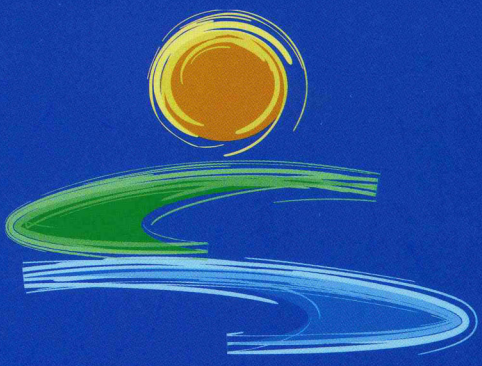
РЕЗЮМЕТА

ABSTRACTS

Международна
научно-практическа конференция

„ЗАЩИТЕНИ КАРСТОВИ ТЕРИТОРИИ – МОНИТОРИНГ И УПРАВЛЕНИЕ“

(16-20 септември 2012 г., Шумен)



International
scientific-practical conference

PROTECTED KARST TERRITORIES – MONITORING AND MANAGEMENT

(16-20 September 2012, Shumen, Bulgaria)

ProKARSTerra

Международна
научно-практическа
конференция

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ТерАрт
София, 2012 г.

Защитени карстови територии –
мониторинг и управление

СБОРНИК РЕЗЮМЕТА НА ДОКЛАДИ
ОТ МЕЖДУНАРОДНА НАУЧНО-ПРАКТИЧЕСКА КОНФЕРЕНЦИЯ,
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FROM THE INTERNATIONAL SCIENTIFIC-PRACTICAL CONFERENCE,
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VLADIMIR POPOV (1912 - 1998) - CONTRIBUTIONS TO THE BULGARIAN KARSTOLOGY

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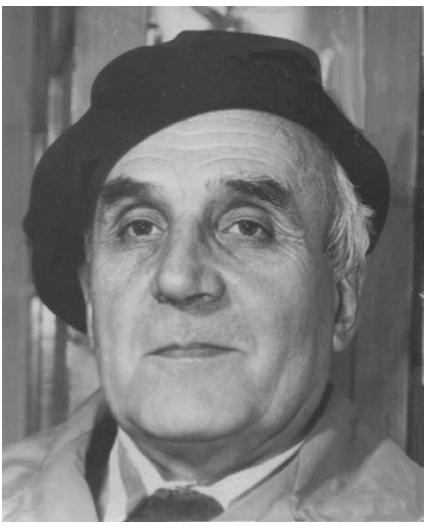

Life dedicated to Caves and Karstology

Professor Vladimir Popov was born and grew up in Stara Zagora, the city of lyricists and romantics. It was not accidental that he chose Geography for his life dedication: it is an unfathomable science about the world in which we live, about its variety and its driving forces. He focused his research efforts to Geomorphology, which studies the complex interactions forming the Earth's visage and its secrets. His geomorphologic interest brought him to the underground karst castles and he remained in a life-long captivity of caves and their still splendor.

Prof. Vl. Popov was a researcher of great creative energy; he had a romantic, and even sometimes adventurous spirit. More than 60 years he studied actively the miraculous cave morpho-sculpture. At the same time, using his talent of taleteller and artist, he created a community of the underground beauty admirers, from children, to people of advanced ages.

Under his pen a series of emotional and lyrical descriptions of the Bulgarian cave pearls was born. Those include the caves of Ledenika, Saeva dupka, Snejanka, Bacho Kiro, Magurata, Dyavolsko garlo, Gradeshnica cave. These descriptions are saturated by love and adoration to the Nature-sculpturer, but also by deep anxiety about Cave world, which is defenseless to Man's aggression.

As a mythical champion, prof. Vladimir Popov distributed generously sparks from his never-dying love to caves. This love was inherently with him when his eyes closed forever. Quietly, he immersed into the silence of Eternity, to which his spirit yearned. But he left to us the embers of his love…

BIOGRAPHY		REWARDS
07.03.1912 -	born in the village of Gostilya (Pleven district)	
1935	- graduated from the Sofia University, speciality "Geographer"	
1936-1955	- Geography teacher in the Exemplary Trade Secondary School	
1944-1945	- participated in the first phase of the Patriotic War against Germany	
1955-1975	- worked as a researcher in the Institute	
1955-1976	of Geography, Bulgarian Academy of Sciences	
(since 1955	- Geomorphology researcher	The Order "Cyril and Methodius" (1973)
since 1965)	- Assoc. Professor	The UIS Gold Medal (1974)
1975-1998	- as a pensioner continued his active research work and expert activity	The "Aleko Konstantinov" Medal A Medal for Distinguished Service Rendered to the Bulgarian Tourist Union (1982)
19.09.1998	- died in Sofia	"Golden Bat" of the Bulgarian Federation of Speleology (1976, 1982) Honorary member of the Bulgarian Geographical Society Honored scientist of the Bulgarian Tourist Union

Major Contributions of Prof. Vladimir Popov to the Bulgarian Karstology:

● Clarified the distribution and the most important features of karst in Bulgaria (1968, 1970, 1973);

● Explored and described regional geomorphologic karst complexes: surface and underground land forms and their relations (basically in the Pre-Balkan and Stara Planina, Northern Pirin, North Black Sea Coast);

● Established traces of old (Pre-Quaternary) karst relief in the Vrachanska Planina - "comic (kegel) karst" (1964);

● Described the spelo-genesis of big Bulgarian caves such as Ledenika, Magura, Saeva dupka, Orlova chukka, Bacho Kiro, Dyavolsko garlo, Snejanka, Prohodna, Gredehsnishka.

● Analyzed the first quantitative data about karst denudation in Bulgaria (1972 – together with M. Pulina and M. Markovicz from Poland).

● Organized and participated personally in the instrumental mapping of famous Bulgarian caves, such as Saeva dupka, Ledenika, Snejanka, Bacho Kiro, Dyavolsko garlo, Magura etc. and introduction of speleo-morpho-metrical analysis and laboratory analytical methods in karst research; introduction of unified symbols for cave mapping (UIS);

● Systematized and specified the Bulgarian terminology of Karst Morphology (89 terms, 1982, together with P. Stefanov);

● Described disclosures of volcanic glass in some Bulgarian caves (1968);

● Compiled the first regionalization of Bulgarian caves (1973, 1977), (M 1:600 000)

● karst provinces (4) karst regions (51);

● Promoted public interest to caves suitable for tourism (about 15 in Bulgaria), analyzed visits and worked on different problems of speleo-protection and rational use of caves;

Created a school of karst research in Bulgaria and formulated the need of a specialized institution of Karstology in Bulgaria.

MORE IMPORTANT PUBLICATIONS

K**arst Studies:**

- The Bulgarian Black Sea Coast of Dobrudja: geomorphological survey. 1953 (in Bulgarian)
- The karst in Vrachanska mountain (co-author). 1958 (in Bulgarian)
- Gradeshnishka cave. 1959 (in Bulgarian)
- Karst morphology in the region between the valleys of the river Vit and river Batuliiska. 1962 (in Bulgarian)

- Morphology of the Golemia Kazan cirque in Pirin Mountain. 1962 (in Bulgarian)
- Morphology and genesis of the Ledenika cave. 1964 (in Bulgarian)
- Karst morphology and karst hydrology in Bulgaria (co-author). 1964 (in Bulgarian)
- Ice formations in the Ledenika cave. 1965 (in Bulgarian)
- Karst morphology and hydrology in the Fore-Balkan northern part between the rivers Yantra and Osam (co-author). 1965 (in Bulgarian)
- Pirin. 1966 (in Bulgarian)
- Snezhanka. 1967; 1971 (in Bulgarian)
- Rozsireni krasu v Bulharsku. 1968 (in Czech)

Morphology and genesis of the Ledenika cave. 1968 (in Russian)
- Saeva Dupka cave. 1969; 1979 (in Bulgarian)
- The karst in the Fore-Balkan northern part between the rivers Iskar and Vit. 1969 (in Bulgarian)
- Karst distribution in the Stara Planina Mountains and some of its characteristic features. 1970 (in Russian)
- Karst distribution in Bulgaria and some of its characteristic features. 1970 (in Bulgarian)
- The karst in the northern part of Central Fore-Balkan (co-author). 1971 (in Bulgarian)
- Bacho Kiro cave (co-author). 1972 (in Bulgarian)
- Comments on karst denudation in Bulgaria (co-author). 1972
- Geomorphology of the Bulgarian Black Sea Coast (co-author). 1974 (in Bulgarian)
- Cave zoning in Bulgaria. 1976 (in Bulgarian)
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- Morphology, genesis and age of the Magura cave. 1977 (in Bulgarian)
- Speleogenesis (Magura cave case study). 1977 (in Bulgarian)
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- Basic terms of karst geomorphology (co-author). 1980 (in Bulgarian)
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- Travels under the ground. 1982 (in Bulgarian)
- Genesis and age of the Prohodna rock bridge. 1985 (in Bulgarian)
- Main approach and principles for elaborating a model of a geomorphological map of Bulgaria, scale 1:400 000 (co-author). 1986 (in Bulgarian)
- Caves with man-made facilities in Bulgaria. 1987 (in Bulgarian)
- Problems of the Bulgarian caves supplied with all necessary facilities (co-author). 1989 (in Bulgarian)
- Karst morphosculpture - In: Geography of Bulgaria, 1997; 2002 (in Bulgarian)

Publications on Protected Areas:

- The beauty spots of our native land. 1957;1970 (in Bulgarian)
- Distribution and problems of the protected natural sites in Bulgaria.1975 (in Bulgarian)
- Protected natural areas, sites, forms and species in North Bulgaria.1978 (in Bulgarian)
- Protected natural sites in Bulgaria.1980 (in Bulgarian)
- Bulgaria's natural scenery (a photo-album)
- Natural recreational resources on the Bulgarian Black Sea Coast and its rational use (co-author).1983 (in Bulgarian)
- Protected natural sites in Bulgaria (co-author).1984 (in Bulgarian)
- Bulgaria's nature parks.1995 (in Bulgarian)
- The natural pearls of Bulgaria (unpublished)

PUBLICATIONS ABOUT VLADIMIR POPOV

- Mishev, K. Vladimir Popov is getting on for 60. - Изв. Бълг. геогр. д-во, 1972, Т. XII (XXII), 179-181 (in Bulgarian)
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„proKARSTerra" – МОСТОВЕ КЪМ БЪДЕЩЕТО*

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Ключови думи: *карст, защитени карстови територии (ЗКТ), карстова геосистема, специализирани информационни системи, комплексен мониторинг, управление на ЗКТ, устойчиво развитие, образователни програми, международни мрежи, моделиране*

Широкото разпространение на карста в България прави актуални въпросите за използването, стопанисването и управлението на карстовите територии с оглед тяхното устойчиво развитие. В това отношение голямо значение придобиват защитените карстови територии (ЗКТ). Те са **уникални**, поради което са от изключителен обществен интерес. Същевременно карстовият им произход ги прави силно чувствителни и уязвими на човешки въздействия, поради което те са **рискови територии**. В този аспект обявените защитени карстови територии и обекти имат важно научно, екологично, рекреационно-туристическо и образователно **значение**. Това ги прави подходящи и като полигони за разработване на модели за рационално природоползване в карстова среда.

С настоящият доклад се представя същността на пилотен научно-изследователски проект в тази област, който по тематика и целева насоченост на очакваните резултати (специализирани научни изследвания; земеползване, стопанисване и управление; образователни програми) е сериозна заявка за създаване модел на методическа платформа за съвременно управление на карстови територии с природозащитен статут. Проектът се основава на *концепцията за карстовата геосистема, специализираната информационна система за карста* (кадастър на карста) в ГИС-среда и *комплексността на мониторинга* предвид уникалността и уязвимостта на карстовите геосистеми. Експерименталният модел на комплексен мониторинг се разработва на примера на избрани карстови геосистеми в репрезентативни ЗКТ в България от различна категория (Природен парк "Шуменско плато", Природна забележителност "Маарата", Природна забележителност "Съева дупка" и Защитена местност "Триградско ждрело") и в Чехия (Природен резерват Моравски крас) и Япония (Акиоши-квазинационален парк), партньори на проекта.

Научно-изследователският опит показва, че за изясняване спецификата на карстовите територии и протичащите в тях процеси най-ефикасна е концепцията за **карстовите геосистеми** (Воропай, Андрейчук, 1985; Михова, Стефанов, 1993; Stefanov, 2004; Андрейчук, Стефанов, 2006; 2008; Андрейчук, 2007 и др.), разработвана в Географския институт на БАН (дн. Деп. География на НИГГГ-БАН) от 1980 г. Според нея, карстовите процеси имат системообразуващо значение и по определен начин организират средата на своето развитие, като образуват териториално единни и функционално цялостни образувания - карстови геосистеми. За тях е типична определена пространствена, функционална, динамична и генетична съподчиненост на взаимосвързани и взаимодействащи елементи.

Спецификата в структурата на карстовата геосистема е преди всичко в съществуването на две основни съставни части – повърхностна и подземна. Между повърхностната и подземната подсистеми съществуват парадинамични и парагенетични отношения. Веществено-енергетичните взаимодействия на подсистемите изграждат същността на функционирането и динамиката на карстовите геосистеми. На етажния строеж на карстовите геосистеми и функционалното единство на под-

* Докладват се резултати по проект ДО 02.260/18.12.2008: „Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии" на Фонд „Научни изследвания".

системите се базират и двата основни принципа на опазване на карстовите обекти и територии, изведени от В. Андрейчук и П. Стефанов (2005, 2006).

Специалният статут на ЗКТ по презумпция изисква висока степен на изученост (включително чрез плановете за управление), но карстовата специфика налага и експертни оценки и провеждането на допълнителни специализирани проучвания. Практическата стойност на получените резултати зависи от организацията им в **специализирана информационна система (кадастър на карста)** на ЗКТ и по-точно, от умелото проектиране на нейната структура и съдържание, попълването ѝ с липсваща информация (чрез инвентаризация, актуализация и допълнителни специализирани изследвания) и въвеждането на базите данни в ГИС-среда (Стефанов и др, 2002).

Друг съществен момент е необходимостта от провеждането на специализиран мониторинг, който поради спецификата на карста трябва да бъде комплексен и съобразен с конкретните структурно-функционални особености на съответните геосистеми в границите на защитените карстови територии. Проектирането и експериментирането на модел на такъв комплексен мониторинг е голямо предизвикателство и отговорност и изисква както сериозен професионализъм в карстологията, така и изследователски опит и познаване на особеностите в организацията и управлението на ЗКТ.

Всички тези методологически особености са в основата на **парадигмата proKARSTerra** (фиг. 1). Тя прави възможно с прилагането на съвременни ИКТ 4-D моделиране на карстовите геосистеми, което има изключително важно практическо значение с оглед тяхното управление и устойчиво развитие. Поради това proKARSTerra не е само проект, но и стратегия. За нейното развитие ще способства сформирането на специализирано научно звено – *Център по карстология*, от което България отдавна има необходимост. Предвид успешно разработваната досега дългосрочна научно-изследователска и образователна програма по карстология, главно чрез проекти, на основата на които е изградена и специализирана изследователска инфраструктура, една от възможностите за базиране на този център е НИГГГ-БАН.

Ясно е, че осъществяването на идеите, заложени в стратегията proKARSTerra, е труден и продължителен процес, изискващ много професионализъм, широко сътрудничество и координация. Поради това тя до голяма степен е и наднационална - резултатите от нейното реализиране се проектират в бъдещето и ще ги постигнат привлечените и обучени чрез proKARSTerra млади последователи на идеята.

Фиг. 1.
Парадигмата proKARSTerra

MANAGEMENT AND CONSERVATION OF QUASI-NATIONAL KARST PARK AKIYOSHI, JAPAN

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According to the Law of Environmental Protection in Japan the following types of protected areas are designated:

- Wildlife territories, where all human activities are prohibited;
- Areas of environmental protection, which are natural landscapes, where small adjustments are allowed, aiming mainly at conservation;
- Nature parks. They are of three kinds: National parks, Kwazi-national parks and Prefectural natural parks;
- Areas with conservation of the natural habitat of certain species. They allow certain activities with special permission;
- Natural monuments;
- Protected forests;
- Protected waters.
- Areas of international importance and such registered as World Heritage sites, registered as members of the Ramsar Convention and the International Program “Man and Biosphere”.

In this paper object of research is the Karst Park Akiyoshi, which falls under the category of “quasi-national parks”.

Natural Parks in Japan are declared under the Natural Parks Act, aiming at protection of the Japanese landscape and improvement of their use. The Act contains many provisions, most of which are valid for the three types of parks. Since Japan is a densely populated country, there are not huge natural/national parks of the size we see in USA, Canada and Australia. In Japanese national park people live and find their livelihood there. About 90% of their area is private. It is therefore necessary to harmonize all interests, yet the ultimate goal remains good management and conservation practices. The difference between National parks and Kwasi-national parks is largely in the level of responsibility. National parks are directly subordinate to the Minister of Environment. Quasi-National parks are subject in some cases to directly to the Minister of Environment, but in many points of the Law they are subject to the Prefectural (Regional) administration. Such is the case with the Karst Park Akiyoshi. In the management of the park and its protection role have different institutions, such as:

- the Ministry of Environment;
- the Prefectural office, mainly its Environmental Directorate. The Prefectural responsibilities include not only control, but also some direct investments such asbuilding prefectural roads;
- the Mine city municipality, which is directly responsible for the use, management and conservation of the park;
- private associations of owners of land, infrastructure, tourist and other establishments, of people, who live on the park territory;
- public organizations, including people of scientific, exploration (cavers), scientific interests, volunteers, etc.

The present study attempts to reveal the responsibilities and interactions among the above mentioned institutions, organizations and individuals.

AGRICULTURAL ACTIVITIES AND "GREEN TOURISM" IN THE KARST PARK AKIYOSHI, JAPAN

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This paper reports about a research on the Green tourism in the Karst park Akiyoshi, Japan.

Karst plateau area of Akiyoshi extends far beyond the borders of the Akiyoshi karst park. Outside the park land use is exempt from prohibitions of land use and business activities. The resources are actively used for farming within three settlements near the town of Mine. The area which comes within the Karst Park, declared as "quasi-national", continues to have mixed status of ownership: there are parts, which are community/state land, but there are parts which are still privately owned.

But regardless of ownership, as required by the statue of national parks and the Ramsar Convention commitments, business, recreation, sports and other activities are regulated. Control is exercised at the regional (prefecture) level and national level (Ministry of Environment).

Before the announcement of the park parts of it are actively used since ancient times for agriculture. Due to the warm climate and high humidity the vegetation grows rapidly and there is a practice of burning it in February, when it is dry. This land is prepared for t

he agricultural season, starting in March-April and sowing of rice starts in May. The grass is used for animal feed, but Japan this is not a traditional farming sector and the number of animals is very small.

With the announcement of the park and in the process of socio-economic development the number of farming population decreased greatly. Within the park some small agricultural activities continue for some time, but they gradually stop. The annual burning of grass continues, but after that most of the former agricultural land remained unused for this purpose.

Over the past 20 years in Japan the so called Green Tourism developed. The definition of this form of tourism is ambiguous according to different authors, people and institutions involved in it. The meaning ranges from identification with ecotourism, defined as distinct form of tourism, to identification with rural tourism. There is another aspect in terms of "greening" of all forms of tourism, to work on reducing the adverse impacts of tourism on nature. In most definitions the emphasis is on "contact with the ground, practicing activities related to agriculture and related culture and tranditions".

In the karst park Akiyoshi forms of Green tourism are developed, which are different from traditional ones. They combine eco-tourism and rural tourism, while performing function set out as a national policy for health, improving social contacts, family support.

In this study the authors seek to reveal how this form of Green tourism appeared in the karst park Akiyoshi; how it is organized; what are the pros and cons from the point of view of the users and those, who offer it; what are the relationships between the land owners and higher institutions and control authorities, responsible for observation of the Park statute as a quasi-national park. A study was held to find out the prospects for further development of Green tourism in the park.

A CONSIDERATION ABOUT THE LOCAL REVITALIZATION WITH THE ART OF THE OBSERVATORY IN A KARST PLATEAU, AND A CIRCUMFERENCE AREA

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Akiyoshidai in the Yamaguchi prefecture in Japan is the greatest Karst topography in Japan, and it is a place to which many tourists come all through a year. However, the number of tourists is decreasing every year now compared with 40-year before. A main subject is also having considered a possibility in the karst plateau which is a quasi-national park of redeveloping the observatory as an institution with art.

ACTIVITY ADMINISTRATION OF PROTECTED LANDSCAPE AREA OF MORAVIAN KARST

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Administration of Protected Landscape Area of Moravian Karst was established in 1977. It takes care of karst in an area of 92 km^2 and 2 national nature reserves and 2 national nature monuments outside the karst area. Currently has 8 zaměstanaců: director + zoologist, deputy-director + geologist + rangers manager, botanist, agriculture + water, GIS + computer network administrator, forests, construction, economics department. The operational environment we have a 5 year time working on the implementation of Natura 2000. Main directions of Administration of the state administration and care for assigned territory. Administration has 2 official cars and other car is available for implementation of Natura 2000. Administration is part of the Agency for Nature Conservation and Landscape of the Czech Republic in the Ministry of Environment. State administration in issuing administrative decisions (authorizations, prohibitions) and binding opinions for administrative decisions of other authorities. A specific authorization is speleological surveys and investigations and making caves for the public. The most common act is binding opinions, when construction activities are assessed with regard to the conditions of conservation. Prepare management plans for specially protected areas, which has in care. Here you determine the tasks and the conditions of nature protection, which will enforce the ten-year period. Prepares proposals and declared nature reserves, natural monuments and memorial trees. Prepares draft decrees on national nature reserves and national natural monument. Collaborates with professional organizations through participation in conferences and seminars, participates in the work of expert working groups, coordinating student professional work, leads the student and professional experience working on research grants. Entrusted to the care of the Administration has disposal annually from the state program of landscape around the amount of 1,200,000, - CZK. Funded are: mowing, grazing, invasive plants disposal, improving the species composition, tree památkých maintenance, revitalization of various types, landfill disposal, maintenance, closure of caves, especially maintenance designation of protected areas. At the Natura 2000 project implementation is carried out off control of national monuments and reservations, externally in these areas provide inventory surveys. For land owned by the State and care ANCLP CR forest Administration specialist manager and also can make purchase of land for nature conservation purposes by the Directorate ANCLP CR. Comments on the economic plans of forest and land use plans. Administration cooperates with specialists in surveys of various kinds, in botany provides monitoring of selected species and habitats and updates layers in the databases. For the public, organized in collaboration with other bodies the exhibition, an annual European Day of Parks and exposure to the night for bats, occasional Open Days Amateur cave annual Earth Day clean sweep for the PLA high youth participation. Prepares materials for the construction of a new exhibition and visitor center of the Moravian Karst, which will be funded from operational environment. Lecture and excursion activity has recently been cut down for financial reasons. Workers in a lesser extent the media publish or present the Moravian Karst. Management inspections of its decisions and binding opinions, especially caves are checked and speleological activities. When managing a vow to work guard formed by voluntary guardians, which coordinates and manages the system administrator. Rangers usually resolves unauthorized cars and driveways may grant a minor penalty on the spot. Management is involved in long-term cross-border cooperation with Poland and Bulgaria with very intensively.

THE NATURE RANGERS IN THE CZECH REPUBLIC

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Nature Rangers have an important role in contact with visitors to protected areas. Since they know the terrain perfectly and often are the only ones who can advise or help. Rangers are representatives of nature protection, which the visitors meet. They are important educational workers.

Ranger is a man who meet on a mountain trail in the woods, the meadows, which will give you information on local nature, attractions and services (restaurants, bike shops, from where buses), highlights the activities allowed and disallowed, will offer guided tours or passes be an information leaflet. In addition to the penalty blocks in the bag first aid kit, map and phone number of the Integrated Rescue System.

If the ranger finds violations of regulations on nature protection, it shall, within their capabilities to intervene. It becomes an arm of the law. It should be noted that the voluntary nature is a guardian of the law officer! This not only gives greater powers and legal protection, but also places greater demands on his responsibility.

How do you know the guardian in the field

Rangers in national parks are equipped with a single uniform. All the rangers in the Czech Republic in the service worn on the left side of the chest (on the pocket, lapel) metal badge. On the left sleeve guard wears a business emblem - badge with the emblem of the PLA or NP and the term “ranger”. This proves the service card.

The ranger is in the nature of its activities shall:

- demonstrate evidence of the nature and guards wear badge;
- monitoring compliance with regulations on the protection of nature and landscape.

Nature Ranger is authorized to:

- identify the persons who violate the law on nature conservation;
- impose and collect fines for violations in the field of nature protection;
- enter a foreign land as provided in the Act;
- detain to identify the person you walk in the violation of laws of nature and landscape and submit it to the Police.

Nature ranger may be appointed an individual who:

- is a citizen of the Czech Reublic;
- is over 21 years;
- has not been convicted for an intentional crime;
- has the legal capacity;
- is physically fit;
- demonstrate knowledge of rights and duties of officers under the Act on nature conservation and landscape and knowledge of related legislation;
- passed by stimulating the promise of nature Ranger.

The Moravian Karst (92 km^2, five caves open to the public the traditional way - an annual attendance of 250 000 persons), a professional ranger we have full-time. Manager rangers as a watch guard 20% of his workload, his main profession is geologist. Moravian Karst has 14 rangers (3 employees are PLA MK), of which 12 are active. It manages 15 employees, including 8 trainees - to ranger candidates. New this year: 3 trainees are employees Cave Administration of the Czech Republic was concluded.

The ranger of nature in the Moravian Karst is the annual training. Once every 5 years of testing are the rangers of the laws of nature. They are encouraged to practice

a tolerant in dealing with offenses and bringing visitors to protected areas. Some guards also control the cave in cooperation with speleologists. Most guards are volunteers and are not paid for their work.

Rangers Association of protected nature territory of the Czech Republic (abbreviated Rangers Association) was founded in 1998 as a professional organization that brings together nature of the particular ranger of national parks and protected areas in the country. Rangers are welcome and acting within the scope of the regional offices outside NP and PLA. Rangers Association is a civil association, not a trade union guards.

The aim is to increase the Rangers Association and professional level of expertise of its members, as long we feel the lack of attention, coordination and methodological guidance of the Ministry of Environment. Therefore, the Association holds regular annual meeting of the rangers of the whole country, to exchange experiences from the guard, information and guide services in the field. At these meetings are regularly invited as experts for consultations and lectures on topics related to the work of the guards. The Association offers its members training, professional excursions and internships in foreign countries. The Association is a member since 1999 IRF - International Ranger Federation, an organization bringing together national associations of nature rangers around the world. In 2000, an Agreement on mutual cooperation between the Czech and Slovak Association of rangers.

THE HOUSE OF NATURE OF MORAVIAN KARST

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The Moravian Karst with 5 caves which are accessible to public, its unique landscape and remarkable sights is one of the most frequently visited places in the Czech Republic (Fig. 1).

The caves alone are visited by more than 350 000 tourist every year. In this locality there are seven marked trails with information boards and tourists can also find interesting information in the Blansko Museum (metallurgy), in the Technical Museum in the iron mill called Františka (history of ore treatment) in Josefov, in the windmill in the village of Rudice (geology and speleology) and in the Museum of Vilémovice (speleology).

Accessing of caves and building the tourism infrastructure started in the beginning of the twentieth century. Between 2000 – 2009 there was quite extensive reconstruction of their technical facilities (new electrical equipment, wiring, renovation of foot trails) and new entrances were built at the Sloup-Šošůvka Caves, the Balcarka Cave and Catherine´ Cave. The most recent cave to be made accessed to public is Výpustek Cave; an underground military shelter which the army left in 2006.

The Environmental Operational Programme, approved for the period between 2009 – 2013, provides for subsidies of up to 90 % of all investments which are used for the construction of visitors centres (Houses of Nature) funded by the financial means of the European Union. The Houses of Nature Program has created an opportunity to construct some buildings in the protected territories but also in some of the most sought after places which are interesting for tourists to visit (Fig. 1). These areas will give tourists closer access to evaluate the worth of this land and also to make them aware of the reasons why these areas should be protected.

The main places to enter the most frequently visited places of the Punkva Caves (200.000 tourists every year) are the Rock Mill (Skalní Mlýn) and area of the Macocha Abyss. It is precisely these places which are intended to be improved by a building which is going to be called the House of Nature of the Moravian Karst. The building will have an information area with a shop while the main area will be used for a permanent exhibition.

On the first floor you will find more information about the geological history of Moravian Karst (for example a model of the Devon Sea), formation of karst chambers and origin of caves, ancient and present life in the caves. The spiral staircase will take visitors into lit up premises on the second floor with an exhibition of living nature.

In the motion-picture theatre you will be able to choose from an offer of short films (the projection of a 3D film about the Moravian Karst is being planned. The youngest visitors will be catered for by a play room where karst themes will be depicted and shown. The indoor exhibition will be supplemented by another outdoor exhibition. The model of the karst landscape will allow visitors watch water passing through the karst landscape where water disappears into caves and then emerges from caves. Sections of rocks with brightly polished cuts will give visitor a greater insight into the karst area rocks.

The House of Nature of the Moravian Karst should be open all year round. The time when the number of visitors will be smaller will be compensated by offering programmes for schools including outdoor excursions. Planning permission for the House of Nature has been already issued and the investments for construction have been allocated. Running the House will be partly covered by its own incomes (entrance fees, tickets sales) and by a contribution provided by our organization and the Caves Administration. Almost a half of all financial investment is to be given by nearby towns, villages and by some local

entrepreneurs.

The construction is subject to the final consent provided by the Ministry of the Environment. If the consent is given, the commissioning of the House is expected to be in spring 2013.

