

ACCESS APPLIED HYDROGEOLOGY OF FRACTURED ROCKS SECOND EDITION

Arne Harmense

Applied Hydrogeology Of Fractured Rocks Second Edition Introduction

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Hydrology is a topical and growing subject, as the earth's water resources become scarcer and more vulnerable. Although more than half the surface area of continents is covered with hard fractured rocks, there has until now been no single book available dealing specifically with fractured rock hydrogeology. This book deals comprehensively with the fundamental principles for understanding these rocks, as well as with exploration techniques and assessment. It also provides in-depth discussion of structural mapping, remote sensing, geophysical exploration, GIS, field hydraulic testing, groundwater quality and contamination, geothermal reservoirs, and resources assessment and management. Hydrogeological aspects of various lithology groups, including crystalline rocks, volcanic rocks, carbonate rocks and clastic formations, are dealt with separately, using and discussing examples from all over the world. Applied Hydrogeology of Fractured Rocks will be an invaluable reference source for postgraduate students, researchers, exploration scientists, and engineers engaged in the field of groundwater development in fractured rock areas.

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Applied Hydrogeology for Scientists and Engineers

In order to properly plan, design, and operate groundwater resources projects, it is necessary to measure - over time or distance - pertinent groundwater variables such as drawdown and discharge in the field. Applied Hydrogeology for Scientists and Engineers shows how to assess and interpret these data by subsurface geological setup and processing. The book helps readers estimate relevant groundwater parameters such as storativity, transmissivity, and leakage coefficient. The text addresses many interrelated disciplines such as geology, hydrology, hydrogeology, engineering, petroleum geology, and water engineering. Traditional and current models for application are presented. One of the unique features of the book is the inclusion of new and previously unpublished ideas, concepts, techniques, approaches, and procedures developed by the author.

Among these are hydrogeophysical concepts, slope matching techniques, volumetric approach solution for complicated groundwater flows, non-Darcian flow law applications, aquifer sample functions, dimensionless-type straight line methods, non-linear flow-type curves, discharge calculations from early time-drawdown data, storage coefficient estimation procedure for quasi-steady state flow, and much more. The pitfalls in aquifer test analysis are also detailed. Fractured medium flow adds yet another dimension to the book. Each method is supplemented by actual field data applications from worldwide case studies. Applied Hydrogeology for Scientists and Engineers covers the topics of groundwater reservoirs, the evaluation of aquifer parameters, aquifer and flow properties, flow properties and bore hole tests, aquifer tests in porous and fractured media, well hydraulics, groundwater flow and aquifer tests, and field measurements and their interpretations. This new reference also works well as a post-graduate textbook on the subject. Applied Hydrogeology for Scientists and Engineers expands the reader's knowledge by providing valuable information not found in any other publication.

Fractured Rock Hydrogeology

Fractured rocks extend over much of the world, cropping out in shields, massifs, and the cores of major mountain ranges. They also form the basement below younger sedimentary rocks; at depth; they represent a continuous environment of extended and deep regional groundwater flow. Understanding of groundwater flow and solute transport in fractured rocks is vital for analysis of water resources, water quality and environmental protection, geotechnical and engineering projects, and geothermal energy production. Book chapters include theoretical and practical analyses using numerical modelling, geochemistry, isotopes, aquifer tests, laboratory tests, field mapping, geophysics, geological analyses, and some unique combinations of these types of investigation. Current water resource and geotechnical problems in many countries—and the techniques now used to address them—are also discussed. The importance of geological interpretation is re-emphasised in analysing the hydrogeology of fractured, mostly crystalline rocks and in how critical this is for understanding their hydrology and the wise utilisation of resources. This is indeed hydrogeology in its broadest sense. The importance of, but great difficulty in, extending or upscaling fractured rock hydraulic properties is also made clear. This book is aimed at practicing hydrogeologists, engineers, ecologists, resource managers, and perhaps most importantly, students and earth scientists not yet familiar with the ubiquity and importance of fractured rock systems.

