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REVIEWS

Geodynamics

by Donald L. Turcotte and Gerald Schubert

Cambridge University Press
2002; 472 p.; ISBN: 0521661862
Hard cover US $110.00 US; Paperback US $45.00 US

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"Geodynamics" is the second edition of a book entitled: "Geodynamics, Application of Continuum Mechanics to Geological Problems", originally published in 1982. The book provides a comprehensive overview of the fundamental physical processes bearing on our understanding of plate tectonics and a variety of other geological phenomena. In presenting the revised edition, the authors explicitly state that relatively few changes were required owing to the fact that our understanding of most of these processes has been well grounded for some time. Starting in Chapter 1 with a thorough overview of Plate Tectonics, and some discussion on Comparative Planetology, the book discusses nine major topics in succession: Stress and Strain in Solids, Elasticity and Flexure, Heat Transfer, Gravity, Fluid Mechanics, Rock Rheology, Faulting, Flow in Porous Media, and Chemical Geodynamics. Although there are some minor but important additions to some chapters, Chapter 10 on Geochemical Dynamics represents the only major new element in the second edition.

On the whole this book is well laid out and easy to read. However, instructors should be aware that concepts are dealt with using a rigorous, mathematical approach, which makes the book more suitable for upper level undergraduate and graduate students with a solid background in mathematics and physics or geophysics, and perhaps some disciplines of engineering. Each chapter contains an introductory section, which outlines the basic principles to be addressed and provides some context on how these bear on real geological situations. Thereafter, each sub-topic is presented in a logical progression with a number of example problems designed to allow the student to gain more familiarity with the related sub-topic, especially its physical and mathematical basis. Such continuity is also evident on a chapter by chapter basis whereby the authors build and (or) expand upon certain concepts, and (or) demonstrate how they can be approached from different points of view. For example, following introduction of the topic of "mantle convection" in Chapter 1, aspects of it are addressed in Chapter 4 (Heat Transfer), Chapter 6 (Fluid Mechanics), Chapter 7 (Rock Rheology), Chapter 9 (Flows in Porous Media), and Chapter 10 (Geochemical Dynamics). In terms of the overall content of this book, my only criticism is that I would like to have seen a section dealing with how various physical processes may have influenced tectonic style throughout Earth history; for example, if heat production was markedly higher in the past, what influence would this have had on various tectonic processes such as accretion and subduction etc.? Understandably, however, there may not have been enough room to discuss such a broad topic.

The authors state that this book evolved from a series of courses given at Cornell University and UCLA to students with a wide range of backgrounds (geology, geophysics, physics, mathematics, chemistry and engineering), and that the book is designed to encourage a thorough understanding of some of the fundamental physical laws, e.g., Hooke's law of elasticity, Fourier's law of heat conduction, and Darcy's Law for fluid flow in porous media. In my opinion, the revised edition would therefore serve as an excellent textbook for a fourth year undergraduate (or graduate) course in Geodynamics for students registered in Geophysics or Geological Engineering. Although parts of it would be useful in a course in Structural Geology and Tectonics, its highly mathematical approach could prove very intimidating to the average Geology major. Aside from the potential shortcoming in the area of tectonics throughout Earth history mentioned above, as a structural geologist and metamorphic petrologist with interests in mountain building processes and rheology, I give this book a very good to excellent rating.