Preface

The need to predict, understand, and optimize complex physical and chemical processes occurring in and around the earth, such as groundwater contamination, oil reservoir production, discovering new oil reserves, and ocean hydrodynamics, has been increasingly recognized. Despite their seemingly disparate natures, these geoscience problems have many common mathematical and computational characteristics. The techniques used to describe and study them are applicable across a broad range of areas.

The study of the above problems through physical experiments, mathematical theory, and computational techniques requires interdisciplinary collaboration between engineers, mathematicians, computational scientists, and other researchers working in industry, government laboratories, and universities. By bringing together such researchers, meaningful progress can be made in predicting, understanding, and optimizing physical and chemical processes.

The International Workshop on Fluid Flow and Transport in Porous Media was successfully held in Beijing, China, August 2–6, 1999. The aim of this workshop was to bring together applied mathematicians, computational scientists, and engineers working actively in the mathematical and numerical treatment of fluid flow and transport in porous media. A broad range of researchers presented papers and discussed both problems and current, state-of-the-art techniques.

Over seventy people from Australia, Bulgaria, China, France, Ghana, Germany, Norway, Russia, South Korea, Spain, Taiwan, and the United States of America attended this workshop and more than fifty papers were presented on a variety of subjects in mathematical theory, numerical methods, parallel computation, optimization, surface water and ocean modeling, chemically reactive phenomena, atmospheric modeling, multiscale phenomena, and media characterization.

This book contains thirty-eight selected papers presented at the workshop. They cover recent advances and developments of a wide range of numerical issues of multiphase fluid flow and transport in porous media. The porous media considered range from ordinary media to fractured and deformable ones. The physical and mathematical models treated involve a variety of flows from single phase compressible flow to multiphase, multicomponent flow with mass interchange between phases. The numerical methods studied range from standard finite difference and finite element methods to nonstandard mixed finite

element and characteristics-based techniques. The computational algorithms developed utilize classical fast iterative solvers and modern multigrid and domain decomposition approaches combined with local grid refinement techniques. The characteristics-based techniques for advection-dominated flow and transport processes are emphasized in this book; the classical modified methods of characteristics to newly developed locally conservative Eulerian–Lagrangian methods are addressed.

Financial support for the workshop was generously provided by the National Natural Science Foundation of China, the Beijing Institute of Applied Physics and Computational Mathematics, the Chinese State Key Basic Research Project, the US Army Research Office-Far East, the Office of Naval Research International Field Office Asia, and the US Air Force Asian Office of Aerospace Research and Development. We also thank the local organizers at the International Center of Computational Physics, Beijing, China, for their hard work and hospitality.

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May 29, 2000