Groundwater in Fractured Rocks

The hydrogeologic environment of fractured rocks represents vital natural systems, examples of which occur on every continent. This book discusses key issues, methodologies and techniques in the hydrogeology of fractured rocks, summarizing recent progress and anticipating the outcome of future investigations. Forty-four revised and updated papers w

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Characterization, Modeling, Monitoring, and Remediation of Fractured Rock

Fractured rock is the host or foundation for innumerable engineered structures related to energy, water, waste, and transportation. Characterizing, modeling, and monitoring fractured rock sites is critical to the functioning of those infrastructure, as well as to optimizing resource recovery and contaminant management. Characterization, Modeling, Monitoring, and Remediation of Fractured Rock examines the state of practice and state of art in the characterization of fractured rock and the chemical and biological processes related to subsurface contaminant fate and transport. This report examines new developments, knowledge, and approaches to engineering at fractured rock sites since the publication of the 1996 National Research Council report Rock Fractures and Fluid Flow: Contemporary Understanding and Fluid Flow. Fundamental understanding of the physical nature of fractured rock has changed little since 1996, but many new characterization tools have been developed, and there is now greater appreciation for the importance of chemical and biological processes that can occur in the fractured rock environment. The findings of Characterization, Modeling, Monitoring, and Remediation of Fractured Rock can be applied to all types of engineered infrastructure, but especially to engineered repositories for buried or stored waste and to fractured rock sites that have been contaminated as a result of past disposal or other practices. The recommendations of this report are intended to help the practitioner, researcher, and decision maker take a more interdisciplinary approach to engineering in the fractured rock environment. This report describes how existing tools-some only recently developed-can be used to increase the accuracy and reliability of engineering design and management given the interacting forces of nature. With an interdisciplinary approach, it is possible to conceptualize and model the fractured rock environment with acceptable levels of uncertainty and reliability, and to design systems that maximize remediation and long-term performance. Better scientific understanding could inform regulations, policies, and implementation guidelines related to infrastructure development and operations. The recommendations for research and applications to enhance practice of this book make it a valuable resource for students and practitioners in this field.

Fractured Rock Hydraulics

Uniquely devoted to hard and fractured rock hydraulics, this advanced-level introduction provides tools to solve practical engineering problems. Chapter I covers the fundamentals of fractured rock hydraulics under a tensor approach. Chapter II presents some key concepts about approximate solutions. Chapter III discuss a few data analysis techniques applied to groundwater modeling. Chapter IV presents unique 3D finite difference algorithms to simulate practical problems concerning the hydraulic behavior of saturated, heterogeneous and randomly fractured rock masses without restriction to the geometry and properties of their discontinuities. Supported by examples, cases, illustrations and references, this book is intended for professionals and researchers in hydrogeology, engineering geology, petroleum reservoir, rock and hydraulic engineering. Its explanatory nature allows its use as a textbook for advanced students.

Groundwater Dynamics in Hard Rock Aquifers

This book contains the results and findings of the advanced research carried out in a pilot area with a thorough investigation of the structure and functioning of an aquifer in a granitic formation. It characterizes the hard rock aquifer system and examines its properties and behavior as well as systematically details the geophysical, geological and remote sensing applications to conceptualize such an aquifer system.

Practical Handbook of Soil, Vadose Zone, and Ground-Water Contamination

A synthesis of years of interdisciplinary research and practice, the second edition of this bestseller continues to serve as a primary resource for information on the assessment, remediation, and control of contamination on and below the ground surface. Practical Handbook of Soil, Vadose Zone, and Ground-Water Contamination: Assessment, Prevention, and Remediation, Second Edition includes important new developments in site characterization and soil and ground water remediation that have appeared since 1995.

Presented in an easy-to-read style, this book serves as a comprehensive guide for conducting complex site investigations and identifying methods for effective soil and ground water cleanup. Remediation engineers, ground water and soil scientists, regulatory personnel, researchers, and field investigators can access the latest data and summary tables to illustrate key advantages and disadvantages of various remediation methods.