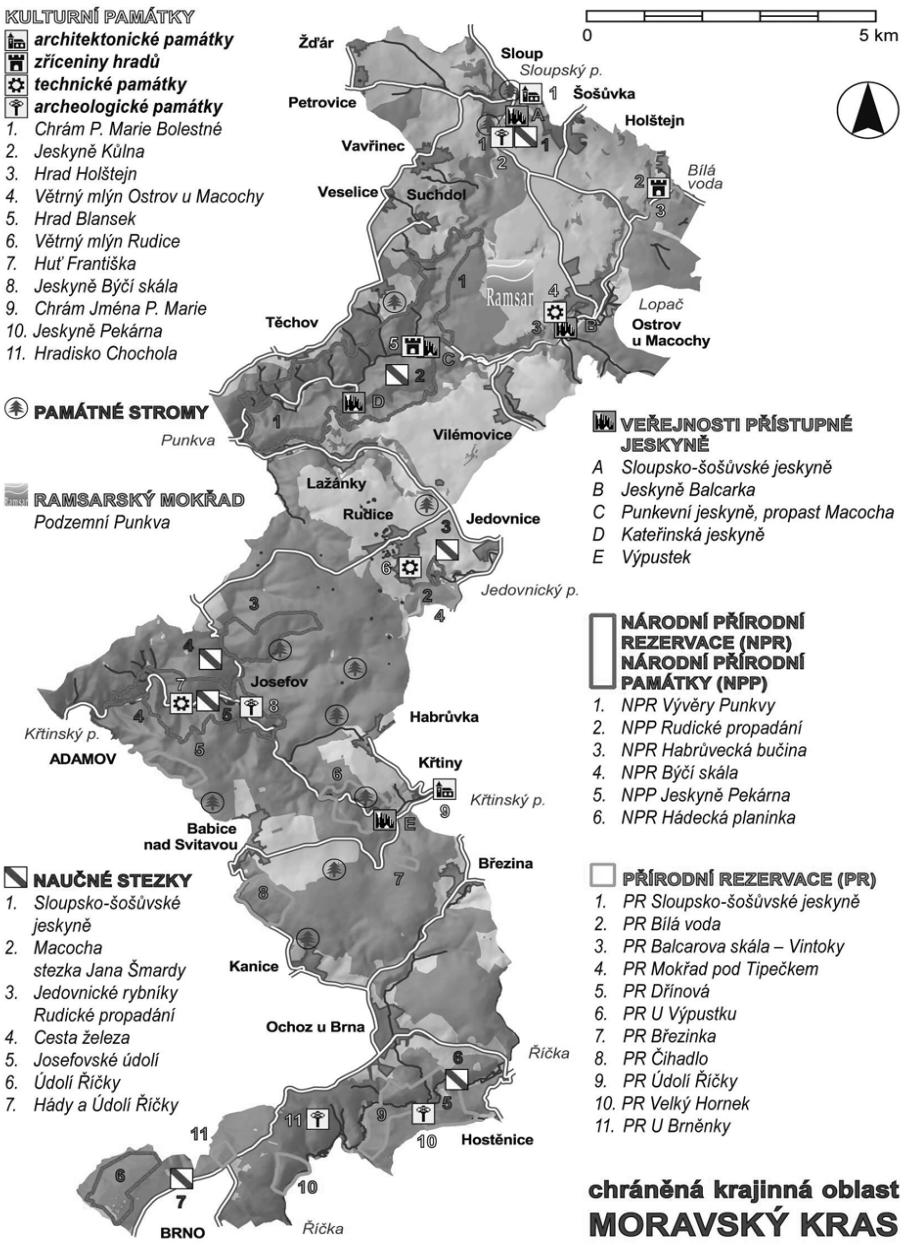

Fig. 1. A map of the Moravský kras – Protected landscape area, visitors infrastructure

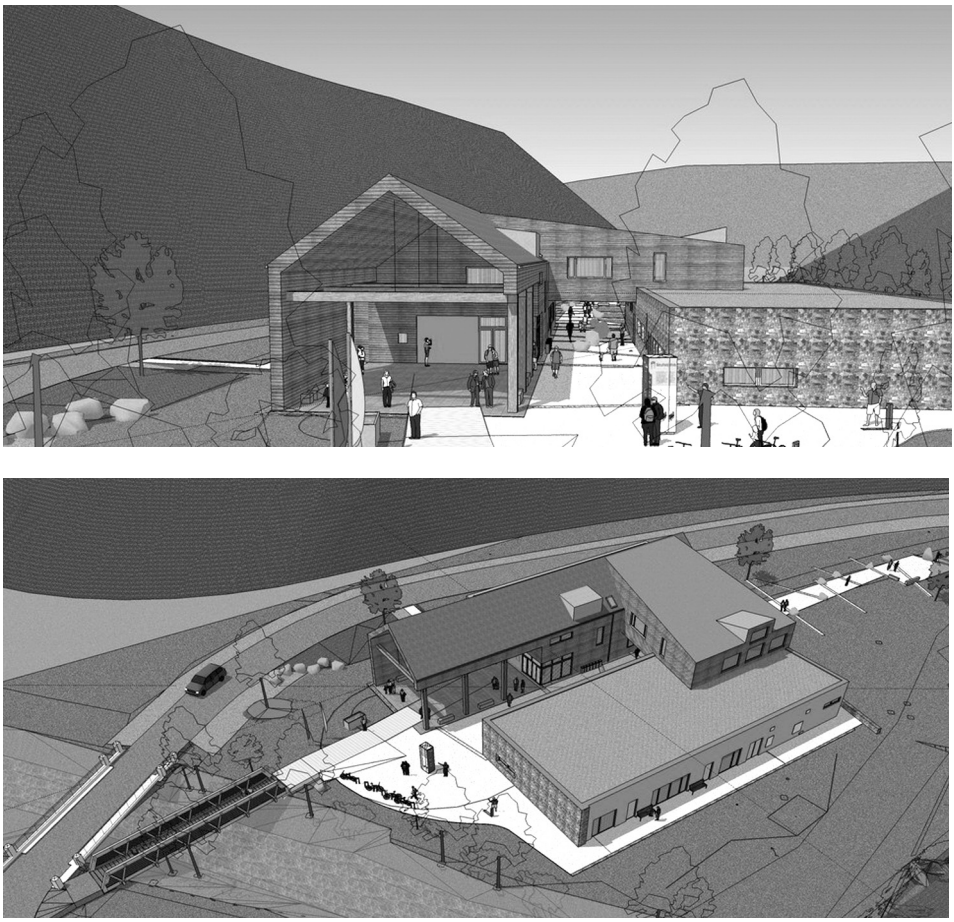

Fig. 2. Visualisation of the House of Nature (project by PParchitects s.r.o.)

INSECT RESEARCH, MANAGEMENT AND POPULARISATION IN THE BOHEMIAN KARST PROTECTED LANDSCAPE AREA (CZECH REPUBLIC)

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The Bohemian Karst Protected Landscape Area (PLA) is a limestone area of 130 km2 located in central Bohemia, close to the capital of Prague. Due to its specific natural conditions it belongs to prime and most important zoological areas from the whole Czech Republic, with many unique species found nowhere else in the state. The most valuable 20 sites stand under a special protection mode: two in the category of national nature reserves, four national nature memories, eight nature reserves and six nature memories. The zoological administration of the PLA deals with insect problems relevant to nature conservation as one of main topics.

Research activities consist mostly of monitoring, inventory and mapping of particular groups, from which the best known up to date are Lepidoptera with the history of research dated back to the half of 19th century and the amount of about 2200 species found historically. Population dynamics studies were recently made as a diploma or Ph.D. theses on several endangered species (e.g. Hipparchia semele, Zygaena osterodensis) and subsequent research is in progress, including the completing of the first Lepidoptera monograph of the PLA or extensive time study monitoring Lepidoptera of grazed grassland. There is also a tradition in studying other insect orders – mainly Coleoptera, Heteroptera and Trichoptera together with certain families of Diptera and Hymenoptera, including some surprising founds of a new species to be described from the PLA.

The management problems solved in the PLA are focused on grassland and light lowland deciduous forests associations. They are represented mainly by protecting the grassland against overgrowing with expansive and invasive plant species by the means of grazing, pruning or mowing. The PLA is also supporting the restitution of traditional forestry to help many unique species inhabiting light deciduous forests. The management activities are made either for a concrete species or a group of species due to their habitat preferences.

An important area of interest in PLA activities is also a contact with public and the popularisation of the above mentioned problems. Every year an event called The Moth Night of Karlstejn takes place, simultaneously to the annual European Moth Nights project. Its participiants are introduced to the life and conservation of moths and basic methods of their research. Another public activity is an annual entomological excursion which is a one-day field trip showing the most valuable sites of the PLA and their unique insect fauna. The organization of these events is supported by cooperation with the Czech Society for Butterfly and Moth Conservation.

MANAGEMENT, PROTECTION AND CARE FOR THE SHOW-CAVES IN CZECH REPUBLIC

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In connection with political changes in the Czech Republic after 1989 and then in the independent Czech Republic, quite new conditions for protection and care for the caves were formed and also a new section of the environment and creation of a new structure of the state nature conservation were created. There are 4000 of natural caves (cave entrances) both of karst and non-karst origin presently registered in the Czech Republic. The longest one is the Amatérská Cave system in the Moravian Karst with the length of 35 km, the deepest one is the Hranice Abyss with the maximum depth of 289.5 m achieved so far (220 m of which is under the water surface). Fourteen of cave systems are adapted and open to the public.

All the caves (regardless of their administrative identification) are strictly protected according to Act No. 114/1992 Coll., on Nature Conservation and Landscape Protection. It is prohibited to destroy, damage, adapt or otherwise modify their survived state. The exception can be approved by the nature conservation authority only in exceptional cases of prevailing public interest. Also exploration and research are approved by the nature conservation authority. The same protection as caves is automatically enjoyed by natural phenomena on the surface which are connected with caves (dolines, ponors, seepages etc.). Caves are neither parts of the land nor subjects of property. In case of a sale, the owner of the land with a cave is obliged to offer it first to the nature conservation authority. The exceptions are mining spaces of exclusive ore deposits, where the protection can be claimed only after agreement with an authorised producer. There is, however, an obligation to notify the nature conservation authority about the discovery of the cave and prepare documentation of the cave according to the implementing decree. A large number of caves is also found in the area of small-scale or large-scale conservation areas (national parks, protected landscape areas, nature reserves, nature monuments), where other conservation conditions according to the mentioned law are also applied. The caves with archaeological findings or with historical meaning are also protected as cultural relics and archaeological sites by Act No. 20/1987 Coll., on State monument care.

The nature conservation and landscape protection belongs to the section of the Ministry of Environment with administrations of national parks, Agency of Nature Conservation and Landscape Protection of the Czech Republic (hereinafter referred to as ANCLP CR) and the Cave Administration of the Czech Republic as expert workplaces and nature conservation authorities. The nature conservation authorities competent for decisions on caves are workplaces of ANCLP CR (administrations of protected landscape areas); the authorities in the area of national parks are their administrations. The decisions on the less significant caves outside the protected areas are carried out by regional authorities. The conditions of cave protection and use are defined by the nature conservation authorities. Also cave exploration, research and plans of care are approved by them. The Cave Administration of the Czech Republic ensures especially the protection, care and management of the caves open to the public, but also carries out the professional duties specifically focused on the karst, caves and speleology according to requirements of the state nature conservation. ANCLP CR and the Cave Administration of CR keep a record of caves (IRSO – Integrated Record of Speleological Objects) as a part of Information system of nature protection.

The protection and management of fourteen cave systems is ensured by the Cave Administration of CR according to the conditions and limits specified by administrations of protected landscape areas of ANCLP CR. There is a specification of range of routes open to the public, opening hours of caves during the day and during the year (e.g. terms of winter closures for hibernation of Chiropterans), number of visitors in groups and intervals of groups (for the recovery of cave microclimate) and other conditions

Already in 1990, a newly constituted uniform cave administration in the system of nature protection prepared new principles of care for caves ("The plan of purification of caves" was also introduced at the 11th international speleological congress in Peking in 1993). They became not only a pattern for subsequent planning documents, but also a base for immediate implementation. At present so called "protection management of caves" is implemented in agreement with ten-year „plans of care". In addition to the conditions of cave use, the protection management defines particular tasks of further exploration, documentation and monitoring, specifies activities of sanitation and restoration (corrective actions) and manners and forms of educational use. The corrective actions are funded from resort programs.

According to Act No. 61/1988 Coll., on mining activities, explosives and the State mining administration, the show-caves are under supervision of the State mining administration as well. Opening up of caves and their maintaining in a safe state is "an activity carried out in a mining manner". Therefore "Operating regulations", "Visitors regulations", "Emergency plans" are compulsory for the caves; specified inspections and revisions are performed, the employees undergo qualification and periodic testing. It is not easy to harmonize requirements of mining-technical maintenance of caves with conditions of their protection.

According to Act No. 18/1997 Coll., on Peaceful Utilisation of Nuclear Energy and Ionising Radiation, the management of the show-caves is also supervised by the State Office for Nuclear Safety. There is a compulsory monitoring of radon concentration and evaluation of annual personal effective doses of ionising radiation of employees (all doses remain permanently within specified limits!).

Since 1990, the Cave Administration carried out general reconstructions of nine show-caves according new ecological approaches and partial adaptations of other caves. Negative influences of previous exploration works and works to make the cave accessible are totally or at least partly eliminated, together with consequences of long-term tourist attendance. Mine fillings, backfills and waste dumps, often quite large, are being systematically removed from the underground. Unwanted and redundant concrete areas and non functional technical equipment are being disposed. New pavements and staircases are rated to attendance limited by protection conditions (concrete staircases and footbridges are more and more often replaced by precast constructions from stainless steel); water from washing of pavements is collected separately from natural karst water. If possible, the cave routes accessible to people who use wheelchairs are being adapted. To maintain the underground microclimate, air locks are being installed on access routes. New technical equipment is based on stainless metals and plastics. More suitable lighting devices with limited lighting mode and (experimentally) also LED lamps are used for lighting. Camera systems or at least safety signalling elements are being installed according to the needs to protect the caves and visitors. The show-caves thus undergo very distinctive changes.

You can see changes of entrance areas of the show-caves as well. There are seven quite new service buildings. In all of them there are conditions for improvement of visitor services and for establishment of presentation and learning expositions.

All the show caves (including the parts not open to the public) are mapped in details and documented in photos. In all of them monitoring of underground microclimate is being carried out, in selected caves using continuous automatic systems. There is also permanent monitoring of radon concentrations, including calculation of annual personal effective doses of ionising radiation of employees. Also geotechnical state of walls and ceil-

ings of caves and rock massifs above the premises is being studied. Special monitoring protects the Koněprusy Caves against seismic shocks from blasting operation in a near large quarry. Monitoring of water level on the underground Punkva River is the condition for safe boat traffic. The occurrence of lampenflora and moulds is systematically studied and subsequently chemically disposed. A special research with chemical interventions is focused on elimination of biological attack of aragonite crystals in Opona (Curtain) in the Zbrašov Aragonite Caves. Within the resort research program, the Cave Administration has finished the task "Determination of dependence of cave microclimate on outer climatic conditions in the show-caves of the Czech Republic". The result is, among others, a binding resort methodology and source materials for more precise conditions of cave protection and use. As a part of the whole world system, in selected caves there are instruments from the Institute of Rock Structure and Mechanics Academy of Sciences of the Czech Republic for monitoring of movements in the cracks of Earth's crust. The Institute of Geology AS CR is engaged in stratigraphy, content and age of cave fillings.

In addition to plenty of propagation material and printed information, publication and educational mission of the Cave Administration of CR is accomplished mainly by publishing of popular educational publications. It should be mentioned that editing of the first compendium of Czech caves JESKYNĚ – 14th part of edition Chráněná území ČR (Protected Areas of the Czech Republic) (2009), a set of brochures about the show-caves, and a new edition of professional papers Acta Speleologica (3 edited titles). Also the first movie from the series of video films about the show-caves was shot. Thematic information and presentation CDs and DVDs were produced as well.

The traditional tourist tours of caves are occasionally revived by thematic actions demonstratively showing e.g. their archaeological or historical meaning (played scenes from the life of Neanderthal man, Cro-Magnon people, adventures of first discoverers and explorers). In addition to technically modified routes, excursion paths with professional accompaniment are starting to be used as well in areas that were not made accessible. Selected underground objects are more and more often used for cultural and social events. Particularly impressive are music festivals Čarovné tóny Macochy (Charming Tones of Macocha) held in the Punkva Caves. Chamber music concerts, exhibitions of graphic works or serious social events are held also in other caves with favourable conditions of cave protection. In 2011 there was a series of very interesting concerts "Didgeridoo v jeskyních" (Didgeridoo in caves); in 2012 the travelling festival "Cave Beat" with leading interprets should be mentioned. Also thanks to this form, the most beautiful and impressive underground "cathedrals" become more and more famous for public.

After the phase of demanding reconstructions of caves, the up-to-date task of the Cave Administration of CR is to continue in increasing of educational and information potential of the show-caves. It is a gradual complementation of entry objects and underground spaces with educational expositions which are able to enhance the spectrum of information about caves (geological, paleontological, archaeological – e.g. The Balcarka Cave or "Mladečské jeskyně – jeskyně cromagnonského člověka" /The Mladeč Caves – the caves of Cro-Magnon man/). Among larger events there is a prepared project of exposition on the theme "Cave and People" in the Výpustek Cave, including museum and information centre about the karst. Another prepared event is an education exposition in the archaeological site of Neanderthal man in the Kůlna Cave in the Moravian Karst. A new premises with exposition and information centre of the Bohemian Karst is presently being designed for the Koněprusy Caves. There are finished projects of complete reconstruction of premises in the Punkva and Javoříčko Caves.

The Cave Administration takes also part in other tasks of nature protection concerning natural or historical underground and requiring speleological or mining-technical qualification. At present it prepares documentation of newly discovered caves, studies pseudokarst caves in sandstone rock towns, cares of unique caves on fluorite veins of old mine workings, processes source materials for saving of abandoned historical mine

workings, performs speleobiological exploration and research, compiles thematic documentation files etc. etc. During that it cooperates with many expert workplaces, esp. with institutes of Academy of Sciences of CR, universities, museums etc. Speleological explorations in the Czech Republic are performed also by regional parts of the Czech Speleological Society, a registered association of both amateur and professional cave explorers. Together with them the Cave Administration of CR is a partner of the prepared 16th International Speleological Congress which will be held in 2013 in the Czech Republic.

Fourteen show-caves are annually visited by 700–800 thousand of visitors. The most frequently visited are the Punkva Caves with a monumental Macocha Abyss and a cruise over the underground Punkva River (over 200 thousand of visitors). An extraordinary attention is paid to their protection and dignified presentation by the Ministry of Environment, not only by supporting the projects, but also through distinctive propagation. In 2012 it is especially marketing campaign “Dny jeskyní” (Days of Caves), where exhibitions, lectures, press conferences are held not only in Prague and there are many radio and TV programmes devoted to caves. Through the above described activities of the resort and the Cave Administration of CR the show-caves are becoming not only a strictly attended treasure of our nature and prehistory, but also a direct and dignified part of culture and education of inhabitants.

THE MICROBIAL INFESTATION OF ARAGONITE DECORATION IN ZBRASOV ARAGONITE CAVES (CR) AND IT´S REMEDIATION

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Zbrašov aragonite caves (hereinafter refferead to as ZAC) are the only one made available caves of hydrothermal origin in Czech republic with unique microclimate and decoration – raft stalagmites, doughnut crusts and mineral aragonites. The caves system discovered in 1912-1913 was opened to public in 1926, visit time is running since April until October and yearly number of visitors makes around 50 thousand people. The main topic of studying is liquidation of aragonite attack on the place called Opona (The Curtain), which was solved by many specialists from many branches and makes uprecedented problem.

Opona (The Curtain) is given name of vertical rock shield of lenght 10 m and height 3 m, which is situated in the roof of the biggest room ZAC – Jurik's Dome. It's the only one continuous space of aragonite in whole ZAC system, which is occured from needle-shaped to shrub pieces. Aragonite is one of the valuable modification of calcium carbonate crystallizing in diamond system, which was arised in the area above mineral water lakes. Negative changes were firstly macroscopically seen around year 1980 in shape of polluted places in the end of crystals and colour changes of previously white decoration.

In 1990 was excluded anorganic origin of samples dust pollution by mineralogical analyses and also there was found iron presence in red coloured aragonit crystal crusts (MORÁVEK 1992).

In 1991 the composition of the dust clumps was identified as a coating predominently constituted by **textile fibers** (wool, cotton, rabbit hair, polyester etc.). They are released due to mechanical abrasion from clothing of visitors and are carried by the upward flow of air toward the edge of the Curtain.

At the same time team of microbiologists from Czechoslovak collection of microorganisms from Masaryk University in Brno under the leadership of dr. Lubomír Schánìl first demonstrated the occurrence of **microscopic fungus** with the source of nutrients in these textile fibers. As a possible cause of colour changes of aragonite was labeled metabolic products of microbial growth – organic pigments and enzymes. At the same time were documented degradation symptoms of metabolic products of microorganisms on the surface of aragonite crystals. Next research in 1991-94 was more focused on the detailed identification of species found bacteria and fungus (HANULÁKOVÁ – MARVANOVÁ, 1993, 1994).

In the years 2000-3 was made detailed mineralogical analysis of Curtain by M. Geršl *(see the enclosed scheme)*. At that time were known for many years successful rehabilitation effects of an **aqueous solution of hydrogen peroxide** during the liquidation of dust and mold coatings on sinter decoration in Koněprusy caves. When using hydrogen peroxide leeds to oxidation of biomass and during it´s decompotision there are no unnatural chemicals that could contaminate the cave environment. These procedures were laboratory verified on sinter filling of cave (FAIMON 2001, 2003).

In 2003 verification the effect of the considered spray on aragonite in **laboratory conditions** was performed at first. Mainly the optimal concentration of the solution due to the potential disruption of crystallographic forms of aragonite were investigated, also suitable for practical use in the ZAC. A propsal for the application of hydrogen peroxide solution at a concentration of 5-12 % calcite pre-unsaturated was the result. It was also found

that after application on the taken sample of aragonite occur to bleaching of this sample, but only if it is not already covered with younger mineral coating.

In 2004 the experimental spraying was carried out on the selected section of Curtain, in 2005 **the first full area application** of the solution, in the concentration 12 %. On the Curtain 11 checkpoints were determined to spatial orientation during photo-documentation and repeated sampling. In increments of five months the hydrogen peroxide solution was applied 2x and after second application the surface of the Curtain was washed by water to remove adhering organic impurities and residual peroxide solution.

By analyzing samples of solutions trickled downd from the Curtain after application an equivalent weights of dissolved minerals were monitored, which, due to minimum values appear to be negligible. Thus we concider applied concentration of peroxide to be cave decorations safe, even so there is a spontaneous decomposition of peroxide in regular water after a short time.

To decrease contribution of the air-borne elements administration of ZAC made also radical technical precautions in year 2005. By the reconstruction of the visiting route was the traffic pavement in Jurik´s Dome moved. Now people don´t stand directly below the edge of Curtain.

In years 2007-8 was proved effectivity **in time horizont**. Before opening cave for the public in March 2007 was implemented repeated spray of 9 % solution of hydrogen peroxide. Samples for mycological analyse was taken periodically one time per month from spray. We have looked for two goals. One was start of microorganisms growht with context to the visiting traffic. Second was lowering quantity of disinfection intervention.

From year 2009 is applied area-wided spray one time per year before opening cave for the public with samples taken one per month. Samples were observed for their effectiveness. Positive results allow lowering samples from year 2012 to four times per year, area-wided spray stay one time per year before opening cave for the public.

Parallely now running research of red pigments, which maybe are crated during metabolism of microorganisms.

Remediation and research continue. Main goal is to stabilize today´s condition of valuable aragonite decoration. Complete removing of coloured aragonite is not now in human hands. This is a warnig before hasty or insensitive opening caves with valuable decoration for public anywhere in the world. **Realizitation of sprays**, samples and their laboratory evaluation are financed by special programs of Ministry of the Environment of the Czech Republic, which are specified for care of specially protected natural areas.

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Fig. 1. Schematic plan of The Curtain. Location with occurence of minerals: aragonite, aragonite with huntit and magnezit, kalcit. Sites of verification sampling (X,Y,Z). Authors: Milan Geršl, Zuzana Blahová, 2003.

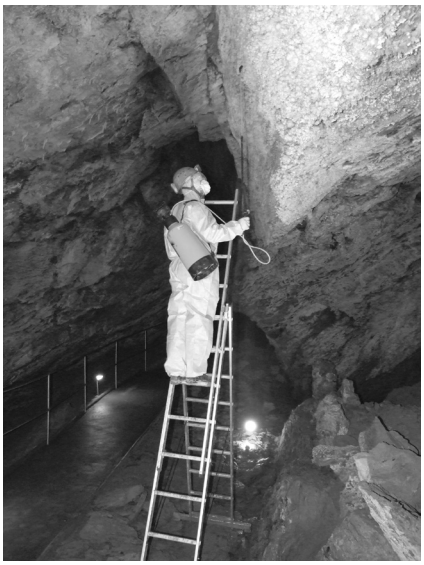

Fig. 2. Spraying of The Curtain, 2009. Photo: Slavomír Černý

Fig. 3. Detail of polutted aragonite decoration on The Curtain before spraying. Photo: Milan Geršl

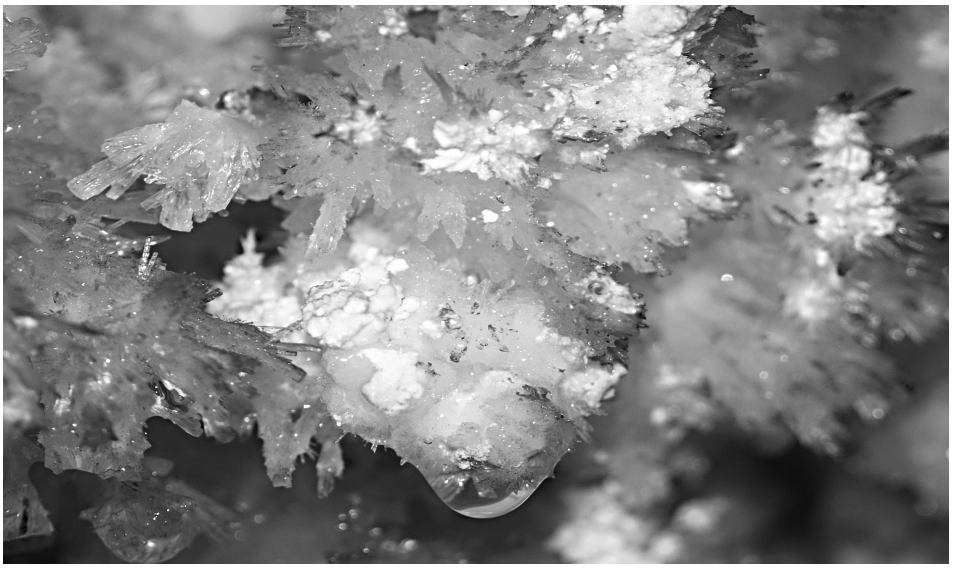

Fig. 4. The same site 30 minutes after the spraying with 10 % solution of hydrogen peroxide. Photo: Milan Geršl 3. Detail of polutted aragonite decoration on The Curtain before spraying. Photo: Milan Geršl

THE RECONSTRUCTION OF VISITING ROUTE IN ZBRASOV ARAGONITE CAVES (CZR)

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The Zbrašov Aragonite Caves (hereinafter refferead to as ZAC) is characterized by next parameters:

- Czech Republic, Teplice nad Bečvou;
- Hydrothermal karst genesis;
- Length of the cave system 1.322 m ;
- Denivelation of the cave system 55 m;
- Length of visiting route 375 m;
- Denivelation of visiting route 17,5 m;
- Discovered 1912 – 1913;
- Opened to public 1926;
- Reconstruction of visiting route 2003 – 2005.

The visiting route of ZAC was builded in years 1913 to 1926. Accessible works which was done reflected technical and financial possibily of the early 20th century. Sometimes they didn´t respected natural character of the cave areas. The biggest negative was depositing of superfluous rocks. They was deposited along almost all visiting route in walls. On the bad condition of the visiting route had influence of course long-time turnout, high aggression of water and devastate flood in summer of 1997. Reparation of visiting route from the time which was created was made poorly and they didn´t increase comfort.

In the years 2001-2002 professional team created study of new accessible visiting route in ZAC. The study contains base „philosophy“ of the new visiting route. In the proposal of solution authors taked consideration to the protection of the cave, visiting traffic, safety regulations, terrain´s limits with the level of gas lakes, present day´s technical possibility and of course experience with previous recontructions in show caves of CZ. The study was commented by independet specialists. The main points of the views were protection of SPA mineral waters and the tunneling of connecting passageway and it´s impact on the microclima of the cave. Neccesary technical and security parametrs of mining regulations was detaily given to the project by it´s main project architect.

In June of the year 2003 after selective procedure for supplier of the reconstruction and execution of administration operations the reconstruction finally starts.

In the preparation phase was necessary to cover decoration from mechanical destruction and from the dust. Then was destroyed and removed all existing structual constructions, pavements, stairs, embankments, electric devices and of course old walls from superfluous rocks. Separate part of reconstruction was mtunneling of 80 m long connection passageway, which connected visiting route to the circle. Into the cleared and connected underground areas was implemented new unit of visiting route, which was after added by engeneering nets, stainless steel constructions and by technical devices. At the end was tunneled new entrance for the visitors below the base of administration building in lenght of 9 m.

All the time of the reconstruction was executed supervision of cave´s protection and hydrogeological observation. In June of 2005 was reconstruction approved by Building Authority with Minig office board and other institutions in charge for commercional use.

Total cost of the reconstruction was 18. mil Czech crowns (approximately 700 00 Eur) from the investments funds of Ministry of the Environment of the Czech Republic, which is fouder of the investor.

The reconstruction has to bring thouse assets for the protection of the caves, the appereance of the sightseeing route and the visiting traffic:

- More sensitive incorporation of the sightseeing route depending on morphology of cave areas
- Completely removing of the old visiting route and rock deposits, which leads tooptical lightening of the areas
- Connecting of visiting route to the circle with the communication gallery
- Installation of suspended footbridges
- Material for all constructions from stainless steel
- Tunneling of more comfortable new entrance for the visitors
- Outflow of rinse water by the drainage system outside the caves
- Installation of continual microclimate monitoring with the regulation of exhausting CO2.

With distance of the time we may say with satisfaction that reconstruction used for maximum today´s possibilites. Experiences with some year´s traffic confirms rightness of the technical, aesthetical and visiting traffic. All this of course respect requirements of keep and protecting today´s condition of the cave for the future.

Care of the show caves and their protection is always team work. With apologies, that I can´t introduce all people which participate on this successful work, I list the main ones:

The study of the accessible and philosophy of the new visiting route	Dipl. Tech. Josef Řehák sen., Semily Mgr. Vratislav Ouhrabka, Bozkov u Semil Barbora Šimečková, ZAC
The minnig project architect:	Ing. Karel Klobása, Brno
The projects of the stainless steel bridges:	Ing. Kamil Kocmánek, Brno
The minemeasurer:	Mgr. Vratislav Ouhrabka, Bozkov u Semil
The mineblaster:	JanVýmola, Ludmírov
The speleological works:	Miroslav Vaněk, Prostějov
Investor:	Ministerstvo životního prostředí ČR, Praha
The technical supervision of the investor:	Ing. Martin Šimek, Rosice u Brna
The proffessional supervision and the protection of the cave:	RNDr. Jaroslav Hromas, Praha Barbora Šimečková, ZAC
The hydrogeological supervision:	RNDr. Vladimír Řezníček, Brno
The supplier of the reconstruction:	VH Devon s.r.o., Sloup v Moravském krasu

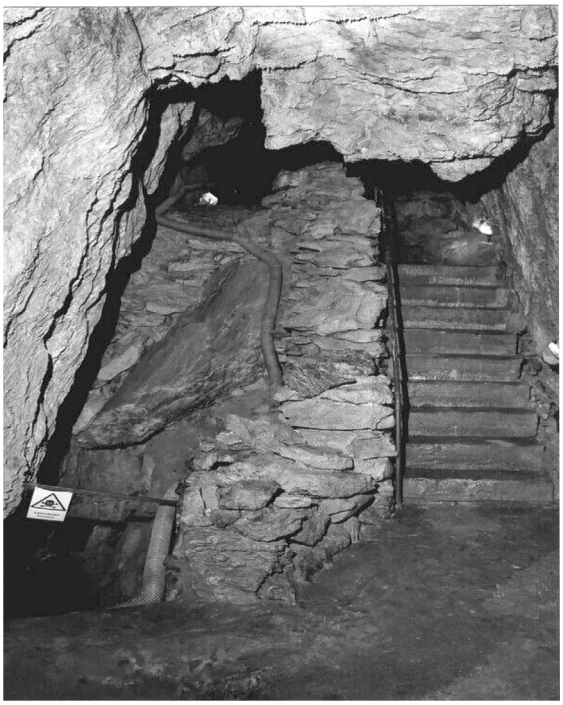

Fig.1. Gallas Dome before the reconstruction, old visiting route and rock deposits, 2002.
Photo: Petr Zajíček

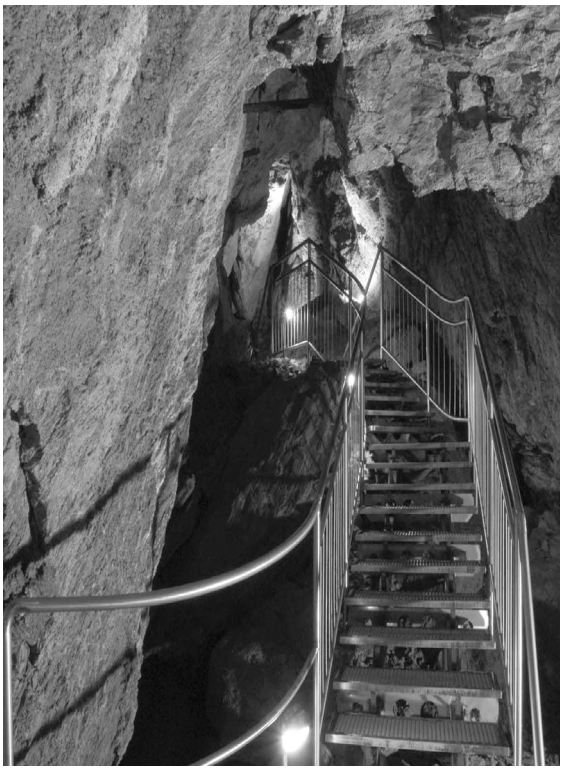

Fig. 2. Gallas Dome after the reconstruction, new visiting route, 2005.
Photo: Petr Zajíček

TRADITION OF VISUAL ARTS IN ZBRAŠOV ARAGONITE CAVES (CR)

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The Zbrašov aragonite caves are not only thanks to the unique natural hydrothermal karst genesis a European phenomenon. Since 1981 the local underground spaces are used to exhibitions of contemporaty art each year. It is a singular achievement, no other show cave in Evrope does not engage in such activity systematically.

