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Time Series Analysis and Cyclostratigraphy: Examining stratigraphic records of environmental cycles

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cal problems are arranged in such a way that the reader is introduced painlessly into techniques of increasing complexity. The core of the book contains 46, two-page chapters illustrated with composite figures of high quality. At the end of the book, solutions are given to the exercises that are presented in some of the chapters. There are also seven appendices that have graphical templates, useful formulas and alternative projection algorithms. In light of the new trends in teaching and research, a list of freely available stereographic software is supplied at the end of the book.

The selection of problems is designed to train inexperienced geoscientists in 3-D geometry. In this aspect, the first 25 chapters are critical for the understanding of the entire content; here, all the basic operations with lines and planes are marvellously explained and the road is paved for a better understanding of more complicated problems. Rock-mechanics applications are discussed in brief in the last five chapters of the book. Crystallographic (mineralogical) applications of the stereographic projection are not discussed.

The book fills a gap in the market place. Recently, most of the authoritative manuals in structural geology offer concise introductory chapters in basic stereographic techniques; however, the explanations and the selection of problems are too economic and fail to address the needs of many students. Lisle and Leyshon's book introduces the basic stereographic concepts in a more clear and efficient way than any other textbook of similar content, except perhaps for the classical book of Phillips (1971), which is still an unbeatable short introduction, but it is now out of print. Lisle and Leyshon's book is expanded in scope and has more illustrations than the book of Phillips (1971), and is more focused and internally coherent than that of Ragan (1985). The quality of the book becomes obvious, when the reader examines the chapters dealing with rotation around an inclined axis, analysis of refolded structures or the introduction of cones and small circles. These problems are explained with less detail and efficiency in the other textbooks of Phillips (op. cit) and Ragan (op. cit).

The chapter dealing with geotechnical applications could have been more detailed; the authors include analysis of simple wedge failure, the friction cone solution and some simple analysis of daylighting conditions, but there is no mention of the mechanical basis of these methods. Comments on the resolution of stresses on discontinuity surfaces or the modified Coulomb failure criterion for fractured rocks would have facilitated the understanding of the material.

Some of the methods explained in the book have well entrenched names in the geological literature. For example, the method for finding of preferred direction by observations in arbitrary planes (pp. 38-39) is known in the geological literature as the N-plane method of Lowe (1946), which might have been mentioned in the text.

The book does not include some less common applications of the stereographic method, which can be found in the scientific journals. For example, it does not introduce operations with vectors in stereographic space. However, these applications are beyond the scope of an ordinary undergraduate course and certainly would overburden students unnecessarily.

Based on my experience in teaching structural geology, the information in the book is sufficient for a complete undergraduate course. For purely practical geological mapping projects the book offers plenty of good advice and certainly will be useful to field geologists. In conclusion, I can recommend the book to students and practitioners alike as a thorough and affordable modern introduction in the stereographic projection method.

REFERENCES

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Phillips F.C. 1971, The Use of Stereographic Projection in Structural Geology (3rd edition). New York, John Wiley, 90 p.

Ragan, D.M. 1985, Structural Geology: An Introduction to the Geometrical Techniques (3rd edition). New York: McGraw-Hill, 393 p.

Time Series Analysis and Cyclostratigraphy: Examining stratigraphic records of environmental cycles

By Graham Weedon
Cambridge University Press, New York, 2003
ISBN 0-521-62001-5
US $70.00, hardcover, 259 p

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This book provides a very useful and well illustrated introduction to time series analysis and its application to the determination of cyclic behaviour of environmental variables. The author has succeeded admirably in summarizing the main methods used in the examination of quantitative records of ancient environmental change. The book is well-organized and clearly written with a minimum of jargon. The Table of Contents allows easy search for sections cross-referenced in the text. The author has included an index at the end of the book which also makes for easy searching. At the end of each of the six chapters, a brief summary of key issues addressed is presented in point form, an excellent idea for an introductory book. I especially liked the use of bold typeface for terms relating to time series analysis, particularly appropriate for an introductory text. Both the author and the editors are to be commended on production of a remarkably well-edited book.

Weedon demonstrates the applicability of time series analysis to a wide temporal range of palaeoenvironmental data ranging from annual to Milankovitch cycles. The overall balance in the examples presented is quite appropriate to the author's stated aim of encouraging new researchers to venture into the field of cyclostratigraphy and time series analysis. Weedon has drawn extensively on his own experience which, in some respects, strengthens his presentation through personal familiarity with his own time series data and its interpretation. This reviewer would

have preferred a somewhat more varied use of examples in order to expose the reader to a broader range of applications using different data sets.

