The Volcano Adventure Guide, by Rosaly Lopes. ISBN 0-521-55453-5, Cambridge University Press, 2005, 368 pp. $50.

In "The Volcano Adventure Guide" Rosaly Lopes aims to provide a travel guide for the aspiring 'volcano tourist'. To this end Lopes, a planetary geologist and vulcanologist from the Jet Propulsion Laboratory, provides a detailed description of over forty of the world's most interesting active volcanoes. Note well the importance of the word 'active,' this is not a gentle guide to extinct volcanoes or ancient lava flows, this is a tome dedicated to travelling to some of the world's most lively centres of volcanic activity. As a result, Lopes places much emphasis on the safety aspects of such adventures and on giving detailed descriptions of recent eruptions as a guide to possible future activity.

The core of the book is based around travel guides to forty-two volcanoes in many different geological and geographical localities. Preceding these field guides are five short chapters giving an overview of volcanic activity worldwide; a basic introduction to volcanoes and the different types of eruptions that they produce; a detailed guide to safety when visiting volcanoes and some hints and tips on how to plan your 'volcano adventure'. The introductory chapters by their very nature skim the surface of much of the complex science involved in volcanology, however in a book of this nature the safety chapters are vital reading. Certainly, I was quickly taught the correct reaction to being caught in a shower of volcanic bombs - apparently you should stand still and dodge the projectiles as they fall, not blindly run for your life as this reviewer certainly would. However, if the safety chapters haven't scared you off, then the field guides that follow do their best to persuade you to visit some exciting volcanic activity. The locations described vary from the sites of some of the twentieth century's most infamous eruptions, Mt. St. Helens and Mont Pelée, through well known active volcanic locations such as Yellowstone to the lesser known, but no less spectacular, volcanoes of Costa Rica and Iceland. Each volcano is described historically, geologically, and geographically, with detailed access and safety instructions. Naturally, some of the locations (such as Yellowstone) are much more 'tourist-friendly' and thus are covered with a wealth of information. Locations such as Montserrat which have been recently been devastated by large scale volcanic activity are naturally harder to visit and thus the descriptions are considerably sparser.

While the book is undeniably well produced and well written (it particularly benefits from the personal views and reminiscences of the author about certain volcanoes), I consider its format to be a major problem. It is produced as a glossy, coffee-table volume complete with spectacular volcano photographs, however, upon reading, it appears to be the kind of guide that you should be able to stuff into your day-sack as you set off hiking. If the publishers make a smaller format, softbound version available then it really will be a true volcano adventure guide. Until then, what you have is a good, original book that may well provide pleasant reading but will not be the active (if you'll excuse the pun) guide the author I'm sure intended it to be.

—John Brittan
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Seismic Signatures and Analysis of Reflection data in Anisotropic Media, by Ilya Tsvankin. ISBN 0950-1401 (Series), 0-08-044618-3 (paperback volume), Elsevier, 2005, Handbook of Geophysical Exploration: Seismic Exploration v.29, 436 pp., $102.

This paperback is a reprint of the 2001 hardback edition. While the book has not been updated, it still provides a comprehensive and useful look at seismic velocity anisotropy. The book is designed for geophysicists in research, exploration, and development interested in anisotropic effects in reflection seismology. The book is divided into chapters on basic theory, anisotropic influence on seismic energy radiation and AVO analysis, normal-moveout analysis in anisotropic media, non-hyperbolic moveout, mode-converted waves, time-domain signatures in transversely isotropic (TI) media, parameter estimation in vertically TI (VTI) media, and imaging for VTI media. The notation for the anisotropic equations is given in both Thomsen notation and stress-strain equation relationships. Tsvankin keeps the mathematical development in the main portions of the chapters fairly simple. More extensive development is reserved for the appendices following the first six chapters that are concerned with the theoretical development of anisotropic equations for reflection moveout and AVO.

The type of anisotropic media developed most extensively in the book is VTI, although tilted TI media are also discussed at length in several portions. Horizontal TI and orthorhombic anisotropic media are touched on briefly. Most of the book is concerned with P-waves, although there is a chapter on reflection moveout of PS-waves. Interestingly, surface P- and S-wave seismic data alone can be used to determine the P- and S-wave velocities, plus the Thomsen P-wave anisotropy parameters δ and ε.

The last two chapters cover using seismic data to determine the anisotropic parameters of the earth and their effect in imaging. Velocity analysis in anisotropic media can show the effects of the anisotropy even at fairly short offsets. Good determination of the far-offset anisotropy requires that the source-receiver offset be greater than the depth of the reflector. Time-domain VTI imaging requires only the NMO velocity and the Thomsen η parameter. Depth imaging for a VTI media requires a velocity and two Thomsen anisotropy parameters. A couple of figures in Chapter 8 were to read, but overall the figure quality is good. Not taking into account anisotropy can lead to incorrect depth estimates and distortion of dipping events.

This book provides a good development of the equations for seismic waves in anisotropic media, anisotropic parameter estimation, and imaging. The reference list seems to be fairly complete and it is easy to find the references to a specific paper using the Author Index. There are, of course, more recent developments in anisotropy than the true publication date of this book (2001). But this book provides a solid treatment of seismic anisotropy from theoretical equations through application to imaging. Tsvankin has been involved in much of the advance of the theory of anisotropy for seismic reflection and imaging. This familiarity with the subject shows through in the book. The book is quite readable and useful to geophysicists in understanding and using anisotropy in processing, imaging, and interpreting seismic data.

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Ground-Penetrating Radar for Archaeology by Lawrence B. Conyers. ISBN 0-7591-0772-6, Alta Mira Press, 2004, 173 pp., $85.