Exhibitions are installed in latest part of the visiting route – Marble hall. So the different experience is waiting for visitors after finishing of routine inspection. That will enhance their impression of cave tour.

Shows always start at the beginning of school holidays and usually last until the end of the visitor season. If exhibition have not been organized in any year, for example due to reconstruction of the visitor route, visitors demanded renewal this tradition themselves. Many of them come to caves each year intentionally only during the exhibition. To date there has been 31 exhibitions organized here (including the year 2012). Czech republic artists primarily, but also artists from Slovakia or Germany, presented their artworks in authorial and collective exhibitions.

The limitation for the artworks is practically only the choice of material, that must be resistant to very hight humidity (about 98 %). Exhibits are mostly made of ceramic, enamel, natural and false stone, glass, laminate or plastic. These materials are also inert and environmentally friendly.

The interaction of the artworks and the natural environment is the interesting, high aesthetic value project, that increases attractiveness of caves and visitor interest appropriately (Figures 1 - 5).

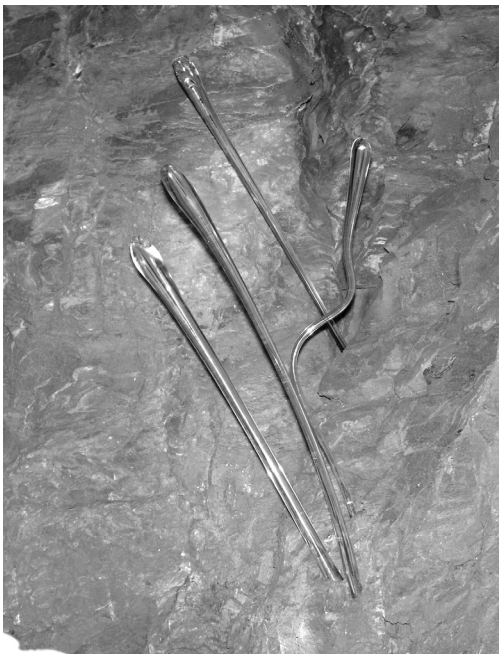

Fig.1. Name of visual art:
Made under the Surface, 2008
Author: Jaroslav Kolářek (CR)
Name of Work: The Squirts
Material: glass
Photo: Jan Flek

Fig.2. Name of visual art: The Last City, 2009
Author: Anke Binnewerg (BRD)
Name of Work: -
Material: plast, UV light
Photo: Slavomír Černý

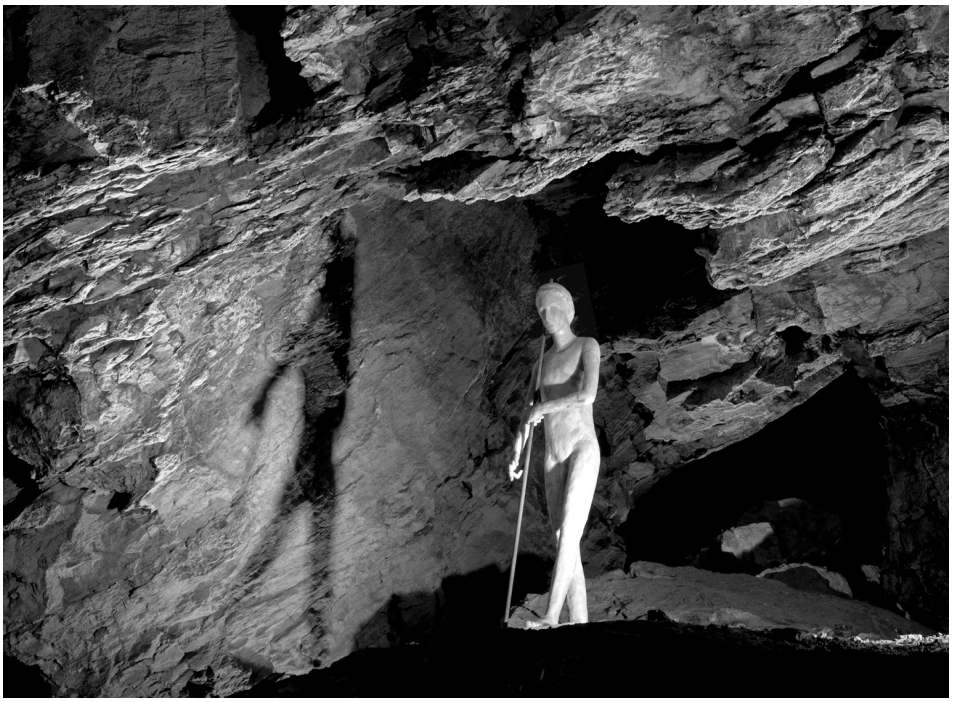

Fig. 3. Name of visual art: Statua Cavatica, 2010
Author: Hana Bučková (CR)
Name of Work: The Meditate Youth
Material: laminate
Photo: Petr Zajíček

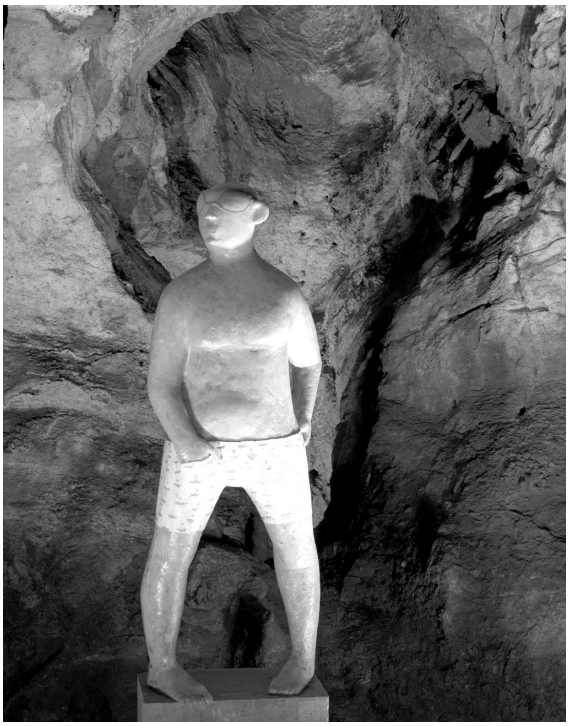

Fig. 4. Name of visual art: Statua Cavatica, 2010
Author: Eva Fojtíková (CR)
Name of Work: The Swimmer
Material: laminate
Photo: Petr Zajíček

Fig. 5. Name of visual art: Danaé in the Cave, 2011; Author: Miroslav Machala (CR); Name of Work: Gaia; Material: Swedish granite; Photo: Slavomír Černý

ENVIRONMENTAL IMPACT OF UNUSUAL LOWERING OF PRESPA LAKE LEVEL

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Key words: *karst flow, lake water balance, climate changes, biodiversity, stabile isotope.*

Prespa Lake System shared by Albania, FYR of Macedonia and Greece includes two lakes, Prespa and Small Prespa. Prespa Lake's surface is 254 km2, and actually is situated at an altitude of ~844 m asl, which is about 160 m higher than Lake Ohrid. Both lakes are separated by the karst massif of Mali Thate/Galicica mountain range (Fig 1).

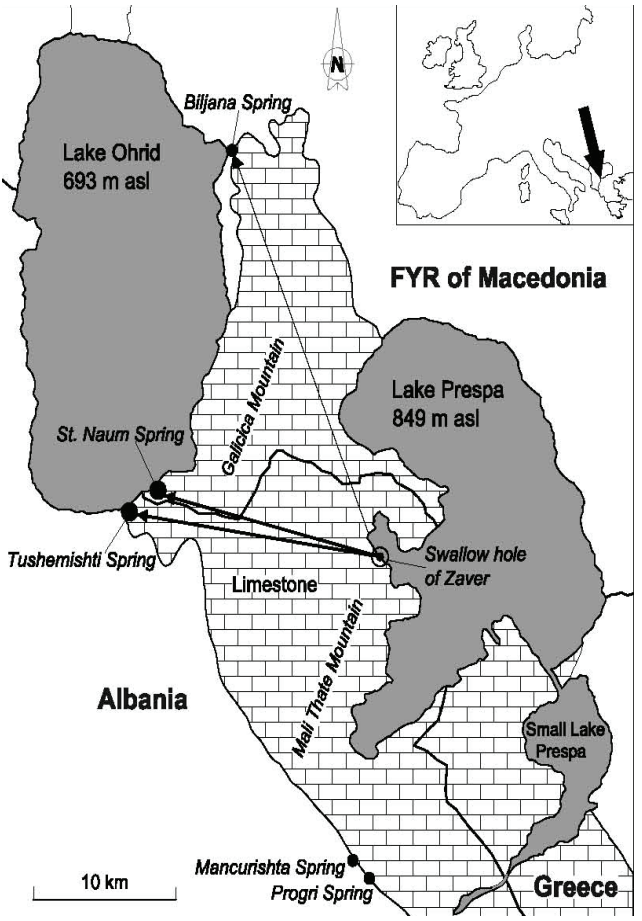

Fig. 1. Geographical overview.
The black arrows show the underground flow direction

Balance investigation shows that the underground outflow of Prespa Lake to Ohrid Lake is about 7.8 m^3/s, and the stable isotope investigations and tracer experiments have confirmed that most of the outflow recharges the big springs of St. Naum and Tushemishte. Some additional recharge these springs receive also by the karst water of Ohrid Lake basin.

At 2006-2007 the lake water level is ~8.5 m lower than in 1963. This decrease equals to a loss of ~1.6 km^3 of water, which roughly consist about 30% of the total lake volume. Some remarkable archaeological findings indicate that lake water lowering has been subject of the past, also. Different explanations proposed for the observed water lake decrease are discussed by the author of this paper.

The area of Prespa Lake is characterised by its natural beauty, its great biodiversity and its populations of rare birds. The fauna of the area includes tenths of endemic fish and mammal species. The basin is of a specific importance for waterbirds as the Dalmatian pelican, white pelicans and pygmy cormorants. The average total phosphorus concentration in Lake Prespa is increased to about 30 mg/m3, which mean that the lake is in a process of eutrophication.

The goal of this paper is to evaluate the natural and anthropogenic factors controlling the unusual lowering of Prespa lake level and to generally asses the environmental impact of this phenomenon.

ГЕОМОРФОЛОГИЯ НА ШУМЕНСКОТО ПЛАТО

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Ключови думи: *карст, съвременни морфогенетични процеси, заравнени повърхнини, речни тераси*

Морфохидрографска характеристика

Шуменското плато е разположено югозападната част на СИ България. Представлява самостоятелен блок от Мизийската плоча, разчленен по периферията от заливовидно вдадени в него речни долинни. Към платото се включва и височината Фисека (500,5 m) с площ 3 км^2. За граници на Шуменското плато служат: на север - долините на реките Стражка, Пакоша и Чаирдере; на СИ - горната част от долината на река Мътнишка и ЮЗ част от вододела на река Каменица; на И-ЮИ – Шуменско-Смядовското понижение, с част от долината на река Голяма Камчия; на юг и запад – Търговишкото субструктурно понижение, с част от долината на река Врана. Дължината на Шуменското плато от запад на изток е средно около 12 км, променяща се от юг на север - от 7-8 км в най-южната част, 9-10 км в централната част, 11-12 км по на север до около 20 km в най-северната част на платото. В направление С-Ю широчината на платото колебае между 15-17 км. В посочените граници, с надморска височина над 300 m, общата площ на платото е 73,13 km^2.

От седловината "Терзията", през който минава пътя от с. Лозево до с. Новосел, Шуменското плато се разделя на две части: източна - широка и западна – постеснена. Източната част заема пространството между град Шумен на изток и селата Троица, Осмар и Кочово на юг и село Лозево на север. Западната част се заключва между селата Новосел, Средня и Черенча на юг, село Градище на север, а на СЗ завършва с височината "Фисек".

Шуменското плато е развито в хипсометричния пояс 200-500 m (Фиг. 1). Най-висока точка е вр. Търновтабия (501,9 m.), а най-ниската е на около 200 m н.в., разположена в м. "Корталъка" (СЗ от Казълтепе-269,3 m). В платото (без вис. Фисека) ясно се отделят няколко височинни пояса: от 300 до 400 m - с площ 32 км^2, от 400 до 500 m – с площ 38 км^2 и над 500 m - с площ 0,13 км^2. Изчислената площ на в. Фисека е около 3 км^2. Най-високата й част включва шест самостоятелни издигнатини (с обща площ – 0,7 km^2) разпределени в две групи по три височини, увеличаващи височината (от 430 до 500,5 m) и площа си (от 0,02 km^2 до 0,16 km^2) от ЮЗ към СИ. Изчислената средната надморска височина на цялото плато е 350 m.

От геоморфоложка гледна точка релефът на Шуменското плато може да се подели на три части – било, склонове и подножие. Билото е с равнинно-хълмист и карстов релеф, в който преобладават малки наклони и разчленение на релефа. Склоновете на платото на места са значително разчленени, различаващи се както по наклони, така и по преобладаващи съвременни морфогенетични процеси. Подножието е развито във височинния диапазон между 180-200 m (от юг) и 250-330 m (от изток и от север), като на много места площите са селскостопански усвоени.

Шуменското плато се включва към Черноморската отточна област. Постоянен повърхностен отток се открива само в отделни периферни части на платото, като се формира радиално (центробежно) изтичаща мрежа от рекички и потоци с типично подземно (карстово) подхранване. Реките, които отводняват платото, са притоци на р. Голяма Камчия (вливат се директно в нея или чрез р. Врана) и р. Провадийска (чрез р. Мадара). В Шуменското плато грунтови води от класически тип няма. Карстовите води от платото подхранват грунтовите води в подножните части – на прехода към Шуменско-Смядовското и Търговишкото понижение. Около ¾ от подземните

води в платото могат да се определят като води от смесен тип - карстово-грунтови. Над 70% от речния отток се формира от подземните (карстовите) води. Под влияние на карстовия релеф в централната част на горнището на платото е формиран един сравнително голям безотточен карстов басейн, с площ около 8,5 км^2. Пукнатинни води са типични за западната част на платото.

Със сравнително по-голяма дължина и водосборна площ се отличават:
Река Поройна – извира от Сулумарски дол и е с дължина - 23 km, водосборна площ – 46,37 км^2, средна надморска височина на водосбора – 152 m. Включва последователно доловете Зандански, Чанаджишки и Сархошчешмански; Селска река – с дължина 4,075 km и водосб. площ –18,25 км^2; Река Суджалъ, протичаща недалеч от село Буховци – с дължина 6,8 km, на 1-ви ляв приток – 2,5 km, на 2–ри ляв приток – 0,75 км; Троицка река – дължина – 5,25 km, водосб. площ – 11,44 км^2, увес – 340 m (най-големи притоци: дължина на 1-ви ляв приток – 0,5 км, водосб. площ – 1,18 км2; дължина на 2–ри ляв приток – 0,55 км, водосб. площ – 2,8 км2; дължина на 3–ти ляв приток – 2,95 км, водосб. площ – 3,75 км^2). С приблизително същите морфоложки параметри се отличава река Осмарска; Река Бяла вода (до язовира) дължина – 7,6 км, водосб. площ – 11,69 км^2, ср. надм. вис. на водосбора – 351,6 m; увес - 170 m (най-големи притоци: р. Содулч, дължина – 1,5 км, водосб. площ – 1,88 км2; дължина на 1-ви ляв приток – 2,5 км, водосб. площ – 2,69 км^2; дължина на 1–ви десен приток – 1,6 км, водосб. площ – 4,5 км2; дължина на 2–ри десен приток – 2 км, водосб. площ – 2,62 км^2); Новоселска река – дължина - 9,7 км, водосб. площ – 21,66 км^2, ср.н.вис. на водосбора – 395,9 m; увес – 251 m (най-големи притоци: река Големия чучур - дължина – 4,675 км водосборна площ – 9,6 км^2, ср.н.вис. на водосбора – 244,5 m; дължина на 1–ви десен приток – 2,5 км; дължина на 2–ри десен приток -1,57 км); Река Средня – дължина – 4,5 км, водосб. площ – 13,1 км^2, ср.н.вис. на водосбора – 280 m; увес - 132 m; Река Черенча – дълж. – 3,825 км, водосб. площ – 6,19 км^2, ср.н.вис. на водосбора – 293,9 m; увес - 203 m.

Височината Фисека няма постоянна отточна речна мрежа, а се отводнява от няколко малки ручея, пресъхващи през лятото. От всички страни (с изключение на югоизточната) в. Фисека е заобиколен от долината на река Пакоша (Черенджидере). Тя е най-големия приток на р. Врана, с дължина 31 км. Води началото си от района на село Развигорово, като приема няколко малки притока идващи от селата Длъжко, Звегор, връх Колабаджик (436,8 m) и др.

Геоложка характеристика

В тектонско отношение Шуменското остатъчно плато се отнася към Южномизийската периплатформена област. Горнокредният структурен етаж изгражда Шуменската синклинала, като в геоложки аспект е оформен инверсен спрямо тектониката релеф. В Шуменската синклинала са развити няколко второстепенни гънки - синклиналата на Илдъзтабия (дълж. 6 км, шир. 2 км, посока 50°), Черенченската синклинала (дълж. 10 км, шир. 3 км, посока 110°), Лозевската антиклинала (дълж. 3 км, посока 50°), антиклинала южно от Търновтабия (посока 70°) и Дивдядовската синклинала (дълж. 9 км, шир. 5 км, посока 70°). Южното бедро на Шуменската синклинала е усложнено от разседи около с. Кочово. До образуването на разломи се стига и в резултат на проявилите се разтягащи земекорни движения в южния край на Мизийската платформа (Карагюлева, Стоянов, 1971)

На повърхността на Шуменското плато се разкриват горнокредни варовици и мергели, в ЮИ и ЮЗ периферия – долнокредни пясъчници и мергели, а на юг - неразчленени палеогенски седименти. Плейстоценски льосовидни глини се откриват в ниските участъци под СИ склонове на платото и западно от долното течение на река Пакоша. Холоценски алувиални материали - чакъли, пясъци и глини, изтраждат заливните и ниските надзаливни речни тераси на реките, протичащи в подножието на платото (Чешитев, Недялкова, 1995). Продължилото от неогена насам издигане на

Шуменското плато е унаследено от положителни съвременни вертикални движения в границите на 1-2 mm/y (Тотоманов и др., 1978).

Геоморфоложка характеристика

В съвременния релеф по билото на Шуменското плато на височина около 400-450 m се откроява бронирана в горнокредните (мастрихтски) варовици субхоризонтална пластова повърхнина. Остатък от първичния релеф са и структурните ръбове по платото. В края на долния плиоцен вследствие на диференцирани движения, Южномизийската равнина и Предбалканът са обхванати повсеместно издигане и всичане (до 50-120 m) на речната мрежа. В резултат на този ерозионен етап по склоновете на Шуменското плато са формирани характерни склонови стъпала. В края на плиоцена и началото на плейстоцена се проявява значителна ерозионно-акумулативна дейност, като се оформят от едно до две наклонени подножни плиоплейстоценски (вилафранкски) нива. Ниските нива (на 150-250 m) в много случаи са вложени заливовидно в по-високите (250-300 m). На много места подножните стъпала са отделени от платото от напречни млади долинни врязвания, успоредни на стръмния пластово стъпален склон. Особенно изразително е това отчленяване в южна посока при Дивдядовския, Чаталарския, Тороицкия и Осмарския дол. Речни тераси във високата част на платото не се откриват, тъй като тук липсват реки с постоянен отток, а падналите валежи бързо понират. Средни, ниски надзаливни и заливни речни тераси са картирани след долната пречупка на склона на платото и в приточните долини към главните реки - Врана, Камчия и Провадийска. Значителна изява в района на Шуменското плато имат карстовите процеси, формиращи: вертопи (над 200), валози (над 16), ували, слепи карстови долове, карстови извори, кари, карни полета и окарстените скални венци, карстови ниши и пещери. Съвременната изява на морфогенетичните процеси в платото се определя, както от хидро климатичните условия, така и от брониращият ефект на субхоризонталните мастрихтски варовици. Последните формират в периферията на платото отвесни склонове, скални венци, свлачища, срутища и сипеи.

Изводи

Еволюцията на Шуменското плато преминава през следните основни етапа:

Донеогенски етап – характеризира се с неколкократно сменящи се палеогеографски обстановки. През юрско-долнокредния седиментен цикъл се осъществява потъване в южната част от периплатформената зона, на север морето изплитнява и част от територията се осушава и подлага на денудация. В края на триаса района се превръща във висока издигната суша. Денудираните триаски материали се изнасят от платото и не са запазени. Блокът на платото се разчленява в периферията и повърхността му се денивелира. През горна креда се осъществява трансгресия от И-СИ, като водите заливат ниските части на платото. Осушаването става от север на юг до края на г.креда. През палеогена продължава деструкцията.

През *неогенския етап* потъването на Черноморската котловина от изток продължава. Ерозионният базис се понижава и периферията на платото се разчленява. По горнището на платото постепенно се оформя пластова, здрава, повърхнина. Превръщането на Шуменското плато от слабоизразена синклинална структура във възвишение е продължителен процес. Това се потвърждава от дебелата известрителна покривка по билото на Калугерския рид, Ченгелтабия и Илдзтабия.

По време на *плиоплейстоцена* поради влажния и топъл климат и увеличения речен отток, формираните по склоновете и долната пречупка на склона на платото първоначални речни системи се всичат, а по вододелните части се натрупват материалите от твърдия отток. Плиоплейстоценските нива са най-широко представени в източната и югоизточната част на платото. Засилената ерозионно-денудаци-

онна дейност води до всичане между основната част на Шуменското плато и Фисека, като се оформя типична седловина.

През кватернерния етап продължава всичането на центробежната, спрямо платото, речна мрежа. В долната пречупка от склона се формират надзаливни речни тераси. Задълбочава се денудацията по склоновете и всечените речни долини. Височината на речните тераси разкрива колебанията в нивото на главния ерозионен базис – Черно море.

Съвременният етап от развитието на релефа в Шуменското плато се характеризира с активизиране на морфогенетичните процеси. В платото изява имат най-вече карстовите, ерозионните, гравитационните, акумулационните, дефлационните и антропогенните процеси.

LANDSCAPES IN THE DOWNSTREAM OF THE RIVER VRANA

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Key words: *karst landscapes, vertical structure, horizontal structure, Vrana River.*

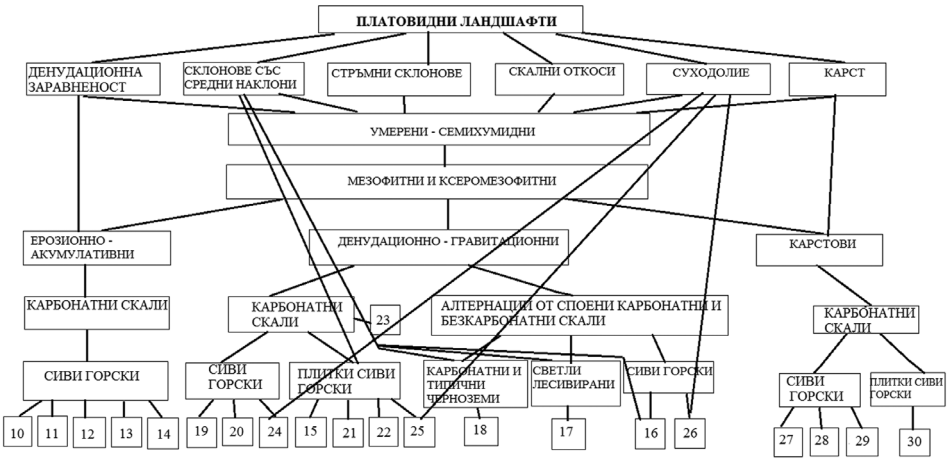
The downstream of the river Vrana is characterized by broad landscape diversity. The classification system of the landscape in the study area includes eight grades - class - subclass - type - subtype - description - subgenus-species - subspecies. In the classification of the landscape diversity in the downstream of the river Vrana taxonomic unit class landscape is perceived as leading. The main diagnostic criterion for its separation is the macrorelief (Velchev et al., 1992; Popov, 1998). For the territory of Bulgaria there are two classes of landscapes - respectively mountain and plain - piedmont (according Velchev et al., 1992) and mountain and plain (according to Popov, 1998). The territory of the survey area falls within the plain - foothill landscapes (Velchev et al., 1992). For the purpose of our study we have divided the territory into three classes - plain, plateau and low mountain. The second taxonomic level is represented by a subclass. Information from the classification system of Nikolaev is used for the composition of this taxon (1978, 1979). This system takes into account morphostructural features of the predominant type of relief from lower - rank (erosion, denudating, karst, etc.) and formation of mezorelief forms. The territory of the survey area has the following mezorelief forms: floodplains and upper floodplains, denudation plains, erosion - denudation slopes, rocky slopes (gums), valleys, dry valleys, foothills and karst. The third taxonomic level is presented by landscape types. Areas with similar hydroclimate conditions are defined and grouped by this taxon (Velchev et al., 1992; Popov, 1998), These conditions have impact on the morphological processes, the formation of certain relief forms, plant and animal communities, soil types and the use of certain land. (Zhelezov, Iliev, 2003). The leading criterion for the separation of the landscape types is the character of the climate, represented by the thermal characteristics and the nature of the humidity (according to the Köpen classification and the Torndtueyt index) (Topliyski, Popov, 1995). According to Velchev et al. two types of landscape are determined on the territory of the survey area (1992) - 1. moderate semi-humid and 2. hydromorphic and subhydromorphic. The next taxonomic level is determined by the landscape subtypes which are defined by the specifics of the climatic characteristics of the territory, reflecting on the nature of the plant formations. In the study area the following subtypes are determined: hygrophytic, xeromezophytic and mesophytic plant communities. The taxon genus takes into account the contemporary relief formating processes and the type of the migration of substances: erosion – accumulation, eluvial – denudation, denudationally - gravity, karst and eluvial - accumulation. Taxon subgenus is defined on the basis of lithology of surface rocks. In general the cliffs in the study area can be grouped into three breed with different effects such as geochemical background: alluvial formations, carbonate rocks and alternations of cemented carbonate rocks and without carbonate. The next taxonomic level is presented by type of landscape. It is used in all taxonomic systems and is split by soil characteristics. The lowest taxonomic unit is the subspecies, distinct on the basis of dominant vegetation, taking into account a class, subclass, type, subtype, subgenus and species. The landscape structure of the study area is characterized by the prevalence of plateau and lowland landscapes. They occupy approximately 80% of the area of the region. The remaining 20% are related to the low mountain.

Plateau landscapes. This landscape class occupies the largest part of the studied area. It is characterized by the most complex vertical and horizontal landscapes structure of the three classes of landscapes in the studied territory. The vertical structure of these landscapes is with a significant thickness of 25, 5 m, as there are three surface and one underground geohorizon outlined in them.

Out of the plateau landscape the most interesting is the subclass of karst landscapes. Karst landscapes cover the highest (plain) parts of the plateau at an altitude of 450 m. These landscapes are formed upon solid (partly organogenic) limestones. They include the surface karst forms: vartops, hollows and uvalas. Vartops are presented in the southeast of Tarnov dyal and in the region above the cave Zandana. There are hallows in the areas Bukaka and Bostanlaka. Uvals are also presented in Bostanlaka region and between “Bukaka” reserve and the edge of the plateau - Hankrumovi gates. The vegetation is represented by mixed deciduous forests. The most widespread are hornbeam - durmast forests and mizian beech. In order to preserve its natural habitats, the reserve “Bukaka has been founded.” The soil cover consists of humus - calcareous soils - Rendzic Leptosols, Haplic Luvisols (N. Ninov, 2002)). Part of karst forms are on chalky limestone with flint nodules occupied by coniferous forests, which are secondary.

Lowland Landscapes. The second group landscapes includes poljes in Dalgite Polyani area, one part of which is occupied by forests of hornbeam and the other - by bush and grass vegetation. Their distinctive vegetation is the xerothermic. Representatives of this plants are Festuca pratensis, Andropogon ischaemum, Poa bulbosa, Chrysopogon gryllus, Paliurus spina_kristi, Rosa canina, Syringa vulgaris and other. Widespread soils are the shallow gray forest soils (Hr Trashliev) degraded humus - carbonate (rendzinas-(N. Ninov, 2002)).

Fig.1. Vertical structure of the plateau landscapes of Shumensko plato.



10. Мизийски бук, 11. Мизийски бук с примеси от клен, явор и шестил, 12, 29. Габър, 13, 19. Габър с горун и цер, 14, 17, 20, 24, 28. Иглолистни гори с доминант черен бор, 16, 26. – Габър с примеси от бук и леска, 18, 25. – Лозя, 21. Плоскач, смрадлика и космат лъб, 15, 22 Ниви, 23 Без растителност, 27. Габър с бук, 30. – храстова и тревна растителност.

Fig. 2. Horizontal structure of the landscapes of Shumensko plato.

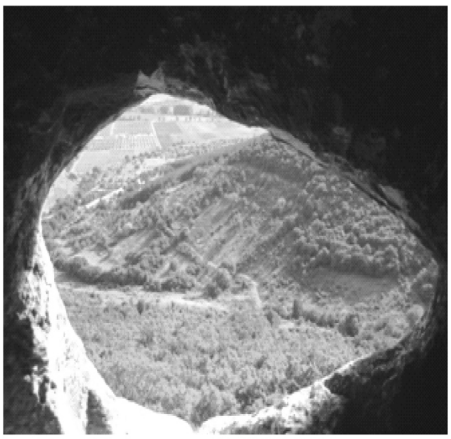


Fig.3. Kalugerski boaz

ТУРИСТИЧЕСКИ МАРШРУТ “СКАЛНИ МАНАСТИРИ” – ПРИНОС В РАЗВИТИЕТО НА АЛТЕРНАТИВНИ ФОРМИ НА ТУРИЗМА В ПРИРОДНИЯ ПАРК

Марин Николов
ДПП „Шуменско плато”

Природен парк “Шуменско плато” е създаден като вид защитена природна територия през м. февруари 1980 г. с две основни цели: защита на биологичното разнообразие и развитие на туристически дейности, спорт и рекреация за посетителите на неговата територия. Успоредно с това на Шуменското плато се извършват проучвателни и научни дейности и се осъществяват образователни инициативи за хора от различни възрасти.

Природният парк се отличава със своя платовиден релеф. Тук е най- високата точка на Дунавската равнина в м. “Търнов табия” – 502 м.н.в., а средната надморска височина е 350 метра. По повърхността на платото се срещат множество карстови форми като: понори, вртопи и пещери. Тук протичат карстови процеси, които обуславят разпределението на водния отток, богатството на растителния и животинския свят. Периферните части на Шуменското плато са характерни с наличието на стръмни долинни врязвания и отвесни скални венци.