Fluid Dynamics in Complex Fractured-Porous Systems

Despite of many years of studies, predicting fluid flow, heat, and chemical transport in fractured-porous media remains a challenge for scientists and engineers worldwide. This monograph is the third in a series on the dynamics of fluids and transport in fractured rock published by the American Geophysical Union (Geophysical Monograph Series, Vol. 162, 2005; and Geophysical Monograph, No. 122, 2000). This monograph is dedicated to the late Dr. Paul Witherspoon for his seminal influence on the development of ideas and methodologies and the birth of contemporary fractured rock hydrogeology, including such fundamental and applied problems as environmental remediation; exploitation of oil, gas, and geothermal resources; disposal of spent nuclear fuel; and geotechnical engineering. This monograph addresses fundamental and applied scientific questions and is intended to assist scientists and practitioners bridge gaps in the current scientific knowledge in the areas of theoretical fluids dynamics, field measurements, and experiments for different practical applications. Readers of this book will include researchers, engineers, and professionals within academia, Federal agencies, and industry, as well as graduate/undergraduate students involved in theoretical, experimental, and numerical modeling studies of fluid dynamics and reactive chemical transport in the unsaturated and saturated zones, including studies pertaining to petroleum and geothermal reservoirs, environmental management and remediation, mining, gas storage, and radioactive waste isolation in underground repositories. Volume highlights include discussions of the following:
Fundamentals of using a complex systems approach to describe flow and transport in fractured-porous media.
Methods of Field Measurements and Experiments
Collective behavior and emergent properties of complex fractured rock systems
Connection to the surrounding environment
Multi-disciplinary research for different applications

Flow and Contaminant Transport in Fractured Rock

In the past two or three decades, fractured rock domains have received increasing attention not only in reservoir engineering and hydrology, but also in connection with geological isolation of radioactive waste. Locations in both the saturated and unsaturated zones have been under consideration because such repositories are sources of heat and potential sources of groundwater contamination. Thus, in addition to the transport of mass of fluid phases in single and multiphase flow, the issues of heat transport and mass transport of components have to be addressed.

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aquifer test analysis are also detailed. Fractured medium flow adds yet another dimension to the book. Each method is supplemented by actual field data applications from worldwide case studies. Applied Hydrogeology for Scientists and Engineers covers the topics of groundwater reservoirs, the evaluation of aquifer parameters, aquifer and flow properties, flow properties and bore hole tests, aquifer tests in porous and fractured media, well hydraulics, groundwater flow and aquifer tests, and field measurements and their interpretations. This new reference also works well as a post-graduate textbook on the subject. Applied Hydrogeology for Scientists and Engineers expands the reader's knowledge by providing valuable information not found in any other publication.

Remote Sensing in Applied Geophysics

The Special Issue is focused on recent and upcoming advances in the combined application of remote sensing and applied geophysics. Applied geophysics analyzes the distribution of physical properties in the subsurface for a wide range of geological, engineering, and environmental applications at different scales. Seismic, electrical, magnetic, and electromagnetic methods are among the most applied and well-established geophysical techniques. These methods share the advantages of being non-invasive and exploring wide areas of investigation with respect to conventional methods (e.g., drilling). Geophysical surveys are usually carried out deploying or moving the appropriate instrumentation directly on the ground surface. However, recent technological advances have resulting in the development of innovative acquisition systems becoming more typical of the remote sensing community (e.g., airborne surveys). While applied geophysics mainly focuses on the subsurface, typical remote sensing techniques have the ability to accurately image the Earth's surface with high-resolution investigations carried out by means of terrestrial, airborne, or satellite-based platforms. The integration of surface and subsurface information is often crucial for several purposes, including the processing of geophysical data, the characterization and time-lapse monitoring of surface and near-surface targets, and the reconstruction of highly detailed and comprehensive 3D models of the investigated areas. Recent contributions showing the added value of surface reconstruction and/or monitoring in the processing, interpretation, and cross-comparison of geophysical techniques for archaeological, environmental, and engineering studies are collected in this book. Pioneering geophysical acquisitions by means of innovative remote systems are also presented.

