

● 钱让清 编著

21

Teaching Reform Material of Civil Engineering  
in Institution of Higher Learning  
for 21st Century

世纪高等学校土木工程学科教改教材

# 公路工程地质

Highway  
Engineering  
Geology

中国科学技术大学出版社

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21 世纪高等学校土木工程学科教改教材

HIGHWAY ENGINEERING GEOLOGY

# 公 路 工 程 地 质

Compiled by Qian Rangqing

钱让清 编 著



## 内 容 简 介

本书是作者在系统归纳总结 20 多年来的科研与教学成果,以及多位国内著名专家指导意见的基础上,编撰而成的一部独具特色的公路工程地质教改教材。全书由绪论及 10 章内容组成,介绍工程地质的任务及其在公路工程中的作用;岩石的成因类型及其工程地质性质;地质构造及其对工程的影响;土的物理性质及工程分类;水的地质作用和对工程的影响;边坡工程地质;地基和地下工程地质;环境工程地质;公路工程地质勘察内容、方法和常见的工程地质问题;工程地质测绘与调查,勘探与试验,不良地质现象和特殊土的勘察与评价等。重点突出了公路工程所涉及的路基、边坡、桥基、隧道等方面环境工程地质问题的勘察与评价,软基处理方法等,并结合国内外实例进行了研究,能使学生在大量的工程实例中提高分析问题和解决问题的能力。

本书内容丰富,实用性强,将教学与科研、生产紧密结合(含工程地质勘察技能训练指导和公路工程地质多媒体教学软件),反映了最新的科研成果。可作为高等学校土木工程学科公路与桥梁工程、公路与城市道路等专业教材,亦可供工程建设勘察、设计、监理、施工、实验、检测技术人员和土建类师生及科研人员参考。

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# 前 言

工程地质学是地质学中的一个分支。它是调查、研究、解决与兴建各类工程建筑有关的地质问题的科学。做好工程地质工作,对于进一步提高工程质量,提高地质科技水平,提高各类工程的规划、勘察、设计、施工建设水平都具有重要意义。

本书是教育部 21 世纪高校土木工程学科公路与桥梁专业教改教材、教育部普通高等教育“十五”国家级重点规划教材。作者在撰写过程中,一方面系统总结了自己 20 多年来从事公路工程地质、岩矿鉴定分析、工程检测、环境检测等科研和教学成果,同时吸收了国内外有关环境学、环境工程地质学的研究成果。是公路工程地质理论和实践紧密结合所取得的研究成果与心得。

本书的主要内容曾编入安徽大学公路与桥梁工程专业《公路工程地质》课程的试用教材,该教材曾被评为安徽大学(交通分校)优秀教学成果一等奖,深受学生喜爱。1999 年 8 月南京大学博士生导师王赐银教授、合肥工业大学瞿尔仁教授等热情指导修改并积极推荐本书出版,在此基础上又增加了一些最新的研究成果并经王奎仁教授、王国强教授详细审阅,中国科学院院士、中国工程院院士常印佛教授和中国科学技术大学博士生导师王奎仁教授在百忙中欣然为本书作序。对本书的撰写和调研,安徽省公路学会、安徽省地质学会均给予大力支持;此外,杨晓勇博士、教授级高工郭正言、周文雅等为本书的撰写提供了部分资料;全书插图由钱芳、周满兵、钱小中同志绘制。

本书出版得到国家攀登计划重点科技攻关项目(A-30-12B)、国家教育部教学改革重点项目(M2002-282)、国家科技部重点科技攻关项目(G1999043204)、安徽省教学研究项目(97YB055)、交通科技进步通达计划项目的资助,同时得到中国科学技术大学出版社的帮助。在此一并表示衷心的感谢。

在使用本书进行教学时,由于学时所限(或相近专业使用),不能教授全部教材内容时,可在该书的第三、六、九、十章中进行针对性的选择。有的章(节)应结合实验和野外实习进行教学,不占校内理论教学时间。

本书在编著过程中曾以编写大纲广泛征求过有关兄弟院校(如合肥工业大学、北方交通大学、安徽理工大学、安徽建筑工业学院、长沙交通学院等)同行的意见,许多老师都提出了很好的意见和建议,在此谨向关心、帮助过本书编著工作的老师们致以诚挚的谢意。

