

Preface

When my distinguished colleague and friend Jim LaMoreaux sent me a letter at the beginning of 2013 asking if I could edit a practical guidebook on karst hydrogeology for the new Springer series *Professional Practice in Earth Sciences* I was very honored for several reasons.

First, I felt this as a kind of recognition of the importance and high quality of the school to which I belong, the University of Belgrade, which has a long tradition in hydrogeology and karst-related disciplines. The school was founded at the beginning of the twentieth century by the famous karstologist Jovan Cvijić. Thanks to him and his doctoral thesis *Das Karstphänomen*, karst explorers worldwide use the local Slavic terms doline, ponor, polje, uvala, and others. Since that time, many other Yugoslavian and Serbian karst hydrogeologists have become known and many successful projects have been implemented in the engineering regulation of karst surface and groundwater.

Secondly, I was personally very proud to get such an invitation because I felt it as an appreciation of my earlier efforts and work in karst hydrogeology. Together with colleagues, today I try to strengthen the capacity and ability of our Centre for Karst Hydrogeology at the University and the Department for Hydrogeology.

Thirdly, there is a great practical justification for such a book. In 2012, we started to prepare materials and the organizational setup for the international course and field seminar *Characterization and Engineering of the Karst Aquifers*, a course which will traditionally be held in the city of Trebinje, Bosnia and Herzegovina, the heart of classical Dinaric karst, and which is certified by the University of Belgrade as one of the regular courses of the M.S. Program of the Department of Hydrogeology. The course however is developed to be of interest also to other graduate students or students in their senior years of undergraduate studies in geology, environmental sciences, and engineering interested in the research of karst environments and in the development and engineering of karst water resources. The professionals and decision-makers involved in engineering and management of karst waters or environments should also benefit from the course by improving their understanding of karst processes and sensitivity.

The first course in 2014 supported by UNESCO was attended by more than 20 participants from 11 countries, and lectured by ten professors.

There are many excellent books written on different aspects of karst science. During the last decade the published books of Derek Ford and Paul Williams, and of my compatriots Petar Milanović and Neven Kresic, traced a new path and I am quite certain will soon be recognized as the new classical works on karst hydrogeology. For this reason writing something very new and fresh seemed to be no easy task, but the idea to edit a book which should be less theoretical and more a catalog of possible engineering interventions in karst and their implications sounded attractive and finally got support from the Springer authorities.

For this book I asked for support from several well-known karst scientists, who happen also to be good friends of mine from all over the world, but I invited a few younger and prospective researchers working in and studying classical karst of southeastern and Mediterranean Europe to participate as well. I am proud to have worked with and even to have been a mentor to four of them who have already obtained their Ph.Ds at the University of Belgrade. Their topics considered modern methods and innovative techniques in time series analyses of spring discharges, water reserves and recharge components assessment, and the mathematical and physical modeling of karst. I firmly believe they have properly exploited the chance to be co-authors of this book and have demonstrated a good capability for individual scientific work. However, the final judgment will be with the readers and future attendees of the international course.

The practical guidebook *Characterization and Engineering of the Karst Aquifers* consists of three parts. The first is more introductory. It includes a historical review of karst research as well as a presentation of basic karst terminology, a description of landscape and features, and a discussion of the distribution and importance of karst water resources. The chapter on the characterization of karst aquifer consists of several subchapters. It is a guide to the analysis and evaluation of karst aquifer from various angles essential for its optimal utilization and/or protection. Although presentation of research methodology is not the principal aim of this book an overview of existing and mostly applied methods is given, along with an assessment of their practicability and limitations.

The second part of the book comprises several contributions written by leading experts in related fields. The topics include a consideration of the brief theory and practice of some of the most important steps in karst aquifer engineering control and protection such as the relationship between surface waters and groundwater, budgeting and assessing groundwater resources, evaluating spring discharges regime, and estimating aquifer vulnerability to pollution. The chapters explaining how to model the karst environment physically and mathematically and how to organize monitoring of its water regime are also included in this section. The last chapter presents a catalog of possible engineering interventions aiming to control karstic flows. Plunging ponors and cavities, placing blankets over karstic surfaces, and constructing grout curtains are some such measures aiming to use the hydro-power potential of karst waters or prevent them from being diminished.

The third part covers practical experiences in karst waters management. It consists of one introductory article and 15 case studies in different fields of karst hydrogeology. The introductory article aims to provide general guidance on how to deal with problems in karst, create a conception for research, evaluate obtained results, and optimize technical solutions. Discussion of typical conflicts between the water users and possible management resolutions as well as assessment of the environmental impacts of various measures and constructions applied in karst are also discussed. The following case studies describing the most common problems in karst water management are separated into three groups. The first group includes assessment of groundwater availability, and forecasts the effects of further intensive over-extraction as a permanent or temporary measure to overcome water shortage. The second group includes four presentations dealing with karst waters inflow in underground mines, leakage from reservoirs, and mixture of salt or lake waters and fresh groundwater. The third group consists of six contributions which discuss the quality of karst groundwater in terms of protection, contamination, remediation, heating, sharing.

Although the majority of the users of this book will be professionals with a geology/hydrogeology background we have tried to utilize language which is not purely technical but, rather, accessible to a wider audience. In this way presented methodology, case studies, and obtained experiences should also benefit water managers working in karst environments.

I gratefully acknowledge the work and contributions of all my colleagues who are co-authors of this book. I believe their expertise and experience will benefit a wide reading audience and will help toward more successful and sustainable projects to be implemented in karst environment in the future. I am especially grateful to Jim LaMoreaux for giving me the opportunity to edit this book, and to my friend Neven Kresic for his advices and some ideas brought from his infinite mind storage. My personal special thanks go to Beverly Lynch, who made most of the chapters of this book legible and to Branislav Petrović, who provided technical support in preparation of the illustrations for the chapters that I wrote.

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