Applied Ground-water Hydrology and Well Hydraulics

Coupling the basics of hydrogeology with analytical and numerical modeling methods, Hydrogeology and Groundwater Modeling, Second Edition provides detailed coverage of both theory and practice. Written by a leading hydrogeologist who has consulted for industry and environmental agencies and taught at major universities around the world, this unique book fills a gap in the groundwater hydrogeology literature. With more than 40 real-world examples, the book is a source for clear, easy-to-understand, and step-by-step quantitative groundwater evaluation and contaminant fate and transport analysis, from basic laboratory determination to complex analytical calculations and computer modeling. It provides more than 400 drawings, graphs, and photographs, and a variety of useful tables of all key groundwater parameters, as well as lucid, straightforward answers to common hydrogeological problems. Reflecting nearly ten years of new scholarship since the publication of the bestselling first edition, this second edition is wider in focus with added and updated examples, figures, and problems, yet still provides information in the author's trademark, user-friendly style. No other book offers such carefully selected examples and clear, elegantly explained solutions. The inclusion of step-by-step solutions to real problems builds a knowledge base for understanding and solving groundwater issues.

Hydrogeology and Groundwater Modeling, Second Edition

Fractured bedrock aquifers have traditionally been regarded as low-productivity aquifers, with only limited relevance to regional groundwater resources. It is now being increasingly recognised that these complex bedrock aquifers can play an important role in catchment management and subsurface energy systems. At

shallow to intermediate depth, fractured bedrock aquifers help to sustain surface water baseflows and groundwater dependent ecosystems, provide local groundwater supplies and impact on contaminant transfers on a catchment scale. At greater depths, understanding the properties and groundwater flow regimes of these complex aquifers can be crucial for the successful installation of subsurface energy and storage systems, such as deep geothermal or Aquifer Thermal Energy Storage systems and natural gas or CO₂ storage facilities as well as the exploration of natural resources such as conventional/unconventional oil and gas. In many scenarios, a robust understanding of fractured bedrock aquifers is required to assess the nature and extent of connectivity between such engineered subsurface systems at depth and overlying receptors in the shallow subsurface.

Groundwater in Fractured Bedrock Environments: Managing Catchment and Subsurface Resources

An extensively revised 2006 second edition of the well received and widely adopted textbook on groundwater.

Groundwater in Geologic Processes

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Groundwater in Fractured Rocks

The 2006 second edition of this well received and widely adopted textbook has been extensively revised to provide a more comprehensive treatment of hydromechanics (the coupling of groundwater flow and deformation), to incorporate findings from the substantial body of research published since the first edition, and to include three new chapters on compaction and diagenesis, metamorphism, and subsea hydrogeology. The opening section develops basic theory of groundwater motion, fluid-solid mechanical interaction, solute transport, and heat transport. The second section applies flow, hydromechanics, and transport theory in a generalized geologic context, and focuses on particular geologic processes and environments. A systematic presentation of theory and application coupled with problem sets to conclude each chapter make this text ideal for use by advanced undergraduate and graduate-level hydrogeologists and geologists. It also serves as an invaluable reference for professionals in the field.

Hydrologie des roches fissurées

A comprehensive review and analysis of recent field, laboratory, and modeling investigations of flow and transport through fractured rock worldwide. Topics include recent advances in modeling, unsaturated flow and transport processes, field and laboratory experiments, microbiological processes coupled process and geothermal resources, NAPL transport in fractured rock, geochemistry and chemical transport and more.

Groundwater in Geologic Processes

Hard rock hydraulics concerns arrangements of adjoining intact rock blocks, occurring down to a depth of hundreds of meters, where groundwater percolates within the gaps between these blocks. During the last decades, technical papers related to successful or failed attempts for mining groundwater from hard rocks, and achievements or failures of public or mining developments with respect to these rocks, increased the knowledge of their hydraulics. Examples of activities where the mechanical behavior of these rocks highly interacts with their hydraulics are projects under the sea or groundwater level, such as open pits or

underground mines, galleries, tunnels, shafts, underground hydropower plants, oil and LPG storage caverns, and deep disposal of hazardous waste. This book dedicated to hard rock hydraulics assumes some prior knowledge of hydraulics, geology, hydrogeology, and soil and rock mechanics. Chapter I discusses the main issues of modeling; chapter II covers the fundamentals of hard rock hydraulics; chapter III presents concepts regarding approximate solutions; chapter IV discusses data analysis for groundwater modeling; chapter V focuses on finite differences and chapter VI provides examples of some particular unusual applications. This book will help civil and mining engineers and also geologists to solve their practical problems in hydrogeology and public or mining projects.