Благоприятните природни условия и стратегичекското местоположение на Шуменското плато са вероятните причини за неговото заселване от най- дълбока древност. Съществуват археологически доказателства за човешко присъствие от каменно-медната епоха в м. “Хан-Крумови порти”. За развитието на човешката цивилизация по тези земи през по-късните исторически епохи съдим по разкритите културни пластове в Шуменската крепост и останките от тракийски селища. Най-впечатляваши са запазените и до днес скални манастирски комплекси в крайните източни и южни части на природния парк. Дейностите по проучване на тези уникални обекти от културно – историческото наследство включиха обобщаване на издирените досегашни исторически сведения за тях и провеждането на изследователски експедиции. В резултат на това бяха попълнени познанията по отношение на някои от тези исторически обекти, тяхното позициониране, достъпност и възможните туристичиски подходи към тях. За популяризиране на скалните манастири бе издадена книга, рекламна дипляна и бяха заснети два научно-популярни филма. Естествено продължение на дейностите по развитие и популяризирване на тези обекти от българското средновековие е да бъде подобрена тяхната достъпност за туристически посещения, да отговарят на изискванията за безопасност и да се превърнат в предпочитана дестинация за пешеходния туризъм и неговите алтернативни форми. Това доведе до изпълнението на идеята част от скалните църкви и манастири да бъдат включени в един общ туристически маршрут наречен “Скални манастири по Шуменското плато”.

Естественият човешки стремеж за обогатяване на познанията в различни насоки се проявява и по отношение на окръжаващата ни среда наред с интересните обекти за посещения, каквито са обектите от културно-историческото наследство и скалните манастири в частност. Тази потребност може да се задоволява успешно с развитието на различни форми на традиционния туризъм. Трасето на туристически маршрут “Скални манастири” преминава през източните, южните и централните части на природния парк и дава възможност за запознаване с разнообразието от релефни форми, природни дадености, растителен и животински свят, исторически обекти за посещения. Като алтернатива на масовия туризъм трасето му е подходящо за практикуване на приключенския туризъм /с велосипед, на кон/. Когато посетителите на природния парк имат туристическа насоченост свързана с определена тема то-

гава става дума за развитие на тематичен туризъм. В зависимост от целта на посещенията и съществуващата възможност за разширяване на познанията в различни сфери от окръжаващата ни среда можем да говорим за практикуване на различни алтернативни форми на традиционния туризъм, като: познавателен, културно-исторически, религиозен /поклонически/, образователен, екотуризъм.

Настоящият доклад се съпровожда с: презентация на туристически маршрут “Скални манастири”, която включва неговото трасе, обекти за посещения, изградените обезопасителни съоражения и информационни табла, както и възможността за практикуване на различни алтернативни форми на туризма.

Нарастващият посетителски поток на територията на парка предполага разширяване и дообогатяване на съществуващата туристическа инфраструктура. Тя се състои от туристически маршрути и обекти за посещения, както и от туристически инфраструктурни елементи като: туристически заслони, беседки, информационни табла, кътове за отдих и др. Новоизграденият туристически маршрут “Скални манастири” е с дължина 18 км. и е подходящ за двудневни туристически посещения. Той създава възможности за по-продължително пребиваване в природната среда, т.е. съжителство с природата, от практикуването на което все повече се нуждае съвременото общество на 21 век.

МОРФОЛОГИЧНИ СВОЙСТВА И СПЕЦИФИЧНИ ФУНКЦИИ НА ПОЧВИТЕ И ПОЧВЕНАТА ПОКРИВКА ВЪВ ВРЪЗКА С РАЗРАБОТВАНИЯ МОНИТОРИНГ НА КАРСТА (НА ПРИМЕРА НА ПП „ШУМЕНСКО ПЛАТО") *

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Ключови думи: *карст, съвременен карстогенезис, почви и почвена покривка, защитени територии, устойчиво развитие, сукцесии, почвено картиране, почвен мониторинг, комплексен мониторинг на карста*

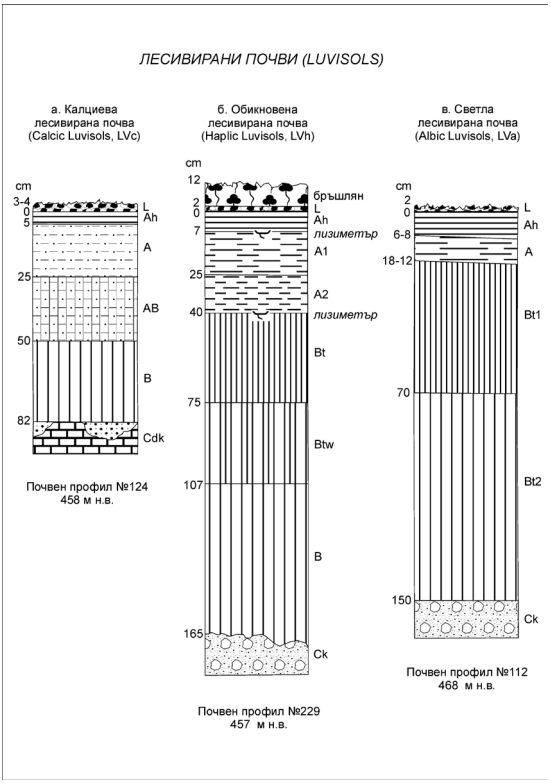
За целите на разработвания специализиран почвен мониторинг като елемент на комплексния мониторинг на карста, са осъществени изследвания на почвите и почвената покривка в моделни защитени карстови територии в България. За избраните обекти за мониторинг са установени морфологични данни, почвени функции и специфика на почвената покривка. В настоящия доклад се обсъждат техните особености в ПП "Шуменско плато".

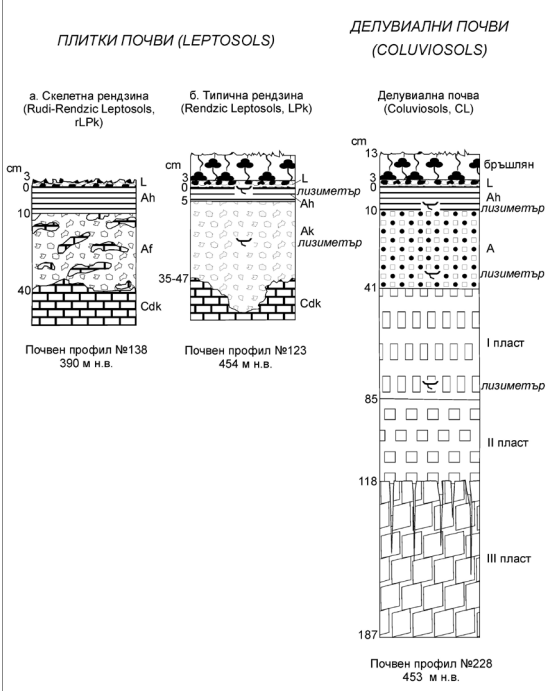
Изследванията на почвите и едромащабното почвено картиране в Шуменското плато (М 1:5000) показват, че там са развити главно почвените типове Литосоли (Leptosols lithic, LPq), Рендзини (Leptosols rendzic, LPk), Лувисоли (Luvisols, LV) и делувиално-колувиални почви (Colluviosols, CL) (фиг. 1). Те образуват силно накъсана почвена покривка с формирани микро-, мезо- и макро-комбинации от мозайки, съчетания и вариации, свързани с особеностите на почвообразуващата скала и карстовия релеф (фиг. 2).

Важен фактор е и дълговечният и силен антропогенен натиск, с който е свързано широкото разпространение на разнообразни Антропогенни почви (Anthrosols, AT). Те са обект на специално внимание при почвения мониторинг, като се предлага той да обхване и еталонни участъци с: утъпкване от туризма, рекреацията и спорта в парка; влошени хидрологични почвени показатели, режимни характеристики и продуктивни ресурси; силно изменение на динамиката и запасите на мъртвото органично вещество (опад и горска постилка) и комплицирано състояние на дишането на почвата и съответно продукцията на CO2, който е изключително важен за карстовите процеси; нарушено хумусообразуване и геохимична миграция.

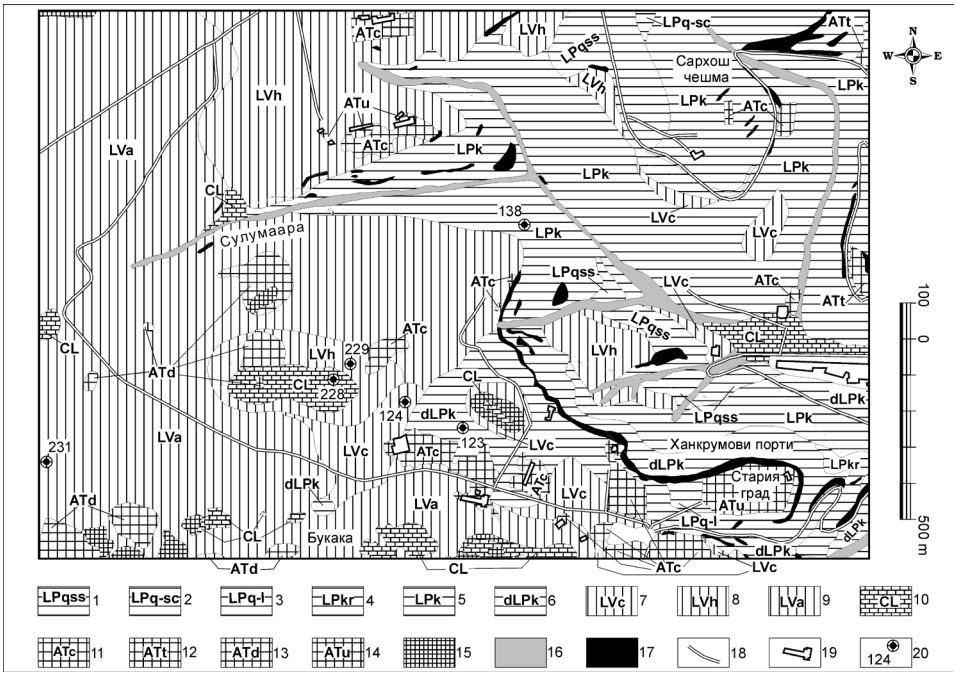
В рамките на експериментални мониторингови изследвания в участък Кьошковете (в границите на карстова геосистема Зандана) са оборудвани и функционират 4 мониторингови пункта. В еталонни почвени профили са монтирани лизиметри (тип вкопани) при различни условия на транзит и миграция на веществата – съответно в рендзини, лувисоли, колувиални почви и под горски опад. С оглед проследяване влиянието на сукцесионните процеси върху почвообразуването и съвременния карстогенезис се предлага към изградените вече мониторингови пунктове да се включат допълнителни площадки за мониторинг върху динамиката на карбонатите (за рендзините); динамиката и състава на лизиметричните води (за лувисолите); повърхностния воден отток и геохимичната миграция – чрез отточни площадки и лизиметри (за делувиално-колувиалните и антропогенните почви). Безспорно, тези изследвания трябва да се съвместяват с мониторинг на биоразнообразието и на водите и микроклимата, поради тясната им генетична взаимозависимост.

* Докладът е по проект ДО 02.260/18.12.2008 „Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии" на Фонд „Научни изследвания".





Фигура 1. Профили на основните почвени различия в участък “Кьошковете” на Шуменското плато



Фигура 2. Дигитална почвена карта на участък "Кьошковете" в Шуменското плато (по Нинов, Стефанов, Илиев, 2002)

УСЛОВНИ ЗНАЦИ:

Почвени типове, подтипове, родове и фази: Плитки почви (Leptosols, LP): Литосоли (Lithic, LPq): 1. върху силикатни скали (Lithosol strict silicat, LPq-ss), 2. върху варовици (Lithosol strict calcaire, LPq-sc), 3. петнисти в карните полета (Lithosol lesine, LPq-l); Рендзини (Rendzic, LPk): 4. каменливи (rudic rendosols, rLPk), 5. обикновени (Rendzic, LPk), 6. декарбонатизирани (Rendisols, dLPk); Лесивирани почви (Luvisols, LV): 7. калциеви (Calcic Luvisols, LVc), 8. обикновени (Haplic Luvisols, LVh), 9. светли (Albic Luvisols, LVa); 10. Делувиални и колувиално-пролувиални почви (Colluviosols, CL); Антропогенни почви (Anthrosols, AT): 11. уплътнени (Compacted Anthrosols, ATc), 12. терасирани и/или риголвани (Terraced Anthrosols, ATt), 13. размесени (Disturbed Anthrosols, ATd), 14. рудерални (Urbic Anthrosols, ATu).

ДРУГИ ЗНАЦИ: 15. Плоскостна почвена ерозия; 16. Дол, дере; 17. Скален венец, откос; 18. Асфалтово шосе, паркинг; 19. Отделна сграда; 20. Почвен профил (с номер).

KARST GEOSYSTEMS IN THE SHUMEN PLATEAU, BULGARIA *

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The Shumen plateau (area of 73 км^2 and maximum altitude of 503 m) is a typical example of classical karst region in the Moesian plain (North Bulgaria). The entire complex of autogenic karst forms has developed in this plateau. In 1980 its greater portion has been pronounced as Natural Park of the Shumen Plateau.

Based on continuous specialized explorations, field experiments and regime observations karst geosystems have been differentiated, the largest ones being within the boundaries of the natural park. Among the largest geosystems the Zandanska (2,0 км^2) and Troishka (9,2 км^2) stand out, having as their elements the largest karst caves in the Shumen plateau, namely Zandana (more than 2900 m long) and the precipice-type cave of Tainite ponori/The secret pot-hole (1716 m long and elevation amplitude of 101m, the deepest cave in Eastern Bulgaria). They have been included into the network of model karst geosystems where karst genesis and land use on karst territories in Bulgaria are being investigated. This has been one of the priority research fields carried out at the Department Geography of the National Institute of Geophysics, Geodesy and Geography of the Bulgarian Academy of Sciences (NIGGG-BAS) during the last 20-25 years.

The Shumen plateau karst geosystems are subject to karst investigations utilizing experimentation with modern technologies among which GIS, karst cadastre, specialized monitoring, modeling, etc. The good research results, as well as the established beneficial cooperation between the Dep. Geography of the NIGGG-BAS and the Park Directorate form the foundations of management optimization and making this park a model of protected karst territory in Bulgaria.

*The results reported are obtained along Project ДО 02.260/18.12.2008: "Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development" of NSF – Bulgaria.

ENVIRONMENTAL ISOTOPE AND HYDROCHEMICAL TRACER METHODS USED TO CHARACTERISE THE KARST WATER, WITH EXAMPLES FROM ALBANIA

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Key words: *environmental isotope tracer, environmental hydrochemical tracers, karst flow system, recharge sources, mixing analyses.*

Karst aquifers are characterised by high heterogeneity created and organised by groundwater flow. The classical study methods – bore hole, pumping tests, point observations give important data but cannot be extended to the whole aquifer. With study examples from Albania in the paper is shown that environmental isotope and hydrochemical methods could give important information for the big scale aquifer characterization. Basic isotopes used to characterized the karst water are oxygen 18 (18O), Deuterium (H2) and Tritium (H3). Among the chemical parameters most important are electric conductivity, total hardness, sulphate (SO4), Cl, ionic ratios rCa/rMg, rSO4/rMg, CO2 pressure and the indexes of calcite (Sic) and dolomite saturation (Sid) etc.

Concerning the identification of recharge sources, the combined application of the effect of altitude on stable hydrogen and oxygen isotope, and the chemical characteristics of surface and groundwater are successfully applied in karst areas.

In the paper are described some successful applications of karst water studies in Albania. The first study describes the Poçemi spring, discharge 1.5 m /s, issuing from a karst massive of South Albania. Using environmental isotope and hydrochemical methods is established that the Poçemi springs at about 80% is recharged by the Vjosa River.

The second study deals with Big Prespa Lake and Ohrid Lake, which share their water with Albania, FYR of Macedonia and Greece and constitute a common hydraulic system. The elevation of the Prespa Lake is 850 and that of the Ohrid Lake is 695 m a.s.l. and high karst mountains separate them. At Ohrid lakeside, in the Albanian-FYROM borderland the big karst springs of St. Naum and Tushemishte are situated, which in total discharge about 8.1 m^3/s. Environmental studies applied as a supplementary method to the hydrologic balance calculations established that about 50 % of the discharge of the springs on Ohrid Lakeside is recharged by Prespa Lake and the remaining 50% represents the infiltrated precipitation into the karst massif.

Mali Gjere Moutain karst massif is located in the south-eastern part of Albania, on the border with Greece. The total surface of the karst massif is 440 km^2, and the mean elevation is about 900 m a.s.l. The Mesozoic carbonate sequence constitutes most of Mali Gjere Mountain, which on the east border is near to the abundant with groundwater Drinos River alluvial basin. In the western side of Mali Gjere Mountain is located Bistrica spring, the biggest Albania's spring, mean discharge of 18.4 m^3/s at elevation about 45 m lower than the Drinos River alluvial basin. By the environmental hydrochemical and isotope methods is estimated that at about 70% the Bistrica spring is recharged by the infiltrated precipitations into the Mali Gjere Mountain karst massif, and at about 30% is recharged by the seepage into the karst massif of the alluvial groundwater of Drinos River alluvial basin.

FLOW AND MEAN RESIDENCE TIME IN KARST UNSATURATED ZONE (OCHOZ CAVE, MORAVIAN KARST, CZECH REPUBLIC)

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Flow pattern, mean residence time and geochemical processes in karst unsaturated zone and epikarst are intensively studied nowadays. Karst unsaturated zone plays a fundamental role in karst aquifers and caves protection against contamination. Knowledge of mean residence time can be applied in the field of groundwater use and protection, especially in karst environment, where quantification of pollution and groundwater flow prediction is difficult due to its heterogeneity. Results of various studies concerning mean residence time in karst unsaturated zone differ significantly: from weeks (Harmon 1979) and months (Atkinson et al. 1985, Fuller et al. 2008, Lambert and Aharon 2008) to years or decades (Kluge et al. 2010, Even et al. 1986). It is not clear with which part of the karst system can be the longest residence time connected. In agreement with Perrin et al. (2003) and Aquilina et al. (2005), it seems, it doesn´t have to be necessarily in saturated zone, that have been generally supposed, if already soil and epikarst can cause residence time over 1 year. In the Czech Republic this topic hasn´t been studied much until now (Bruthans 2006).

Flow and mean residence time in epikarst and unsaturated zone was studied above the Ochoz cave in the Moravian Karst (Czech Republic). Various flow components with different residence time in unsaturated zone and the influence of soil and epikarst on seepage composition and residence time were surveyed. Residence time in unsaturated and saturated zones were compared. Contribution of freshly infitlrated water to seepage during intensive rain events and snowmelting was solved. Karstification is connected to limestones of devonian age (Macocha formation, Vilémovice limestones), which create the main hydrogeological structure. Thickness of unsaturated zone ranges from several tens to more than 100 m in the Moravian Karst, saturated zone of karst aquifer reaches up to 500 m. Seepage sites E, Kužel and Beránek in the Ochoz cave were observed and sampled in 2001 – 2009. Seepage sites Kašna in Rudické propadání cave system and Mapa Republiky in Býčí skála cave were reference localities in unsaturated zone. For comparison we modeled residence time in saturated zone: at Kaprálka outlet (close to the Ochoz cave), and underground streams Stará řeka (Rudické propadání) and Konstantní přítok (Amatérská cave).

Combination of several methods was used; in the Ochoz cave there was a long-term monitoring of discharge/water volume, temperature, pH and conductivity of seepage and soil water on monthly basis. Seepage site E is equipped with an automatic meassuring station, which collects water from unsaturated zone with no contact with cave atmosphere. Discharge, conductivity and temperature of water was measured with the interval of 20 minutes. Sampling of seepage and soil water for δ18O content and chemical composition was performed monthly, sampling for tritium, CFC and SF6 concentration was done occasionaly several times per monitoring period. The frequency was higher during snowmelt or rain events. For cases of intensive flow events an automatic programmable sampler ZKZ 1.0 was developed, which allowed to cover even short - time changes dur-

ing seepage water outbreak when the cave wasn´t accessible due to flood. Soil samples for moisture determination were taken monthly above the Ochoz cave. Five tensiometers (0.4 – 0.9 m below surface) were located in the soil to survey the stage of soil saturation, when the water can freely flow down by gravitation. Partial pressure of carbon dioxide in the soil atmosphere was manually monitored. Together seven no tension lysimeters were placed into the soil cover above the cave, to the depth of 0, 15 and 60 cm below the surface. Volume of infiltrated water, its pH, conductivity and temperature were meassured and samples for chemical composition and δ18O analysis were taken monthly. One lysimeter was equipped with a data logger and a sensor for monitoring the level and temperature of water that had infiltrated into the soil with the interval of 1 hour. Precipitation amount was observed daily in the close Hostěnice village, samples for δ18O analysis were taken (mixed weighted monthly sample). FLOW PC program (Maloszewski and Zuber 1996) was used for mean residence time modeling based on tritium, oxygen and CFC. Storativity was calculated using method of Atkinson (1977) from water level oscillation in boreholes (Mokrá quarry in the vicinity) compared to outflow from the system (PB0337 Kaprálka spring) during flow recession periods. A tracer tests with four fluorescent dyes was realized in unsaturated zone.

Mean residence time in unsaturated zone above the Ochoz cave reaches 7 – 20 years, while it is only few months in the soil (1 – 8 months, depending on the depth). At Kašna seepage site, the residence time is similar to the Ochoz cave - about 18 – 20 years, at Mapa republiky seepage site, it reaches 150 years due to unusual geological settings. Mean residence time in order of 10 – 20 years corresponds to storativity values (0.6 % in average, declines with depth to 0,3 % in 100 m b.s.). calculated from parallel water level recession in boreholes in unsaturated zone and flowrate decrease of a local spring. Mean residence time in outlets from saturated zone, which drain water both from unsaturated and saturated zone, is 5 – 23 years. The main water storage in unsaturated zone of the Moravian karst is apparently placed above the regional water level.

Even during intensive infiltration events, pre-event water prevails in the epikarst. Monitoring of seepage conductivity and δ18O composition prooved that freshly infiltrated water component doesn´t exceed 20 %. Hydraulic impulse spreads tens of hours or first days. It is very fast compared to long residence time. Unsaturated zone represents a huge water reservoir. Despite significant hydraulic reaction (which spreads in tens of hours or first days after rain or snowmelting), δ18O and conductivity values don´t change substantially. Epikarst and unsaturated zone are more important reservoirs for water accumulation than soil.

Based on all data a conceptual model of water flow and mixing in karst unsaturated zone was created. This model consists of four storage zones: soil reservoir, epikarst, lower unsaturated zone and perched aquifer in fissures above the cave ceiling. Regime of flow, water mixing and flow paths distribution depends on epikarst saturation and intensity of infiltration.

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MANAGING THE THREATS TO THE KARST WATER RESOURCES OF THE CRADLE OF HUMANKIND WORLD HERITAGE SITE, SOUTH AFRICA

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A poor understanding of the surface and groundwater resources of the Cradle of Humankind World Heritage Site (COH WHS) in Gauteng Province, South Africa, has precipitated often alarmist reporting in the media regarding the negative impacts associated with various sources of poor quality water. The most notable of these is the acid mine drainage (AMD) threat from defunct and flooded gold mines to fossil sites and karst ecosystems in the COH WHS. Globally, the COH WHS appears to be the only protected karst landscape that is under threat from AMD. This perceived threat has generated wide and considerable concern for the preservation of the UNESCO-inscribed fossil sites. A recent assessment of the water resources environment has better informed this situation. It also provides the basis for the implementation of an integrated water resource monitoring programme in support of management efforts to protect the aquatic environment and outstanding universal value of the site.

The surface water environment comprises the pristine Skeerpoort River and the impacted Bloubank Spruit system. These drain to Hartbeespoort Dam via the Magalies River and the Crocodile River as respective main stems. The Skeerpoort River, with a long-term median discharge of ~9.5 Mm3/a, is fed by karst springs delivering a similar volume of excellent quality dolomitic groundwater. This contribution represents ~5% of the net capacity (~186 Mm3) of Hartbeespoort Dam. The Bloubank Spruit system, with a long-term median discharge of ~22.6 Mm3/a (~12% of the net capacity of Hartbeespoort Dam), receives >7.1 Mm3/a (>19.5 ML/d) of poor quality raw and treated (neutralised) mine water and >4.7 Mm3/a (>12.8 ML/d) of treated municipal sewage effluent in its headwaters upstream of the karst environment. The balance of ~11 Mm3/a (~30 ML/d) is contributed by four karst springs delivering good to excellent quality dolomitic groundwater. The Crocodile River median long-term discharge of ~9.5 Mm3/a of good quality surface water (measured before the confluence with the Bloubank Spruit) also represents ~5% of the net capacity of Hartbeespoort Dam. Expressed in terms of long-term median annual total dissolved salt (TDS) load contributions, these drainages deliver in the order of 2500, 8600 and 2700 tons of TDS respectively to Hartbeespoort Dam. The historical persistence of poor bacteriological quality associated with surface water in the Bloubank Spruit (as reflected in very high E. coli values of >3000 counts/100 mL) represents a significant threat to the 'fitness for use' of this resource. The recent and current presence of a significant mine water component is cause for further concern.

The groundwater environment comprises ten dolomitic compartments, two of which are subdivided into subcompartments. Most of the compartments are drained by springs with quantified discharges and water qualities. The aggregate discharge of eleven enumerated karst springs amounts to 25.2 Mm3/a (~800 L/s or 69.1 ML/d). This equates to ~14% of the net capacity of Hartbeespoort Dam, and reflects the important contribution of good to excellent quality dolomitic groundwater rising mainly in the COH WHS, to the water budget of the wider region. The very wet 2009-'10 and 2010-'11 summers precipitated an exceptional recharge of groundwater resources in the study area. A rise in

groundwater rest levels by ~3 m on average (also observed in the Sterkfontein Caves water level) reflects these circumstances. Greater water level rises (by as much as ~5 m) are attributed to allogenic recharge associated with the infiltration of surface water contributed in the form of mining and municipal wastewater effluent from upstream non-karst areas. This infiltration has amounted to as much as ~32 ML/d in the case of mine water, and ~7 ML/d in the case of municipal wastewater effluent.

A correlation between spring discharge, basin catchment area, spring water chemistry and rainfall recharge is demonstrated for most of the compartments. This has provided an improved understanding of groundwater flow patterns especially in regard to the karst formations, and which forms the basis for a plausible conceptual hydrologic and hydrogeologic model of the water resources environment in the COH WHS. The recognition of groundwater resource units (GRUs) is a key element of this model.

The improved understanding of the groundwater environment has informed an assessment of the relative risk to fossil sites from anthropogenic impacts on the water resources environment. A fossil site hydro-vulnerablity assessment indicates that nine of the 14 fossil sites in the COH WHS reflect a very low or low vulnerability because of their location (a) in groundwater compartments that are hydrogeologically separated from those where the contaminated water impact is manifested, and (b) at substantial elevations above the ambient groundwater level. Only the Bolt's Farm site reflects a very high vulnerability. Although the Sterkfontein Caves site intersects the water table, it is assigned a high vulnerability on the basis that the observed long-term cave water quality record and recent hydrochemical data reflect a low impact to date. The Swartkrans, Minnaar's and Plover's Lake sites reflect a moderate vulnerability. From this assessment it is apparent that the majority of the known fossil sites in the COH WHS are not under threat from either changes in surface water or groundwater levels and/or changes in surface water or groundwater chemistry (quality), whether these are the result of mine water, treated sewage effluent or agricultural return water ingress. The more vulnerable sites are targeted for closer monitoring.

The state of the environment assessment results for the 15 ground water resource units (GRUs) shows that two of these are assigned a 'largely modified' class D classification, and a further three a 'modified' class C classification. The remainder are assigned either a 'slightly modified' class B/BC or a 'natural' class AB classification. These circumstances reflect the good, and in some instances even excellent, state of the groundwater environment associated with 66% of the GRUs in the COH WHS. A closer inspection of the spatial representation of the 13 karst GRUs shows that 59% of the karst area supports a 'slightly modified' class B/BC or better classification, and only 27% of this area a 'largely modified' class D classification.

It is concluded that the platform built from historical data, and its integration with a wide range of rigorous and defensible newly-generated and interpreted hydrologic and hydrogeologic data and information, convincingly underpins the situation assessment of the surface water and groundwater environments in the COH WHS. This, in turn, has provided the means to objectively gauge the impact of varied and numerous threats to and on the water resources, and to develop a coordinated, appropriate and cost-effective water resources monitoring programme. It is equally evident, however, that the unprecedented abnormally high flow conditions experienced in the past two hydrological years in the Bloubank Spruit system is cause for grave concern under circumstances where much of this discharge has been attributable to abnormally high acid mine drainage volumes peaking at ~65 ML/d.

PROTECTION OF KARST GROUND WATER IN ARID AND SEMI-ARID ZONES IN IRAN

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The pressure of population development on the one hand and the global environmental problems on the other hand require a more integrated view in protection of karst ground water resources.

More than 11 percent of Iran territory is cover by Fissured and carbonate rocks. A sustainable utilization of water resources is limited naturally by its nonuniform distribution according to climatological and geological conditions. The general lack of understanding of karst vulnerability increase the risk of pollution in these resources, Therefore their protection and management is highly important Carbonate rock in many regions in Iran are intensively Fissured and karstified, and they are able to retain underground water for a longer time .On the other hand these karst aquifers are of outstanding importance for water supply. In this paper the protection of karst water which also belongs to future generation in Iran is presented.

As sited in the poster karst water production area has to be well protected and sustainable management has to be observed and restricted for future use and generation.

THE LEAKAGE POTENTIAL OF KUHRANG III TUNNEL DURING EXCAVATION, IRAN, HYDROGEOLOGICAL APPROACH

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Kuhrang III tunnel with the length 0f 23.4 km is designed to transfer 17 m3/s water from the Birgan River to the Naleshkanan River under the Zarab Anticline. The Karstic Formations are extensively outcropped in route of the tunnel. A considerable amount of water emerged from a karstic conduit during the excavation of the Nasirabad adit. Water with a pressure of about 10 atmospheres and a flow rate of about 20 l/s emerged from a karstic channel during the excavation of the main tunnel. Two dye tracings were performed in the study area. At the first one, 42.5 kg Rhodamine B was injected in ponor No. 1 in the north of Lagharak polje. In second dye tracing, 20 kg Uranine was injected in ponor No. 2 in the south of Lagharak polje. It is concluded that: 1) Most of the water in the Lagharak plain does not flow in the vicinity of the tunnel. 2) Karstic channels connect the injection sinkholes and most of the springs emerging from both sides of the main tunnel. 3) Naleshkanan River had high dye concentrations flowing on the Eocene and Oligocene Formations. Parts of Naleshkanan River water infiltrate into the above mentioned formations and head toward the karstic channels, emerging from the main tunnel and the springs. The tunnel is located at least 200 m below the karstic springs; therefore an extensive karstic system is unlikely. However small conduits with high water pressure may be found during excavation. The flow model in the study area is proposed.

CHEMICAL AND TEXTURAL COMPOSITION OF THE KRKA RIVER TUFA DEPOSITS FROM THE DINARIC KARST REGION OF CROATIA

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The Krka National Park is situated near the city of Šibenik on the Adriatic Coast of southern Croatia (Fig.1). The Krka River with its series of spectacular waterfalls and cascades (i.e. carbonate barriers), as well as the lakes behind them, and the estury, represents a well-known karst phenomenon. The most prominent features of this specific biotop are rapid current and sprinkling water abounding in dissolved bicarbonates, together with the micro- and macro-biological communities which flourish on the tufa barriers, contributing to the build-up of the dams (Matoničkin & Pavletić, 1961).

