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Time-series Analysis and Cyclostratigraphy—Examining Stratigraphic Records of Environmental Cycles, by Graham Weedon, 2003. Cambridge University Press, 259 pages, hardbound; GB£ 55.00. ISBN 0-521-62001-5.

Cause-and-effect analysis in any branch of natural science ultimately generates quantitative data, and one has to apply mathematical and statistical techniques to get meaningful information out of these data. Geologists, paleo-oceanographers and environmental scientists are increasingly collecting quantitative records of environmental changes from recent sediments, ancient successions and, among others, growth bands in corals. Cyclostratigraphy refers to the study of such records and the records themselves, time-series. Weedon discusses the methods of analyzing cyclostratigraphic data in six chapters.

The first chapter presents a brief overview of past studies of cyclic sediments. It has been rightly emphasized that - instead of just examining the transitions between lithologies at bed boundaries in Markov chain analysis - the thickness of successive beds (time-series) is of fundamental importance in the assessment of sedimentary cyclicities. The basic concepts of time-series analysis, including technical terms, are explained in an accessible form.

The second chapter is concerned with the categories of cyclostratigraphic time-series. Unlike the continuous signal, cyclostratigraphic time-series, the discrete-signal time-series involves thickness of successive layers/beds as the measured variable, and the layer/cycle number is used in place of time or depth/thickness scale (p. 26). The basic requirements for the generation of meaningful cyclostratigraphic time-series are discussed also as the fundamental differences in the information provided by mathematical and cyclostratigraphic time-series. It is rightly pointed out that whether the bed-thickness/time relationship can be demonstrated, depends on the circumstances (i.e., the paleogeographic setting: p. 29-30).

Spectral estimation is discussed in the third chapter, which has four sections that highlight: (1) processing time-series prior to spectral analysis; (2) the background of the generation of power spectra; (3) methodologies used to generate spectra; (4) issues concerning the distinction of spectral peaks from background noise, and assessing statistical significance of spectral peaks.

Various techniques for analysing regular cyclicity detected via spectral analysis are explained in the fourth chapter. This includes wavelet analysis, phase portraits and singular spectrum analysis. Cyclostratigraphic signals are invariably distorted because of the modifications of both amplitude and frequency characteristics due to various factors (variabilities in sediment accumulation rates, bioturbations, variation in sediment compaction, etc.). One must be aware of these distortions for the sake of correct

interpretation of cyclostratigraphic signals; wherever and whenever possible, remedial action should be taken. The fifth chapter deals with these practical issues.

The sixth chapter presents a brief overview of various environmental processes that generate regular cycles (e.g. climatic, tidal, annual, cycles, the El Nino/Southern oscillation, the North Atlantic oscillation, solar activity, Milankovitch cycles, etc.) and the nature of resulting stratigraphic records.

The book nicely introduces basic methods used in cyclostratigraphy. Natural scientists often find it easier to grasp new ideas graphically, than through formal mathematical treatment. Obviously, the main emphasis is on explaining the concepts, procedures and problems, and not on the details of mathematics. I must welcome this sincere as well as successful effort to explain time-series analysis to non-mathematicians in a highly readable form. Although Weedon seems to be bothered that part of the material may not appear directly relevant, I believe that the content of the book is highly relevant. The list of published algorithms for time-series analysis will be extremely helpful for both students and professionals. The aspects dealt with in the sixth chapter are, however, treated somewhat superficially. For example, the section on stratigraphic records of tidal cycles is very short! Although the author states that “Thick – thin alternating silt mud couplets and the extremely regular cyclicity are particularly diagnostic of tidal cyclicity”, a field photograph of silt/mud couplets of tidal origin is missing, and this is also the case with respect to the description of well documented ancient tidal rhythmites.

For a possible next edition, I recommend inclusion of (1) field photographs of laterally as well as vertically accreted tidal rhythmites, and (2) a case study (e.g. the Elatina rhythmite) explaining stratigraphic records of tidal cycles. An up-to-date list of highly relevant references, particularly on tidal cyclicities and their stratigraphic records, is also needed. In spite of these shortcomings of relatively minor importance, I sincerely believe that the book will motivate new research in the field.

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