

# 16<sup>th</sup> INTERNATIONAL CONGRESS OF SPELEOLOGY

## Proceedings

VOLUME 1



Edited by  
Michal Filippi  
Pavel Bosák

16<sup>th</sup> INTERNATIONAL  
CONGRESS OF SPELEOLOGY



WHERE HISTORY MEETS FUTURE



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OF SPELEOLOGY**

**Czech Republic, Brno**

**July 21–28, 2013**

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**Cover photos** (some photos were adjusted/cropped)

Top left – José Bidegain, on his way for the recovery Marcel Loubens' body. Author unknown. For details see the paper by A.A. Cigna.

Top right – "Walking Mammoth" – a prehistoric drawing from the Kapova Cave, Russia. Photo by O. Minnikov. For details see the paper by Y. Lyakhnitsky et al.

Bottom left – "Astronaut" David Saint-Jacques (CSA) collecting microbiological samples for the scientific programme of the ESA CAVES course. Photo by V. Crobu. For details see the paper by Bessone et al.

Bottom right – The long-legged cave centipede *Thereuopoda longicornis* – a typical species of Lao caves. Photo by H. Steiner. For details see the paper by H. Steiner.

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## “proKARSTerra-Edu” – A KARST-EDUCATIONAL PROJECT

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The wide distribution of karst makes topical issues concerning its use and management with a view of sustainable development of these territories. The solution to the problems related to karst depends on effective education and training concerning karst specifics. In this respect protected karst territories acquire high importance: they can serve as sites for karst education so as test grounds for developing models of rational land use in karst environment.

This paper presents a strategy of karst education, entitled proKARSTerra-Edu. Exemplified by model PKT, it integrates the contemporary research concept of “Karst geosystems” (supported by karst cadastre, developed as a result of complex monitoring and data management in GIS environment) and the educational concept of “Life-long education”. proKARSTerra-Edu is a part of a pilot model of a methodological platform for modern management and conservation of protected karst territories (based on representative karst geosystems in Bulgaria, the Czech Republic and Japan).

### 1. Introduction

Karst occupies a significant part of the Earth’s land (according to Pulina and Andrejczuk 2000 it occupies about 12 % of the Earth’s surface) and this specific environment is closely related to the lives of millions of people. Bulgaria is a typical example, where karst is not just a phenomenon of tourist attraction. Because of its wide distribution (ca. 23 % of this country, Popov 2002) and heterogeneous diversity, it makes a specific natural environment, inhabited since ancient times. For millenniums both the karst landscapes and people have had mutual impact on each other. Human impact on karst reached especially large scale during the recent decades of increasing economic growth.

Some consequences are evident, such as: destruction of and surface karst forms; pollution and change of regimes of underground karst water; pollution and turning potholes into landfills; destruction of the natural soil cover, followed by accelerated erosion, trampling of soils, succession, etc. These processes result into typological transformation of karst (most often producing bear karst). They change not only the karst landscape (often irreversibly). They reflect both directly and indirectly upon the functioning of karst geosystems. That is why attempts to apply the topical principles of sustainable development disclose serious problems (about some of them society is still not aware of).

Serious problems have been revealed in the management and control of karst territories, the society not being aware of it’s. A review of the legislation concerning business and management practices shows that both in Bulgaria and in the world problems still exists in large karst areas, away from the attention and interests of government and society. This alarming fact has been confirmed by specially conducted surveys held by the authors in karst areas. More than 60 % of the Bulgarian respondents do not know karst as a phenomenon as well as its related natural features, even

though they live in karst regions and use their various services.

It is getting clear that these problems are associated with serious gaps in education and training about karst at all levels – from school to University, at state institutions and specialized institutions that manage karst areas. Paradoxically, at the same time the interest in Karst and Speleological research is increasing, leading to publications. As noted by some American researchers, including the authoritative NCKRI (National Cave and Karst Research Institute) scientific information about karst does not reach people and politicians because of poor dissemination. Moreover, most of the specialized educational initiatives address caves only (example, over 54 % in USA, North and van Beynen 2011). Free access to academic resources does not always ensure their proper use in the development of educational and information materials about karst. Work in karst education is also insufficient at the largest international organizations, such as the Geographical and Speleological ones.