Dynamic Fluids and Transport in Fractured Rock

Gelombang seismik adalah rambatan energi yang disebabkan karena adanya gangguan di dalam kerak bumi, misalnya adanya patahan atau adanya ledakan. Energi ini akan merambat ke seluruh bagian bumi dan dapat terekam oleh seismometer. Pada pemodelan bawah permukaan, gelombang seismik merambat melalui medium dengan kecepatan yang berbeda pada variasi arah, baik lateral maupun vertikal. Hal ini diakibatkan medium yang bersifat heterogen dan anisotropik. Sifat tersebut merupakan hasil dari keunikan proses geologi pada arah tertentu, seperti misalnya arah sedimentasi yang mengikuti pola aliran, kelerengan dari batas sekuens dan lain sebagainya. Oleh karena itu, perlu kiranya untuk mengetahui tetapan anisotropi dari suatu medium. Monograf ini merupakan hasil penelitian penulis pada periode tahun 2006 sampai dengan tahun 2011, yang menggunakan gelombang difraksi seismik untuk menentukan tetapan anisotropi, di mana pada umumnya penentuan tetapan anisotropi menggunakan gelombang seismik refleksi. Sasaran utama dari pembaca monograf adalah para kolega dosen peneliti pada khususnya serta para mahasiswa ilmu kebumihan serta kalangan profesional pada umumnya. Diharapkan dengan terbitnya buku ini maka metode yang ada bisa lebih dikembangkan. Materi yang dibahas dalam buku ini mencakup: Bab 1 Latar Belakang Bab 2 Anisotropi Seismik Bab 3 Medium Anisotrop Bab 4 Relasi Kecepatan Grup dan Kecepatan Fase Bab 5 Gelombang Difraksi Bab 6 Penentuan Tetapan Anisotropi Bab 7 Studi Kasus Bab 8 Kesimpulan dan Rekomendasi

Hard Rock Hydraulics

The second edition of this well established book provides a readable and highly illustrated overview of the main facets of geology for engineers. Each topic is presented as a double-page spread with a careful mix of text, tables, and diagrams. Comprehensively updated, and with four new sections,\" Foundations of Engineering Geology\" covers the entire spectrum of topics of interest to both student and professional.

Tetapan Anisotropi Seismik

FLUID FLOW IN FRACTURED ROCKS \"The definitive treatise on the subject for many years to come\" (Prof. Ruben Juanes, MIT) Authoritative textbook that provides a comprehensive and up-to-date introduction to fluid flow in fractured rocks Fluid Flow in Fractured Rocks provides an authoritative introduction to the topic of fluid flow through single rock fractures and fractured rock masses. This book is intended for readers with interests in hydrogeology, hydrology, water resources, structural geology, reservoir engineering, underground waste disposal, or other fields that involve the flow of fluids through fractured rock masses. Classical and established models and data are presented and carefully explained, and recent computational methodologies and results are also covered. Each chapter includes numerous graphs, schematic diagrams and field photographs, an extensive reference list, and a set of problems, thus providing a comprehensive learning experience that is both mathematically rigorous and accessible. Written by two internationally recognized leaders in the field, Fluid Flow in Fractured Rocks includes information on: Nucleation and growth of fractures in rock, with a multiscale characterization of their geometric traits Effect of normal and shear stresses on the transmissivity of a rock fracture and mathematics of fluid flow through a single rock fracture Solute transport in rocks, with quantitative descriptions of advection, molecular diffusion, and dispersion Fluid Flow in Fractured Rocks is an essential resource for researchers and postgraduate students who are interested in the field of fluid flow through fractured rocks. The text is also highly suitable for professionals

working in civil, environmental, and petroleum engineering.