鉴于作者水平有限,书中不当之处诚恳希望读者批评指正,以便再版时更正。由于出版时间仓促,未能全部注明资料来源,请读者谅解。

钱让清

2003 年 6 月 18 日

# 序 1

工程地质学是地质科学的一个分支,是研究与工程规划、设计、施工和运用有关的地质问题的学科。它的主要任务是:勘察和评价工程建筑场地的地质环境和工程地质条件;分析和预测工程建设活动与自然地质环境的相互作用和相互影响;选择最佳的场地位置;提出不良地质作用的工程措施,为工程建设的规划、设计、施工和运营提供可靠的地质依据。

各种土木工程,如公路、铁路、桥梁、隧道、房屋、港口、水利等工程都是修建在地表或地下的工程建筑。建筑场地的地质环境和工程地质条件(包括场地及周围的岩、土体类型和性质、地质构造、水的地质作用等),都与工程设计、施工和运营密切相关。在进行工程建设时,无论是总体布局阶段,还是个体建筑物设计、施工阶段都应当进行相应的工程地质工作。总体规划、布局阶段应进行区域性工程地质条件和地质环境的评价;场地选择阶段应进行不同建筑场地工程地质条件的对比,选择最佳工程地质条件的方案。在选定场地进行个体工程建筑物设计和施工阶段,应进行工程地质条件的定量分析和评价,提出适合地质条件和环境协调的建筑物类型、结构和施工方法等的建议,拟定改善和防治不良地质作用 and 环境保护的措施、方案等。为了做好上述各阶段的工程地质工作,必须通过地质调查、测绘、勘探、试验、观测、理论分析等手段,获得必要的地质资料,结合具体工程的要求进行研究、分析和判断,最终得出相应的结论。鉴于工程地质对工程建设的重要作用,国家规定任何工程建设必须在进行相应的地质工作、提出必要的地质资料的基础上,才能进行工程设计和施工工作。

在国内外工程建设实践中,重视工程地质工作使工程建设获得成功的经验和忽视工程地质工作引起工程建设失败的教训不胜枚举。

各类工程(公路、铁路、水利水电、工业与民用建筑等)对工程地质条件有不同的要求。由于公路工程是一种延伸很长的线型建筑物,又主要是一种表层建筑物,它会遇到各种各样的自然条件和地质问题,并易受频繁变化的大气物理作用的影响,因而,公路工程地质无论在研究对象和方法上都有自己的特点。在国内外,《公路工程地质》的教科书和专著仍寥若晨星。因此,钱让清同志编著的《公路工程地质》一书,对本学科的教学以及科研和生产是十分有益的。本书的主要特点是:1. 吸收了近 10 年来工程地质和岩土工程学科中的新进展、新成就;2. 结合我国自然景观、地质条件和公路、桥梁与隧道工程的特点,综合应用地质学原理及 20 世纪 90 年代发展起来的新技术、新

方法、新理论,较全面地论述了评价公路工程地质条件的各项内容;3. 反映了我国公路工程地质工作近 10 年来的部分重要进展和研究及实践的新成果,这些成果体现了科学技术服务于经济建设的宗旨,为我国的公路建设提供了科学依据。可以认为本书是目前有关我国公路工程地质调查研究的成功实践的一份总结,无疑具有广泛的应用价值。

深信本书对于推动我国公路工程地质的教学和勘察研究具有重要的意义,必将受到有关领域的教学、科研和工程技术人员的欢迎。

中国科学院院士、中国工程院院士

常印佛

2003 年 4 月 26 日于合肥

## 序 2

公路工程地质工作涉及的范围是在地表或地下,所以对于从事公路与桥梁工程专业的人员来说,必须掌握公路工程地质的基础理论和技能。本书依据国家教育部“关于 21 世纪高等学校课程改革”的精神和国家教育部关于高校土木工程学科、公路与桥梁工程专业高级专业人才的培养目标以及《公路工程地质》教学大纲的要求编著而成。我和合肥工业大学王国强教授审阅了全部书稿。

公路工程地质是公路工程、桥梁工程、隧道工程、土木工程、地下工程等众多学科的专业基础课,是促进这些学科和相应工程不断发展的原动力。因此,这门课程的重要性是显而易见的。为适应目前土木工程学科公路与桥梁工程专业《公路工程地质》课程发展的需要,钱让清先生编著了《公路工程地质》一书,并遵循如下四个基本原则。

