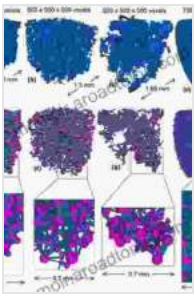
Modelling of Flow and Transport in Fractal Porous Media: Unlocking the Secrets of Complex Geological Systems

Porous media are ubiquitous in nature and play a crucial role in a wide range of geological, environmental, and industrial processes. Understanding the flow and transport of fluids and solutes through these complex systems is essential for addressing challenges such as groundwater contamination, hydrocarbon recovery, and carbon sequestration.



Modelling of Flow and Transport in Fractal Porous Media

★★★★★ 5 out of 5

Language	: English
File size	: 43876 KB
Text-to-Speech	: Enabled
Enhanced typesetting	: Enabled
Print length	: 471 pages

Fractal porous media are a special class of porous media characterized by their highly heterogeneous and self-similar structure. This complexity poses significant challenges for traditional modelling approaches, which often fail to capture the intricate flow and transport dynamics observed in these systems.

Fractal Porous Media: A Unique Challenge

The fractal nature of porous media gives rise to unique challenges in modelling flow and transport processes. The highly irregular pore geometry and connectivity result in:

- **Heterogeneity:** Fractal porous media exhibit significant variations in pore size, shape, and connectivity, leading to complex flow patterns.
- **Tortuosity:** The tortuous nature of flow paths increases the effective distance travelled by fluids and solutes, affecting their transport rates.
- **Scale dependency:** The flow and transport properties of fractal porous media vary with the scale of observation, requiring multi-scale modelling approaches.

These challenges necessitate the development of specialized modelling techniques that can accurately capture the complex behaviour of fractal porous media.

Modelling Flow and Transport in Fractal Porous Media

This comprehensive book provides a systematic overview of the state-of-the-art in modelling flow and transport in fractal porous media. It covers a wide range of topics, including:

- **Darcy's law and its extensions:** The fundamental governing equations for flow through porous media, modified to account for fractal heterogeneity.
- **Navier-Stokes equations:** Detailed analysis of the Navier-Stokes equations for modelling flow at the pore scale, capturing the effects of viscous forces and pore geometry.

- **Pore-scale modelling:** Advanced techniques for simulating flow and transport at the pore level, providing insights into the microscopic mechanisms governing flow behaviour.
- **Numerical methods:** Computational techniques for solving the governing equations, including finite element methods, finite volume methods, and lattice Boltzmann methods.
- **Analytical solutions:** Simplified analytical solutions for specific flow and transport scenarios, providing valuable insights into the underlying processes.

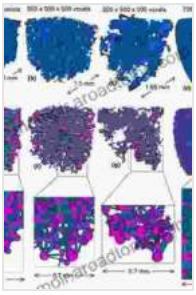
The book also explores the application of modelling techniques to real-world problems, such as groundwater flow and contamination, oil and gas recovery, and porous media heat transfer.

Applications and Impact

The modelling techniques presented in this book have wide-ranging applications in various fields, including:

- **Environmental science:** Modelling groundwater flow and contaminant transport, assessing the impact of human activities on water resources.
- **Petroleum engineering:** Optimizing hydrocarbon recovery by understanding flow and transport processes in reservoir rocks.
- **Industrial processes:** Designing and optimizing porous media-based technologies, such as filters and heat exchangers.
- **Carbon capture and storage:** Evaluating the effectiveness of geological formations for storing carbon dioxide.

By providing a comprehensive understanding of flow and transport in fractal porous media, this book empowers researchers, practitioners, and students to address complex geological problems and contribute to sustainable solutions.



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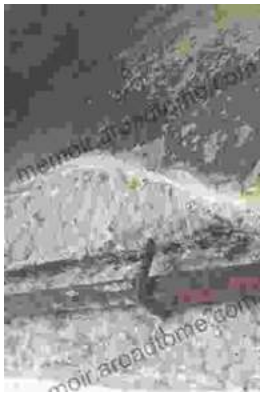

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