The locality has been investigated for a number of years, mainly using isotope methods (Horvatinčić et al., 2000; Lojen et al., 2004), whereas elemental analyses (Fe, Mn, Sr, Mg, Pb, etc.) were carried out on composite samples (i.e. carbonate phase together with insoluble residue) by means of XRF (Frančišković-Bilinski et al., 2004) and ICP-AES (Cukrov & Lojen, 2010); there have been no petrographic studies. Due to the paucity of research concerning the integration of geochemical data from the Krka River tufa deposits with their textural and mineral composition, this study has been initiated to characterise them by chemical, petrographical and mineralogical analyses. Hereby, this paper presents data on geochemical and petrographic features of the Krka River tufa deposits.

Tufa samples were collected at the location Skradinski Buk waterfall which is 49 km downstream of the spring, at an altitude of 20 m above sea level. A total of six samples were taken either from the river bank or from the crest of the cascade. Calcite is the predominant mineral in the deposits, as determined by x-ray powder diffraction, whereas quartz, 10 Å phyllosilicate (illite and/or mica), chlorite, K-feldspar, amphibole, and smectite were detected in the insoluble residue.

Fig.1: Geographical location of the study area (in frame); two photographs (a, b) of the slices show different morphologies of tufas.

Commonly, freshwater carbonates exhibit a great variety of structures, textures, and morphologies, containing a wide diversity of constituents. On the basis of a framework of encrusted plant remains and porosity type, the studied tufas (Fig.1) are similar in texture and composition to deposits reported by Love & Chafetz (1988). Four specimens were extremely friable, except the two shown on Fig.1, having brown to light brown colours.

Broadly, two major morphologies of sampled tufas distinguished in this active system are encrusted mossy deposits (Fig.1, a) and algally laminated crusts (Fig.1, b). Aquatic mosses abound at the Skradinski Buk waterfall, constructing the bulk of highly porous deposits. Hereby, moulds (Fig.1, a) readily visible in the form of numerous irregular cavities present in the rock testify as to their former existence. In thin-section, mossy-type encrustations they consist of microcrystalline aggregates composed of peloidal, clotted or structureless micrite.

Additionally, scarce occurrences of recrystallization and pore-filling cements are also present. In some speciments, algally laminated crust (Fig.1, b) is a hard and compact stratified rock composed of alternating dark and light laminations up to 2 and 4 mm thick, respectively. On a microscopic scale, these laminae are micritic and microsparitic as a result of seasonal encrustation by algal filaments.

Trace element concentrations in carbonate phase were measured after a single extraction with 1M Na-acetate (Tessier et al., 1979; Cook, 1992) by a Prodigy High Dispersive ICP-AES spectrometer (Teledyne Leeman, Hudson, NH, USA), working in a simultaneous mode, and equipped with a glass concentric nebuliser. All measurements were run in triplicate.

The precission of the method expressed in RSD ranged from 0.4 to 6%, whereas the accuracy evaluated on the basis of the analyse recoveries by spicking experiments ranged from 84 to 103%. The concentrations of Ag, Al, Co, Cu, and Ni were below their detection limits as follows: 0.0746, 0.0257, 0.0311, 0.116, and 0.0782 µg/g, respectively.

The organic matter content was determined by loss on ignition at 550oC for 2.5 hours. A rough inspection of the measured variables values (Tab.1) demonstrates a chemical heterogenity of the precipitates comparable to their petrographic diversity. This finding is in agreement with above statements regarding the diversity of environments and microenvironments existing within the overall tufa-depositing environment.

Table 1: Results of geochemical analyses: trace metal levels (µg/g) in carbonate phase; O.M. (organic matter) and I.R. (insoluble residue) expressed in %wt on the basis of the whole rock

Samples	Fe	Mn	Sr	Mg	Zn	Pb	Cd	Cr	O.M.	I.R.
K1	11.60	20.00	82.4	525.0	2.50	3.95	0.95	2.30	2.0	3.7
K2	0.00	5.35	103.0	689.0	2.75	1.65	1.15	2.55	0.5	3.1
K3	3.10	11.40	144.0	561.0	5.65	4.75	1.05	5.20	0.8	3.7
K4	3.65	17.50	102.0	614.0	2.35	2.00	1.20	2.20	1.6	2.2
K5	8.30	27.30	88.2	604.0	4.30	2.85	0.90	4.15	1.2	3.9
K6	21.75	53.80	85.3	529.0	21.50	1.85	1.05	20.10	3.5	21.1

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THE DEVELOPMENT OF THE KARSTIC LANDFORMS IN THE NEOGENE FORMATIONS IN MESSINIA (S. GREECE)

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Introduction

Karstic landforms (surface and underground) are very common in Greece due to widespread of the soluble rocks. Only the limestone occurrences cover over 35% of the surface (Papadopoulou 1999). Neogene formations cover also about 25% of the Greek area and karstic or pseudokarstic landforms formed often in these rocks. The aim of this study is to clarify the formation and development of the numerous small caves, which are located north of Kalamata city, Messinia, South Greece.

Methodology

For this study geomorphological, geological and mineralogical data have been used . The studied karstic landforms are located in absolute altitude about 160 m, along steep slopes and in a N3060 to N3200 direction. These landforms are horizontal to sub horizontal small caves (rockshelters) with a few narrow passages. The caves have shallow depth, up to 10 m, with a maximum develop in a N200 to N840 direction Their height are low, up to 3 m, but the entrances are relatively wide.

From a geological point of view the post-alpine sediments at the eastern margin of the South Messinia basin overlie unconformably the alpine ones. Their deposition took place over an already well-formed erosional paleorelief. Based on sedimentological and stratigraphic criteria, the above mentioned post-alpine sediments may be distinguished into: Marine Pliocene – Plio-Pleistocene sediments, Continental Pleistocene deposits, Continental Holocene deposits. The eastern part of the Southern Messinia area had been submerged until the end of the Middle Pleistocene (Marcopoulou-Diacantoni et al., 1988, Mariolakos et.al 1997). Since then the area is under uplifting regime. Climate and tectonism, however, has now become the main morphogenetic factors. Nevertheless, tectonism is the main factor of morphogenesis in the area after the Middle Pleistocene since the Early Pleistocene marine deposits have been uplifted up to 450m above sea level.

From a mineralogical point of view the sediments which are the caves consist mainly of quartz and calcite according to Powder X-Rays Diffraction analyses (PXRD). The calcite is pure $CaCO_3$ as shown by the position of the 104 reflection [d(104)=3.036Å] in the diffractogram (Goldsmith et.al 1961), as well as by the relevant Electron Probe Microanalyses (EPMA) (table 1). The grains of quartz are cemented by the above carbonate (pure calcite) material as shown by the Scanning Electron Microscopy (SEM) studies (fig.1). A small percentage of other minerals are present, as micas and illite, iron oxides and hydroxides and also zircon.

Results

Numerous small caves (rock shelters) usually observed at the contact of the (oligomictic or polymictic) marine conglomerate with the plio-pleistocene sediments consisting from fine texture materials. The Plio-Pleistocene sediments which are the karstic landforms consist mainly from quartz and calcite. The calcite is pure $CaCO_3$ and the quartz

grains are cemented by this carbonate material. The karstification took place due to the high content of the sediment in $CaCO_3$ .The karstification cannot be older than the end of the middle Pleistocene.The suitable climate favored the corrosion of the calcite, but also the erosion of the quartz. The differences on the degree of the erosion and corrosion of the conglomerates are considerable too.

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Table 1 Microanalyses (EPMA)

Sample	KP	KP	KPB2	KPB2	KPB2	KPB2
Position	1	1	a	b	c	d
Mineral	Calcite	Quartz	Calcite	Calcite	Mica	Calcite
SiO_2	0,27	98,37	0,14	0,21	45,81	0,23
Al_2O_3	0,08	nd	nd	0,11	24,65	nd
P_2O_5	0,07	nd	nd	nd	nd	nd
MgO	0,06	0,26	0,39	0,07	2,15	0,23
CaO	48,23	0,11	48,36	48,53	0,76	47,39
SrO	0,06	nd	nd	nd	nd	nd
Na_2O	0,11	0,78	0,16	0,17	0,86	0,18
K_2O	0,17	nd	nd	nd	8,23	nd
FeO	0,04	0,18	0,09	0,11	5,76	0,06
MnO	0,14	nd	nd	nd	nd	nd
ZrO_2	nd	nd	nd	nd	nd	nd
CO_2^*	43,96	nd	43,89	43,93	nd	43,90
Total	93,19	99,70	93,03	93,13	88,22	91,99

*CO_2*calculated after determination of total carbon. The positions are in correspondence to the respective*

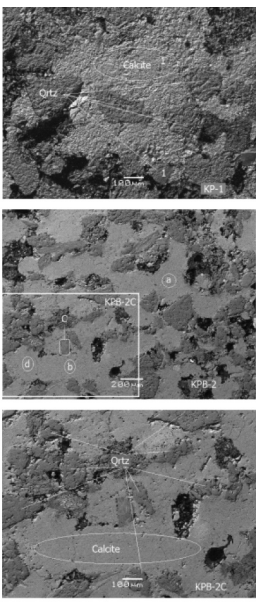

fig.1 nd: no detected

INFLUENCE OF THE SOLAR ACTIVITY ON STRUCTURAL COMPONENTS OF KARST AND CAVES

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Solar irradiance is the ultimate source of the energy that powers the terrestrial climate system and enables the biosphere. Solar activity influences all natural processes and phenomena including Karst and cave formation and their evolution.

The study of this influence needs constant monitoring of the air temperature and physical parameters of the cave – rock temperature, condense processes, heat exchange etc.

The relation solar activity – regional climate is well studied from observations of the Sun in astronomical observatories and registration of meteorological conditions in the Earth's atmosphere in meteorological stations. It is also well known that basic reason for global climate changes are changes in the Earth's cloud cover. High negative correlation is ascertained between galactic and solar cosmic ray fluxes and the tropospheric temperature. It comes into evidence that the more long lasting powerful active events on the Sun, the larger number of days without clouds on Earth, and the higher temperature of the boundary layer.

The atmosphere of caves is generally included in the processes that happen in the external atmosphere. Circulation of the air in caves is a fragment of the most general circulation of the air in the atmosphere. Even such conservative media as the air volumes of Karst caves response to the variations of climate and solar and geomagnetic activity.

Cave air temperature response to climate and solar and geomagnetic activity for four show - caves in Bulgaria (latitude φ=42.50°, longitude λ=25.30°) have been studied for a period of 36 years (1968 – 2003). Everyday noon measurements in Ledenika, Saeva dupka, Snezhanka and Uhlovitsa cave have been used.

Cave temperatures in the zone of constant temperatures (ZCT) are compared with surface temperatures recorded at meteorological stations situated near about the caves – in the towns of Vratsa, Lovech, Peshtera and Smolyan, respectively.

The Hansen cave, Middle cave and Timpanogos cave from the Timpanogos Cave National Monument, Utah, USA have also been examined for comparison (latitude φ=40.27°, longitude λ=111.43°).

It has been found that the correlation between cave air temperature time series and sunspot number is better than that between the cave air temperature and Apmax indices; that t°ZCT is rather connected with the first peak in geomagnetic activity, which is associated with transient solar activity (CMEs) than with the second one, which is higher and connected with the recurrent high speed streams from coronal holes.

Decreasing trends in the air temperatures of all examined show - caves have been identified, except for the Ledenika cave, which is ice cave. The well known mechanism of cooling is clearly expressed – the dry surface air lowers the temperature of the cave air and the drier air evaporates water from the cave environment, which further cools the cave.

On the contrary, increasing trends in the air temperatures on the surface, measured at the meteorological stations near about the show caves in Bulgaria have been identified. The trend is decreasing for the Timpanogos cave system, USA. It can be concluded that surface temperature trends depend on the climatic zone, in which the cave is situated, and there is no apparent relation between temperatures inside and outside the caves.

Our results can help in studying heat exchange between the surface and subsurface air and its influence on cave ecosystems.

Studying the evolution of secondary Karst formations, we find direct connection between their enlargement and the cave air temperature. On the other hand, we know about the direct connection between cave air temperature and solar activity. Thus, we can define an indirect index of solar activity, determining the influence of solar activity on formation and enlargement of secondary Karst formations.

At a luminescence analysis of cave speleothems microzonality in their structure is found. Densitograms of the luminescence intensity can be transformed in time series, which enables dating of the secondary Karst formations. Enlargement of speleothems from the cave Duhlata, near the village of Bosnek, Pernik municipality has been investigated using this methodics. The obtained time series embraces about 22 000 years. Its resolution is 5 steps for a year and it gives an information about the characteristics of the 11-year cycles of Solar activity in the past (phases, periods, epochs of minimum and maximum), which is very important for the mechanisms of solar magnetic field generation.

Investigations of the Karst caves response to variations of the climate and solar and geomagnetic activity shows that Karst systems very faithfully preserves a record of environmental changes, which is very important for socializing of Karst objects and p rognosis of their future.

THE MONITORING OF ACTIVE FAULT DISPLACEMENTS WITHIN SELECTED CAVES ACROSS CENTRAL EUROPE

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The most appropriate sites for studying active fault displacements are located within caves as these systems commonly develop along significant fault structures. In central Europe, 48 caves have been equipped with the extensometric gauges known as TM71s. These enable us to study active fault displacements at the local scale and provide information about the regional geodynamic regime. The instrument is an optical-mechanical crack gauge that records displacement as moiré interference fringes on two identical optical glass plates referred to as the combined indicator.

It has a number of specific advantages as it is able to record precise three-dimensional data without the need for an electrical supply while it is known to be capable of surviving for decades in the field without maintenance. Furthermore, recent advances mean that it is now possible to undertake automated data logging.

This significantly increases the frequency over which data can be recorded and there are currently six automated sites. The selected faults are located in caves that are characterised by features typical of active deformation such as cave infill, damaged speleothems, or known nearby active seismogenic fault structures. The active displacement monitoring has been ongoing at many of the sites for several decades but may extend as far back as the 1970s at certain sites (e.g. Stěny in the Malá Fatra). Our data have recorded significant displacements within the selected caves.

These data may be characterised as continuous tectonic creep trends or as sudden pulses that are normally associated with significant reversals in the sense of movement. The latter are commonly seen before or during registered earthquake events. These phenomena are not simply related to local strain changes but also appear reflect global pressure pulses that affect the entire tectonic plate. In addition, a high number of gauges at one site, such as at Driny Cave or Plavecka Caves, enables us to determine the recent stress orientation at the local scale (Fig. 1). It has been found that dilation within the upper crust decreases rapidly with depth beneath the surface and therefore the monitored fault displacements are not affected by climatic effects. This is in marked contrast to other methods that observe tectonic deformations at the surface and reflects the most significant advantage of using caves for the monitoring of active fault displacements.

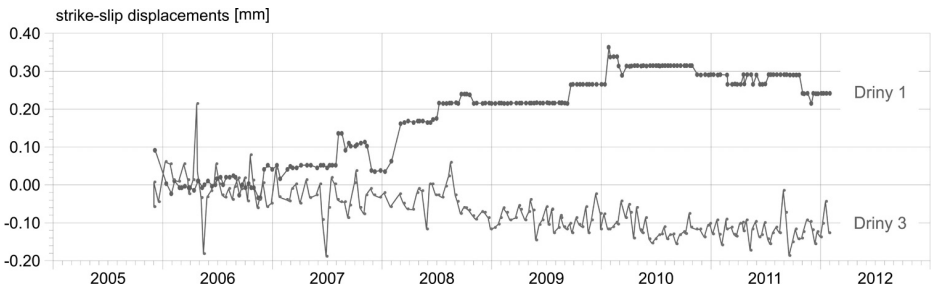

Fig. 1 The strike-slip displacements recorded on two instruments at Driny Cave. These are installed across two transverse fault systems and record different strike-slip mechanisms. From these data, it is possible to define the precise fault kinematics. It is clear that there is a horizontal stress field at Driny Cave

IN-SITU MONITORING OF CRACKS AT WESTERN PERIPHERY OF MADARA PLATEAU AT VICINITY OF THE HISTORICAL ROCK BAS-RELIEF

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Keywords: in-situ monitoring, rock deformations, Madara plateau, seismic impact

At the Western periphery of Madara Plateau (NE Bulgaria) is affected by geological hazard processes as rockfalls, toppling and landslides that seriously menace the historical bas-relief named Madara Horseman. This place is situated about 10 km E from the town of Shumen, NE Bulgaria (Figs. 1 and 2). The bas-relief was created in 8th Century AC during the rule of the First Bulgarian State. It is included in the World Heritage List of UNESCO.

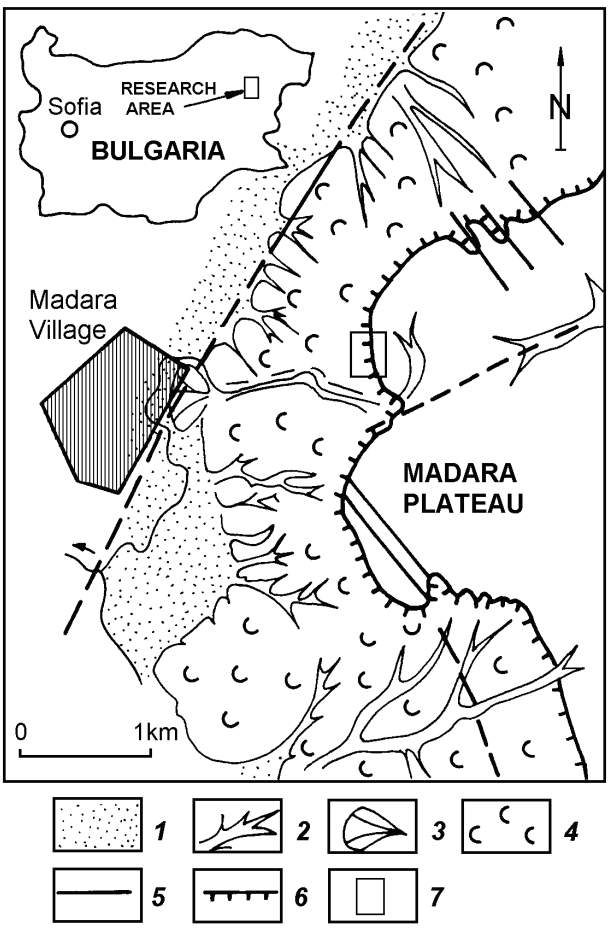

Fig. 1. Geomorphological map of the research area (Angelova 1995): 1 – alluvium; 2 – gully; 3 – alluvial fan; 4 – creeping depo¬sits; 5 – fault; 6 – plateau edge; 7 – Madara Horseman locality

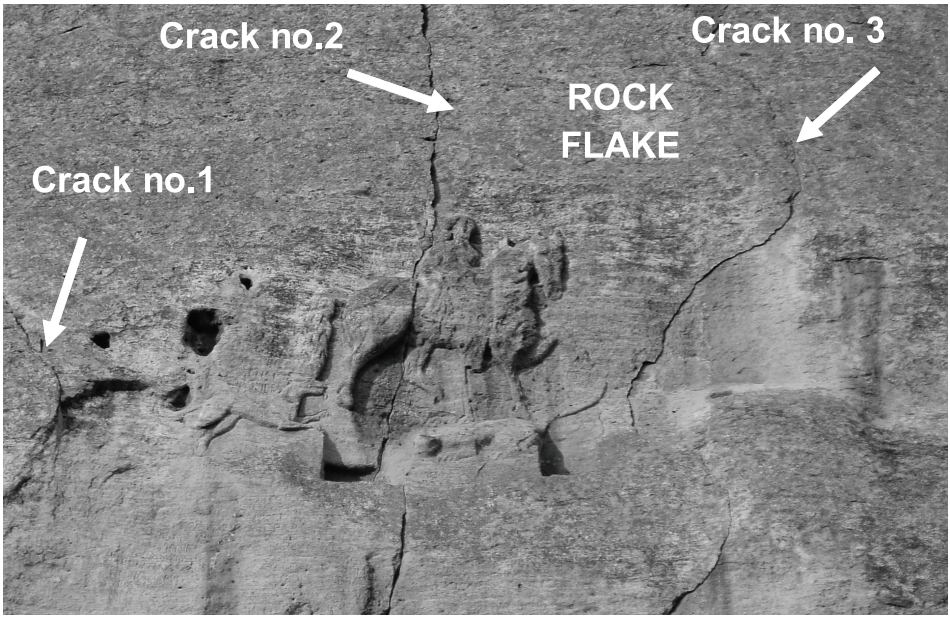

Fig. 2. The Madara Horseman bas-relief with the location of the main cracks and the dangerous rock "flake"

In its present form, the bas-relief has survived for 12 centuries, but with significant deteriora-tion. Nowadays, there is three vertical cracks cut through the rock composition. Two of these cracks (no. 2 and 3) divide a thin rock "flake" that creates the main danger for the bas-relief. Till present various studies were conducted in recent years to identify these processes and to take appropriate decisions for countermeasures to preserve this monument. To understand the dynamics of the rock deformations, three precise 3D extensometers type TM71 have been installed. The observation is located at two sites: 1) around the bas-relief, and 2) at the edge of the plateau just above the monument.

The monitoring system includes the use of 3D extensometers TM71 and few shift marks, which are designed especially to monitor the micro-displacements along cracks (Košťák, 1991). This gauge works of mechano-optical principle of interference, which records displacement as a fringe pattern on superposed optical grids mechanically connected with the opposite walls or crack faces. Sensitivity of the system is 0.05 to 0.0125 mm in all the three space coordinates of displacement. The meaning of three spatial axes is as follows: X means extension or compression of the monitored crack; Y means horizontal slipping long the crack; Z means a vertical movement. The results from the monitoring around bas-relief show large variations at the X axes due to the seasonal temperature fluctuations. However, the long-term observations identified a clear trend in the processes in the front part of the rock scarp. The trend of movement of rock flake outside the massif ("flaking") is revealed clearly (Košťák et al., 1998). The obtained rate is 0.05 mm per year. The subsidence of the rock flake is calculated as 0.03 mm per year.

At the plateau edge, the results show continuous slip movement of the rock slice at a speed of 0.85 mm per year towards SSE6). The vertical movements of the slice are characterized with subsiding by 0.8 mm per year during the period 1990-1999, and a relatively stable state from 1999 up to present. Movements along the X-axis show both periods of opening and closing the fissure. For the past 10 years, a clear trend of compression of the crack has been recorded. This process of compression could be explained as a formation of a new rock slice. The acceleration of the process started in 1999 as an

influence of the August 17, 1999 Izmit Earthquake, Turkey, M=7.4 (Fig. 3). The gauge at point M9 recorded sharp displacements as the following: ΔX = +6.91 mm compression of the fissure; ΔY = +46.78 mm horizontal slip to SSE; ΔZ = +10.43 mm vertical uplift of the rock slice (i.e. sharp subsiding of a new-formed slice behind the plateau edge).

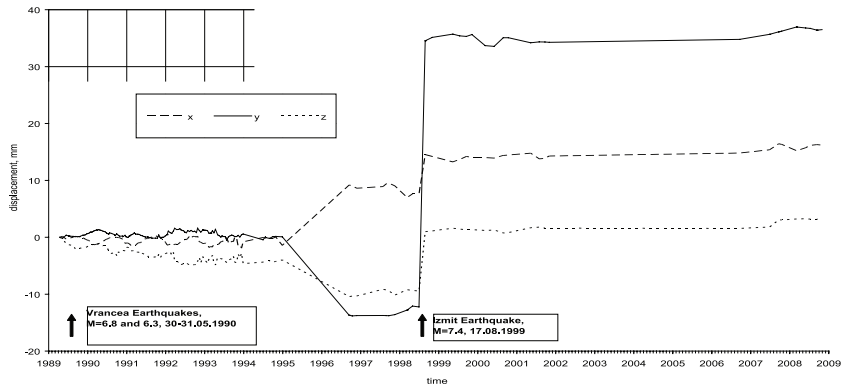

Fig. 3. Diagram of displacements established at monitoring point M9 for the period 1990-2009: +X – compression of the crack; +Y – the rock slice to SSE; +Z – uprising of the rock slice

The long-term monitoring succeeded to establish the main trends of movements at the western periphery of Madara Plateau. The obtained results already began to clarify the dynamics of the rock massif, and thus will help to take decisions on the protective works on the monument.

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MICROCLIMATE OF KARST GEOSYSTEMS – RESEARCH METHODOLOGY DURING INTEGRATED MONITORING *

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Climate is the longstanding meteorological weather characteristic for the given region. Weather, for its part, is the physical state of the atmosphere in a definite moment or time span determined by combination of meteorological elements and atmospheric phenomena. By definition, microclimate should be considered as climate of not large territory, which comes into being under the influence of the relief peculiarities, vegetation, state of the soil, reservoirs availability, buildings and other specificities of the surface. Actually, this is the climate of the field, slope, hill, small forest, shore of the basin, town etc. Specificities of the climate appear in the upper layers of the soil and in the lower boundary layer of the atmosphere, up to 100 – 200m and 5 – 10km horizontally. Usually, we speak about the idiosyncracity of the climate of a given place, which differ it from the climate formed in heterogeneous territories.

Taking into account the previous considerations, we can try to formulate the notion of cave microclimate. It has been arisen in the beginning of 20th century and usually was connected with comparatively not large caves with one and the same climate. Recent discoveries in speleology led to investigations of numerous caves with large length and several levels. If the caves are in the mountains they can be very deep and pass through several climate belts on the surface. Climate of such cave is very inhomogeneous, has a complicated hierarchic structure and organization of relations. That's why, it is supposed to speak specially about microclimate of separate parts of a large cave or cave systems. Detailed analysis of the cave climate gives us the possibility to speak about its complex and dynamics not only for large and long caves. Something more, it is very difficult to describe climatic conditions in caves taking into account their parameters and displacement. General principles for climatic organization (the so called climatic systems) of caves with different morphology and dimensions are also important.

Basic factors of cave climate determining are:

- climate of the region, where the cave is displaced;
- form of the underground cavity, which determines physical character of the air flows there;
- geothermal state of the massif, where the cave is developed;
- physical character of the water flows circulation in the cave;
- quality of the atmospheric rainfall (water and snow) influx in the cave.

Let us briefly consider influence of these factors on the climatic state of the cave. External cave climate is determined by the geographic situation of the site, its altitude, physical character of the passing over it flows carrying humidity, distance to the sea, etc. Most important characteristics of the external boundary layer climate, which influence the cave climate, are: air temperature T, pressure P, and humidity E, wind velocity and direction. Also, in cold climate sites air temperature in caves is lower than that in warm climate sites. In caves, situated on the south slope of the mountains, mean year air temperature is higher than that in caves situated on the north slopes and lower altitude. In comparatively dry regions the humidity in caves is lower than that in caves situated in geographic regions with high humidity. This dependence is for caves without flowing water. Strong summer winds blowing around the entrance of not very large caves is a reason for cave climate

*The results reported are obtained along Project ДО 02.260/18.12.2008: "Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development" of NSF – Bulgaria.

comparatively equal to the external climate. On the other hand, sudden changes of the atmospheric pressure lead to appearance of a wind in the cave or from it. Movement of the air masses in the cave is the most important agent for transmitting different physical constituents of the external climate in depth of the caves. Air movement in caves depends on the underground cavity form. We know two main mechanisms for air movement in caves:

1. In underground cavities with several entrances, situated at different altitudes, movement of the air arises because of the difference in the weight of the column air at different entrances. And also, movement of the air from lower entrances towards higher ones is generated during the winter, and vice versa – from higher entrances towards lower ones during the summer. Air movement change happens when the external air temperature reaches the value of the temperature in the middle region of the cave, also called neutral zone.

2. In inclined caves, movement of the air is caused by the difference in the thickness of the air at different zones of the cave. In the inclined descending caves, the cold external air during the winter pushes out the warmer cave air, and in the inclined ascending caves the warmer air during the summer pushes out the colder cave air in ascending gradation; the natural draught in caves is excluded when the external temperature is equal to the internal one. Movement of the cave air is also possible at strong blowing wind at the entrance, water movement in the cave, changes in the atmospheric pressure outside of the cave.

Temperature of the rock massif, in which the cave is situated, also has a great influence on the cave climate. It is considered as a background, on which the air temperature change provoked by the external climate and water flow is added.

Taking into account that the Karst caves' microclimate is completely different from the meteorological situation in the region, total influence of the following factors on it is investigated for a long period of time:

- morphological specificities of the cave or cave system;
- altitude of the cave entrance and Karst area, where it is developed;
- level of crackness of the basic rock of the Karst massif;
- orientation of the entrance towards solar beams, local air flows and relief;
- existence of ice and firn snow in the cave;
- existence of intensively dropping or flowing water in the cave;
- local intensity of the terrestrial thermal field in the region of the Karst massif.

Specialized integrated monitoring on the natural processes and human activity influence on the zone of constant temperatures in previously chosen caves and cave systems in protected Karst areas has been organized and developed for studying the Karst cave microclimate. Methods for microclimatic investigations have been developed and equipment is bought. Real time processing of microclimatic data has been tested. Characteristics of the cave microclimate have been obtained by investigation of the following parameters:

- hydrochemical and temperature characteristics of cave waters;
- air temperature and humidity;
- CO_2 content in the cave air;
- radiometric investigations of the cave atmosphere;
- influence of the anthropogenic factors on cave microclimate.

This methodology also gives a complex of methods, approaches and means for analysis and estimation of the cave atmosphere recreation capacity, which is important for the general touristic development of the show caves in Bulgaria.

DETERMINING THE DEPENDENCE OF CAVE MICROCLIMATE ON EXTERNAL CLIMATIC CONDITIONS IN SHOW CAVES OF THE MORAVIAN KARST

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Cave Administration of the Czech Republic

The Moravian Karst is the best-known and most important karst region in the Czech Republic. It is primarily formed of limestone from the middle and late Devonian period to lower Carbiferous. We are aware of more than 1.000 caves here, five of which have been opened to the public. The largest of these caves is the Amateur Cave, which is more than 40 km long.

Detailed knowledge of the microclimatic conditions inside caves provides valuable information necessary for solving questions concerning protection of caves, their karstification, distribution of animal species in caves and also enables us to discover the answers to issues such as specification of visiting rate limits, the number of entries made into caves, etc.

On the basis of a grant received from the Science and Research Program of the Ministry of the Environment, monitoring of microclimatic relations in caves in the Moravian Karst was launched in 2007. Its chief purpose is to determine the dependence of cave microclimate impact on external climatic conditions. The Cave Administration of the Czech Republic is the research organisation in cooperation with the University of Wroclaw and the Czech Hydrometeorological Institute is the co-researcher. The whole five-year project was completed in 2011.

The Katerinska Cave, Punkevní Caves and the Sloupsko-šošůvské Caves in the Moravian Karst were chosen for microclimatic measurements. Amatérská Cave, which is not open to the public, is also monitored for comparative measurements. Measurements of external climatic conditions is ensured through a network of meteorological stations (Sloup, Macocha, Punkevní Caves, Katerinska Cave, Ostrov u Macochy). An automatic stationary monitoring system was installed in the Katerinska Cave and Punkevní Caves to monitor microclimatic conditions. This enables continuous monitoring of individual variables with remote transfer of measured values to computers. The record interval is 1 minute. The monitoring system is made up of a system of sensors for measuring air temperature and relative air humidity, temperature of the rock formation, water temperature, air flow speed and direction, atmospheric air and carbon dioxide pressure.

Changes in air temperature are monitored in the Sloupsko-šošůvské Caves and in the Amatérská Cave using temperature sensors, which record measured values.

The preliminary results of monitoring indicate that cave microclimate is affected by the presence of tourists. For instance when visitors pass through a cave the temperature increases temporarily by several tenths of a °C, after they leave the temperature returns to its original value fairly quickly. It is also clear from the monitoring results that changes to air temperature in some parts of the cave, caused by changes in external climatic conditions or as a result of running water, are significantly greater (up to several °C) than changes caused by visitors to the cave.