Foundations of Engineering Geology, Second Edition

Scientific understanding of fluid flow in rock fractures—a process underlying contemporary earth science problems from the search for petroleum to the controversy over nuclear waste storage—has grown significantly in the past 20 years. This volume presents a comprehensive report on the state of the field, with an interdisciplinary viewpoint, case studies of fracture sites, illustrations, conclusions, and research recommendations. The book addresses these questions: How can fractures that are significant hydraulic conductors be identified, located, and characterized? How do flow and transport occur in fracture systems? How can changes in fracture systems be predicted and controlled? Among other topics, the committee provides a geomechanical understanding of fracture formation, reviews methods for detecting subsurface fractures, and looks at the use of hydraulic and tracer tests to investigate fluid flow. The volume examines the state of conceptual and mathematical modeling, and it provides a useful framework for understanding the complexity of fracture changes that occur during fluid pumping and other engineering practices. With a practical and multidisciplinary outlook, this volume will be welcomed by geologists, petroleum geologists, geoengineers, geophysicists, hydrologists, researchers, educators and students in these fields, and public officials involved in geological projects.

Fluid Flow in Fractured Rocks

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Contaminant Hydrogeology

Fractured bedrock aquifers have traditionally been regarded as low-productivity aquifers, with only limited relevance to regional groundwater dynamics and storage. However, as this volume demonstrates with contributions from Europe, Africa and America, it is increasingly being recognized that understanding and characterizing these complex bedrock aquifers is fundamental to managing catchments and subsurface water and energy resources.

Rock Fractures and Fluid Flow

In recent years, the focus in hydrogeologic investigations has expanded to include aquifer sustainability as part of resource evaluations. While there are other books on the subject, *Field Hydrogeology: A Guide for Site Investigations and Report Preparation* provides the first integrated presentation of the American Society of Testing Materials (ASTM) standards, US Geological Survey (USGS), and US Environmental Protection Agency (EPA) field techniques. It also includes access to a website containing software for designing aquifer tests and aquifer-recharge experiments. Written by an author with more than 50 years of experience in

hydrology and geology, this reference treats the subject from a field standpoint. Useful as a field guide or textbook, it contains standard methods for planning and undertaking hydrogeologic investigations. It incorporates case studies, contains a glossary of field-hydrogeology technical terms, and provides a detailed list of ASTM standards and key hydrologic Web sites. The guide is based on ASTM standards as well as EPA and US Department of Interior field technical manuals. The text covers hydrogeologic fundamentals, conceptual models, planning an investigation, surface investigations, subsurface investigations, field inventory, stream flow measurements, water quality measurements, and report preparation. This revised and updated Second Edition also includes new material on the history of hydrogeology, field safety, aquifers, groundwater quality, hydrogeologic maps, and federal regulations. It gives students and seasoned professionals a vast array of clearly written descriptive materials and an extensive source of references available at their fingertips. What's New in This Second Edition: New chapter on the history of hydrogeology New chapter on groundwater development and management, including US federal regulations and transboundary aquifers New material on field safety, groundwater quality and testing, and construction of hydrogeologic cross section and maps New international case studies New THEIS computer model to design aquifer tests Updated information on latest principles and techniques

Rock Fractures and Fluid Flow

Tremendous progress has been made in the field of remediation technologies since the second edition of Contaminant Hydrogeology was published two decades ago, and its content is more important than ever. Recognizing the extensive advancement and research taking place around the world, the authors have embraced and worked from a larger global perspective. Boving and Kreamer incorporate environmental innovation in studying and treating groundwater/soil contamination and the transport of those contaminants while building on Fetter's original foundational work. Thoroughly updated, expanded, and reorganized, the new edition presents a wealth of new material, including new discussions of emerging and potential contaminant sources and their characteristics like deep well injection, fracking fluids, and in situ leach mining. New sections cover BET and Polanyi adsorption potential theory, vapor transport theory, the introduction of the Capillary and Bond Numbers, the partitioning interwell tracer testing technique for investigating NAPL sites, aerial photographic interpretation, geophysics, immunological surveys, high resolution vertical sampling, flexible liner systems, groundwater tracers, and much more. Contaminant Hydrogeology is intended as a textbook in upper level courses in mass transport and contaminant hydrogeology, and remains a valuable resource for professionals in both the public and private sectors.

