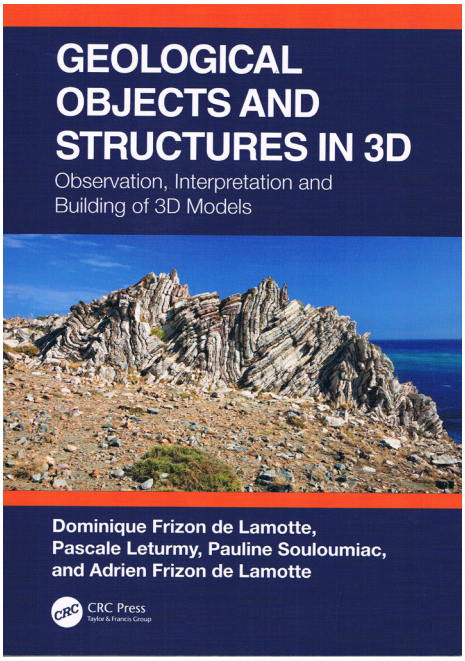
sciendo

Geologos 30, 3 (2024): 233–235
https://doi.org/10.14746/logos.2024.30.3.21

GEOLOGOS

Geological objects and structures in 3D: observation, interpretation and building of 3D Models, by D. Frizon de Lamotte, P. Leturmy, P. Souloumiac & A. Frizon de Lamotte, 2021. CRC Press, London, 138 pages. Paperback: price GBP 39.09, ISBN 978-0367497507



There are some books that readers may perceive as unusual, on account of some specific element not seen before in any other publication. Such a feeling of uniqueness came over me during and after reading of the tome reviewed here. This impression was fuelled by the fact that a new, exceptional attitude to the topic of geological, mostly tectonic, structures, is introduced, on the basis of presentations of three-dimensional models produced by 3D printers. By all means, this technically novel way of constructing models of geological objects is commendable, especially so for teaching, although, as the book shows, it is neither trivial nor easy, and requires considerable skills in computer-aided design, as well as a proper understanding of 3D printing technology and, of course, geological expertise. It must be stressed that this technical novelty is not the only major merit of the book. The volume is also an excellent guide through the plethora of tectonic features and processes, which makes it a highly recommended supplementary text for students, lecturers, researchers and other enthusiasts of structural geology and tectonics.

The book is elegantly composed and consists of six main chapters, preceded by a foreword and followed by several supplementary items, including appendix, glossary, bibliography and index. Besides, a chronostratigraphical chart is also appended, which would seem unneeded; however, its presence is explained by the authors as a reference for the colour system applied in their 3D-printed models. Each of the chapters focuses on a different type of geological structures or objects, starting from the simplest in geometry and formation, to the most complex ones. The reader's journey starts with uniformly dipping layers, then continues with unconformities, faults and folds (with two chapters devoted to these), to end up with salt-related structures. The book is very harmonious in its layout. As to every chapter, its main contents are concise but thorough, presenting current knowledge on types of structures implicit in its title. All chapters conclude with an illustrated description of 3D-printed models of the objects discussed. The additional subdivision of the text into subchapters makes it more accessible. Simultaneously, these smaller segments are mutually connected and sequential and logically pass into one another. Additionally, almost all chapters, except for the last one, contain isolated inserts (boxes), which extend the main topics with additional information. Although the boxes are valuable components of the chapters, they can be read separately, forming independent entities as it were. The chapters start with a presentation of basic knowledge of features discussed, e.g. a description of the outermost layers of the Earth's globe (Chapter 1), or basic concepts related to folding and fold classifications (Chapter 4). In others, following an introduction, the contents of the chapters become more advanced and demanding, in the positive sense of the word. The large number of illustrations, including sketches, diagrams, maps, cross-sections

and photographs really aid in absorbing the knowledge and digesting information comprised in this book. Especially, the numerous coloured, well-drawn instructive graphics that depict the objects and structures discussed, as well as their evolution, deserve appreciation. The theoretical description and explanation of specific groups of structures is supported by numerous regional examples. In view of the fact that the authors are French, and the book was originally published in their native tongue (just a year prior to the publication of an English version), it seems natural that a great number of regional references comes from France. By the way, this appears to be an additional advantage of the book, because it brings closer the tectonics of classic areas of this country, strongly related to the development of geology as a science, such as the Alps, the Jura Mountains and the Pyrenees. In addition, other regions are examined, with excellent, representative examples of structures discussed, such as the Zagros Mountains or the Moroccan Atlas, which are definitely very well known to the authors, who conducted research in those areas. Unfortunately, in some cases, field photographs, and in single case also other figures, appear too small to illustrate the structures presented well (e.g. Fig. 3C2 intended to show the tectonic compaction cleavage). Here, access by a book owner to digital versions of the figures would be a huge, helpful benefit. Perhaps, this could turn out possible in the case of new editions of the "Geological objects and structures in 3D"…

The present book is evidently erudite, which brings additional pleasure during reading. The authors refer to facts, concepts and publications covering the deep past in terms of scientific research. Some of these may be depicted as extracted from pages of a treatise on the history of geology and its subdiscipline, tectonics. Examples include not only the brilliantly presented contribution of the "father of geology", James Hutton, reported in the introductory subchapter on unconformities, but also mentions about the beginnings of analog modelling of tectonic processes, with the pioneering experiment by another Scottish naturalist, James Hall, described by him as early as 1815. The next interesting feature in the present book is a short essay by Julien Douçot entitled, "Geological time and philosophy". This unique component of the tome can inspire personal reflections, not only about time in geology, but also about the history and present state of human thought and knowledge about the world around us.

