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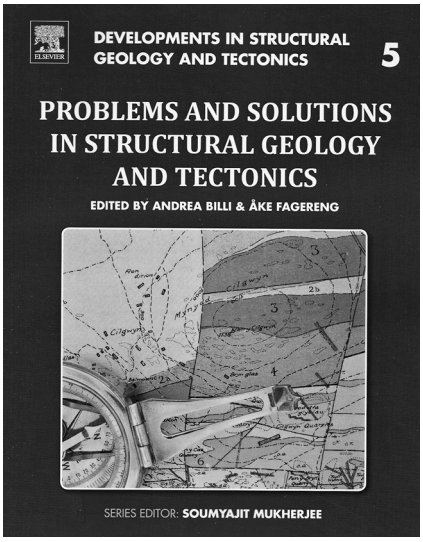
Problems and solutions in structural geology and tectonics, by A. Billi & Å. Fagereng (Eds.), 2019 [Developments in structural geology and tectonics, vol. 5], Elsevier Inc., Amsterdam. 316 pages. Paperback: price €142,79, ISBN 9780128140482.



The editor of the series "Developments in structural geology and tectonics", S. Mukherjee, states in the preface to the fifth volume of this highly valuable set of monographs, that this novel tome is addressed primarily (but not only) to students and their instructors, as well as to young researchers and industry professionals. The book's contents perfectly meet the objectives formulated in this declaration. People interested in developing skills and acquiring knowledge of structural geology and tectonics, i.e., both students and lecturers, now have an up-to-date, excellent source of didactic materials at their disposal. The present volume presents exciting opportunities for gaining practical skills by means of the most modern methods related to the studies of deformational processes and structures in rocks. The tome aids in theoretic understanding and efficient working with tectonic data at different scales (mesoscopic, regional and global), using a wide spectrum of methods (field studies, maps and cross section interpretations, computer techniques, mathematical calculations, geophysical methods etc.). By reading this text, readers, of the young generation in particular, who have grown up in a computer-dominated environment, can also learn about useful applications of universal digital tools, such as Google Earth, as well as of the considerable range of software that is more strictly suited to the geosciences.

The present book is the result of the work of more than 30 authors who are specialised in diverse methods of tectonic sciences and beyond and are affiliated to over 20 academic institutions and commercial companies. Together, these contributors have created twenty-two mutually independent units (chapters) that are grouped by the editors into six separate thematical parts. The chapters deal with a wide array of issues in the field of structural geology and tectonics, but particular units of the monograph repeatedly show interconnections, even when located in different thematic blocks. This makes this tome into a coherent whole, even in spite of relatively distant topics that are discussed in individual chapters. The subdivision aids the reader in finding those chapters that are within his/her scope of interest. In a few cases, one could raise questions about the assignment of specific chapters to a particular thematic segment, but is a subordinate observation at best, which does not detract from the enthusiastic reception of this useful and unprecedented publication. Sequentially, the specific parts are dedicated to methods of observation and interpretation in tectonics, stress-and-strain analysis, fieldwork and hand-specimen observations, novel methods in field geology, structural and geophysical techniques in subsurface geology with reference to petroleum geoscience and, finally, to the application of mathematical and computer methods in structural geology.

The distinctly didactic goals of this book are reflected in the structure of its chapters. Following an introduction to specific issues and thorough explanations of these, the chapters include tasks (*problems*) and their *solutions*. The latter are separated from the problems, and close every unit, which is an accurate idea for the layout of the chapters. In most cases, the reader does not get to see the answers, while browsing the questions. Each of the

twenty-two units includes its own, frequently quite extensive, set of literature items,which facilitates the efficient use of this volume. The book will certainly be read and used not as a single entity, going from cover to cover, but as single units; such is the most efficient, even though some references are repeated in a few chapters. The educational character of the present volume corresponds well with the numerous citations of textbooks on these two subdisciplines of geoscience. I find these references especially important and helpful to the young geology adepts, who can find the additional basic background for the detailed issues highlighted in this monograph. There are two indexes: one listing referenced authors and one of subjects. Both guarantee easy navigation through the book, and allow to find the links and common threads between its individual chapters. The big advantage of this monograph are the illustrations, of which there are many and most in full colour. Coupled with the relatively large size, these allow the reader of the paperback version to analyse illustrations in a comfortable way, which, in case of structural geology, is critical to the efficient transfer of knowledge. In most cases, chapters are based on examples from the author's/authors' own research or educational activity, and are put in a specific regional context. Such concrete references to defined localities make explanations of individual methods presented in the volume even more attractive.

