Book Review

Introduction to Numerical Geodynamic Modelling, by T. V. Gerya, Cambridge University Press, 2010;
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Numerical modeling is an important tool for understanding dynamic processes of the solid Earth. However, no introductory textbook to that topic has been available to date. This monograph fills that gap by providing solid knowledge of fundamental modeling prerequisites and explaining important numerical concepts.

The book is divided into 19 chapters, each covering one important concept or method of geodynamic modeling. First, the basic geodynamic equations of continuity, momentum conservation and heat conservation are introduced using both Eulerian and Lagrangian formulations. Their numerical solution is achieved by means of the Finite Difference Method and Marker-in-cell techniques. Special attention is thereby given to rheology, treating elastic, viscous, and plastic constitutive laws. After explaining the structure of a thermo-mechanical code, the author provides solutions to specific problems of numerical implementation. The textbook treats numerical models in three dimensions, speed-up of calculation using the Multigrid Method and the essential topic of numerical benchmarking. Finally, applications to geodynamic problems are discussed, such as subduction, lithospheric

extension, mantle convection and planetary core formation.

This book requires only minor previous mathematical knowledge. All important technical terms and concepts are explained step by step. The text is written in a colorful way and includes many vivid examples evoking the feeling of attending a university lecture. In this manner it also provides “soft” knowledge that is often discarded when lectures are condensed into a book. Many detailed formulas are given that offer clear insights into actual numerical processes. Exercises at the end of the chapters and additionally provided matlab files allow readers to apply new techniques and deepen their understanding. As a minor drawback, the textbook focuses solely on the Finite Difference Method, while Finite Element techniques, which also play a prominent role in computational geodynamics, are missing.

This textbook is a great introduction to computational geodynamics. It constitutes an excellent starting point for graduate and PhD students, but also for experts of Earth sciences who are new to the field of numerical modeling.

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