After the main body of the book, i.e. the six chapters related to geological features and their models, the authors proposed a separate unit named Practical tips for designing and printing 3D objects, included in the Appendix. Not only does this part of the volume answer questions about the technical side of producing the printed models. When reading the structure-related chapters, it also inspires, by means of precise and clearly written tips, readers to make their own attempts in the nearest fab lab, i.e. a place, where 3D objects are being printed. Not all questions raised during reading are answered in this part of the Appendix (the dove-tail system used for merging individual model parts, and mentioned in chapters 2 and 3 is not shown, nor explained here), but this appears to be a minor disadvantage. Here the authors also present other applications of 3D printing in geology. They include models of regional geological structures, a sequence-stratigraphical model, crystallographic system models and even a petrological diagram. The glossary is a useful and significant component of the Appendix. It comprises a vast array of important geological terms used in the book. The definitions are concise and clear. Only a few terms are omitted, such as extensional collapse, arch and basin geometry or compaction band; such would have enriched the glossary, especially so as they play an important role in the text.

As mentioned above, the book represents a valuable tool to be used by students and educated professionals alike, in order to deepen or consolidate their knowledge of structural geology and tectonics. Below, a few selected examples are given. The short Chapter 1 clearly describes terms related to the orientation of geological layers, as well as the relationship between their geometry and land topography, manifested by the V rule. Subsequently, the presented 3D models strictly refer to this issue. Here, as well is in the remaining chapters, the 3D models of geological structures and objects show several different perspectives (from above, in side view and in oblique view), which really helps to absorb the ideas behind the creation of these models. Chapter 2 presents a review of unconformities, with convincing regional examples from the Paris Basin and the broader North African and Near East region. The following chapter very efficiently explains the Coulomb-Mohr theory of brittle failure, which makes for a good background in the presentation of fault structures. The next two chapters are devoted mostly to fault-related folds; however, the authors present also general knowledge of the theory of folding (e.g. Biot's law), discuss the idea of balanced cross-sections and reveal the intricacies of analogue modelling of tectonic processes (with reference to experiments conducted in their laboratory, too). Chapter 4 focuses on detachment faults, while fault-bend folds and fault-propagation

folds are discussed in Chapter 5. All of these three types, obviously, are represented also by 3D-printed models designed by the authors. An advantage of Chapter 5 is the presence of three diagrams with kinematic models showing the step-by-step development of a fault-bent fold and a fault-propagation fold (in the second case in two versions: by kink method and including trishear zones). What is important is the fact that they are also described in detail in the text. Unfortunately, one of these figures (Fig. 5.9) is lacking in the reviewed edition of this volume, due to erroneous repetition of Figure 4.9. This then presents the next argument for giving book buyers access to digital versions of the figures, because all illustrations play a critical role in the book's perception. The last chapter, Chapter 6, is remarkable in explaining different reasons of salt mobility and differing geometries of structures generated by these diverse mechanisms. The above listed issues are only the chosen topics covered in the reviewed book, which is not thick, but substantially rich in valuable content.

An old truth claims that good geologists, especially structural geologists and tectonicists, but also sedimentologists, geological mappers and many others should be able to imagine structures and objects in three dimensions. Therefore, shaping this skill during geological education is one of the basic tasks and challenges for people engaged in geoscience didactics. This need is mentioned also in the present book. The novel technique of making the spatial models using 3D printers, referring to idealised geological objects and structures, but also imitating genuine regional geology, may be one way of constructing three-dimensional imaginations for future geologists, as an alternative to the increasingly more sophisticated digital models, which, unfortunately, cannot be taken in your hands. It can be also an attractive tool for the popularisation of geology. The authors convincingly show that printed 3D models reflect geological objects accurately and precisely, also in case of complex structures, whose forms are concordant with results of calculations or geometric constructions. The book also constitutes an excellent background for studying geological structures in 3D, based on theoretical knowledge and appropriately selected regional examples. Finally, it should be admitted that '3D thinking during reading' not only was apparent during analysis of the photographs with the printed models. Such 3D imaging was triggered in my mind just by following the textual descriptions of the geological structures and their evolution! Let me conclude with a personal wish for more of such inspiring and instructive publications on our geological bookshelves.

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