Chapter 1 provides a rather brief history of cyclostratigraphy, followed by an introduction to time series analysis. Weedon's synthetic time series (Figures 1.6 and 1.7) are particularly instructive. The author demonstrates the progressive increase in the graphic visual complexity of perfectly ordered, relatively simple time series in which several cycles are present, and their resolution into simple line spectra with time series analysis. The key bullet at the end of the chapter highlights the ability of spectral analysis to detect multiple regular cycles.

In Chapter 2, the author addresses the construction of time series in cyclostratigraphy. The reader progresses through a concise and very useful section in which discrete- and continuous-signal records are clearly and succinctly described. Three conditions fundamental to the construction of meaningful time series follow and should not be disregarded by those who seriously intend to undertake such an exercise. The chapter ends with a brief discussion of sampling, sample intervals, and aliasing related to sampling procedures. The use of irregularly spaced data is briefly discussed, almost at the level of an aside, and does not sufficiently acquaint the novice with viable alternatives that allow this procedure.

Chapter 3 deals with spectral estimation; it presents a variety of methods for doing spectral analysis of time series with examples of outputs. Preliminary discussion highlights time series that require pre-processing. The determination of statistical significance of spectral peaks completes the chapter. Here the author has, as promised in his preface, kept mathematics to a minimum. Chapter 4 continues in a partially similar vein, but here less familiar methods of time series analysis such as phase spectra, complex demodulation, wavelet analysis and singular spectrum analysis are presented. Much of this chapter deals with methods that allow follow-up analysis after a time series has yielded spectral indications of potentially significant periodicities.

In Chapter 5, Weedon deals with practical considerations and offers a cautionary perspective on environmental cyclicity, its invariable distortion in real stratigraphic records, and limitations on the interpretation of such cyclic signatures. Here synthetic time series, simplified in a mathematical context but still graphically realistic, provide an especially useful illustration of the author's points. This chapter is perhaps the most enlightening for the uninitiated reader. One suspects that Weedon has avoided overt criticism of certain techniques that deal with sediment accumulation rate distortions of natural time series. He cites instances where methods have been shown to give results "other than expected". Such restraint may be appropriate for a general text, but this lack of emphasis does not serve the target audience well.

Weedon finishes strong with Chapter 6 in which he links environmental processes to the cyclostratigraphic record, beginning with an admission that the mechanism through which this is done remains controversial in many instances. Perhaps fewer pages could have been used to address the climate spectrum but this might simply reflect new emphasis in this field in very small scale cyclicity in the stratigraphic record.

With the publication of this introductory book, Weedon has achieved his stated objective of providing a text on methods and concepts in cyclostratigraphy and time series analysis for students and those new to the field. Any disappointment I felt with the text no doubt reflects slightly different personal views, no fault of the author. My only criticism is in Weedon's hesitation to highlight in more detail some of the contentious issues in methodology and in the interpretation of spectral results, an effort that would have served the reader well. For example, Weedon could have usefully addressed very current research where orbital versus radiometric time-scale estimations are dramatically at odds and remain unresolved. The dramatic successes in the development of astronomical time scales receive lots of emphasis, and appropriately so. Why not some of the controversial issues which should be cautionary eye-openers for the neophyte?

Early Earthquakes in the Americas

By Robert L. Kovach
Cambridge University Press, New York, 2004
ISBN 0-421-82489-3
US $90.00, hardcover, 268 p.

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This book, written by geophysicist Robert Kovach, documents large earthquakes of the last millennium in the Americas and describes their effects. The author's premise is that much can be learned about earthquakes from myths, legends, and accounts and from the effects of past disasters on human settlements.

The book includes 12 chapters. An introduction (Chapter 1) is followed by short summaries of the seismo-tectonic setting of the Americas (Chapter 2), earthquakes in myths and legends (Chapter 3), and earthquake effects (Chapter 4). The next six chapters are a "cook's tour" of earthquakes in different parts of the New World: Mexico (Chapter 5), the Maya empire (Yucatan, Belize, Guatemala, and Honduras; Chapter 6), Costa Rica, Panama, and Colombia (Chapter 7), Peru and Chile (Chapter 8), California (Chapter 9), the North American Cordillera (Chapter 10), and eastern and central America (Chapter 11). A very short concluding chapter is followed by several appendices, a glossary, bibliographic summaries for each chapter, and a list of references.

Cambridge University Press states that "students and researchers in the fields of earth science, archaeology, and history will greatly benefit from this book. I'm not so sure about this assertion, as I had difficulty, as reviewer, identifying the audience for the book. Geologists would like to know what the geological record can tell them about earthquakes in space and time, but this book probably will not interest them. Seismologists may benefit from the useful tables of historical earthquakes included in the book, but there are no new insights into seismicity in the Americas. Archaeologists need to under-