### 一、突出“三基”

工程地质学和公路工程地质是由多学科交叉形成的新兴学科。它不仅涉及矿物岩石学、构造地质学、地球物理、地球化学等基础地质理论、方法;同时需要实验力学、数理统计、计算数学等大量数学、力学理论,还涉及材料物理、信息论等大量的相关学科理论,特别是一系列的现代科学理论。为了把浩如烟海的理论和知识以及工程实践成果浓缩在 50~60 学时内,首先要遵循的一个基本原则,就是要突出“三基”,即基础理论、基本知识和基本技能的教育。基本知识主要包括进行公路工程地质勘察、设计、施工和维护所应掌握的知识,基本技能首先是实验的技能,因为科学实验是公路工程地质发展的基础,这些实验包括岩、土和岩体的物理力学性质实验、工程地质调查和现场稳定性监测等。

### 二、通用性

工程地质是有关工程领域的基础学科,为了适应社会主义市场经济发展和高等教育体制改革、学生分配制度改革的需要,拓宽学生毕业后的就业渠道和竞争能力,作者在编著《公路工程地质》新教材时,本着增加教材的通用性原则,吸收了铁路、土木、建筑等有关行业工程地质理论和实践的特点。由于作者长期在高校从事教学、科研和技术开发工作,产学研结合,这就保证了新教材的通用性。

### 三、实用性

公路工程地质是一门应用性很强的工程学科,它具有一个特定的应用领域,在很长的一段时间里,工程地质学研究存在理论脱离实际的现象。在以往的工程地质学和公路工程地质教材中,也存在理论和工程实践脱节的现象。为此,作者在编著本教材时,将理论和工程放在同等重要的位置,并将教材名称定为《公路工程地质》。全书以突出篇幅介绍了工程地质基本知识在公路、桥梁工程中的应用,并从两个方面强调工程地质理论和公路工程的结合:一是如何运用工程地质理论指导公

路、桥梁、隧道工程的勘察、设计、施工和维护;二是如何在公路工程实践中不断产生公路工程地质的新理论、新技术,推动工程地质学不断向前发展。理论和工程紧密结合的教育,将能使学生在大量的工程范例中提高分析问题、解决问题的能力。这样,他们在走向工作岗位后,就能较快地适应工作需要,把学到的知识用到工程实践中去,起到“独当一面”的作用。

#### 四、先进性

现代科学技术突飞猛进的发展和我国经济建设步伐的加快,尤其是我国交通公路建设的快速发展也对公路工程地质提出更高的要求,并促进了公路工程地质的不断发展。目前应用较为广泛的几本工程地质学和公路工程地质高校教材都是一二十年前编写的,与当前公路工程地质与公路工程的发展现状已经不相适应。钱让清先生编著的《公路工程地质》新教材把新理论、新技术和新的工作实践成果介绍给广大学生,为大学生今后深入学习和应用提供了正确的思路和难得的素材。

因此,此时此刻,钱让清先生撰写的《公路工程地质》对本学科的教学、科研和生产是十分有益的,此外,本书还有若干特点:

1. 本书采用了已经出版和即将出版的岩土工程和公路工程地质新标准和新规范,吸取了有关行业近年来地基工程处理中的科研成果和新成就。

2. 本书紧密结合公路工程建设需要,体现了公路工程地质技术服务于交通公路建设的指导思想;同时对经济建设发展规划、重大工程建设和环境问题提供了丰富的基础资料。

3. 将地球化学、矿物岩石学、环境学、地震学中的一些重要新进展和新成果,有机地与公路工程地质融会到一起,丰富了工程地质学的内容,促进了工程地质学的发展。

4. 书中引用了作者多年来从事工程勘察、工程检测、岩土测试分析、矿物成因与矿物物理研究、水化学分析、工程地基处理技术、环境工程处理技术等方面的研究成果与心得,从而使本书的观念新颖,融会贯通,既具有大学教科书的完整体系,又带有公路工程地质方面的专著性质,相信所有关心工程建设、环境与工程问题及可持续发展的人都有可能成为其热心的读者。

总之,本书与科研、生产紧密结合(有工程地质勘察技能训练指导书和公路工程地质多媒体教学软件配合教学),反映了本学科最新的科研成果和发展动态。为此,我深信,本书对我国公路工程地质的教学、科研和生产必将起到重要的推动作用。