Based on this generally negative background some good educational practices concerning karst can be outlined, such as: The group on karst at the University of South Florida, USA (Brinkmann 2010); Ecological educational program focusing on karst in Virginia, USA (Zokaites 2007; <http://www.dcr.virginia.gov/underground.shtml>); Karst international schools (for students and young scientists) in Poland (Faculty of Earth Sciences of the Silesian University) and Slovenia (Karst Research Institute of the Slovenian Academy of Sciences and Arts); Specialized educational activities concerning karst mainly in Slovakia (Slovak Caves Administration – Research, monitoring and documentation department) and in the Czech Republic (The Administrations of Moravský kras PLA and Český kras PLA and the Cave Administration of the Czech Republic). Very important, but less known is the experience in

specialized training at the Akiyoshi karst park in Japan. Their first step was to teach the locals about the nature of karst. Further they created protected areas in karst regions.

Although the concept of Karst geosystems entered the Geography curriculum for 8<sup>th</sup> Grade in 1994 and was apprehensively explained in one of the approved textbooks (Geography for grade 8, Publ. House “K & M”, Sofia, 1995), Bulgaria still lags far behind the active involvement of karst issues in education. Serious attempt to produce significant changes in this field has been declared in the Final Document of the International Conference on Karst research and management in Shumen (18–21 October 2005, <http://karst.iit.bas.bg>; Stefanov 2006). In this document it is recommended that the Bulgarian Ministry of Education and Science “reconsiders the topic of karst in the curriculums of Geography and Biology, updating them with studies of karst phenomena and objects, under different forms such as free elective classes, green schools, school trips and other extracurricular training. For this purpose the use of wide opportunities offered by karst areas was recommended, as well as modern information technologies (ICTs and specifically GIS)”. Seven years later these ideas were again raised, discussed and developed at the Second International Karst Forum in Shumen (16–20 September, 2012, [www.prokarstterra.bas.bg/forum](http://www.prokarstterra.bas.bg/forum) 2012). One of the main topics was the role and the importance of karst in the Education program (Stefanov et al. 2013; Stefanova et al. 2013; Nakano and Iwamoto 2013).

These persistently proposed changes in the Bulgarian Educational system have been based on serious long-term research at some of the representative karst regions in this country. Karst geosystems have been defined and described, experiments have been held, as well as relevant measurements and mapping. Original databases have been developed, by using modern IT and GIS environment, which lead to a serious base for specialized educational programs. In the course of time serious professional expertise has been acquired concerning karst research and education. It involved work with pupils, students, young researchers, as well as enthusiastic teachers with interests in karst. An additional favorable condition has been the growing international cooperation and specialized educational initiatives held at the international Karstologic forums in Bulgaria.

## 2. The proKARSTerra paradigm

Based on the experience gained along wide-range karst studies, the **paradigm of proKARSTerra** for protected karst territories (PKT) has been developed as a methodological platform for their modern management. It uses the Concept of Karst Geosystems, the specialized Information system of Karst Cadastre in GIS environment and the Complex Monitoring (Fig. 1). The concept of *Karst geosystems* has been developed at the Institute of Geography of the Bulgarian Academy of Sciences (now Department of Geography, NIGGG, BAS) since 1980,

based on selected representative model karst regions (Stefanov 2004).

According to this concept karst processes have system-forming importance and organize the environmental development in a specific way, creating territorially uniform and complete functional entities, called Karst Geosystems. They consist of mutually related and interacting elements, structured in spatial, functional, dynamic and genetic hierarchies (Voropay and Andreychuk 1985; Mikhova and Stefanov 1993; Andreychuk and Stefanov 2005, 2006; Andreychuk 2006).

Karst geosystems are specific in that they have two main components: surface and underground subsystems. Both exist in paradyamic and paragenetic relations. Material-energetic interactions between them build the nature of karst systems' functions and dynamics. This multilevel structure and functional unity of karst subsystems has been taken into account in creating the two basic principles in protection of karst derived by V. Andreychuk and P. Stefanov (2005, 2006).

