Fig.no.1).

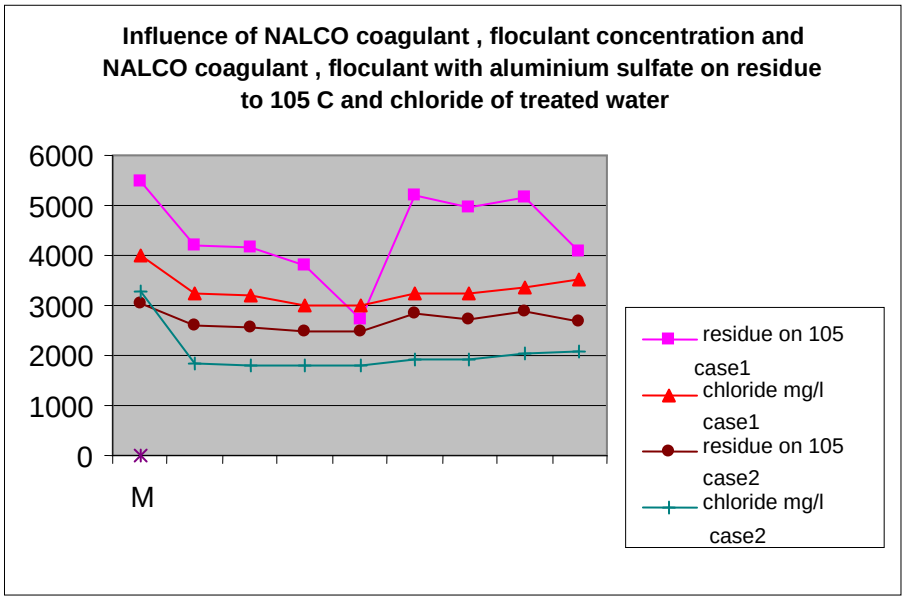

Fig. 1. *Influence of NALCO coagulant, floculant concentration*

ELECTROCHEMICAL TREATMENT

The second method used was the electrochemical treatment and chemical treatment with coaglants and floculants from NALCO to treat the wastewater fron Textiles. So, using this treatment the chlorides and the residue to 105 ºC decreased segnificantlly .

Using the electrochemical treatment the natrium chloride is transformed in other salts which precipite in the water . This reaction was realised in laboratory in an electrochemical cell with aluminium and iron electrode .

Using the electrochemical treatment , the sodium chloride is transformed in other salts which deposide(reside) in water. This reaction was realised in laboratory in an electrochemical cell , with iron and aluminium electrodes.

$$NaCl \xrightarrow{CampElectric} Na^{+} + Cl^{-}$$

$$Fe^{3+} + 3Cl^{-} \rightarrow FeCl_3$$

The resulteh iron chloride precipites as well as the other complex salts formed with the aluminim ions .

An iron gram from the electrode from the electrochemical cell reduce 3 grams of salts, For this it is necesary a quantity of electricity of 1729Q.

For the tests using the electrochemical treatment in combination with coagulants and floculants we used the wastewater marked with B, with smaller values to the studied parameters.

Table 4

The electrochemical and chemical treatment used in case of wastewater from textile industry

No.	Sample	Treatment				Remarks
		Chemical			Electrochemical Q	
		Coagulant		Floculant Nalco ml/l 0,5%		
		Nalco ml/l 0,5%	Aluminium sulphate ml/l 0,5%			
1	13	2			200	In the first step we used the electrochemical treatment
2	**14**	**2**			**240**	
3	15	2			500	
4	16		4	2	200	In the first step we used the electrochemical treatment
5	**17**		**4**	**2**	**240**	
6	18		4	2	500	
7	19		4	2	200	In the first step we used the chemical treatment
8	**20**		**4**	**2**	**240**	
9	21		4	2	500	

RESULTS

The electrochemical treatment was realised in three sample categories.

In the first case , the wastewater was introduced in the electrochemical cel and was treated with an electrochemical treatment to 200-500 Q, and then it was added 2 ml /l coagulant .

We observed a significant effect to 240 Q . The chlorides quantity in this case varied between 1500-1450 mg/l.

In the second case , after the electrochemical treatment, it was used a chemical one with 4 ml aluminium sulphate as coagulant and 2 ml/l anionic floculant..In this case we obtained good results too: the chlorides decreased to 1500ml/l.

In the third case we used, first the chemical treatment with aluminium sulfate, then we applied the electrochemical treatment and finally we added the anionic floculant in the quantity we used in the second case. We observed in this case too a segnificant decrease of chlorides under the value of 1500ml/l.

CONCLUSIONS

Using the chemical treatment to reduce the parameters chlorides and residue to 105ºC from the wastewater from the textile industry we obtained a decrease of the studied parameters : approximate (about) 20% in case of chlorides and about 11% in case of residue to 105ºC. The decrease was not enough to bring the parameters to the value allowed in NTPA 002/2002 , to be discharge into the municipal sewerage system.

Table 5

Values of wastewater parameter from textile industry after the chemical and electrochemical treatment

No.	Sample	U/M	Parameter	
			Chloride	Rezidue to 105 ºC
			B	**B**
1	M	mg/l	2360	3139
2	13	mg/l	1780	1760
3	**14**	**mg/l**	**1450**	**1245**
4	15	mg/l	1380	1100
5	16	mg/l	1810	1900
5	**17**	**mg/l**	**1500**	**1311**
7	18	mg/l	1458	1299
8	19	mg/l	1743	1673
9	**20**	**mg/l**	**1380**	**1300**
10	21	mg/l	1230	1120

✓ Using the electrochemical treatment used in combination with the coagulants and floculants we obtained good results : the chlorides decreased under 1500 mg/l in all the variants. That represents a decrease with 63% to this parameter.

✓ The electrochemical treatment gives the possibility to treat various quantities of wastewater ,with various quality.

✓ This method has a disadvantage too, the iron and aluminium electrodes must be periodicallz replaced and it is necessary a big quantity of electric energy.

✓

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REDUCEREA CANTITATII DE CLORURI SI REZIDUU FIX LA 105ºC DIN APELE UZATE REZULTATE DIN INDUSTRIA TEXTILA, UTILIZAND PROCEDEUL DE TRATARE ELECTROCHIMICA

(Rezumat)

Apele uzate din industria textilă prezintă o mare varietate a compoziției, acest fapt datorindu-se în principal tehnologiilor utilizate în procesul de producție. Din aceasta cauză metodele pentru tratarea acestora sunt diverse.

Lucrarea de față prezintă studii şi încercări de corectare a parametrilor apei uzate rezultate din industria textilă (în special de reducere a clorurilor şi a reziduului fix la 105ºC), prin metode chimice şi electrochimice.

Testele efectuate în cadrul tratamentului electrochimic au fost realizate cu ajutorul unei celule electrochimice cu electrozi de aluminiu şi fier. Ca rezultat, clorura de sodiu se transformă în clorura ferică insolubilă în apa, care, cu ajutorul unor produse cu caracter coagulant şi floculant, sunt precipitate.

S-au luat în considerare mai multe variante de tratament, în cazul unor ape uzate cu calitați diferite, pentru a obține tehnologiile optime, atât ca efect, cât şi din punct de vedere economic. De asemenea s-au efectuat teste utilizând un tratament chimic şi s-au evidențiat prin comparație avantajele utilizării procedeului de tratare electrochimic.