The first part of the book, entitled "Integrating observation and interpretation to understand tectonics, past and present" , comprises four chapters on methodologically distant topics that are united by the clue in the title. These focus on cross section constructions and balancing, on methodology and data analysis of measurements obtained for very gently dipping structures, on the use of GPS data to decipher tectonic plate movements and related deformation, respectively. The last chapter in this part is a successful attempt to bring closer to home the seismologic intricacies related to earthquakes and their magnitudes, and to make these data useful for interpretation by structural geologists.

The next five chapters, included in Part II ("Relating observed deformation to stress and/or strain history") deal with issues related to the widely understood strain analysis, as well as to stress assessments. This section heads off with an interesting case study on mud volcano activity and the possibly related eruption during the drilling of an exploration borehole in Indonesia. Pore pressure changes and resultant hydraulic fracturing are elegantly discussed, and used as the basis for problem solving. This is followed by a text on the use of geometric parameters of faults in validation of spatial framework of these structures. The next two chapters are related to strain problems. The first, focused on pure shear mechanism, is strictly theoretical and based on mathematical calculations, while the second, on finite strain analysis, combines the exemplary real data with algorithm implementation. The last unit of this section refers to the issue of unfolding of bedding by using accompanying mineral veins, based on an example from the famous Ardennes-Eifel Basin.

In view of the fact that fieldwork is still essential for most structural geologists, the third part of the volume ("Observations and interpretations in fieldwork and hand specimens") draws special attention and does not disappoint in any way. The chapters discuss appropriate identification and interpretation of structures induced in shear zones and assessment of the relative age of structures in travertines (an incredible example of studying geological problems in Rome, by observations on decorative and construction stones!). There are also two papers related to the efficient combination of data and methods from two distant geological realms: stratigraphical and structural, as the necessary integration for proper tectonic interpretation (in contexts of the Wilson cycle and the overprinting Palaeozoic orogenies in the Appalachians).

Part IV is also focused on field-oriented issues. As the title, "Adding modern methods to field geology" suggests, a novel approach to field data interpretation is shown in this section. The fascinating two first chapters introduce the use of Google Earth as a valuable tool in superficial geological mapping and 3D modelling. Exercises are based on the use of freely accessible satellite images delivered by this platform. The second of these two chapters, concerning 3D models, is more advanced and includes an exercise based on elementary programming in Python language. Remote sensing analysis of images delivered by Google Earth and other open-source applications, applied for identification and interpretation of tectonic lineaments, is presented in the last unit of this thematic part.

The following section, entitled "Geophysical and structural techniques in petroleum geoscience and borehole projects", refers to various issues connected with exploration and exploitation of oil ad gas. It starts with a chapter that elucidates the significance of accurate identification of fault geometry (and their sealing properties) for an overall understanding and correct modelling of hydrocarbon reservoirs. Also, the following unit is dedicated to the issue of fault structures. In this case, the problem of displacement scale along faults *vs* thickness

of fault damages zones in terms of petroleum trap characterisation is introduced. This aspect is also potentially important for other practical applications, like carbon dioxide storage or groundwater pollution monitoring. The third chapter of Part V takes the reader to another area of petroleum geosciences, and refers to well-logging interpretation of petrophysical properties. The neutron log analysis using the numerical method is perhaps the most distant issue in the entire scope of this volume.

The sixth, and last, segment of this monograph, entitled "Novel integration of mathematical methods, computer science, and structural geology", refers to those methods that appear to be the future for all geosciences, including tectonics. The mathematical approach to geological processes, coupled with the use of continuously developing computer technology and user techniques, are expected to play an increasingly important role in improving our understanding of complex Earth structures. The closing chapters in the present tome are elegant examples of such a perspective and back up this prediction. The first of these is purely mathematical and discusses the application of the graph theory in analyses of fracture networks. The next is a presentation of Boolean algebra (logic) implementation in studies of fluid flow. The final chapter deals with the topic of 3D imaging and interpretation of fold structures, including superposed folds, using the Bezier surfaces.

Without doubt, any reader who will go through the extensive collection of questions and problems included in this volume and will either find the answers personally or at least will explore the solutions presented, will reach the next competence level as a structural geologist, a tectonician or, more generally, a geoscientist. The present tome deserves to be recommended for self study by any ambitious geology student, but even more, for teaching resource to academic lecturers. Researchers and industry workers who deal with issues related to structural geology and tectonics will also be satisfied with the richness of examples that document a modern methodological approach to numerous subjects. Apart from being an excellent collection of exercises, the volume can be treated as a source of inspiration for deeper studies of the topics discussed, as well as for developing the next improvements of methods presented. This innovative book brings new quality and new insights into the literature that is aimed to propagate knowledge of modern methods in structural geology and tectonics.

Wojciech Stawikowski
Adam Mickiewicz University, Poznań, Poland
e-mail: wojst@amu.edu.pl