The special status of PKT presumably requires a high degree of knowledge about them (including management plans), but karst specificities impose the need of special expertise and conducting of additional specialized research. The practical value of the results obtained depends on their organization into a specialized information system (*Karst cadaster*) of PKT. More specifically it means skillful design of this database structure and content; filling out the missing information through inventory updates and additional specialized studies; entering all this data into GIS environment. Another important point is the need to carry out specific *monitoring* which in the case of karst landscape should be complex and consistent with the concrete structural-functional features of the respective karst geosystems of PKT.

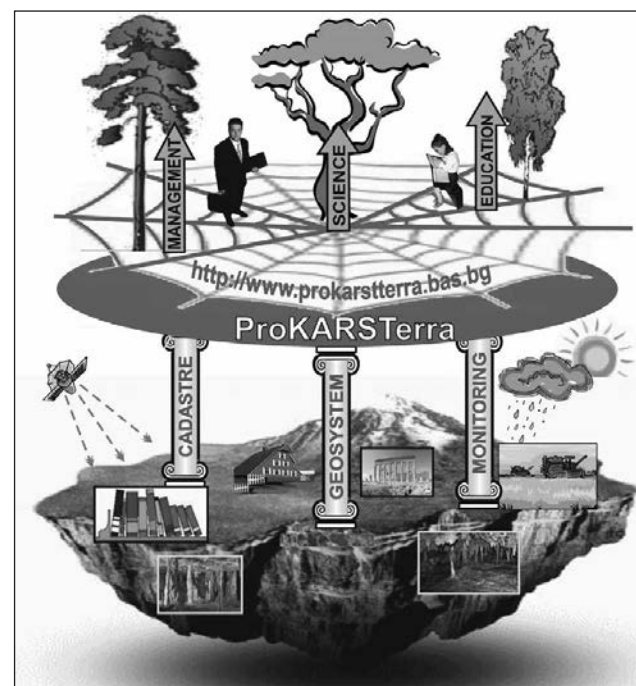


Figure 1. The proKARSTerra strategy.

The pro proKARSTerra paradigm enables the implementation of modern IT technologies for 4-D modeling of karst geosystems, which has very important practical significance to their management and sustainable development. Therefore proKARSTerra is not only a project, it is a strategy (Stefanov et al. 2009, 2013).

It also involves extensive use of the Internet as a powerful information and communication tool. As a first step a specialized MSSQL “proKARSTerra” has been established (Borisova et al. 2013). Its purpose is to: enable promotion, discussion and practical realization of the experimental results of the model for an integrated monitoring of PKT; to offer information concerning various scientific and practical issues in these areas.

A specialized open Internet network “proKARSTerra” has been planned, aiming at coordination of the guidelines for development of PKT, namely building up the “Science-Management-Education” relationships (Fig. 1). It is expected that this network will become a scientific and advisory center for administration of protected karst areas, which will be linked with the appropriate karst specialists (Stefanov et al. 2013). On the other hand, karst experts will have the opportunity to receive feedback on the state of the environment in PKT and the results of solving/or not solving specific problems. This would form a virtual open forum for all interested in karst protected areas. Moreover, the network will compensate some karst-related deficiencies (such as lack of information, political insouciance, regulatory gaps, limited managerial experience about karst specifics, inadequate practices in karst areas, shortage of specialists, etc.) and will enable international exchange and coordination of this type of activity. The designed information network proKARSTerra can be defined as a scientific and applied informational and communication network, as “proKARSTerra-Edu” is one of its important modules (Stefanov et al. 2009, 2013; Stefanova et al. 2013).

### 3. proKARSTerra-Edu as a strategy

#### 3.1. Strategy development

The strategy of proKARSTerra-Edu which is being experimentally developed in Bulgaria is one of the important aspects of Karstology in this country. The active research during the last 20 years as well as the experiments in representative karst regions have been held within the framework of a series of research projects funded by the National Science Fund concerning (Petrov et al. 1998; Mikhova and Stefanov 1993, 1995 a,b; Mikhova and Stefanov 1999; Stefanov and Mikhova 2000; Stefanov et al. 2002; Stefanov 2004; Stefanov and Iliev 2004; Stefanov et al. 2009):

- Contemporary karst genesis;
- Complex monitoring of karst geosystems;
- Karst cadaster.

