# Reviews

Coordinated by Amit Padhi

**Anatomy of a Paleozoic Basin: The Permian Basin, USA,** by Stephen C. Ruppel, ISBN 978-1-970-00740-4, 2019, AAPG and the Bureau of Economic Geology, 412 p., US$49.95 (print).

This is a review of the first volume of a two-volume set. The first volume is divided into three major sections: structure and tectonics, paleontology and biostratigraphy, and Paleozoic stratigraphy and sedimentology. Chapter 1 is an introduction, and Chapter 2 is on a gravity and magnetic study.

On the second page, Stephen Ruppel wrote, "The goal of the chapters in these two volumes is to capture in a single publication, the wealth of information and knowledge about the Permian Basin geology… Collectively, the chapters in this publication provide an up-to-date, comprehensive picture of what we know about the geology of the Permian Basin, how it was formed, its hydrocarbons, and how to better exploit them." This volume spans a broad and lengthy portion of geologic evolution.

The geopotential data from Chapter 2, the only geophysical chapter, reveal variations in basement structure in the lower crustal. Chapter 3 presents a helpful timeline, showing the type and amount of volcanic activity from before 1600 to 1000 MYBP. I was surprised to learn the span of geologic time data, the variety of rocks over which this complex basin was formed, and how it was affected by major global and regional tectonic events.

Chapters 6–9 establish the connections of conodonts, foraminifera, and other microfossils with the establishment of local, regional, and global correlations. Chapters 9–13 establish the history and origin of the source rocks and the region's paleoenvironment.

In total, these chapters show the complexity, long duration of time, and how many tectonic elements that formed this basin. The entire timeline extends from the Late Cambrian through the Permian. Noteworthy is how the history of the Permian Basin was involved with virtually all of the major tectonic and geologic occurrences of the Proterozoic and Mesozoic.

It goes without saying that if you are working on any aspect of this region, this volume should be on your desk. Even if you are not, the formation and evolution described here could apply to many regions. It is written at a basic science level. Therefore, I recommend this book to every earth science student as a classic study of a highly important region, as it covers sedimentation, stratigraphy, micropaleontology, plate tectonics/structural geology, and geophysics. I further recommend a course based on these two volumes. The second volume should be published next year.

The volume includes 221 high-quality figures. Most are color images on excellent paper, making a heavy book. However, in a study comparable to this, there are items I would have liked to have seen included, most importantly a volume index. There are fewer seismic reflection profiles than I expected. (I realize that critical 3D seismic data remain unpublished.) Some of the figures lack latitude and longitude marks. There are few outcrop photographs — only five in three of the chapters. However, these criticisms are minor when considering the scope of this study.

I will give the last word to Ewing, "Knowledge of the basin proceeded with the drill bit, with limited assistance from geophysics until the 1970s."

— Patrick Taylor
Davidsonville, Maryland

**Quantifying Uncertainty in Subsurface Systems,** by Céline Scheidt, Lewis Li, and Jef Caers, ISBN 978-1-119-32583-3, 2018, American Geophysical Union and John Wiley & Sons, 304 p., US$189.95 (print), US$151.99 (eBook).

The subsurface medium created by geologic processes is not always well understood. The data we collect in an attempt to characterize the subsurface can be incomplete and inaccurate. However, if we understand the uncertainty of our data and the models we generate from them, we can make better decisions regarding the management of subsurface resources. Modeling and managing subsurface resources, and properly characterizing and understanding the uncertainties, requires the integration of a variety of scientific and engineering disciplines.

Five case studies are outlined in the introductory chapter, which are used to demonstrate various methods throughout the book. The second chapter introduces the basic notions in decision analysis. Uncertainty quantification is only relevant within the decision framework used. Models alone do not quantify uncertainty, but do allow the determination of key variables that influence models and decisions. Next, an overview of the various data science methods relevant to uncertainty quantification in the subsurface is provided. Sensitivity analysis is then covered, specifically Monte Carlo-based sensitivity analysis. The next three chapters develop the Bayesian approach to uncertainty quantification, and this is the focus of the book.

All of this is brought together in Chapter 8, which describes a solution regarding quantifying the uncertainties for each of the problems presented in the first chapter. The authors admit that it is not the only solution. No single solution fits all problems of uncertainty quantification. The results in this chapter allow the reader to see the previously described methods applied and how choices influence models and decisions. The final two chapters discuss various software components necessary to implement the strategies presented in the book and challenges faced in the future of uncertainty quantification.

The book uses a number of relevant subsurface problems to explore the various aspects of uncertainty quantification. Understanding uncertainty, and how it affects modeling and decision outcomes, is not always straightforward. However, it is necessary in order to make good, consistent decisions. The book is not an easy read. Some portions require good mathematical understanding of the underlying principles. However, the book is well documented and organized. I would say that is not a good

book for a beginner, but it is a good resource for someone to get a grounding to go further into the subject. I appreciate the authors putting together this book on a complex problem that is important to our industry.

— David Bartel
Houston, Texas

**Innovation in Near-Surface Geophysics,** by Raffaele Persico, Salvatore Piro, and Neil Linford, ISBN 978-0-128-12429-1, 2018, Elsevier, 534 p., US$150 (print), US$150 (eBook).

*Innovation in Near-Surface Geophysics* provides an overview of a wide variety of near-surface geophysical techniques, complete with examples of their applications. In fact, the book covers a wider swath of techniques than average undergraduate geophysics texts. Each technique is introduced briefly and at a high level. Some details are provided regarding the background physics, along with the governing equations in most cases. Some typical physical modeling and data interpretation techniques are discussed, and a number of field study examples are given. Among other methods, various forms of ground-penetrating radar, controlled-source electromagnetic induction, x-ray fluorescence, magnetometry, and electric resistivity imaging are addressed.

This book would serve well as a broad overview or a supplementary textbook in a geophysical classroom, even if the focus is not strictly on near-surface investigation. However, it would not suffice as a primary educational text on near-surface geophysics. A development of the underlying mathematical theory is not the objective of this text. It is instead an approachable text that someone who is not a career geophysicist, but who has some experience with geophysical methods, can absorb. It is generally easy to read, and the examples logically follow from the introductory text in each section.

The book devotes a good amount of time to the integration of multiple data collection methods, especially for archaeological surveys, which is an area not well covered in the literature. On the other hand, readers interested in other near-surface applications, such as environmental or geohazard surveys, will find only light treatment.

The book does suffer from some English translation errors and some low-resolution images. Because it is a collection of submissions from multiple authors, not all chapters have these issues. Also, though it serves as a good survey, the title is a bit misleading. The presented approaches are mostly standard fare rather than innovations. However, the case studies present fresh applications of near-surface methods, and the final chapter provides an interesting audit of multimethodological data integration techniques. Moreover, a chapter on anomaly detection touches on the use of machine learning for target detection via image segmentation and classification.

In summary, *Innovation in Near-Surface Geophysics* is a good supplementary text on near-surface geophysical methods that nicely collects a modern view of the field, discarding outdated and seldom-used methods that fill pages in classic geophysics tomes. If readers are particularly interested in applications to archaeology, they will find this text useful.

— Jack Stalnaker
Houston, Texas