Ground penetrating radar (GPR) has now become one of the major tools of archaeology and shallow geophysical studies, due to its ability to map underground regions, albeit at a shallow depth, with relative ease and economy. Surprisingly, the first ground to be penetrated with GPR was lunar; astronauts mapping the moon's subsurface used it during the Apollo 17 mission. Lawrence Conyers has presented a complete introduction to the GPR process in this beginner's volume. The presentation is at the nongeophysicist level; this book is best suited as a supplement in an introductory exploration course or as a how to primer for the nonspecialist. However, I would recommend this text to a practicing geophysicist wanting to know about GPR and starting from zero knowledge. While the text is presented in an elementary manner, the author does not talk down to the reader. Another positive feature of this book is that it presents the material in a field manual style with the many caveats and pitfalls of the method being explained from examples of failed surveys; this would permit the reader to immediately begin a GPR campaign.

The chapters proceed from introduction, equipment description (with several photos), survey design, field operations, data analysis, and interpretation to conclusion. Equations are few and far between, being presented only where necessary and without derivation. Not surprisingly, there is a strong correspondence with seismic reflection exploration since both use propagation and reflection of waves within the earth, albeit at a different frequency (with GPR operating at 400-900 mHz), and both record traveltimes. Both methods are subject to the same vagaries of unknown subsurface geometry and velocity variations (fortunately, seismic exploration does not have to be concerned with interference from the ubiquitous cell phones and other consumer devices), subsurface relative dielectric permittivity-electric conductivity and elastic properties being the respective relevant physical parameters. An entire 19-page chapter is devoted to velocity analysis. Unfortunately, GPR depth capability is good to only a few meters except in unusual circumstances (those being arid regions and in the Antarctic, where airborne radar signals can map glacier thickness). The tradeoff between frequency and depth of penetration is thoroughly discussed, enabling the investigator to make the proper decision before the survey begins; however, subsurface water is the major factor in limiting depth of penetration. There are several tips that help in making real-time decisions during the survey to avoid major mistakes. The analogy with seismic reflection continues with the Post Acquisition Data Processing chapter and the description of removing multiple reflections, migration and the like.

In the first sentence in his conclusion, the author writes, "Ground penetrating radar can be one of the most complicated of near-surface archaeological geophysical techniques, but also one of the more rewarding, as it has the ability to map what is buried in the ground in three dimensions." This sentence is a good summary of this book. In this chapter there is also a useful target assessment table where chances of success for typical archeological sites are rated. While there are brief descriptions of GPR archeological findings, the emphasis in this book is GPR and not archeology, which I found somewhat disappointing since I imagine that GPR has revealed some interesting stories. This well produced volume is useful for any beginner interested in GPR; however, I suspect its cost will limit its appeal.

—*Patrick Taylor*
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Parameter Estimation and Inverse Problems, by Richard C. Aster, Brian Borchers and Clifford H. Thurber. ISBN 0-12-065604-3, Elsevier, 2005, 301 pp., $79.95.

In many ways the world of exploration geophysics is all about inverse problems. We go out and collect data (be it seismic, electromagnetic, gravity etc.) and then by any number of methods try and infer the nature of the earth from these measurements. Invariably this involves solving some kind of inverse problem (e.g, we know the measurements, and we know the physics, so what are the parameters of the model?). With this in mind, any book specifically dedicated to the art of estimating parameters in inverse problems is welcome, particularly one that is filled with examples specific to geophysics.

Aster, Borchers and Thurber have produced a well-presented textbook that, in their words aims "… to promote fundamental understanding of parameter estimation and inverse problem philosophy and methodology, specifically regarding such key issues as uncertainty, ill-posedness, regularization, bias and resolution." They suggest that the readership is advanced undergraduate and first-year graduate level students. Certainly and almost invariably by the nature of the subject, this is not a book for the mathematically faint-of-heart. However, recognizing this, the authors provide extensive appendices which cover the basics of linear algebra, statistics, and vector calculus that are necessary to understand the mathematics of the main text. In fact, these appendices are so extensive (covering almost a third of the book) and comprehensive that they are almost a selling point for the volume itself. The book also comes with a CD-ROM containing examples and exercises from the book using MATLAB routines and a useful copy of a Regularization tools MATLAB library.

After introducing the subject in the first chapter (including a section delightfully headed "Why inverse problems are hard"), the authors begin with the simpler inverse methods of linear regression and quadrature methods for continuous inverse problems. After that it is head-first into the world of complex inverse methods with chapter headings such as Rank Deficiency and Ill-Conditioning, Tikhonov Regularization and Nonlinear Regression. Useful for many geophysicists is a whole chapter devoted to Fourier techniques and another to nonlinear inverse problems (with examples using crosswell tomographic solutions). Finally, there is a chapter on Bayesian methods, which contrast in philosophy to many of the methods described in earlier chapters and which potentially offer some advantages in the case of ill-conditioned inverse problems (although the authors are decidedly and, probably sensibly, noncommittal about wading into the Bayesian-versus-classical debate).

Overall, the book is well designed and presented. The diagrams in each chapter are clear, and particularly important, for this reviewer at least, are numerous worked examples of the application of each method. There are exercises at the end of each chapter (many of which also appear on the CD-ROM) and a comprehensive bibliography. The great strength of this book is that is a "one-shop-stop" for solving inverse problems; it contains many different methods for solving your particular problem and, in general, all of the background mathematics to help you understand the method itself. For that reason it is a well recommended addition to the technical library of anybody who has to deal with inverse problems on a regular basis.

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