

KARST HYDROGEOLOGY OF ROMANIA

Iancu ORĂȘEANU & Adrian IURKIEWICZ Editors



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Avant-propos

Editors

The large palette of forms and aspects characterising the karst areas is the result of specific geologic and hydrogeologic complex; it equally integrates factors active nowadays with processes inherited from the past. From a site to another the extreme heterogeneity and complex organization of the karst environment determine the selection of research methods and their complementary utilization. These methods should normally ensure a sufficient knowledge of the internal functionality of the system and its hydrodynamics. On their basis, the estimation of some local characteristics and forecasted reaction at system outlet/outlets would be valuable assets as well.

In hydrogeology the theories regarding the water flowing through permeable horizons constantly focussed on the host rock and its characteristics on one side and the modelling agent which is water on the other. The assemblage usually constitutes an aquifer that develops into extremely particular systems in comparison with other type of aquifers, whenever the host rock is predominantly carbonate or highly soluble;

Understanding hydrology of karst areas firstly depends on the adequate assessment of the geological and structural aspects framing the setting of the carbonate layers. The next step of the same preliminary phase is evaluating the karstification degree through the presence or the absence of the surface karst phenomena. Exploring caves and potholes is equally a challenging adventure but can reveal some key insights to karstification processes and the internal structure of a karst aquifer. Most of these features can be surveyed and digitized at regional or local scale, transferred to data bases or maps, later on being interpreted or statistically analysed. This is usually the base on which the hypothesis concerning the aquifer structure and functioning are formulated and tested.

Some karst areas in Romania got their notoriety from an assiduous research activity going back to 19th century. Thus, the Austrian geographer A. Schmidl has published in Vienna, in 1863, his book titled „Das Bihar Gebirge and der Grenze von Ungar und Siebenburgen” that is the first important study dedicated to karst phenomena including data concerning fresh, mineral and thermal springs explored in one of the most spectacular Romanian karst area i.e the Bihor Mountains.

In 1901, the Romanian geologist S. Mihuția has conducted the first tracer test of a subterranean (underground) stream in Romania. The Tarina stream was labelled with charcoal powder that demonstrated the hydrological connection between Cămpeneasca Cave in Vașcău Plateau and Boiu spring in Vașcău town (S. Mihuția, 1904).

Systematic researches on the hydrology in karst landforms of Romania were carried out by prominent scientists of the Institute of Speleology “Emil Racovita” (ISER) and the Institute of Geography. Identifying the groundwater flow paths by means of tracer tests was an obvious concern that supported their working hypothesis regarding the karstification and the karst evolution in relevant areas.

A comprehensive review has been devoted to karst genesis and karstology in 1974 by Marcian Bleahu a well-known geologist and karstologist as well. Throughout the coming years its impressive synthesis dedicated to karst morphology has been considered among the most important references in the field of karstology.

An important support to the research of karst hydrology has been provided by the Department of Tracers of the Institute of Physics and Nuclear Energy (IFIN) lead by Emilian Gașpar, the author of the important monographic book “Modern

Trends In Tracer Hydrology” published in 1987 in USA.

We shall not fail to remember a long list of colleagues and professionals, experts or simple but enthusiast speleologists which by profession or following their hobbies spent their energy for the knowledge of karst hydrogeology in Romania marking it with noticeable contributions. To them is dedicated the second chapter of this book.

A very active and well organised movement of enthusiasts having speleological hobbies largely contributed to cave discovery exploring and survey so that Romanian cave inventory reached at the end of eighties '80 some 12000 of caves. This is however an amazing number of caves when considering the relatively low percentage of carbonate rocks outcropping in Romania.

The milestone discovery of Movile cave and it's fascinating but isolated ecosystem boosted also the hydrogeological researches dedicated to thermo-mineral waters in the southern part of Dobrogea region.

The socio-economic development and more actual the climate changes can lead to critical situations from the water supply point of view imposing a relevant evaluation of the karst aquifers potential and the opportunities to make an efficient use of it.

This is why improving the knowledge on karst aquifer resources, targeting the delineation of their spatial extension and functioning parameters was considered a prior task not only for karst scientists but also for the technical staff of some relevant companies dealing with various hydrogeology and hydrology aspects. The main goal being thus defined, a large research programme of groundwater in karst systems has been elaborated and gradually implemented on a time span of more than 35 years by few teams of the Hydrogeology Department of the Romanian company Prospecțiuni SA in Bucharest.

These researches have followed a routine framework which was developed and strengthened during the years and always took in account the rich amount of information coming from a large spectrum of professionals and experts mostly from ISER, IFIN and Meteorological and Hydrological

Institute (INMH) that actually enjoyed their participation to this programme. Numerous campaigns of field survey, spring and stream gauging, water sampling or tracer tests were carried out sometimes even in harsh conditions. The results were frequently communicated and published, most part in the frame of the proceedings of *Theoretical and Applied Karstology* symposium that took place with an annual or biennial frequency.