中国科学技术大学教授、博士生导师

王奎仁

2003年3月18日



## Synopsis

This book has summarized results made by the author's experience of more than 20 years of teaching and research. Under the guidance of several domestically famous experts, it becomes a teaching material reform and monograph on highway engineering geology with unique features. The book consists of introduction and 10 chapters, which cover: the task of engineering geology and its application in highway engineering; petrogenetic types and their engineering geological properties; geological structure and its effect on engineering; the physical properties of earth and its categories in engineering; geological process of water and its effect on engineering; slope engineering geological issue; foundation and underground engineering geological issue; environmental engineering geological issues; geological reconnaissance of highway engineering; unfavorable engineering geology, and reconnaissance and appraisal of special earth; major highway engineering geological issues, engineering geological mapping and investigation, exploration and experiment, engineering case analysis and study. This book also stresses engineering geological reconnaissance and appraisal of road foundation, slope, bridge foundation and tunnel that highway engineering involving as well as soft earth foundation treatment methods. A number of examples at home and abroad are included in the book for analysis and research. And this book will also help improving the ability of students' analysis and solving problems.

This book also conveys the characteristics of mutual infiltration and intimate combination of engineering geology with mineralogy, petrology, seismology, physicochemistry, environmental science, etc. This book is rich in content and very practical. It combines the latest scientific results (with geological reconnaissance capability training guide book and highway engineering geological multimedia software as auxiliary teaching means). This book can be used as a textbook for civil engineering, highway and bridge engineering specialties of institutions of higher education, or for relevant technicians and scientific research personnel on engineering construction, reconnaissance, design, inspection and supervision for reference.

## Foreword

Engineering geology is a branch of geology, concerning investigation, research and solution of geological issues related to variety of engineering constructions. Engineering geological work bears significance to improving engineering quality, upgrading geological sci-tech level and enhancing the programming, reconnaissance, design and construction levels of various engineering.

This book is a result of teaching material reform of civil engineering subject of highway and bridge specialty of institutions of higher education for 21 century, and the planned teaching textbook for high education in the 10th five-year-period of the National Education Administration. In this book I summarized research results at home and abroad in environmental science and environmental engineering geology, and also reviewed my work of the recent 20 years in highway engineering geology, rock and mineral identification, engineering testing, environmental testing, and my research results and understandings obtained from the combination of engineering geology with petrology, physiochemistry, geochemistry and environmental science, and of the combination of engineering geological theories with practice.

The major content of this book was once included in the trial teaching material for the course Highway Engineering Geology of the specialty of Highway and Bridge Engineering of Anhui University, and the material was later awarded the first-class prize as excellent teaching achievement in Anhui University (School of Communications) and appreciated by teachers and students. In August 1999, Professor Wang Ciyin, tutor of students for doctorate of Nanjing University, Professor Qu Erren of Hefei University of Technology positively recommended this book for issue. Some latest research results are added to the book and examined by Professor Wang Kuiren and Professor Wang Guoqiang. Professor Chang Yinfo, dual academician of Chinese Academy of Sciences and Chinese Academy of Engineering, and Professor Wang Kuiren, tutor of doctoral students of University of Science and technology of China, wrote prefaces for this book in their very busy time. Highway Society of Anhui Province and Geological Society of Anhui Province gave much support for writing and investigation research of this book. Additionally, Mr. Yang Xiaoyong, senior engineer (professor level) Guo Zhengyan and Mr. Zhou Wenya offered relevant data for writing of this book. All the drawings of this book were described by Comrade Qian Fang, Zhou Manbing and Qian Xiaozhong. The issue of this book was also financially aided by the key sci-tech breakthrough project (A-30-12B) of the National Scaling Program in Science and Technology, the key sci-tech breakthrough project (G1999043204) of the State

Ministry of Science and Technology, the key Project (M2002 – 282) of the Education Innovation for the Ministry of Education, the teaching research project (97YB055) of Anhui province, and the Project (C2003) of Being Open-and-Arrival to Traffic by improvement for Science and Technology. It also received the help from the Press of University of Science and Technology of China. Herein I extend my heartfelt thanks to all of them.

As this book is used for teaching and not all of the content will be taught due to the limitation of class hours (or its application to relevant specialty), choices can be made among chapters 6 – 10 based on different purpose. Some of the chapters (sections) may be used in combination with field practice, not occupying class hours for theory teaching. The issue of this book is intended with multimedia teaching software, which will surely improve teaching effect and quality.