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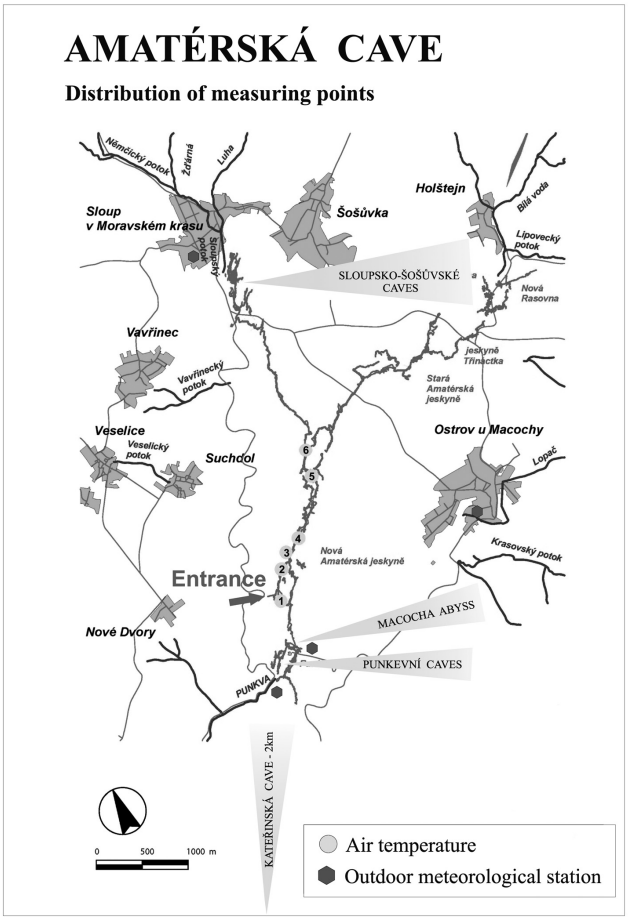

Fig.1. Amatérská Cave, distribution of measuring points

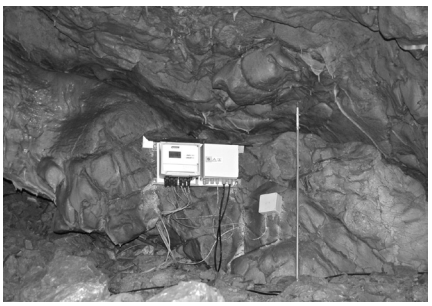

Fig. 2. Measuring station in Katerinska cave. Photo: Jiří Hebelka

Fig. 3. Ultrasonic anemometer in Katerinska cave. Photo: Jiří Hebelka

МОНИТОРИНГ НА ВОДИТЕ В КАРСТОВИ ГЕОСИСТЕМИ *

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Ключови думи: *карстова геосистема, системообразуващ поток, водоносност, вариабилност, уязвимост на замърсяване, хидрометричен и хидрохимичен мониторинг.*

Въведение

Водите, наред с наличието на химически разтворимите карбонатни и анхидритни скали (варовици, доломити, мрамори, гипс, каменна и калиева сол), са основните компоненти при карстогенезиса. Колкото по-богати са повърхностните и подпочвените води на въглена и хумусна киселина, толкова са по-агресивни към скалите, предизвиквайки ускорени химични процеси при тяхното разтваряне и следователно играят ролята на водещ карстообразуващ фактор. Същевременно водите изпълняват ролята и на т.нар. системообразуващ поток на вещество и енергия за формирането и функционирането на карстови геосистеми с присъщи за тях специфични природногеографски характеристики и условия за използване от човека. От друга страна, карстовите води се класифицират като едни от най-силно уязвимите на замърсяване, имайки предвид безпрепятственото и твърде ускорено проникване в дълбочина на обогатени с химични вещества (от торене и растителна защита) почвени води, свързани с валежи или напояване, а не са редки случаите и на инфлуиране (вливане) на замърсени повърхностно течащи потоци и цели реки в силно окарстени масиви.

Следователно, осъществяването на мониторинг на водите в карстови геосистеми е напълно обоснована необходимост както от научноизследователско, така и от практически-приложно гледище.

Методология

Основна принципна постановка в настоящото изложение е разглеждането на процесите на водообмен в един литоложки засебен карбнатен/анхидритен масив в светлината на теорията на системите, което извежда водещата роля на водите като системообразуващ поток при обособяването му като специфично устроена и функционираща карстова геосистема. Сравнявана с речния водосбор като обикновена географска система с топографски граници водоразделите, карстовата геосистема се ограничава условно чрез т.нар. подземни вододели, но най-често се отъждествява с карстифицирания скален комплекс особено при липса на страничен приток води идващи от разстояние. За целта е необходимо хидрогеоложки обосновано ограничаване на подземния водосбор на карстовите басейни и проследяване на връзката им с проникващите от повърхността валежни и други течащи води. В такъв случай притокът на води в окарстения масив се възприема като вход в геосистемата, а изтичащите от него подземни води във вид на извори, потоци, реки – изход от нея.

Основен приходен елемент в карстовата геосистема, както и в речния басейн, са валежните води, които тук обаче инфилтрират бързо, а много често и инфлуират в понори и пукнатини и формират обилни подземни води. Специфичен при-

* Докладът е по проект ДО 02.260/18.12.2008 „Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии" на Фонд „Научни изследвания".

ходен елемент са и кондензатните води, макар и в незначително количество. Като се има предвид, че валежните води, преминавайки през почвено-растителната покривка (доколкото е развита върху окарстените терени), се преразпределят на повърхностни, подземни и за изпарение, то при определянето на прихода в геосистемата е важно да се отчитат и свойствата на подстилащата повърхнина, включително и някои морфометрични и климатични характеристики (например разчлененост, наклони, температура, дефицит на влага и др.), които в своята съвкупност се дефинират като трансформатор на входния вектор в геосистемата в изходен. Напълно логично е да се имат предвид и антропогенните преобразувания на естествената среда. Очевидно е, че мониторингът на водите в карстови геосистема се възприема в два аспекта: първо в тесен смъсъл, пряко върху водните обекти осъществяван самостоятелно, и второ, в широк смисъл, посредством разкриване влиянието на комплекс от външни фактори, осъществяван съвместно с почвения и други видове мониторинг, като в този случай се доближава в голяма степен до същността на един комплексен мониторинг.

Както става ясно, количествените и качествените характеристики на карстовите води се разглеждат като израз освен на естествената динамика на водообмена в карстовите геосистеми, а също така и на антропогенно предизвиканите изменения от пряко въздействие върху водите главно чрез използването им за различни нужди и от косвено въздействие чрез реализираните разнообразни практики по земеползване върху водосборните басейни или използването за стопански цели на подземни пещерни зали и галерии. За установяване на закономерно обусловените и антропогенно повлияните количествени и качествени характеристики се организират постоянни станции и временни пунктове за наблюдение, измерване и регистриране на данни за състоянието на водите с оглед установянане на водния режим, водния баланс, химичния състав, а не на последно място и за проследяване проявата на явления с рисков характер за здравето и дори за живота на хората, обитаващи и използващи ресурсите на карстовите територии. В т.нар. опорна и временна хидрогеоложка мрежа от станции са обхванати многобройни карстови извори с различен дебит, но с важно стопанско и комунално-битово значение.

В рамките на проекта периодично се осъществява т.нар. хидрометричен и хидрохимичен мониторинг на карстови води в използваните като моделни обекти отделни защитени карстови територии като ПП „Шуменско плато", пещерата „Съева дупка", ПЗ „Маарата" и др.

Резултати

Разпространението на карста в България, макар и фрагментарно с различно големи площи, е сумарно върху близо ¼ от нейната територия. Формиран е главно в карбонатни комплекси с различна възраст – от протерозойски мрамори в Рило-Родопския масив, през триаски и юрски варовици в Краищенско – Странджанската блоково-разломна зона и Главната Старопланинска верига и долнокредни варовици в Предбалкана, до долнокредни и мастрихтски варовици в голяма част от Дунавската равнина и сарматски в най-западната и най-източната й части, както и на места в палеогенски варовици в Горнотракийската низина и Източните Родопи. Като цяло в тези карбонатни формации са обособени 50 т.нар. пещерни райони, към които са привързани и многобройни високодебитни карстови извори. Както беше подчертано, формирането на подземни води в карстовите геосистеми е с малки загуби на валежни води за изпарение поради бърза инфилтрация, а дори и инфлуация. На картите отразяващи водоностността на територии с голям обхват окарстените участъци се открояват с по-високи стойности при еднаква надморска височина именно поради по-големия дял на подземни води от тези участъци в сумарния отток на реките, в чиито водосборни басейни те попадат. Не случайно редица невисоки плата в Дунавската равнина се оконтуряват с по-високи стойности на модула на средния годишен

отток при сравнително малки валежи, подобни на Предбалкана (например: началните части от приточната система на р. Русенски Лом, Лудогорско, Франгенско плато и др.) , което се дължи именно на по-големия дял на подземния отток в речното подхранване.

Водообилността на карстовите геосистеми не винаги означава добра естествена регулираност на подземните води. Твърде често се наблюдава изключително голяма вариабилност в секундните водни количества, но не са малко и случаите на сравнително слаби колебания, като закономерно реките, подхранвани с такива води, имат относително изгладен хидрограф, представящ вътрешногодишното разпределение на оттока им особено по средни месечни стойности.

Например най-големият събран карстов извор в България Глава Панега има среден дебит около 4000 dm^3/s при вариации от 850 до 5370 dm^3/s а в отделни случаи и до 10000 dm^3/s, което се дължи на епизодично голям приток на води от р. Вит формиращ този извор, а по средни месечни стойности подхранваната с водите на извора р. Панега има отточен максимум, който превишава едва 2,3 пъти минимума.

С най-големи вариации на карстови извори в България е Искрецкият – от 250 dm^3/s до около 21000 dm^3/s подхранващ оттока на Искрецка река (ляв приток на р. Искър), при която превишението на средномесечния максимум над средномесечния минимум е около 6,5 пъти. Многобройни са карстовите извори в България със среден дебит от 100 до 1000 и над 1000 dm^3/s, като в страната са обособени общо 135 басейна с карстови води, със сумарно водно количество около 40% от всички генетични типове подземни води. Някои карстови басейни са с повишена температура на водите (средна месечна температура 18-20 ^0C) и се класифицират като акратотерми (Мусомища, Девненски и др.).

Интересни резултати са получени от сравнителния анализ на синхронни данни за валежи, дебит на извори и водни количествата на реки, както и на химичния състав на водите, в карстови геосистеми с различен тип земеползване, получени от разработки по предишни проекти.

Особен интерес представляват и данните от периодично извършваните в рамките на настоящия проект наблюдения и измервания на водни нива, водни количества, температура, мътност, химизъм на почвени лизиметрични и подземни води в пещери под формата на стационарни езерни басейни, течащи потоци, водопади, процеждащи се през пукнатини водни струи, капчуци, кондензатни води, обледявания на скални повърхности и други ледови явления и др.Тези данни по същество са резултат от осъществяван експериментален хидрометричен и хидрохимичен мониторинг като базисна част от комплексния.

Заключение

Имайки предвид реакцията – отговор на изходния продукт на карстовата геосистема във вид на карстов извор, река, водопад, езеро на сложното преобразуване на входните елементи (валежи, кондензатни води, понякога и речен приток) посредством влиянието и на други природно-антропогенни фактори, може да се заключи, че в него синтезно се фокусират основните количествени и качествени характеристики, като обем, режим, химичен състав и др., обусловени от естествено протичащи закономерни процеси във водовместващия карбонатен /анхидритен скален комплекс и климатичните условия (вкл. микроклиматични), както и от евентуалните изкуствено предизвикани изменения. Дори само прекият мониторинг на този продукт е до голяма степен достатъчен за разкриване и обосновка на тенденциите в естествено протичащите и антропогенно повлияните процеси при функционирането на карстовите геосистеми, а конкретната детайлизация може да бъде обект на допълнителен диференциран анализ и оценка чрез включване на резултати и от други видове мониторинг. В този смисъл хидромониторингът се явява много важна съставна част на комплексния мониторинг на карстовите геосистеми.

ПОЧВЕН МОНИТОРИНГ В ЗАЩИТЕНИТЕ КАРСТОВИ ТЕРИТОРИИ (ЗКТ) НА БЪЛГАРИЯ *

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Ключови думи: *почвена покривка, почви, почвообразуващи процеси, карст, почвен мониторинг, съвременен карстогенезис, сукцесии*

Мониторингът на почвите и почвената покривка в ЗКТ се създава поради необходимостта от непрекъснато следене състоянието на карста и карстогенезиса в България с цел прогнозиране и осведомяване за своевременни действия при нарушаване и деградация на природната среда от антропогенния натиск върху тях при използването им като природни паркове.

Почвите и почвената покривка са особено активни в карстогенезиса и процесите в околната среда. Най-голяма важност имат богатството на карбонати и високата хумусираност на почвите, както и пъстротата на почвената покривка, характерна с малките площни комбинации и елементарни почвени ареали, често разкъсвани от скали и кари и със слаба физическа устойчивост.

Дишането на почвите, т.е. отделянето на огромни количества CO_2 е най-характерният съвременен процес, който най-осезателно влияе върху карстогенезиса; особена тежест имат хуматният тип на хумуса и високата степен на хумификация, а богатството на карбонати дефинитивно определя разпространението на калцифилна растителност и вариациите в процесите на карстогенезиса.

Пряко или косвено почвеният компонент е атакуван от 4 антропогенни дейности: 1. Туризъм; 2. Водоползване; 3. Производство на вар и инертни материали; 4. Земеделието – база за съществуване и препитание; 5. Защитният режим с проявата на сукцесии с ускоряващ се ефект вследствие рязката смяна на земеползването.

Оригиналната характеристика и веществената същност на почвения компонент правят терените и природата на карста в защитените територии, следователно лесно податливи на антропогенен натиск.

Горните обстоятелства насочват вниманието на мониторинга върху наблюденията за *физическото унищожаване на почвената покривка* от ерозия, кариери, алеи и пр., маркирано чрез непрекъснат инспекторски контрол и поддържане на кадастър, оценка на средногодишните загуби на площи и почви; *утъпкването на почвите* по пасищата, игрищата, пътищата, екопътеките. Определя се по време на развигора един път годишно по обемната плътност на почвите, по наземни и аерофотоснимки и биоиндикатори; *акумулацията и динамиката на МОВ (мъртво органично вещесшво) – опад и горска постилка* преди и след листопада чрез метода на метровките и стратификацията; *хумусообразуването и хумустност* един път годишно, по време на развигора, чрез събиране и анализ на почвени проби от хоризонт Ah и A по метода на Тюрин; *изменения на хумусиращия се Ah, а също и A хоризонт* – един път годишно по време на развигора чрез морфологичния метод; *дишане на почвата* – определя се 5 години, ежемесечно през вегетационния период със специални стационари по метода на Щатнов; *геохимична миграция и кръговрат на елементите* Na, K, Ca, Mg, pH, водоразтворимо органично вещество и твърд отток - определя се 10 или 15 години на три периода, всеки три месеца чрез лизиметри, отточни води и почвен материал.

* Докладът е по проект ДО 02.260/18.12.2008 „Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии" на Фонд „Научни изследвания".

Мониторингът се разполага в следната схема:

1. Предварителни изследвания: детайлни теренни почвени (М 1: 5000) картирания със съставяне на почвена карта, карта на нарушенията на почвите и почвената покривка и характеристика на съдържанието им;

2. **Избор и обзавеждане на терени за полигони и стационари за мониторинга;**

3. **Набор и дефиниране на контролируемите *сезонни (краткосрочни) показатели*, причина за неблагоприятните процеси** - динамика на влажността, дишане на почвите, съдържание на хранителните вещества; ***дългосрочни*** - съдържание и запаси на МОВ, хумус, Е-загуби (евапорация), състав на обменни катиони, миграция и кръговрат на елементите, както и ***показателите на ранна диагностика*** – микроморфология, микрофлора, ОВП (окислително-възстановителен потенциал), активност на почвата;

4. **Попълване на банка база данни** и обработка за международен обмен, както и карстово районiране, оценки и пр. за всеки стационар;

5. **Комплексна интерпретация** в рамките на цялостната информация от мониторинга на карста и ***оценка развитието на карстовия процес*** с помощта на изчислителна програма и други методи.

В таблица са представени като начало показателите и методите, които са достатъчно добри за изискванията на мониторинга на ПП „Шуменско плато". Тези дейности са съобразени с изискването за непрекъснатост на мониторинга и осъществяването му чрез полеви, лабораторни и стационарни методи. Перманентното следене на пространственото, времевото и енергетичното разпределение на почвените процеси, както и координацията с мониторинга на останалите компоненти на природната среда цели още и изясняването на почвообразувателните процеси в условията на карст.

Общите характеристики за почвения компонент в ЗКТ като дребноплощност, разпокъсаност от скали и кари и плиткостта са особено голямо неудобство, препятстващо адекватно прилагане на превантивни и оздравителни мероприятия за опазването му в отделните почвени зони, пояси и райони на страната. В мониторинга се влагат усилия и средства, които най-правилно следва да бъдат осигурявани по линия на общодържавния почвен мониторинг; при стационарните наблюдения – от природните паркове, а резултатите по общия комплексен мониторинг - от официално сформирано за целта научно звено, напр. „Утилизация на карста".

RADON IN CAVES; TRIAL MEASUREMENT IN BULGARIA*

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Radon is a heavy radioactive noble gas, a member of natural decay series. It is released from uranium or thorium containing minerals in bedrock by emanation and diffusion and later it is spread by ventilation and water transport.

Its most important isotope, ^{222}Rn (ρ = 9.73 kg/m^3, $T_{1/2}$ = 3.82 d) has daughter products ^{218}Po, ^{214}Po and ^{210}Po, all are α-particle emitters. Other isotopes are short lived ^{220}Rn (thoron, $T_{1/2}$ = 56 sec) and ^{219}Rn (actinon $T_{1/2}$ = 4 sec),

Studies related to radon presence in caves have two main aims:

- general information about Rn behaviour - concentration, local and time variation, ventilation;
- health risk for persons due to Rn inhalation - daughter products captured in lungs can cause cancer.

Measurement of radon concentration is based on detection of α-particles and can be carried out by two groups of methods - continual and integral. Continual methods, mostly using active electronic devices (typically ionizing chambers, semiconductor detectors, scintillators), provide nearly prompt values and are preferred for short term, detailed measurements. The integral methods, both active and passive, provide mean values over the period of exposure. In caves, however, the use of active methods (with electronic devices) is strongly influenced by the disturbing effect of high humidity, difficulties with transport to distant localities as well as limited access to power supply. Therefore combined usage of measuring equipment is optimal - to apply passive integral detectors, mostly track etch detectors, for general survey/mapping of the whole area and active electronic devices for later, more detailed study of the chosen localities of interest.

Recently, we started the trial measurements of Rn concentration in several Bulgarian caves. The first task was the choice of the detector and appropriate arrangements for its use in caves. Because of limited space and illumination in caves it is better to have detectors ready to use before entering the cave. The arrangement must be simple and easy to handle - sometimes the exchange of detectors is carried out with help of other persons. At present we use small (~20 ml) plastic chambers (vials), shown in Fig.1, with 2 cm^2 window hermetically closed by 5 μm PE-foil. The foil allows Rn to penetrate into the measuring space by diffusion but serves as a barrier for its daughter products from outside (attached on dust and aerosol particles). The μ-particle sensitive CR-39 plastic (Page Mouldings Ltd., UK) is used as a track track¬ etch detector. Vials with detectors were calibrated in the Rn chamber of the National Institute for Nuclear, Chemical and Biological Protection, Kamenná near Příbram, CR, before use. The response is ~68 tracks.cm^{-2} per 1 kBq.m^{-3}.day. Exposed detectors are processed by combined chemical and electrochemical etching. Evaluation of a scanned detector, Fig.2, is carried out using SW ImageJ [http://rsbweb.nih.gov/ij/download.html].

With respect to climatic effects and seasonal variation, it is necessary to cover at least one year period of measurement continuously, exposure by exposure, for a given

*Research results reported have been obtained along Project DO 02.260/18.12.2008 "Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development" of NSF – Bulgaria.

locality. According to our experience quarterly exposures are sufficient in most cases, but sometimes it is necessary either shorten or prolong the exposure time if Rn concentration is too high or too low, respectively. Unfortunately, nearly half of installed chambers were found with ruptured PE foil, in some cases with evident tracks of animals´ (bats or mice) teeth. Obtained results are not correct in such a case and can be considered only as an upper estimate. To avoid this, we consider either use of an additional protective cover (cage) or modification of the design of a chamber.

Up to now, Rn-concentrations were measured in caves Emenska peshtera, Saeva dupka, Zandana (Biserna), Uruschka maara, Vodopada (Maarata), Ledenika iand Snezhanka. Measured values were within 100 - 820 Bq.m-^{3}. There are some indications of concentration >1 kBq.m-^{3}, they must be proved though. Present results are fragmented; therefore the nearest task is to complete the data to have full sets for one year period for each locality.

Later we plan to use them as a base of other studies e.g. correlation with other quantities or parameters (CO_2 concentration, ventilation rate, temperature, humidity etc. …). Estimation of radiation risk in localities with enhanced Rn concentration to different groups of visitors (tourists, guides, speleologists, adults, children) will be performed for these sites.

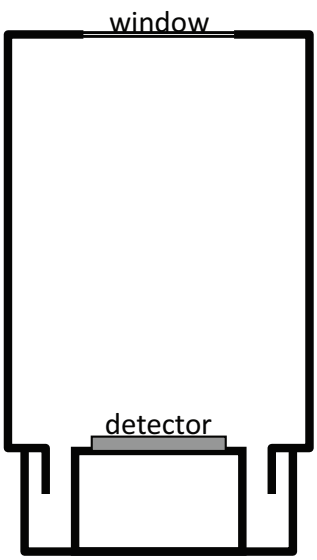

Fig.1 Design of the measuring chamber

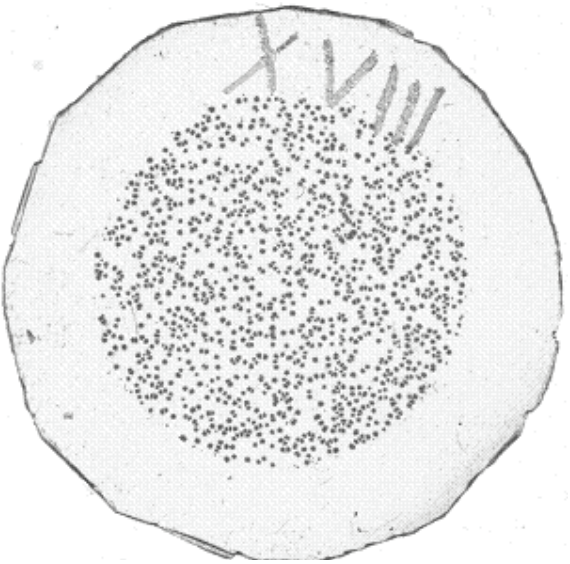

Fig.2 Exposed detector (φ =16 mm) after etching, inner area (φ = 9 mm) with α-particle tracks is evaluated

APPLICATION OF RADICARBON DATING FOR KARST RESEARCH PURPOSES: ITS POSSIBILITIES AND LIMITATIONS

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Environmental compartments contain a mixture of two stable carbon isotopes (^{12}C and ^{13}C) and one radioactive isotope ^{14}C (radiocarbon). This radionuclide of global occurrence has a half-life of 5730 yr. In nature, ^{14}C is produced by nuclear reactions generated by cosmic rays in the atmosphere (Lal and Peters 1967; Burchuladze et al. 1980). The natural ^{14}C production rate is relatively balanced by its removal from the atmosphere to other environmental compartments (e.g. oceans, biosphere). The role of direct radioactive decay in the atmosphere is negligible due to its long half-life and the short residence time of CO_2 in the atmosphere of only a few years.

The radiocarbon dating method was developed by a team of scientists lead by Professor WF Libby. Today, there are over 130 radiocarbon dating laboratories around the world performing radiocarbon assays for the scientific community. The ^{14}C dating technique has been applied and used in many different fields including hydrology, atmospheric scienceklimatology, oceanography, geology, palaeoclimatology, archaeology and biomedicine (http://www.c14dating.com/int.html).

The principle of the method is based on the supposed relatively balanced amount of 14C ($^{14}CO_2$) in the atmosphere. Plants assimilate atmospheric CO_2 (and $^{14}CO_2$) by photosynthesis and ^{14}C enters food chain in this way. After elimination of a given organism from natural carbon cycle (exitus), the activity of ^{14}C decreases as a result of radioactive decay. When we know the ^{14}C activity of a sample, the time which expired from carbon cycle elimination can be calculated. The sample age which can be determined by the radiocarbon method is not related to the time when the sculpture was carved from wood or ivory but to the time when such material was eliminated from CO_2 assimilation or food ingestion.

During several years after the start of the radiocarbon method application, it was found that past ^{14}C activity was slightly varying and first radiocarbon calibration curves were assembled to get more precise dating results. Very exact results of ^{14}C activity determinations were applied in the combination with other dating methods (dendrochronology, lake varves chronology, uranium-thorium dating) to compile the calibration curve (Hajdas et al. 1995, Goslar et al. 2000, Bard et al. 1998, Reimer et al. 2004). Range of actual curve IntCal09 for terrestrial samples was extended to 50 000 years BP and approached the limit of the radiocarbon dating method (Reimer et al. 2009).

Unfortunately, there are also other limitations. Due to several changes of ^{14}C activity in the environment we will receive 3 or 4 time intervals with similar probabilities for samples originated from 1620 to 1950 AD (i.e. we can not receive single valued interpretation utilizing radiocarbon dating for this period). Possibility of dating of samples of origin within this period could be crucial for various historical or environmental studies.

Another type of limitation is given by possibility of sample contamination by “younger” or “older” carbon forms. To avoid such interferences, it is necessary to select proper chemical form of carbon for isolation and perform its purification carefully as a starting step (sample pretreatment) of sample preparation routine (i.e. from bone samples a collagen fraction is isolated, from wood sample alpha cellulose is isolated).

In our contribution possibilities and limitations of the radiocarbon dating method will be discussed in more detail. Likewise, a brief survey of various types of samples which can be used in connection with karsts research will be described.

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RESULTS FROM TESTING AN EXPERIMENTAL MODEL OF SOCIO-ECONOMIC MONITORING IN PROTECTED KARST TERRITORIES *

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Key words: *socioeconomic monitoring, protected karst territories, sustainable development, management of PKT, surveys, visitor monitoring, inventory, sustainable tourism*

Regardless of their special statute, protected karst territories (PKT) undergo pressure from various human activities such as: agriculture, quarrying, construction and operation of small hydropower plants, tourism, etc. Due to the karst nature, anthropogenic impacts are extremely risky for the sustainable development of these territories. In this sense, socio-economic monitoring (SEM), which focuses on observing people, their activities and the use of natural resources, is an essential part of a comprehensive monitoring of PKT.

SEM of PKT can be reduced to monitoring of: 1. Visitors: profile of visitors, their visiting practices, their interest in objects of PKT, etc.; 2. Trends in the use of the urban PKT environment: state and development of infrastructure (social, economic, including tourism, technical, etc.) and the opportunities it provides for the development of a variety of services to benefit businesses and society; 3. Direct use of natural resources to meet the local community needs. Integrated monitoring of all listed above as subjects, objects and activities allows: to trace and identify how interrelated they influence each other and how they change, to identify upcoming impacts and causes of change and to determine acceptable levels of change, to assess resulting consequences – both ecological and socio economic ones for the local community; to make appropriate management decisions for balanced development of PKT.

SEM is built on the geosystems approach as a guiding methodological principle. Karst geosystems set parameters and outline the perimeter of interactions and relationships among the system elements. In the particular case of SEM, the assumed output frame is the natural-social system *"Nature-Society-Economy-Infrastructure-Urban Network"*, with its on-going complex and interrelated natural, economic and social processes and phenomena of different nature. On this basis an experimental model of the system for socio-economic monitoring of PKT is developed. Four main steps are set out in this model: inventory, monitoring, survey (research), and development of plans for management of monitoring data. The combined inclusion of all four steps mentioned above is seen as a main methodological approach of SEM. Each of them has its own specific functions in the implementation of SEM, while on the other hand they are complementary to each other. Each step has its own independent methodology *(goal, task and purpose, object and scope of observation, design and size of observation, method, structure and registration form content, places of observation, periods of observation, etc.)*, which is an integral part of the overall system of SEM.

The models developed for information gathering make an important part of the developed methodology, namely: *forms of inventory* of groups of objects; *forms for monitoring*, including visitors' monitoring, monitoring of sites and facilities of socio-economic infrastructure and related activities, monitoring of activities carried out directly on the pro-

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tected territory with direct use of resources; *questionnaires for research (surveys)*, focused on groups interested in development of PKT.

The methodology for SEM was partly tested in the period 2010-2012 at selected model PKT in Bulgaria (Natural Park "Shumen Plateau", Natural landmark "Maarata", Natural landmark „Saeva dupka", Protected locality „Trigradsko zhdrelo") and in the Czech Republic (Protected landscape area of "Moravski kras").The first results came from realized inventory and visitors' monitoring while testing the information collection models. *Inventory results* are summarized in terms of: organization of information; optimization of inventory forms: quality of data collected; organization and holding of inventory, etc. The results of *visitors' monitoring* are summarized in terms of: visitors' behavior to the visitor card; places to complete the visitor card; quantity and quality of the sampling plan; quality of the collected information and possible benefits from it, etc. Synthesis of partially performed experimental SEM reveals the merits and deficiencies in the developed model.

Analysis of the results from partial testing of the experimental SEM model for different categories of PKT give reason to conclude that the developed proposal should be an integral part of the system for complex monitoring of PKT. Naturally, the presented model is an experimental one and subject to refinement according to the specifics of each PKT.

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ОСНОВНИ ПОСТАНОВКИ ЗА СЪСТАВЯНЕ НА МЕТОДИКА ЗА ЕКСПЕРИМЕНТАЛЕН КОМПЛЕКСЕН МОНИТОРИНГ НА ЗАЩИТЕНИ КАРСТОВИ ТЕРИТОРИИ *

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Ключови думи: *карстова геосистема, защитена карстова територия (ЗКТ), структура и функциониране на ЗКТ, критериално-индикаторна система(КИС), коплексен мониторинг*

Изясняването на методиката е основен момент във всяко изследване, тъй като от нея до голяма степен зависи крайният резултат. Необходимостта от това е повече от очевидна, имайки предвид изключително сложната същност на ЗКТ като комплексни образувания от природни и антропогенни компоненти и елементи и връзки помежду им в качеството им на карстови геосистеми. Използването на различни методи се извършва в хода на целия изследователски процес, но подборът и възможното им съчетание както и включването на съответен инструментариум е почти винаги предшестващ етап с много голяма важност. Този т. нар. методическо-инструментален апарат е предназначен да осигури успеха на изследването под формата на наблюдение и контрол съгласно трактовката на понятието „мониторинг" на всички основни характеристики не само на съставните компоненти/елементи на ЗКТ от различен тип, но и на протичащите процеси на взаимодействие помежду им от различен характер.

Процесът на съставяне на методиката преминава през два основни етапа. **Първият етап**, определян като **емпирично-аналитичен**, цели разкриването на същността на ЗКТ като се обхващат всички структурни елементи и процеси на функциониране на ЗКТ в нейната цялост като управляема природно обособена регионална единица. На първо място в нея като базисна част се имат предвид наличните даденост на територията, в качеството им на условия и ресурси от различен характер - закономерно естествено обусловени и сътворени от човека в резултат от нейното продължително съществуване и развитие, т. е. еднакво важно внимание се отделя както на природните, така и на антропогенните елементи.