The present volume is in fact a follow up of the efforts made beginning with 1994 under the umbrella of the *Romanian Association of Hydrogeologists (RAH)*. This first attempt aiming at bringing together the available data meet at that time only a partial agreement of the professionals more or less involved in karst hydrogeology. Since that moment new significant karst regions in Romania were consistently surveyed so that actually most of karst areas have a satisfactory degree of knowledge concerning the characteristics of the aquifer systems and the availability of water resources.

Karst areas are among the most vulnerable to pollution thus being significantly threatened by the anthropic impact. Numerous researches in the frame of dedicated projects have demonstrated that continuous leakage of wastes to the ground and bellow, no matter if intentionally or accidentally, lead too a progressive pollution of the groundwater. This gradually become a non return phenomenon. The number of chemical components and the diversity of the human activities that may modify the physical and the chemical properties of the groundwater increases daily. They represent a potential danger to karst aquifers and particularly to those used for public water supply.

One of the main goals of the European Program COST – Action 65 finalised in 1995, was to develop a protection strategy for groundwater from karst areas, taking into account the specific vulnerability of these zones. Following the directions established by the previous program, the COST – Action 620 has continued the researches by developing unbiased methodologies based on physical principles to evaluate the specific and intrinsic vulnerability to pollution for carbonate/karst aquifers.

To this extent, our main target was to provide the ground on which such researches should develop to preserve in adequate conditions the actual re-

sources of the Romanian karst aquifers. Nevertheless this is also a good opportunity to make more visible the acquired results in a consistent frame and it is hoped that the new coming professionals will find a reliable reference to guide and support their researches.

The book is structured according to the hydrogeologic type of karst as identified and described in its introductive chapter. According to this classification the first group is that of or of *Carpathian Orogene karst type (Mountain karst type)* including the most spectacular and largest number of karst areas. Starting with Eastern Carpathians passing through the Southern ones and ending with the Western Carpathians the hydrogeologic aspects of relevant karst zones included in the Romanian chain of mountains are presented.

The karst type of the *North Dobrogea Orogene (The peneplene karst type)*, with carbonate deposits involved in complicated geological structures and a flat topography mirrored in reduced water table gradient is added as well.

Several specific topics compose the baseline of each contribution prepared by different authors. Thus, geology, tectonics and delineation of main karst systems, tracer tests, hydrochemistry and water budget can be considered as the skeleton of each such contribution.

The *platforme karst type* is represented by the one of the most important aquifer system in Romania and part of Bulgaria covering the south-eastern part of the country in Dobrogea area. Numerous researches using a large palette of methods from geologic surveys and geophysics to drilling wells and isotope tracing were employed for the assessment of water resources, water balance, hydrodynamics and modeling activities.

More or less similar topics were considered also when presenting the fourth hydrogeologic type of karst, the one developed in *post-tectonic covers (the bedding karst)*. A minor number of karst aquifers displaying however some potential in terms of quantity and quality of water resources has been investigated, the main one being summarized and published for the first time hereto.

A particular group of aquifers related to carbonate areas is that of thermo-mineral waters. Relevant

data outlining the hydrogeology of some famous spa and one still mineral water brand are presented within this last panel of papers.

The authors are solely responsible for the presented data. The interpretation and all results reflect their efforts but also their vision to the hydrogeological characterization of the relevant areas. The editors only recommended and insisted for a relatively standardized profile of the textual and graphical content.

We firstly thank our sponsor, the *Romanian Federation of Speleology*. The almost endless patience in waiting us to complete the initial version of the volume as well as their support to surpass the technical difficulties is gratefully acknowledged.

During the years most authors have been encouraged by their institutions to publish and confront the concluded ideas with those of other experts. Companies, research institutes or governmental entities as National Agency for Mineral Resources, Prospecțiuni Company, ISER, IFIN, INMH Institute of Study and Design for Land Reclamation and the Romanian chapter of the *International Association of Hydrogeologists (IAH)* have been always close to karst hydrogeology by organizing specific scientific events and backing the associated publishing activity. In the name of the authors we warmly shall thank the managerial board of these institutions for their large support provided during the implementation of different projects and research activities.

We are also in great debt to our colleagues that long ago submitted their contributions and perhaps lost any hope to see it published. The ultimate issuance of the volume will likely take them by surprise. To them and to all other authors that contributed this volume we shall address our special thanks.

Various motives of higher priority have lengthened some of our colleagues in their effort to meet even a largely delayed deadline that eventually has been imposed. They are however thank for their constant involvement in karst hydrogeology aspects hoping that a further and more complete edition of this book will cover even those aspects that accidentally could not be included in this version.

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