During compiling this book I consulted many colleagues from fraternal colleges and universities (such as Northern University of Communications, Hefei University of Technology, Anhui University of Technology, Anhui Institute of Architecture, Changsha College of Communications, etc.) and gained very useful opinions on the outline of this book. At this point, I give my sincere thanks to all the teachers who cared for this book and who offered help.

Please don't hesitate to criticize for inadequacies and errors in this book due to restriction of the author's level. For the limitation of time for publishing, the author does not provide all sources of information cited and hopes it to be understood.

*Dian Rangqing*

**June 18, 2003**

## Preface 1

As a branch of geological science, engineering geology is a subject that deals with geological issues concerned with engineering plan, design, construction and application. The main tasks of the subject are: reconnaissance and appraisal of geological environment and engineering geological conditions of the construction site of an engineering; analysis and prognosis of the mutual action and effect between construction activity and natural geological environment; choosing optimal construction site; giving engineering countermeasures against unfavorable geological action and providing reliable geological basis for the plan, design, construction and operation of an engineering.

Variety of civil engineering, such as highway, railway, bridge, tunnel, house, port, irrigation works, etc. are all engineering architecture built on the surface or underground. Geological environment and engineering geological conditions of construction site (including types and properties of rock and earth bodies in and around the construction site) are closely related to engineering design, construction and operation. For engineering construction, engineering geological work must be conducted at either the overall plan stage or the design and construction stage of an individual building. Appraisal of regional engineering geological conditions and geological environment should be made at the overall plan or layout stage. Optimal scheme of engineering geological conditions must be determined by comparing engineering geological conditions of different construction sites at the stage of selecting construction site. Quantitative analysis and appraisal of engineering geological conditions shall be performed at the stage of choosing site for design and construction of individual building, including putting forward suggestions on building types, structures and construction methods, etc. that are compatible with the geological conditions and environment, and giving measures and scheme for improving and preventing unfavorable geological action as well as for environmental protection. In order to implement the engineering geological work at various stages mentioned above, requisite geological data must be made available through geological survey, mapping, exploration, experiment, observation, theoretical analysis, etc; study, analysis, judgment will be made and corresponding conclusion finally reached with a real engineering being taken into consideration. It is stipulated in the state regulations that engineering design and construction must be based on parallel geological work and required geological data in view of the importance of engineering geology to engineering. In the practices of engineering construction at home and abroad, the examples are countless for successful ones resulted from attaching importance to engineering geological work, and those of failure from ignorance of engineering geology. Different en-

gineering (highway, railway, water conservancy and power works, industrial and civil building, etc) have varying requirements for engineering geological conditions. Highway engineering is a long-extending linear structure, and also a building near the surface, which often encounters various natural conditions and geological issues, and is easily influenced by frequently changing atmospheric physical action. Therefore, highway engineering geology has its own characteristics in research subject, theory and method. For this, the book *Highway Engineering Geology* written by Qian Ranqing is quite helpful to the teaching, research and production concerning the subject. The book is characterized by: (1) Absorbing the achievements in the recent 10 years in the field of engineering geology and geotechnical science; (2) quite completely expounding the aspects concerning appraisal of highway engineering geology by considering the natural landscapes, geological conditions, and the characteristics of the highway, bridge and tunnel in China, and by applying new technology, new method and new theory that have been developing since 1990s; (3) reflecting part of major accomplishments in highway engineering geological research and practice in the recent 10 years in China, which embody the purpose of science and technology to serve economic construction, and provide scientific foundation for highway construction in China. This book can be regarded as a sum-up of successful practice of highway engineering geological investigation and research in China. It has widespread application value undoubtedly.

I am deeply convinced that this book bears vital implications for promoting the teaching and research of highway engineering geology, and will be welcomed by people in the circles of teaching, scientific research and engineering.

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**Academician of Chinese Academy of Sciences**

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**April 26, 2003**

## Preface 2

Highway engineering geological work involves the scope on or under ground; personnel who are engaged in highway and bridge engineering specialty are required to master the fundamental theory and technology of highway engineering geology. This book is compiled according to the cultivation target of high-grade professionals made by the State Ministry of Education for the civil engineering, highway and bridge engineering of institutions of higher education, and to the teaching program of Highway Engineering Geology. Professor Wang Guoqiang, the tutor of doctoral students of Hefei University of Technology, and I checked this book before issue.