Groundwater in Fractured Bedrock Environments

The second edition of Restoration of Contaminated Aquifers: Petroleum Hydrocarbons and Organic Compounds incorporates the latest advances in in-situ remediation and natural attenuation, and maintains the comprehensive, accessible structure that made the first edition a classic. The new edition broadens the scope of the first by examining all forms of hydrocarbon contamination. The authors emphasize the remediation of Non-aqueous Phase Liquids (NAPLs) and, Dense Non-Aqueous Phase Liquids (DNAPLs). They also address the growing role of natural attenuation. The second edition opens with an improved introduction. There are new sections on site characterization, remediation economics and site closure. And unlike other books on this subject, the new edition offers vital managerial and project management guidance, such as, initial project planning and assessment, a look at remediation economics, and a how-to on project closure and follow-up. Since its initial publication in 1991, Restoration of Petroleum Hydrocarbon Contaminated Aquifers has been the established, invaluable reference for environmental professionals and regulators. Its sweeping, yet approachable format is inestimable in the field, in the lab, and in the policy-making arena. Restoration of Contaminated Aquifers: Petroleum Hydrocarbons and Organic Compounds will continue to be the guide to the war against petroleum contamination.

Field Hydrogeology

Hard rock hydraulics concerns arrangements of adjoining intact rock blocks, occurring down to a depth of hundreds of meters, where groundwater percolates within the gaps between these blocks. During the last decades, technical papers related to successful or failed attempts for mining groundwater from hard rocks, and achievements or failures of public or mining developments with respect to these rocks, increased the knowledge of their hydraulics. Examples of activities where the mechanical behavior of these rocks highly interacts with their hydraulics are projects under the sea or groundwater level, such as open pits or underground mines, galleries, tunnels, shafts, underground hydropower plants, oil and LPG storage caverns, and deep disposal of hazardous waste. This book dedicated to hard rock hydraulics assumes some prior knowledge of hydraulics, geology, hydrogeology, and soil and rock mechanics. Chapter I discusses the main issues of modeling; chapter II covers the fundamentals of hard rock hydraulics; chapter III presents concepts regarding approximate solutions; chapter IV discusses data analysis for groundwater modeling; chapter V focuses on finite differences and chapter VI provides examples of some particular unusual applications. This book will help civil and mining engineers and also geologists to solve their practical problems in hydrogeology and public or mining projects.

Contaminant Hydrogeology

Groundwater theme is a component of Encyclopedia of Water Sciences, Engineering and Technology Resources in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations. This theme presents a perspective of the field of groundwater and an overview of the important aspects of the subject such as, natural origin and distribution, characteristics under diverse climates and surrounding rocky environments, exploration and management, natural quality and human related sources of contamination, sustainable exploitation of resources, protection and current research trends. The content of the theme on Groundwater is organized with state-of-the-art presentations covering several topics: Origin, Distribution, Formation, and Effects; Typical Hydrogeological Scenarios; Transport Processes in Groundwater; Transport Phenomena and Vulnerability of the Unsaturated Zone; Groundwater Development; Groundwater Use and Protection; Groundwater Management: An Overview of Hydro-geology, Economic Values and Principles of Management; Special Issues in Groundwater, which are then expanded into multiple subtopics, each as a chapter. These three volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, Managers, and Decision makers and NGOs

Restoration of Contaminated Aquifers

The second edition of this well established book provides a readable and highly illustrated overview of the main facets of geology for engineers. Comprehensively updated, and with four new sections, Foundations of Engineering Geology covers the entire spectrum of topics of interest to both student and practitioner.

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