Всички елементи на географската система ЗКТ като необходима и неизбежна първична (базисна) даденост, определяща нейната закономерно формирана природно-антропогенна структура, са обект на специализиран анализ от два аспекта: първо, *идентифициране на структурата на ЗКТ* чрез диференцирани същностни характеристики на всички съставни компоненти/елементи с помощта на конкретни количествени и качествени показатели, параметри, индекси и др. и второ, *изясняване на процесите на функциониране* на системата чрез: осъществяваното **въздействие** от страна на активната антропогенна част в системата, синхронно протичащото **взаимодействие** между елементите, предизвикваните **изменения** в тях и настъпващите **последствия** за цялата система, като се предвижда и приблизително (ориентировъчно) очертаване на **ефекта** от функционирането на ЗКТ, и то предимно в екологична насока.

Вторият етап, определян като **оценъчен**, цели разработването на специализирана целево обоснована критериално-индикаторна система за мониторинго-

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ви изследвания, която фокусира върху установяването на степента на атропогенно натоварване и устойчивост на ЗКТ чрез информация за моментното и усредненото състояние на разнородните характеристики на структурните компоненти/елементи и процеси протичащи в ЗКТ. Очевидно е, че КИС за комплексен мониторинг обединява редица частно-компонентни индикаторни системи за мониторинг, съответстващи на структурните компоненти/елементи на ЗКТ.

По-съществената и трудоемката част от процеса на създаване на КИС е формулирането на конкретни индикатори за оценка на всички категории предметно-дейностни критерии, които да залегнат в специализираните частно-компонентни индикаторни системи за мониторинг. Този процес съответно преминава през няколко основни стъпки.

Стъпка 1. Формулиране на целта. Целта на конкретните специализирани системи индикатори е да дефинират количествени и качествени измерители на основните характеристики на предметно-дейностните елементи като: количество, повторяемост, размер на срещане/разпространение на територията, сила/посока/характер на проява, степен на изменение/отражение и т.н.

Стъпка 2. Типология. Тя се създава от подчинеността на частните индикаторни системи към зададените общи критерии на комплексната КИС. Разграничават се съответно следните типизирани групи индикатори:

- *за измерване и оценка на условия и ресурси* като дадености на територията от природно и антропогенно естество с отчитане на закономерно формираните им основни характеристики, които са твърде специфични. Тук индикаторите всъщност имат най-голямо разнообразие предвид различната им природа и закономерности на проява;
- *за измерване и оценка на въздействия.* Имайки предвид, че тези условия и ресурси на територията са всъщност физическата основа за съществуване и практикуване от човека на различни дейности, те са подложени на непрекъснато въздействие в различно направление и с различна сила и степен. Ето защо в частните набори индикатори се предвижда включване на количествени и качествени измерители и на периодичността, формите, начините, силата на въздействие според упражняваните дейности и същността на използваните условия и ресурси;
- *за измерване и оценка на капацитета.* Много важно е на оценка да се подлагат и възможните граници (лимити) на въздействие като се отчита поемният капацитет на отделните природно-антропогенни компоненти/елементи на антропогенен натиск/натоварване, при което се идентифицират специализирани норми например, за застрояване, добив, паша, лов, риболов, масовост на туристическо посещение и т.н.;
- *за измерване и оценка на степента на изменение*. Напълно логично е, че при всякакъв вид въздействие върху условията и ресурсите при реализирането на разнообразни човешки практики в тях настъпват различни по характер и степен изменения – както количествени, така и качествени - и то много често в отрицателна насока, освен ако въздействията не са целенасочени с оглед на постигане на положителен ефект – например, залесяване, благоустрояване, зарибяване, укрепване, рекултивация и т.н.

Стъпка 3. Идентифициране. Идентифицирането на индикаторите се осъществява в рамките на отделните компоненти в съответствие с тяхната специфика. То се явява като съществена стъпка, важна за уточняване на параметрите, в чийто диапазон функционират индикаторите в системата.

Стъпка 4. Разработване, избор и приложение на индикатори. Включва организиране на системата от индикатори, извършване на подбор/селекция на набори от индикатори по компоненти, необходими за комплексния мониторинг на ЗКТ, провеждане на експериментална теренна, лабораторна, аналитична статистическо - информационна работа по приложение на оценъчните количествени и качествени измерители на компонентните системи индикатори.

Всичко това може да послужи за обосновка и на адекватна управленска политика в аспекта на идеята за устойчиво развитие с подчертан акцент върху т.нар. екологично образование и възпитание (в случая в контекста за карстовите геосистеми) на всички ангажирани в различна степен общностни групи: административно-управленски, стопански, посетителски и др. с оглед на съобразяване на антропогенното натоварване на карстовия тип геосистеми с тяхната природногеографска специфика.

THE UNIFIED DATABASE OF SPELEOLOGICAL OBJECTS OF THE CZECH REPUBLIC AS PART OF NATURE CONSERVANCY INFORMATION SYSTEM

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Protection of caves is provided by law on the Conservation of Nature and Landscape of the Czech republic. The protection is possible only with quality and permanent documentation.

The Unified Database of Speleological Objects (called JESO) represents the integral information system of karst and pseudokarst phenomenos (such as natural underground cavities - caves, swallow holes and their relative forms of relief and hydrological objects - resurgences and sinks) in the territory of the Czech republic.

The database is administrated as a public register and is used by the public administration authorities, specialized organisations and public (landscape planning, research, monitoring etc.).

Data collection, visualization and administration of JESO system is provided by the web application on the URL address http://jeso.nature.cz.

JESO is administrated by Nature Conservation Agency of the Czech republic (NCA CR), which cooperates with Cave Administration of the Czech republic and Czech Speleological Society on the filling the data to database and data evaluation. Nature Conservation Agency of the Czech republic is a governmental body established by the Ministry of the Environment as a successor of the former Czech Institute for Nature Conservation. The main aim of NCA CR is to protect and conserve nature and landscape on the whole territory of the Czech republic.

JESO is produced by NCA CR as part of Nature Conservancy Information System (ISOP). This system manage and make special data of nature conservation open to public. It is one of information systems of the public administration of the Czech republic. It consists of central database and web applications with tools for editing, browsing and searching data. ISOP is provided by the web application on the URL address http://isop.nature.cz. JESO is used on platform SQL – ORACLE in architecture SERVER – CLIENT. The geographic part of application uses GIS technology.

JESO use components of ISOP:

- ArcSDE Geodatabase (called Datový sklad AOPK ČR)
- Nature Conservancy Central Register (called DR USOP)
- Database of Bibliography Register (called BIBLIOGRAFIE)
- Database of Photos (called FOTOARCHIV)

Parts of JESO system are electronic map documentations, map service and map applications.

JESO Electronic documentation consists of plan views and cross-sectional views of caves, 3D models of cave systems and other special maps (e.g. hydrological, geological, archeological). Plan views of significant caves are converted and transformed to GIS layers and displayed as a part of JESO Map Service.

JESO Map Service is presented by technology ArcGIS Server. It is public accessible, therefore there are only caves open for public and other commonly known objects. The password-protected service for professional users will be added to the public one.

JESO map service contains polygonal and point layers of entrance and converted plan views of caves, hydrological objects, karst relief and other special and base maps.

Map Services is showed in web map applications. Links of those applications are situated at the web page http://jeso.nature.cz.

Web map aplication **MapoMat JESO** is made in Nature Conservation Agency of the Czech republic. Link is http://webgis.nature.cz. This viewer of geographical data does not enable connection to external database yet. Basic browser called **JESOVIEW** uses technology ArcGIS Online. This application is integrate into JESO system. This technology enables making direct links to other database applications (e. g. DR USOP). Link is http://webgis.nature.cz/jesoview.

Project of JESO application and its development are common work of authors of this contribution. This work include filling with data, train users, improve of map application and other matters.

THE DEVELOPMENT OF KARSTIC LANDFORMS BASED ON GEOLOGICAL-GEOMORPHOLOGICAL PARAMETERS. A STATISTICAL APPROACH USING GIS

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Intoduction

Karstic landforms developed on the surface and underground, frequency are used for human activities (Papadopoulou-Vrynioti , 1999). In many cases is a geological hazard and can cause serious engineering problems such as subsidence (Farrant and Cooper, 2008). Several factors such as physical process parameters and human activities influence the karstic formations (Gutiérrez et al., 2008). The scope of the study is to identify the importance of geological and geomorphological parameters in karstic landforms development using GIS.

Study area

The study area extends along the southern part of Marathon Lake in north-eastern part of Attica prefecture and is located in northern place of Agios Stefanos that is a suburb of Athens Area (Fig. 1B). The extent of the area is 6,1Km2 and characterized by a low hilly relief with altitudes varying from 100 to 380 m a. s. l. The drainage network is poor development (Fig. 1B). The geological formations that can be identified in the study area are marbles and schists of Almyropotamos-Attiki autochthonous unit and Neogene deposits.

Data and Methodology

The data used in this study consist of: the topographic maps (maps scale 1:25,000 and 50,000), the geological map (map scale 1:50,000 respectively), air photos (scales 1:30,000 and 1:15,000) and extended field investigation. A spatial database was created, and ArcGIS 9.3 software was used to process the collected data. The karst occurrences in the study area and the seven involved factors have been recorded and saved as separate layers in the database.

The karstic landforms, recorded during the fieldwork of this study, but also those recorded from previous works, were used for the creation of the karst manifestation map (Fig. 1). A total of 39 sites of karst manifestation were examined throughout the study area, having affected an area up to 39,684m2. The recorded karst features were separated as 36 small caves, 2 dolines and 1 polje.

The selection of the appropriate factors and the determination of the classes' number as well as their boundary values have been based on literature (i.e Yilmaz, 2007) personal knowledge and experiences as well as extended field observations. The selected factors are: the lithology, the distance from faults, the distance from hydrographic network, the distance from springs, the slope angle, the slope aspect, and the altitude. Each parameter was then separated into various classes. Lithology was classified into four categories, namely: marbles, schists, coarse-grained and fine-grained sediments. Buffer zones were formulated around the faults, streams and springs at distances of 50, 100, 150 and 200m. Thus, the classes of the buffer zones for each factor are five: the nearest (0-50), the very near (51-100), the near (101-150), the moderate distant (151-200) and the distant (>200m). The slope angle was classified in five classes as follows: (i) <5°, (ii)

5°-10°, (iii) 11°-15°, (iv) 16°-20°, and (v) > 20°. The slope aspect map was classified into four categories, that is N 315° - 45°, E 45° - 135°, S 135° - 225°, W 225° - 315°. Finally the elevation map was classified into five categories: (i) <150m a.s.l., (ii) 150-200m a.s.l., (iii) 201-250 m a.s.l., (iv) 251-300 m a.s.l., (v) 301-350 m a.s.l. and (vi) >351 m a.s.l.

The area of karst formations involved in each class of the factors was calculated in order to establish the density of karst incidences. Thus the density distribution of karst events in each class of each factor was computed. This statistical analysis was used in various studies (Bathrellos et al, 2009; Rozos et al, 2011) for the landslide hazard evaluation using GIS.

Results

In the study area lithology greatly influences the occurrences of karstic formations. The class representing “marbles” has the highest karst density (74.5%). In the carbonate rocks such as marbles, karstification is relatively great, resulted the development of many karstic landforms. Regarding faults the highest karst density (27.7%) refers to “the near” class. The percentage of karst density accretes as the distance from the hydrographic axes and springs increases. Flat areas with a slope angle less than 3° favor the karstic formations development, so the karst density is high (62,3%) class for the smooth slopes (<5°). As it was revealed from the fieldwork, most of the karstic formations are manifested in the slopes with orientation from northwest to northeast so this class has a karst density of 73.3%. The increasing of the altitude is not in a direct relation to the karst density, with the higher density percentage to attributing to third class (251m-300m a.s.l.).

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TERRESTRIAL LASER SCANNING: A DATAFRAME FOR MULTIPLY RESEARCH IN A PSEUDOKARST AREA, CASE STUDY OF THE LOCALITY LEDOVE SLUJE (ICE CAVES) IN THE PODYJI NATIONAL PARK, CZECH REPUBLIC

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The locality Ledove sluje (Ice Caves) in Podyji National Park (Czech Republic), with an extensive system of pseudokarst caves, has been known for first researchers since the mid of 19th century. The numerous of various kinds of scientific activities (speleological, microclimatological, geophysical, structural engineering, forest ecology etc.) has increased in this area after the National Park establishing in 1991.But the possibility to draw any detailed map of locality is limited because of extremely complicated terrain conditions (rock debris, block fields, steep slopes). For this reason, a Terrestrial Laser Scanning (TLS) combined with Total Station (TS) and Global Navigation Satellite System (GNSS) was used to prepare a high quality digital elevation model (DEM) as a spatial dataframe for other researches as well for terrain-caves metric analysis. Topographic and speleological plans with 3D laser scanner model are compared in this paper.
Field work included next processes:

- Establishment of local geodetic point network.
- GPS measurement of selected points with network Real-Time Kinematic (RTK) service provided by CZEPOS, Czech national network of permanent reference stations for GNSS via Leica Viva NetRover GS08.
- Land measurement from GNSS points to points with obstructed sky view via TS Topcon GTS.
- Terrestrial laser scanning from established geodetic points and from intermediate points determined during scanning via Leica ScanStation C10.

Geodetic point network consisted of 14 positions (4 pts on crest around the highest peak with the memorial – obelisk; 7 pts through Fault Ravine, i.e. a depression whose wall to the obelisk reaches a height of 20–25 m; 3 pts below the ravine on the slope with the highest concentration of pseudokarst caves). The length of geodetic polygon is ca. 300 m and the size of covered area is 130 m x 85 m with elevation of 55 m. Next 42 position points were fixed in the process of laser scanning inside and near of polygon.

First phase of terrestrial laser scanning was focused on surface terrain and on entrance into 3 biggest caves (Grotte I, Grotte II, Brnenska). It took 6.5 minutes for the scan resolution 10 cm of both horizontal and vertical in the range of 100 m. This means resolution 1 cm @ 10 m, 2,5 cm @ 25 m, 5 cm @ 50 m etc. Although measurement settings included all reflections in the range of 300 m, available data are from one third of the maximum range, the rest was obscured with terrain barriers or with vegetation.

This raw scan data file has size 32 GB. Terrain conditions made average 6 scan position per day possible, completing field works in 9 days.

Leica ScanStation C10 proved suitable properties for mapping in rocky terrain conditions and in caves. Minimum scanner range 0.1 m allows measurement near wall in small space like inside a cave. Scanner's field of view 360° horizontal and 270° vertical made possible to screen vertical walls or roofs. Scan rate up to 50 000 points/sec gives more time for changing scan position in complicated area. The experiences with pick up

targets for registration are discussed in the paper.

On the basis of our measurements, we will create a detail 3D terrain model suitable for advanced geomorphological analyses with relation to pseudocarst caves.

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THE SYSTEM OF SPECIALIZED DOCUMENTATION (THE DOCUMENT CODE) OF THE CAVE ADMINISTRATION OF THE CZECH REPUBLIC

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Cave Administration of the Czech Republic

It is established under the provision of section 4, subsection 2, letter c) of Organization code of the Cave Administration of the Czech Republic reference number 1/2006 (Director´s instruction Nr. 1/2006).

To the professional leading the documentation belong the responsible manipulation, transparent register, system of sorting and storage of the documented materials.

The cave aministrations and their collected materials differ from each other, not only in capacity, but also in kind. Also the existing way of materials sorting is different. But the basic principles of materials sorting are the same for all of the workplaces.

The sorting system of documented materials is indispensable helping mean for getting the overview about the composition and importance of documented materials and helps by orientation and searching of documented materials and their using. It means also the widening of knowlege of the own collection and also offers the base for the improving of the arrangement of the documentation.

The balanced, well presented sorting system of materials signify for the surrounding good reputation of the organization. Authorities of state administration and providers of grants put big emphasis on the fact, that they can find for them important informations, for example when they decide about giving the grant.

The basis of the present collection of the documented materials are these, which are collected by each workplaces of the Cave Administration of the Czech Republic.

The documentation of the Cave Administration of the Czech Republic

It is the collection of all paper-, map-, picture-, audio-, tangible- and digital specialized materials of documenting character, which are in the property of the Cave Administration of the Czech Republic.

The operating documentation

It is the documentation in the meaning of point 5 of Director´s instruction Nr. 4/2006. It is the instruction for ensurance of works and operating in show caves. The operating documentation older than 10 years goes to be stored in the specialized documentation.

There are following database systems for documenting purposes in the Cave Administration of the Czech Republic:

SPELEODATA – the central registration database of documented materials and things of the Cave Administration of the Czech Republic , located on the intranet of Cave Administration of the Czech Republic, which contains the register and description of documented items (paper-, library-, map-, photographic-, audiovisual and tangible documentation).

Partial SPELEODATA – the partial part of the database SPELEODATA for the concrete workplace, which is made and put together at this workplace in the same segmentation as the database SPELEODATA.

JESO – the united register of speleological objects, administrated by the Nature Conservation Agency of the Czech Republic as a part of Information system of nature protection.

Bibliography – the separate database for leading the bibliography.

Library database – the separate database of books and periodic publications of the Cave Administration of the Czech Republic, which is made in librarian program KpWin SQL at the workplace in Průhonice.

The register of documented materials

All accessible informations about documented materials (things) are collected and put into database systems (widened catalogue). The worker responsible for the documentation takes care of materials at the workplace. He records everything into the partial registration database of the concrete cave administration incl. recording of prescribed items and mark the document visible with the registration number (e.g. sign, or some sticker).

The physical and digital documented material of the Cave Administration of the Czech Republic are according to theres character devided in:

- paper documentation;
- map documentation;
- library fund;
- audiovisual documentation;
- photo documentation;
- bibliography;
- JESO – the united register of speleological objects;
- tangible documentation;
- the rest.

The sorting system of specialized documentation…

- it allows due storage and searching of the documentation;
- it gives the overview of the collected materia;l
- it gives the foundations for other presentation activities;
- it makes the loans more easy;
- it gives the overwiev of documented materials at each workplaces;
- it allows to determine the next way of filling in the documentation;
- it says, in which parts of the collection the next documentation or research can be requested; it can serve as the base for putting together of individual plans, e.g. the plan of research and documentation.

THE CAVES ON THE POSTCARDS FROM THE ARCHIVE OF THE CAVE ADMINISTRATION OF THE CZECH REPUBLIC

Jan Flek
Cave Administration of the Czech Republic

In the archive of the Cave Administration of the Czech Republic can be found more than 3000 postcards from the karst regions, karst surface and also underground.

By the most of the postcards it´s not a problem with the location, that means to determine the place or the object – they are mostly described well. Problem is with dating, that means saying the date, when they have been issued. Unfortunately on the most postcards there isn´t written any date in the most cases. If there is no stamp, or the date is not written in the text, it is very difficult to say, from which year they are. But also these data are very misleading – the postcard could be sent much later, than when it has been issued.

The history of illustrations of caves on the postcards is directly related to expansion of karst – cave touristic. The most of the postcards from the turn of 18th and 19th century show the caves only very little. Predominant are the pictures of attractive places, which are free accessible for the visitors. In the karst regions there are from this point of view especially the surface karst formations. These localities are attractive for the merchants and hoteliers, which use the postcards for attracting of the potencial clients. In Sloup that were two localities – the entrance into the Sloup caves with the self standing rock „Hřebenáč" and the tunnel shaped cave Kůlna. But the center of the attention was especially the Macocha abyss. Just like the pilgrim places Sloup and Křtiny also the Macocha was attracting many tourists into this region and that´s why we can find it on the most postcards from that time.

We can say, that the building of the Upper bridge by the Macocha abyss (1887) and especially the restaurant „Útulna u Macochy" (1896) have started the tourism in the Moravian Karst. Some of the postcards propagated „Beauties of Moravia" also with the word description: „The spectacular view of steep proud rocks of the world-wide known Macocha abyss. Its hugeness and beauty evoke the feeling of amazement and admiration. The Macocha abyss has really colossal dimensions – length 280m, width 126m, height 138m in some places almost 152m and it´s the biggest abyss in the whole Europe."

They were also used for the propagation of the touristic business in the karst regions.

When the keen speleologist and propagator of caves K. Absolon started to work in the karst and especially when he has discovered the Punkevní and Kateřinská caves, the rapid increase of exploration works and opening to the public have started. Also the propagation of caves was connected with that.

In that time the „golden age" of the postcards started. The postcards were beautifully colorized and they looked like a small works of art.

When the photographic technology of making the postcards has started in the twenties, the postcards were the carriers of the real look at the karst and caves.

In the thirties the karst postcards were used also as the propagation by companies, which had nothing to do with the karst.

The distribution of „first republic" postcards continued also in the time of the World war II., but the word Czechoslovakia was blacken out.

In the time of the building of socialism the quality of used materials was varying and also the quality of technology and authors.

In the present time of digital cameras and mobil phones it is not easy for the postcards. They are not sent so much, but for sure they are very worthfull as a remembrance of some visited places or they are also very worthfull for the postcard collectors.

The postcards from the archiv CA CR:

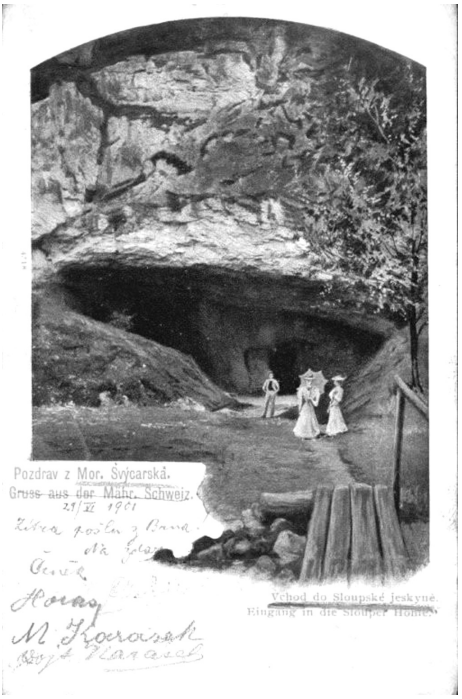

Fig.1. The Sloup Caves, 1901.

Fig. 2. The Abyss Macocha, 1897

Fig. 3. The Cave Kulna (The Shed), 1908. On this postcars is the longhand text and personal signature of Karel Absolon.

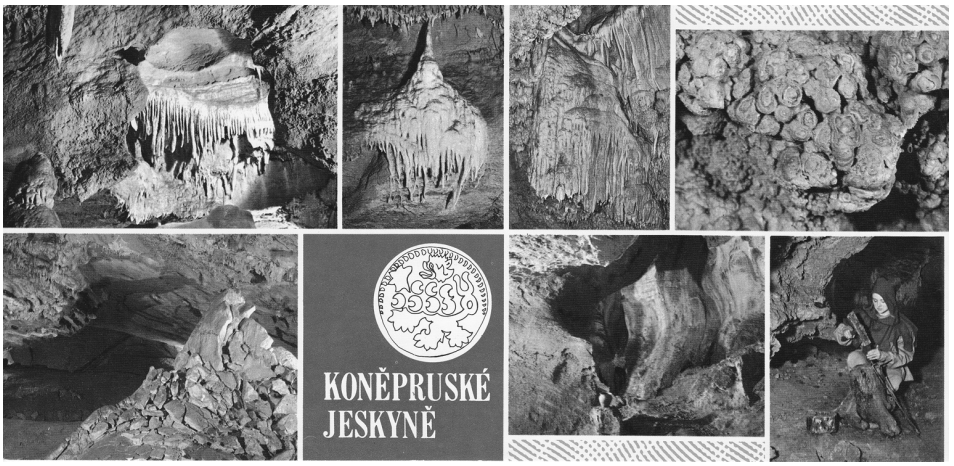

Fig. 4. The Koneprusy Caves, 1980.

FORMATION OF THE MAP DOCUMENTATION IN CAVE ADMINISTRATION OF THE CZECH REPUBLIC

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One of the main parts of cave documentation is their graphic representation in the form of a plan or a map. Mapping and documentation of caves is historically associated with the development of surveying and imaging methods used in mining. First maps of caves in the Czech Republic are known from the early 19th century (V. Süsz 1800 – Sloup caves map, A. Lola 1807 – Výpustek, ...).

As well as this historical documentation, the current methods of cave mapping are based on the methods often used in mine surveying. For the caves available for access in the Czech Republic, these mining methods, techniques and related accuracy characteristics are even legally binding. Basic requirements for the map series are issued by the Czech Mining Office (regulation no. 435/92. Mine surveying documentation for mining activities and some other activities carried out using mining methods).

In 1995, after a unified organization managing the caves available for access in the Czech Republic was established, a mapping documentation of the caves was obtained from the original keepers. It was inconsistent and of varying quality. At that time, each accessible cave was, of course, surveyed and documented, but the quality, completeness and graphical outputs were very diverse. The maps were drawn mostly in the local coordinate systems at scales from 1:50 to 1:500. Some of them, especially those that have been processed by amateur speleologists, had a high quality as for morphology records, character of the cave filling, decoration and technical equipment, but on the other hand, often they lacked data on geospatial bases, coordinate lists were incomplete, surveying network points could not be identified. In order for the documentation to meet the regulation requirements, it was necessary to revise the documentation completely, provide access to the official coordinate systems (JTSK and BPV), check or re-create the dot array of caves and plot new maps on the specified map sheets.

Nowadays, the surveying documentation of the caves available for access is maintained as a digital data model, which includes all the necessary information. Its basis is a vector digital map of the cave, and lists of coordinates of the location points. Another essential part of this system are archival maps (in raster format) and the information about technical and safety devices of the cave (such as electrical and communication wiring, microclimate monitoring system, drainage, etc.). Data on the surface above the cave, processed on the basis of a digital cadastral map, include information on property boundaries, elevation, reserved areas, rivers, buildings, etc. Most of the data for the digital model were obtained from state information systems by means of remote access using the WMS services. Digital model serves as the original of the basic map of the cave, and at the same time is a basis for the internal graphic information system of the accessible caves. Prescribed printouts (so called basic map images), surface maps and other thematic maps (map of accident control, operational map, maps of conservation management activities, etc.) use these materials and are issued as a summary of relevant information layers. Such documents act as legally binding documents of the mine surveying documentation, but can be also used as a basis for design work (reconstruction of tourist routes), for planning of conservation measures and also for creation of caves administration's promo materials.

Management and processing of the documentation in digital format is performed using ©KOKEŠ – the graphic and geodetic software developed and supplied by the Czech company GEPRO Ltd.

Besides the digital part, it contains a set of mine-surveying documentation of the accessible caves and other documents. In particular, basic information about the cave and its operator (e. g. cave characteristics, nature conservation, mining activities data, construction work, etc.), other graphical data (printed map sheets, profiles and sectional views, special maps, etc.) and figures (lists of coordinates, calculation records and surveying notebooks).

Management, maintenance, complementing and surveying fieldworks are provided by Cave Administration of the Czech Republic through its personnel of the Department of Cave Management care.

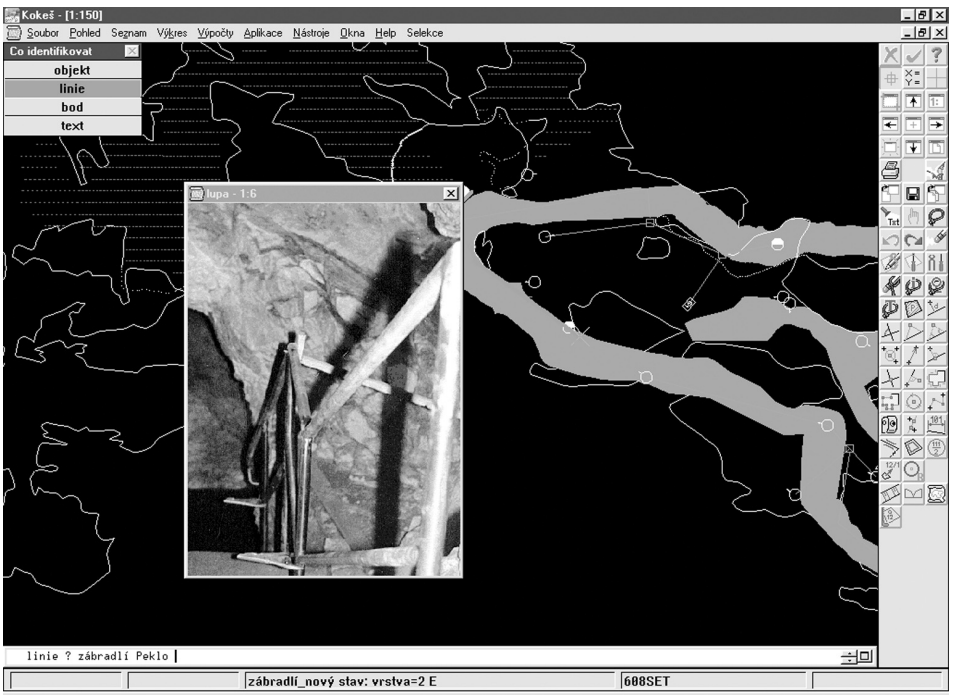

Fig.1 The user-friendly environment of the system "Kokes" for the treatment of geodetic measurements, digital model and GIS.

THE DOCUMENTATION OF SCREE CAVES IN TEPLICE ROCKS (CR)

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In 2006-2008, Cave Administration of the Czech Republic in cooperation with the management of PLA Broumovsko provided documentation of some important pseudokarst forms in the attractive sandstone area of the Teplice Rocks in the north of Bohemia.

Teplice Rocks proved to be an important speleological area long time ago. A famous examples are the Teplická cave (1065 m length), the longest scree cave in Czech Republic or the Poseidon underground system, which is remarkable for its vertical denivelations of the individual abysses up to 71 m (Hromas et al., 2009). In caves of the Teplice rocks there is also located a large amount of root stalagmites, which have been registered here since the 1980's (Kopecký & Jeník 2001). There are hundreds of still unmapped caves hiding in the sandstone rock city area. For example, in the maze of Poseidon, a number of caves was recently newly mapped in the detritus clusters on the edges of the system (Mlejnek, Ouhrabka & Růžička 2008, 2009).

Comprehensive documentation processing required the use of a combination of precise geodetic methods, a surveying by means of GPS devices, detailed aerial photography of the surface and speleological mapping of the inaccessible underground space. Office processing of the obtained data was carried out using the ©KOKEŠ geodetic software from GEPRO Ltd., which allows semi-automatic editing of field sketches, land-surveying calculations and transformations along with subsequent rendering of digital maps, section views and models.

Fig. 1. Aerial view of the central part of Teplice rocks (photo: Libor Jenka)

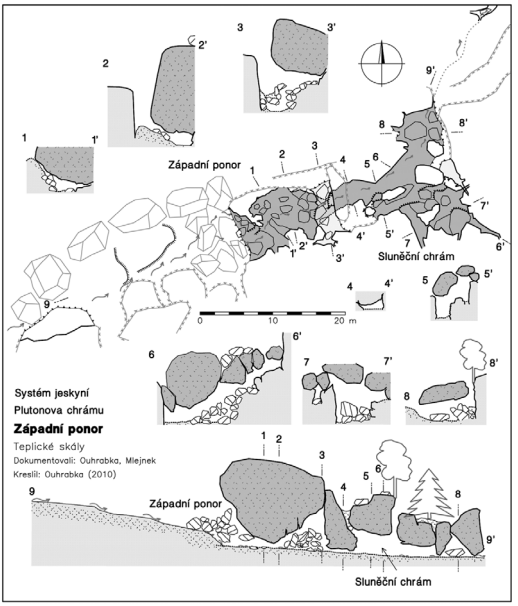

Fig. 2. Example of graphical output digital cave maps

EXPERIMENTAL MODELS FOR COLLECTION AND SYSTEMATIC ARRANGEMENT OF INFORMATION FOR SOCIO-ECONOMIC MONITORING AS PART OF THE IT INFRASTRUCTURE OF A PROTECTED KARST TERRITORY *

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Key words: models of information gathering, PKT visitor card, inventory form, monitoring form, questionnaire, socio-economic monitoring, protected karst areas.