Highway engineering geology is professional fundamental course of many subjects such as highway engineering, bridge engineering, tunnel engineering, civil engineering and underground engineering. So, the importance of this course is apparent. It is the source power to promote the continuous development of the subjects mentioned above. In order to meet the demands of the development of the course of Highway Engineering Geology for civil engineering, highway and bridge engineering subjects, Mr. Qian Rangqing compiled this book, which follows the rules as following:

### 1. Highlighting "Three Fundamentals"

Engineering geology and highway engineering geology are recently developed courses, involving mineralogy, petrology, structural geology, seismology, geochemistry, experimental dynamics, mathematical statistics, fuzzy mathematics, computing mathematics, gray theory, nonlinear theory, mechanical theory, geophysics, material physics, information theory, etc. Highlighting "Three Fundamentals" (fundamental theory, fundamental knowledge and fundamental skill) is to concentrate the wide expanse of knowledge and theories in a range of only 50 – 60 class hours. The fundamental knowledge refers to that necessarily for highway engineering geological reconnaissance, design, working and maintenance; fundamental skill is firstly of experimental skill because scientific experiment is the basis for the development of highway engineering geology. The experiment involves the physical and mechanical properties of rock, earth and rock mass, engineering geological survey and in-situ stability monitoring.

### 2. Popular

Engineering geology is the fundamental course in the field of engineering and the associated. In order to adapt to the socialist market economy and the reforms for higher education mechanism and for system of assignment of graduates and increase their employment opportunities, this book absorbs en-

engineering geological theories and practices from railway, civil works, building and other fields, thus assuring its popularity.

### 3. Practical

Highway engineering geology is a very practical branch of engineering subject. It has specific field of application. For a long period of time, engineering geological study is detached from the practice. For this, the author put theory and practice on equal level and names the teaching material Highway Engineering Geology. The book highlights the application of fundamental engineering geological knowledge to highway and bridge engineering. It combines engineering geological theory with highway engineering practice from two aspects. One is how to use engineering geological theory to guide the survey, design, working and maintenance in highway, bridge and tunnel engineering; the other is how to produce new theory and new technique of highway engineering geology in the practice of highway engineering to continuously develop engineering geology. The integration of theory and practice will help students upgrade their ability of analysis and solving problems so that they can work independently after they enter the society.

### 4. Advanced

With the rapid growth of modern science and technology and the quickening pace of economic construction in China, especially in the field of communications, it is urgent to renew the textbooks of engineering geology and highway engineering geology that were written decades ago. This book introduces new theory, new technique and new work practice to students and serves as a precious material for students to further their study in proper way.

At this moment, Mr. Qian Rangqing compiled Highway Engineering Geology, which will be quite helpful to teaching, scientific research and production concerning the subject. In addition, this book has features as following:

1. It adopts new standards concerning geotechnical engineering and engineering geology, which have been and are to be published, and absorbs new progress and new achievements in engineering geology and geotechnical engineering subjects of the recent 10 years.
2. It also reflects the crisscross and intimate combination of mineralogy, petrology, structural geology, seismology, physiochemistry, geochemistry, environmental science with engineering geology and so on, as a trend of scientific development up to date, and shows the latest research results.
3. It considers the requirements of economic construction and land planning, mirrors the aim of science and technology serving economic construction; it also provides abundant fundamental data for economic development programming, key engineering construction as well as the development, construction and environmental issues of the Yangtze River.

4. It merges some important progress in geochemistry, petrology, mineralogy and environmental science into engineering geology organically and enriches its content; The author put into the book his research results and mature thoughts from his work of many years with regards to engineering reconnaissance, engineering inspection, geotechnical testing analysis, mineralogical genesis and mineral physical research, water chemical analysis, engineering foundation treatment techniques, environmental engineering treatment techniques, etc., as a result, this book is new in conception and achieves mastery through a comprehensive study of the subject, having both the complete system of college textbook and the nature of a book on the special subject of engineering geology. I believe that all who care about engineering construction, environment and engineering issues as well as sustainable development may become the fan of this book.

This book is intimately connected with scientific research and production (with engineering geological reconnaissance capability training guidebook and highway engineering geological multimedia software as auxiliary teaching means), reflects the latest scientific research results and will certainly improve teaching effect and quality. For this, I am sure that this book will play an important role in promotion of the teaching, scientific research and production with respect to highway engineering geology in China.

*Wang Huiren*

**Professor and tutor of doctoral students  
of University of science and technology of China  
March 18, 2003**



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