These research attempts always had educational purposes, as in some cases this issue has been the leading one (for example introduction of GIS in teaching Geography – “GIS in the classroom”) (Stefanov 2004; Stefanov et al. 2005; Mikhova et al. 2007). The created scientific base and

databases for model karst regions, the acquired expertise, including pedagogical one, make that necessary base, on which the proKARSTerra-Edu strategy has been developed. It uses also rich international expertise through the established contacts and the realization of international initiatives such as scientific-practical forums, international projects, original art competition for children and students.

Overall, the proKARSTerra-Edu strategy is based on (Stefanova et al. 2013):

1. Maintenance and further development of the research infrastructure and the modern information system for complex monitoring of model karst geosystems in PKT, aiming at modeling the contemporary karst genesis in the conditions of clearly expressed global change (fundamental, research direction).
2. Development of a multipurpose educational program using the information resources from research held at model karst geosystems; making available data from the complex PKT monitoring, as well as the outlining trends detected by this monitoring (applied, educational direction) in real time.

Integrating these directions essentially means to integrate the contemporary research concept of Karst geosystems (Fig. 1) with the modern educational concept of “Life-long learning”. The latter is well known both from a number of EU educational documents ([http://ec.europa.eu/education/pub/pdf/general/eqf/broch\\_bg.pdf](http://ec.europa.eu/education/pub/pdf/general/eqf/broch_bg.pdf)), and from the National strategy of Republic of Bulgaria ([http://www.nellii.bg/docs/LLL\\_strategy\\_2008-2013.pdf](http://www.nellii.bg/docs/LLL_strategy_2008-2013.pdf)).

Our experience, including also working with children shows that no other scientific field is so attractive and challenging for young people like Karstology. (Especially caves with “white spots” – not studied yet). At the same time as a typical interdisciplinary science it offers ground for disclosure of cross-curricular links and raises awareness of the need to apply the systematic approach of learning.

At this point the experimental integration of both concepts in **proKARSTerra educational model** is based on professional experience, developed research infrastructure and specialized information systems in model karst geosystems for PKT in Bulgaria (Stefanov et al. 2009, 2013), such as: 1) *Natural park “Shumen plateau”*; 2) *Natural landmark “Maarata”* (the biggest calcareous tuff cascade in Bulgaria); 3) *Natural landmark “Saeva dupka”* (the most visited Bulgarian show-cave); 4) *Protected area “Trigrad Gorge”* (with show-cave “Devil’s Throat”). International professional exchange is also of great importance and partners from the Moravsky Kras Protected Landscape Area in the Czech Republic (Štefka 2007, 2011, 2013; Tůma 2013) and Quasi-National karst park Akiyoshi of Japan (Mikhova 2004, 2013; Nakano 2013) participated in the exchange of experience, good practices and comparative experiments.

The choice of model karst geosystems in PKT in the proKARSTerra-Edu strategy has several arguments: it will help to promote specialization of PKT with their attractiveness, representation, tourist infrastructure; in PKT regulated protection, control and security has already been established, which is important for caves with the show-cave



infrastructure, educational and research centers of Karstology, etc. On the other hand, specialization of PKT supports and often provokes their effective management and implementation of modern principals of sustainable development. Performance feedback in this process has the meaning of objective control over the PKT environmental state and to improve the undertaken activities. Also, the practical implementation of the Concept of karst geosystems leads to the need for adjustments of PKT borders, which are often not consistent with the karst features.

