

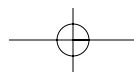
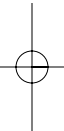
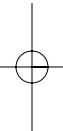
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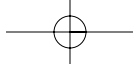
SECOND EDITION

# EARTH STRUCTURE

AN INTRODUCTION TO  
STRUCTURAL GEOLOGY AND TECTONICS

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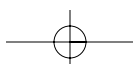
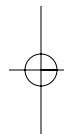
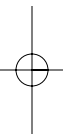
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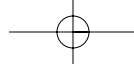
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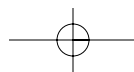
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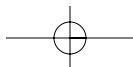
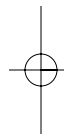
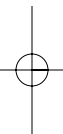
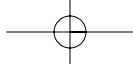
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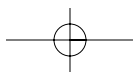
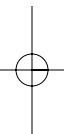
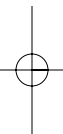
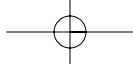
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# Preface

This book is concerned with the deformation of rock in the Earth's lithosphere, as viewed from the atomic scale, through the grain scale, the hand specimen scale, the outcrop scale, the mountain range scale, and the tectonic plate scale. A deformational feature observed on one scale typically reflects processes occurring on other scales. For example, we can't understand continental deformation without understanding mountains, we can't understand mountains without understanding folding and faulting, and we can't understand folding and faulting without understanding ductile and brittle deformation mechanisms at the atomic scale. This book attempts to integrate topics pertaining to all scales of rock deformation, emphasizing the linkages between structural geology and tectonics.

Every month, perhaps a thousand pages of new ideas and observations relevant to structural geology and tectonics are published in the major scholarly journals. The amount of material on structural geology and tectonics that has appeared over the past 150 years is staggering. We have purposely decided to write this book with a novice to the field in mind. We, as instructors, face a massive challenge when trying to distill an introductory course out of this ever-changing and ever-growing mountain of information. We want students to be comfortable with certain basic concepts (say, fault terminology or stress theory), and at the same time, we want them to experience the excitement of discovery and to build their own "big picture" of how the Earth works. And all this must be done in a few short months! Rather than loading the text with excessive detail and peppering it with extensive referencing, we opted instead to present a distillation that offers a perspective on most aspects of the field. The reason for this approach is to highlight the "guts" of structural geology and tectonics, thereby providing a foundation for future study and a platform for further discussion. When reading the text, the reader should maintain a critical and questioning attitude toward the

concepts discussed, which will not only stimulate the mind but also aid in absorbing the material. Concepts are remembered better when their interrelationships are recognized, rather than being presented as just a series of definitions. In some cases we may have advanced a controversial position and perhaps future readers will be the ones to prove some of our viewpoints either right or wrong.

Structural geology and tectonics are a lot of fun once one has waded through the initial terminology morass. Our personal approach to teaching structural geology and tectonics is reflected in the fairly informal writing style of this text. Whenever possible, we use familiar analogies such as rubber bands, syrup, and pool balls. Similarly, we have kept illustrations simple in the early chapters so that the point of the figure is obvious. Terms and definitions related to topics that we do not introduce in the main body of the text are included in tables as a reference. The subject index will direct you to the appropriate location in the text for any specific term.

There's no single right way to teach structural geology and tectonics. Moreover, we increasingly see that structural geology and tectonics is one of the first classes for students who plan to major in geological sciences. We decided to write this book because we found both that existing books did not suit the changing needs of the courses that we teach ourselves and that many other instructors shared our views. Some books try to be a lab manual and a lecture text at the same time, while others are slanted too much toward the research interests of the particular writer(s). Some books are organized in such a way that a reading assignment on a single topic must include splices from all over the book, and others provide more detail than can possibly be covered in a single semester course so that students are, frankly, overwhelmed. We have deleted topics that are generally taught in laboratory sections because these topics cannot be treated adequately within the framework of a lecture textbook. We also do not burden the narrative with references, but



rather provide introductory reading lists at the end of each chapter.

In order to provide instructors with optimal freedom to develop their own course outlines, we've made sure that most chapters are self-contained modules that can be presented in various sequences. Ben, for example, starts his course with a description of rocks, via primary structures, faults and fractures, folds, and fabrics, before introducing stress, strain, rheology, and deformation mechanisms. Steve, by contrast, teaches stress, strain, and rheology immediately after primary structures and presents brittle deformation theory before discussing faults and fractures. We both concentrate on tectonics at the end of our courses, but tectonic implications are typically interwoven with the discussion of different classes of structures earlier in the course. In the end, instructors work hard to make their lectures comprehensive yet comprehensible, accurate yet enjoyable. We have tried to do the same with this book.

## CHANGES IN THE SECOND EDITION

All chapters were revised for the Second Edition, but the general organization remains the same. New sections have been added, while some old ones have been removed or combined. The new edition also includes a chapter on "Geophysical Imaging" and four new essays in Chapters 21 and 22 on the European Alps, the Altai, the Appalachians, and the Cascadia wedge. The remaining essays were updated and revised. The new and revised art offers an even more informative illustration of concepts and topics and will give instructors the opportunity for modern classroom use (see ancillaries).

## ANCILLARIES

*Earth Structure* is supported by a Norton Resource Library offering teachers hundreds of digital copies of the figures from the new edition. The Norton Resource Library images may be used in classrooms as overhead transparencies, computer presentations, and student worksheets incorporated in exams, or course websites. Instructors may either download figures by chapter from the Norton Resource Library, after obtaining a password from Norton, or request the images on a CD-ROM. Both password and CD-ROM requests are located at the Norton Resource Library web address: [www.wwnorton.com/college/nrl/welcome.htm](http://www.wwnorton.com/college/nrl/welcome.htm).

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Ben van der Pluijm, Ann Arbor, Michigan  
 Stephen Marshak, Urbana, Illinois  
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