In terms of socio-economic aspects of sustainable development of protected karst areas (PKT) it is particularly important to have reliable and complete information about knowledge, attitudes, practices of both visitors and local communities, associated with these areas. Collecting, organizing and analyzing data and information for various activities that take place in PKT should be an ongoing process, so as to create a reliable and updated database of ongoing changes in these areas. This is the only way to ensure real basis for prediction and prevention of upcoming social, economic and environmental impacts on PKT. From this perspective, the development of models for collection and organization of information is a major milestone in the overall methodology for socio-economic monitoring (SEM). Models for information collection are the backbone of the whole monitoring system, because they ensure achievement of the SEM objectives. They are a part of the overall information infrastructure of a karst territory, which requires their development to obey a common unifying framework. However, each step in SEM has specific functions in the process of observation and analysis, and this requires a differentiated approach to the development of forms and questionnaires. This makes it extremely difficult to devise practical models and requires the use of connecting elements between forms and questionnaires from the SEM steps.

Because the sites and facilities of social infrastructure are extremely diverse, they should be allocated to groups with identical or similar activities and purposes. Based on them types of inventory have been set up and types of monitoring of objects and equipment from the socio-economic infrastructure (SII) have been determined. In order to standardize information among inventory forms and visitor cards, full match of spelling of target groups by type of inventory and group types has been introduced.Thus infrastructure typology achieves the relationship among different types of monitoring, inventory and visitors' monitoring.

Another unifying element in organizing information is the selection of key indicators that are the same for different types of inventory and monitoring of facilities and equipment by EIA and related activities.

For the purposes of SEM in selected representative PKT in Bulgaria and the Czech republic models of information collection have been developed: for inventory, - *standardized form of inventory*; for visitors monitoring – *visitor card*; for monitoring of sites and facilities from the socio-economic infrastructure and related activities – *a standardized form of monitoring*; for monitoring and activities, carried out directly in the protected area with direct utilization of natural resources – *a standardized form of monitoring*; for survey (research) aimed at all those interested in the development of PKT – *questionnaire re*

*The report is in the frame of the project DO 02.260/18.12.2008 "Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development of NSF – Bulgaria.

I. Inventory of: 1. *Shelter and accommodation; 2. Places of eating, entertainment and drinking places; 3. Sites of information service; 4. Sites and facilities for entertainment, leisure and recreation; 5. Sports sites and facilities and places of sports events; 6. Traffic routes; 7. Natural resources (caves); 8. Places of cultural heritage (objects of real cultural values); 9. Objects of educational infrastructure; 10. Objects of social infrastructure; 11. Sites and facilities of business and infrastructure services; 12.1. Objects of transport – private parking lots; 12.2. Objects of transport: lift stations*. The Inventory forms are identical for all model regions

II. Visitor Monitoring – Visitor cards for: *1. Nature Park "Shumen Plateau", 2. Landmark "Maarata", 3. Landmark "Saeva dupka", 4. Protected area "Trigrad Gorge" and 5. Protected landscape area "Moravian Kras".*

III. Experimental monitoring of: 1. *Shelter and accommodation places and related activities; 2. Catering places, drinking places and entertainment places, as well as related activities; 3. Sites for information services and relative activities; 4. Sites and facilities for leisure and recreation and related practices; 5. Sports facilities and venues for sports events and related activities; 6. Different types of maintained trails within/or through the protected area; 7. Caves and related activities.* Monitoring forms are identical for all model regions.

IV. Experimental monitoring of activities carried out directly within the protected area for direct use of its natural resources: *1. Mowing lawns (meadows); 2. Picking herbs and medical plants, collection of wild-wood products; 3. Grazing; 4. Logging.* Monitoring forms are identical for all model regions.

V. For the survey aiming at finding about knowledge, practices, attitudes and perceptions of people interested in PKT development (such as local community, including students, business managers and tourists, including pupils and students) special models have been developed to collect information from group entities for all model regions.

Through these models for organized collection of information from inventory, monitoring and surveying, information necessary to measure changes and transformations in the socio-economic environment of PKT is provided. It can be directed to those interested in the particular territory, namely local communities, businesses, managers, tourists, etc. The foundations of a *"Specialized register of sites and facilities of the soico-economic infrastructure"* for each model PKT have been set.

A FRAMEWORK OF DATA MANAGEMENT IN E-NETWORK „proKARSTerra *

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Key words: *Web based systems, dedicated server, protected karst territories, complex monitoring, data management system, specialized virtual networks*

Karst processes have strong influence upon all landscape elements: they transfer landscapes, forming specific living environment for plants and animals. Since these processes often appear as immediate environments of human habitation, detailed studies of their nature and character have no alternative. Only through analyzing real monitoring data, literate and effective land use practices can be defined, accomplishing two often conflicting targets: namely, meeting the rising human needs and preservation of biosphere, aesthetical and other important environmental features. Protected karst areas should be integrated into regional management of land use, but the status of many protected karst areas is erratic. All of this requires complex monitoring to define the most appropriate regional management. One indisputable tool for knowledge dissemination as well as providing information and business projects implementation is the Internet network (World Wide Web). It is suitable for the realization of the ideas and expected results from the project proKARSTerra. In order to use the World Wide Web as a global store of information about karst and protected karst areas, it is necessary to take into account the dynamics and features, concerning the design and evaluation aspects as: content, organization and technology (Ambra & Rice, 2001; De Wulf, 2006). On other hand, the design activities are realized using various tools and design environments (Bonnardel & Piolat, 2003; Calzarossa & Tessera, 2008, Chevalier & Bonnardel, 2007).

The dedicated server "proKARSTerra" is part of the strategic objectives of the project to ensure its sustainability. It will provide the opportunity for promotion, discussion and practical realization of the experimental results of the model for complex monitoring, as well as various scientific and practical issues for protected karst areas. In this aspect, it is planned the construction and maintenance of specialized open network in the Internet called "proKARSTerra". It aims to outline the guidelines for development in protected karst areas, namely building the relations "science - management - education". The proposed network is expected to become scientific and advisory center for the administration of protected karst areas, which will liaise with the appropriate professionals' karst. On the other hand, the karst experts will have the opportunity to receive feedback for the environment state in protected areas and possible ways for solving specific problems. Thereby, an open virtual scientific council for interested in protected karst areas will be developed. Moreover, the network will contribute benefit to many organizations and will enable international experience exchange to coordination of such type of activities.

The information network "proKARSTerra" could be defined as a scientific and applied information network as shown on Fig. 1.

Database management system (DBMS) is the most important component of the information system. The methodology for selecting a DBMS includes: clarifying the external constraints, selection of DBMS – modeling the information for database for each DBMS, comparative analysis of the models and choice of the most appropriate DBMS.

* The investigations within this work have been supported by Nation Scientific Fund by Contract # DO 02.260/18.12.2008: "Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development" .

On Fig. 2 a model of information providing and management within dedicated “proKARS-Terra” server is shown.

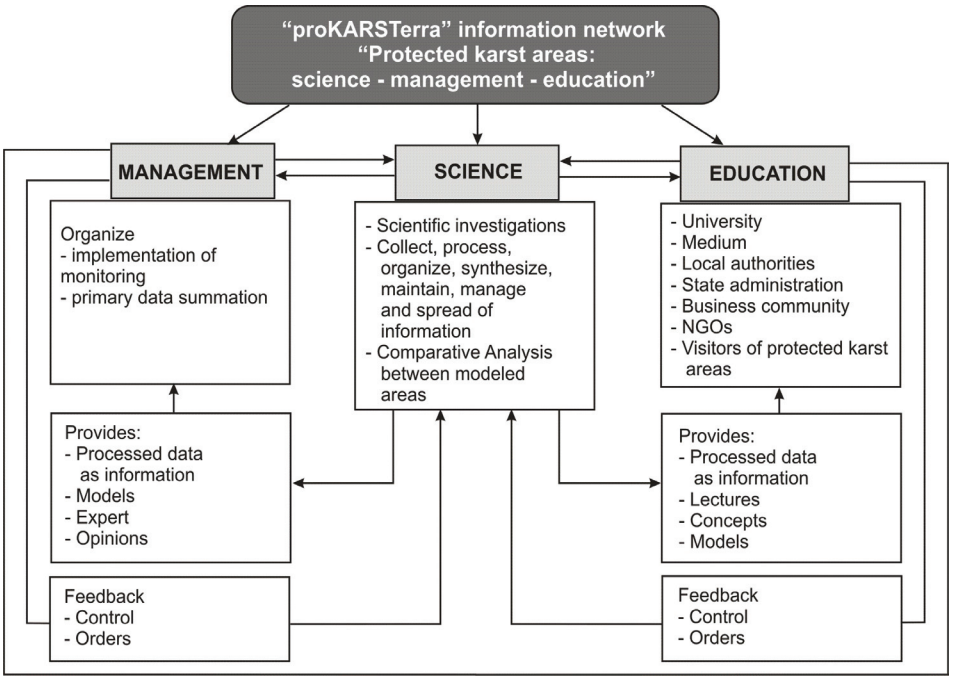

Fig. 1. Model of information network "proKARSTerra" for protected karst areas

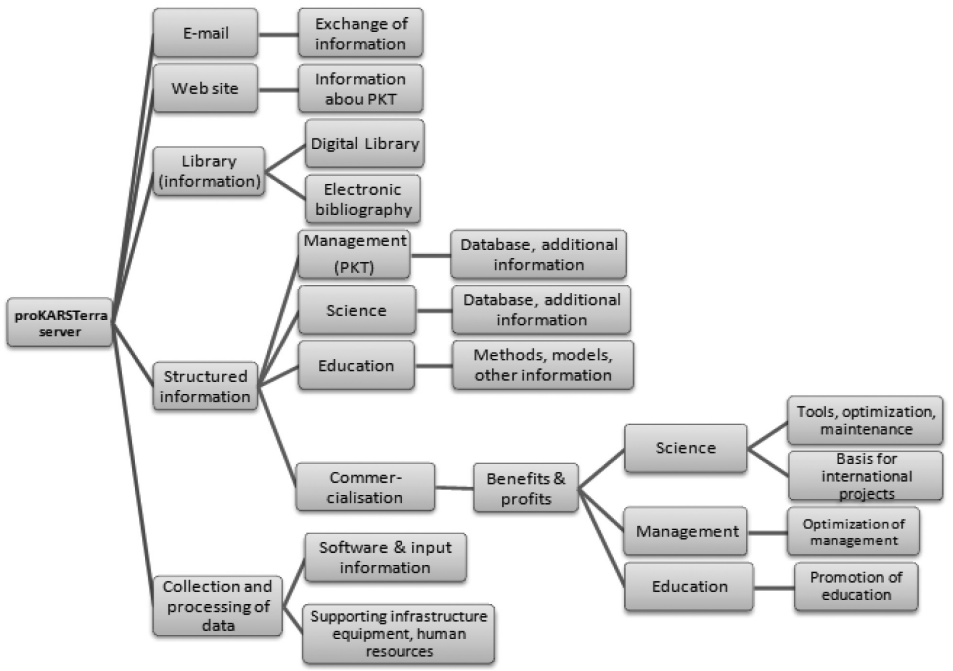

Fig. 2. Model of information providing and management within dedicated server "proKARS-Terra"

Conclusion

In order to utilize the enormous potential of the World Wide Web as a global information repository, it is necessary to comply with its dynamics. This is particularly relevant for information sites, as they are expected to provide relevant information. The largest scope and significance of the project *"Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development"* , its complex implementation program and wider executive staff, as well as a number of interested professionals, managers, local communities, businesses and non-governmental organizations require organization of specialized virtual network to provide, maintain and exchange of information. To ensure accessibility and promote the results of developing an experimental model of integrated monitoring in protected karst areas a dedicated server "proKARSTerra" is established. The virtual network "proKARSTerra" is expected to support different scientific and administrative activities in the area of protected karst territories. The karst experts will receive feedback about the environment state in the protected karst areas and about the status of specific problems. Temporary teams will be formed to solve specific problems.

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KARST PHENOMENA IN THE HISTORICAL DEVELOPMENT OF HUMAN CIVILIZATION

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Beginning of the human history is one of the most exciting stages in human development and provokes an enormous interest of the modern man. Dawn of our civilization, the earliest traces of human existence on Earth, first human steps at the beginning of their long way to dwelling the planet excite our imagination. This human evolution is always connected with caves and Karst areas. Ancient man finds there not only dwelling, food and water but places for cult rituals and festivals. Caves were chosen mainly for the complex of natural processes and phenomena acting there, which strongly influence human perception. Darkness and twilight were one of the most important factors.

Archaeological findings show that at the beginning rituals were conducted in cave halls and galleries, which are difficult to reach (Magura cave), and in later epochs - in cave entrances (Topchica cave and caves near the village of Bailovo). There are a number of criteria for cave sanctuaries and temporary dwellings separation – difficult to reach cave morphological structure, dropping, streaming or flowing water, pottery, pottery fragments or votives, speleothems reminding altars, saints, animals, genitals, votive and idol figurines, etc. Here, we can also add caves with cult paintings and engravings, and these with findings of deliberately well-arranged bones of sacrificial animals. Caves used for inhumation (cave funeral), ritual stay (incubation), and precipices – ritual sacrificials should be also added to cave sanctuaries.

There are a lot of examples for caves, which are not independent cult objects but centre or part of larger sanctuary complexes. At a later stage of religion development in general, and on Bulgarian lands, began building of underground cult buildings – chapels artificially cut in the rocks, churches and monasteries, part of which exist together with natural cave sanctuaries. At every building of such type cult equipment, at every chance builders used natural caves, which were cut, divided or enlarged. They are more than thousand situated mainly in North-East Bulgaria.

The most ancient caves – sanctuaries on our lands are localized in North-West and South-East Bulgaria with the biggest concentration in East Rhodopes. The rock cut cave sanctuaries near the villages of Bailovo and Lipnitsa are the earliest one – from the Neolithic Age. They are sanctuaries connected with the cult towards the Moon. Later, these objects become observatories for observation of the movement and shape of the Moon. Practical necessity to use this information for different purposes was the reason to keep it as calendar or time records. That is why, priests depicted different changes on the cave walls and around their entrances by a variety of techniques. A lot of carved, contour and bar-relief images of lunar phases are discovered in the area.

Sanctuary in the Topchika cave, near the village of Dobrostan, Plovdiv district is dated back in the Neolithic Age on the basis of excavations and semantic analysis of the discovered there engravings presenting the cosmogony notion of the ancient people.

Other sites in the Sredniya Kamik and Govedarnika country, near the village of Tsarevets, Vratsa district are famous with the hundred graffiti carved in the cave complexes. Part of the graffiti are astral images dated back in the Neolithic Age. A lot of them present calendars and time records of Lunar phases and Solar cycles. Numerous astral signs and symbols dated back to the Medieval period (Suns, Moons, stars, dears, swastika) show that cult and practical significance of the heavenly bodies was repeatedly used.

The Tangarduk kaya cave sanctuary near the village of Ilinitsa, Kurdjali district, which can be connected with cult devoted to the Great Goddess-mother is of special inter-

est. Once a year, in the artificial cave, solar beam penetrates in the altar and represents Her sacred marriage with the God-Sun.

The large number of cave sanctuaries dated back to the Eneolithic Age is also of great interest. The most impressive one is the cave in the Koshcha country, near the town of Momchilgrad. Silhouettes of four lying figures are engraved on the left side of the cave entrance. From bottom to top, drawings reminding two marble Eneolithic idols are clearly differentiated. On the wall of another cave, situated in the same municipality, a low-rise altar is cut, and "mature Sun" is painted above it - one frequently met person in theocratic cosmology.

The Magura cave, near the village of Rabisha, with its unique monochrome paintings is another cave sanctuary from the Prehistoric period. Archaeological investigations dated this object back to the Late Eneolith. Modern detailed investigations approved their cult significance – ithyphallic scenes depicted there give a piece of information about the religion, mythology, cults, god's reincarnation and rituals, mysteries of the indigenous tribes for a long period of time. Paintings depict rituals connected with fertility, obtained by prayer from supernatural forces, in specific time of the year using well developed solar calendar.

One of the two small natural caves near the Dolna Chobanka village in the Harman kaya country is the joining centre of the Harman kaya sanctuary complex. Archaeological and archaeoastronomical investigations of the complex improve its cult purpose. Observations of the Sun included in the ritual practices of that time were conducted here. Cult towards the God-Sun was widespread and all sacred practices on the high rock maybe perceived as cosmostructuring activities bridging over chaos and securing fruitfulness.

Investigations also show the existence of a large number of sanctuaries from the Antiquity, which are uniformly spread on the Bulgarian area. Best improvements that caves are sacred territories are the excavated there cult artefacts – votive plates of the Greek-Roman Gods – Heros, Asclepius, Artemis, Sabazius, Hekata, Bendida. According to some researchers, some of the caves in East Rhodopes and caves in the Silistra region are sanctuaries connected with the cult towards death people and the Thracian Heros.

Using the information from all the investigations it can be concluded that one part of sanctuaries kept their sacred functions from the Antiquity to the end of the 19th and first half of the 20th century. These are the caves Golyama peshtera near the village of Madara, Devetashka cave, Zhivata voda cave in the Montana region, etc., which until recently were used as holy spring. Ceremonies were conducted there with different rituality on the Christian festivals Ilinden, Petrovden, Gergyovden, Spasovden. In the centre of the rituals are drinking and washing with the healing cave water, and also the incubation, healing sleeping in the cave or around its entrance. Traces of sacrificing exist almost everywhere – dresses, part of them, food, and other votives.

Answers of the unsolved problems for the beginning and evolution of the human civilization are hidden in the dark silence of caves. Thus, caves become a serious challenge towards the discovery spirit and professionalism of scientists.

КАРСТЪТ В БЪЛГАРСКОТО СРЕДНО ОБРАЗОВАНИЕ – СЪСТОЯНИЕ, ПРОБЛЕМИ И ПЕРСПЕКТИВИ *

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Ключови думи: обучение по география, учебни програми, урочни единици за карста

Формалното образование в училищата е изключително важно за развиването на необходимите на младежта днес знания и умения. Основната цел не само на обучението по география в средното образование вече не може да бъде механичното усвояване и възпроизвеждане на готови масиви от знания, а младите хора да усвоят необходимите умения, и активно поведение за изява като информирани и отговорни граждани, за да намират подходяща реализация в обществото. Същевременно идеята за разработване на балансирани и всеобхватни учебни планове, които същевременно да не са претоварени, представлява голямо предизвикателство. В резултат на постоянните реформи в училищните системи и на свързаните с тях учебни планове се наблюдава значителен дисбаланс в определеното учебно съдържание, което е подложено на критика, както от страна на експертите, учителите, така и от страна на учениците, което от своя страна рефлектира върху качеството и ефективността на учебния процес. Пряко и най-силно засегнато в резултат от тези промени е учебното съдържание в областта на „Общата физическа география" и в частност изучаването на карста и карстообразуващите процеси. Редуцирането до минимум на тези раздели води до незадоволителна степен на усвояване на учебния материал не само на ниво раздел, но и до затруднения в бъдещото усвояване и разбиране на редица изучавани процеси и явления в следващи учебни теми и раздели.

В настоящото изследване са дадени предложения, на основата на сега действащата учебна програма, къде могат да бъдат включени урочни единици от различен вид – за нови знания, практически, обобщителен урок по тематика касаеща карста и карстообразуващите процеси. Обхванати са трите вида подготовка: задължителна, задължителноизбираема и свободноизбираема, както и възможностите за изучаването на тези процеси в извънкласните дейности. Разгледани са и възможностите за въвличането на учениците в изучаването на карста чрез неформални учебни дейности и основните пречки, които възпрепятстват тяхното осъществяване. Направен е преглед и анализ на основните нормативни документи, които определят насоките на развитие на съвременното образование. Формулирани са конкретни насоки и стъпки за усъвършенстване и, където е възможно и подходящо, са предложени препратки за приложението на редица свързани с образованието програми (като SOCRATES и LEONARDO) с цел повишаване качеството и ефективността на образователния процес.

* Докладът е по проект ДО 02.260/18.12.2008 „Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии" на Фонд „Научни изследвания".

A CONSIDERATION ABOUT THE PICTURE OF CHILDREN ON THE THEME OF KARST PLATEAU

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Akiyoshidai in Yamaguchi Prefecture in Japan is the greatest Karst topography in Japan. The huge cave portions of the scenery of surface of the earth and ground underground are the places loved by not only local residents but also many Japanese people.

At the Hongo elementary school located in local of the Akiyoshidai, arts and crafts on the theme of karst, such as performing the karst guide by a child for many years, have been performed.

A main subject considers the viewpoint of evaluation in a drawing work also in it.

COMMUNICATIVE APPROACH IN ENGLISH LANGUAGE TEACHING ABOUT KARST

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Key words: *karst education, language learning, lesson about karst*

The methodological development of my lesson does not differ much from the lessons in a suitable textbook. Except that my ideas of teaching English presented here are different. I’ll first brief you with my lesson plan.

LESSON IN ENGLISH

Topic: Karst in the Zemen Gorge.
Class: eighth preparatory grade.
Duration: 55 min.
Type of lesson - a lesson to present new knowledge about Zemen karst area and karst vocabulary as well as to reinforce the old knowledge of questions: what, where, when,why?

AIMS:

- T**o describe actions** using Present Simple Tense; to reinforce the old knowledge of wh questions /what, where, when, why/ and to practice it.
- **To encourage students to talk** about the present / around the moment of speaking.

NEW VOCABULARY: Karst terminology.

LANGUAGE FOCUS:

- **Structures**: When is the church built?; Where does Struma River rise from?; Where is the cave of St John Rilsky?
- **Active Vocabulary**: historical, geographical, socio-cultural connected with the karst area.

SKILLS FOCUS DEVELOPED IN:

- **Listening** for comprehension as receptive skill;
- **Speaking** as productive skill.

PROCEDURE: The rock groups - Agapye, Saraya,the Twins, Galabinski rocks; the ruins of medieval castles and towers as Zemlungrad, the beautiful Polska Skakavitsa Falls; Struma River; the village of Polska Skakavitsa, Razdavitsa and Garbino; the cave of St John Rilsky.

This is the traditional English language teaching in the classroom. I’ll try to make clear what makes my lesson unusual.

A difference between **approach**, **method**, **technique** in English language teaching is revealed.

The theory of languag:

- the structural view;
- the functional view;
- the interactional view.

The theory of language learning:

- process/condition - Stephen Krashen’s Monitor model of second language development; Charles Curran and his writings on Counseling-Learning /1972/;
- acquisition/learning.

My view of English learning as a second language puts together Krashen’s and Curren’s ideas about the theory of language learning – acquisition and learning could be fulfilled through security and interest /or motivation/,and with one addition to this model –

not only in the classroom but outside it in nature.

Oral approach or Situational Language Teaching - developed by British linguists from the 1930s and the 1960s with leaders of the movement Palmer and Hornby According to them the target language is the language of the classroom. My idea distinguishes and develops the language of the classroom into one outside it. This is a more situational and a more communicative language which is caused by real life situations in a karst area of unique interest.

Some other aspects are concerned:

- Communicative language teaching – Hymes;
- English language students -"intercultural speakers" - Kirsten Jaeger, a German philology scientist;
- Good language learner/learner autonomy - theoretical views
- The role of the teacher.

The communicative theory presents the second language in a more clearly specified social context and situation – the role of nature and karst in an unusual lesson like this in my view about using karst as a setting in a modified current communicative language teaching lesson.

The four learning styles were used – all of them presented in the lesson about karst in the Zemen Gorge:

- Visual;
- Tactile;
- Auditory;
- Kinesthetic.

In conclusion I should say that the information about Zemen karst area arouses interest and considerably motivates students to speak and listen in English. The goal of English language teaching should be students to be able to use English in an uncontrolled situation for communication and not in a situation whatsoever, but karst, landmarks and nature, which inspire them to talk and learn English. Students are asking unforeseen questions in my unusual lesson about karst. Sooner or later they will encounter the English world outside. Why not to encounter in English first the magnificence of nature and karst in their teenage school years?! Lessons of this kind will prepare them for real life use of English and enrich their sight of nature and landmarks for the future.

КОНЦЕПТУАЛЕН НАУЧНООБРАЗОВАТЕЛЕН МОДЕЛ ЗА КАРСТА*
(„proKARSTerra – education")

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Ключови думи: *Карст, система за комплексен мониторинг на карста, защитени карстови територии, устойчиво развитие, карстови геосистеми, специализиран туризъм, образователни концепции и програми, учене през целия живот, е-обучение, специализирани интернет-мрежи, ИКТ и ГИС, научно-изследователска инфраструктура*

Карстът с неговото широко разпространение в България, е не само феномен и туристическа атракция, но има и сериозни социално-икономически и образователни измерения, защото формира специфична среда, обитавана от хората. Последиците от стопанската интензификация през последните десетилетия, както и опитите за прилагане на актуалните за нашето съвремие принципи на устойчиво развитие, разкриват редица сериозни проблеми (част от тях дори още обществено неосъзнати) при стопанисването и управлението на карстовите територии. В България, а и в света като цяло, карстовата проблематика все още остава встрани от интересите на управляващите и обществото. Достатъчен е само преглед на законодателната уредба и на стопанските и управленски практики, за да се открие този тревожен факт. Той се подчертава и от проведените анкетни проучвания - над 60 % от анкетираните българи в моделни карстови райони не познават явлението карст и свързаните с него особености на териториите, които населяват или ползват под различни форми. Възниква въпросът за мястото на обучението и образованието. И тук нещата са още по-тревожни. В нито един български университет няма специалност карстология, няма дори специализирани курсове. В средното образование карста се изучава много бегло, само в един урок по география. Липсват подходяща литература и учебни пособия, а малкото, което се предлага (предимно рекламни материали за карстови туристически обекти) е далеч от необходимото научно ниво.

На този будещ тревога фон, проведените дългогодишни системни проучвания в едни от най-представителните карстови райони на България, дефинираните и описани карстови геосистеми, осъществените експерименти, режимни изследвания и картировки, както и създадените многобройни бази от оригинални данни, вкл. в съвременна ИКТ и ГИС-среда, са сериозна научна база за специализирани образователни програми. Трябва да се отчете и натрупания професионален опит на изследователите-карстолози, вкл. и педагогически от досегашна работа с ученици, студенти, млади учени.

В перспектива две са стратегическите направления, които трябва да се развиват паралелно: 1. Развиване на научноизследователската инфраструктура в моделните карстови геосистеми и приложението на нови методи на изследване, най-вече организиране на комплексен мониторинг; 2. Създаване на модерна многоцелева образователна програма по карстология, базирана на ресурсите на моделните карстови геосистеми. Интегрирането на двете направления ще създаде перспективен научно-образователен модел, който ще привлече млади хора към карстологията и ще разшири общата култура на българското общество за карста. Разработването на този модел е предпоставка и за активизиране на международното сътрудничест-

* Докладват се резултати по проект ДО 02.260/18.12.2008: „Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии" на Фонд „Научни изследвания".

во, за което вече има сериозни професионални контакти.

Стратегическата цел на предлагания модел „proKARSTerra – education" е да разкрие нови форми за интегриране между съвременната наука и образователната система в областта на карста – уникално природно явление, ресурс и среда на обитаване. В реалните условия на защитени карстови територии ще се интегрират най-модерните научни концепции в карстологията (за карстовите геосистеми и за комплексния мониторинг) и в образованието (учене през целия живот). Предвижда се това да стане чрез съществуващата и новоизграждана експериментална научно-изследователска инфраструктура (с подземни станции) за комплексен мониторинг в моделни карстови геосистеми с оглед изследване и моделиране на съвременния карстогенезис в условията на ярко изразени глобални промени. На тази база ще се разработи многоцелева образователна програма (с използване на съвременни ИКТ), която ще използва информационните ресурси от изследванията в моделните карстови геосистеми и ще направи достъпни в реално време резултатите от комплексния мониторинг и тенденциите, които той бележи.

Осъществяването на моделът ще съдейства за специализацията на защитените карстови територии (ЗКТ) в научно-образователни центрове по карстология с функциониращ комплексен мониторинг (като част от стратегия proKARSTerra). Тази специализация и особено организирането на мониторинг в тях, ще направи възможно и управлението на ЗКТ с прилагане на принципите за устойчиво развитие. За апробирането на модела ще се използва мрежа от защитени карстови територии от различна категория: *Природен парк "Шуменско плато"; 2. Природна забележителност "Маарата"* (най-голямата бигорна каскада в България); *3. Природна забележителност "Съева дупка"* (най-посещаваната българска електрифицирана туристическа пещера); *4. Защитена местност "Триградско ждрело"* (с електрифицираната туристическа пещера Дяволското гърло). В осъществяването на обмяна на опит и на сравнителни експерименти партнират *Природен резерват Моравски крас* в Чехия и *Акиоши-квазинационален парк* в Япония (партньори на проекта «proKARSTerra").

Концепцията на научнообразователния модел **„proKARSTerra –education"** включва:

1. Проектиране на специализирани информационни центрове (в т.ч. виртуали) и научнообразователни маршрути в моделните карстови геосистеми за провеждане на различни форми на теренно-демонстрационно обучение («in situ») и електронно обучение и разпространяване на знания и информация от комплексния мониторинг на карста в реално време.

2. Разработване и апробиране на специализирана многоцелева образователна програма по карстология, базирана на изградената научно-изследователска инфраструктура в моделните карстови геосистеми и на информационната система с бази данни за тях.

- Разработване на цялостна концепция за образователна програма по карстология, включваща различни групи потребители – учащи се от различни образователни степени, преподаватели, административно-управленски персонал (в карстови райони), други граждани («Учене през целия живот»);
- Разработване, апробиране и публично представяне на конкретни е-пакети в ГИС-среда, приложими по действащите образователни програми («ГИС в класна стая»);
- Разработване на образователни пакети със съпътстващи учебни помагала за специализираните информационни центрове в МКГ и информационно обезпечаване на проектираните научно-образователни маршрути;

● Организиране и провеждане в МКГ на обучителни семинари с теренни демонстрации за учители и иницииране на уроци на открито с ученици от различни училища – анализ на резултатите от апробираните с тях предварително разработените обучителни пакети;

● Организиране и провеждане в МКГ на специализирани студентски практики (в т.ч. международни) и привличане на дипломанти в областта на карстологията;

● Организиране и провеждане на специализиран обучителен курс за администрации на ЗКТ и представители на държавни институции («учене през целия живот»);

● Проектиране, изграждане, тестване и поддържане на специализиран модул «prokarstterra-edu» в организираната е-мрежа „proKARSTerra".

3. Популяризиране на резултатите и на възможностите за обособяване на специализиран национален/международен научнообразователен центърпо карстология (базиран на стратегията proKARSTerra), който да приобщи широки кръгове от учащи се, изследователи, управленци на различни нива, бизнесмени и местни общности към актуални проблеми на карстовите територии.

● Подготовка и издаване на специализирано електронно списание „e-proKARSTerra" (с международна редакционна колегия);

● Поддържане като традиционен (с 2-годишна периодичност) специализираният международен конкурс за учащи се "Карст под защита – дар за поколенията" (с пътуваща изложба);

● Организиране и провеждане (България, 2014) на международен научно-приложен форум за моделите на интеграция между карстологията и съвременните образователни програми по света.

ProKARSTerra

www.prokarstterra.bas.bg

Научно-изследователски проект:
„Разработване на експериментален модел на комплексен мониторинг за устойчиво развитие и управление на защитени карстови територии"
(2009 – 2013)

Research project:
Working out an experimental model for complex monitoring of protected karst territories aiming at their sustainable management and development
(2009 – 2013)

Базова организация
Host organization

Национален институт по геофизика, геодезия и география – БАН
The Institute of Geophysics, Geodesy and Geography of the Bulgarian Academy of Sciences

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