### 3.2. Main directions for development of the “proKARSTerra-Edu” strategy

1. Designing specialized information centers (including virtual ones) in models PKT. Designing special scientifically based educational path network for different types of demonstrations and field training (“in situ”). Establishing e-learning and dissemination of knowledge and information from the complex karst monitoring in real time (where it takes place).
2. Development and testing of specialized multipurpose karst educational program based on the established research infrastructure in the model karst geosystems and the information system database.
  - Development of a comprehensive concept of karst educational program involving different groups of users – students of different educational levels, teachers, administrative and managerial staff (in karst areas), other individuals (“Life-long learning”);
  - Development of educational packages with accompanying educational materials for the specialized information centers in PKT; provision of designed scientific-educational trails in them.
  - Development, piloting and public presentation of specific e-packages in GIS environment on various topics of Karstology, which are applicable to existing educational programs (“GIS in the classroom”);
  - Organizing and conducting educational seminars and field demonstration in PKT, involving teachers and initiation of field lessons with students from different schools. Analysis of the results obtained from previously developed training packages;
  - Arranging and conducting University students’ practices in the PTK network (including international) and attracting graduates in Karstology;
  - Organizing and conducting special training course for administrations of PTK and state administrations (“Life-long education”);
  - Designing, building, testing and maintaining of a special module “proKARSTerra-Edu” within the organized “proKARSTerra” network.
3. Organizing and building up an international network with specialized multipurpose infrastructure (with use of modern ICT and research equipment): “**University of Karst**” (Karst-Uni). At this stage the possibility of involving the already existing places and infrastructure in partner-countries have been assessed. They include the above-mentioned model PKT in Bulgaria; the Akiyoshi-National Karst Park in Japan (with its Natural Science Museum and the Karst Eco-museum, which is a center

of educational activities, concerning karst and nature); the Natural reserve Moravsky kras (with its new House of Nature, Štefka 2013) and show-caves in the Czech Republic have been intensively discussed.

4. Dissemination of the results and opportunities for establishing National/International scientific-educational center of Karstology (based on the proKARSTerra strategy), to generate and distribute international initiatives and to involve wider circles of students, researchers, policy-makers at various levels, stakeholders and local communities in the current problems of karst.
  - Preparation and publication of specialized scientific and methodological **electronic journal “e-proKARSTerra”** with international editorial board. Three sections can be developed, such as: science, management, education (materials will be published in several official languages);
  - Maintaining as traditional (2-year interval) the already established international **competition for students “Karst under protection – a gift for future generations”** (organizer Bulgaria, international jury). The competition is held in 5 categories: A) For pupils up to 12 years old (Pictures, Art products with natural materials); B) For students above 12 years of age (Posters/Post-cards, Multi-media presentations, Video-clips); C) University students (Research Essays, Multimedia presentations, Art installations); D) Teachers (My unusual lesson); E) Nature-loving photographers (Photo-composition).

The first two editions of the competition (2005–2012 – in five categories and the traveling exhibition of winning works that sparked considerable interest and achieved serious educational effects (Nakano 2006; Nakano and Iwamoto 2013; Stefanov 2006, 2013). The competition has become a tradition and its third edition is planned for 2014.

- Organizing and conducting (Bulgaria, 2014) an International scientific **forum “Protected karst territories – training and education”**, to present and discuss models of integration between Karstology and current educational programs world-wide.

## 4. Conclusions

The proKARSTerra-Edu strategy aims at creating new forms of linking the modern science and education in the field of karst as unique natural phenomenon, resource and living environment. The idea is to carry out this process in the protected karst territories. For this purpose, the existing and new experimental research infrastructure (underground stations) for comprehensive monitoring of model karst geosystems will be used, aiming at studying and modeling the contemporary karst genesis in the conditions of pronounced global change.

At this stage the proKARSTerra-Edu strategy is being developed and experimented on a national level, but it is internationally open (including the planned e-network database). It is also open for discussions and new partners. It is clear that implementation of the ideas, set out in this strategy is a difficult and lengthy process requiring a lot of

expertise, broad international cooperation and coordination. Therefore, it is largely supranational. The results of its implementation will be felt in the future and will be achieved by young people, interested in karst and having obtained their education through proKARSTerra-Edu. Of great help might be an eventual success in promoting the idea raised in Bulgaria about declaration of an **International Year of Karst by UNESCO**.

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