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A Practical Guide to the Study of Glacial Sediments, edited by David J.A. Evans & Douglas I. Benn, 2004, Edward Arnold Publishers Ltd., 338 Euston Road, London NW1 3BH; 266 pages; US$ 24.95. ISBN 0340759593.

This manual on glacial sedimentology has been edited by the glaciologists David Evans and Douglas Benn, who are well known as the authors of the superb book 'Glaciers and Glaciation'.

The last decade has been a period of unusual progress in glacial sedimentology. Studies on glacial deposits have developed in this time into the most advanced branch of Cenozoic research. This is why this kind of manual has been waited for by geologists who work on glacial facies and who want to familiarize with modern research tendencies. Presumably 'A Practical Guide' will therefore become a bestseller. But the main question is, obviously, whether it is worth to spend 24 dollars and become the owner of this book.

The authors' intention was to include in the book a maximum dose of knowledge on the various features of glacial deposits, on their field documentation, on the presentation of graphic data, on genetic interpretations, and on laboratory analyses. The book thus is aimed at both students and young scientists beginning their adventure with the difficult art of glacial-facies study.

The book starts with an 'Introduction and rationale' chapter, after which a very important one on glacigenic lithofacies ('Facies description and the logging of sedimentary exposures') follows, authored by the editors themselves. Undoubtedly this chapter is meant to be a fundamental part of the book. However, I am disappointed by its contents and scope. There are two basic shortcomings: the chapter is too short, and - although it contains information on the classification of lithologic features - the problem of their origin is not even raised. The authors avoid to write how do they understand the term 'glacial sediments'. The contents of this chapter prove, however, that these are all glacigenic deposits, including those connected indirectly with a glacier: Evans and Benn even describe the features of fluvial deposits. They do so quite often and, in my opinion, this has no good reason: good manuals on fluvial sedimentology are abundantly available and this manual of glacial sediments cannot be their substitute at all.

The subchapter 'Deformational structures' contains only one page of text and is restricted to enumerating the structures, without any study of their origin. Frost-induced structures are represented only by sketches of three ice-wedge casts that differ by scale, shape and infill. No explanation about the genetic processes responsible for these differences can be found in the text. This is unfortunate, because the identification of deformation structures in the field is essential, and very difficult. This manual is not of much help in this respect.

The part on fossils and trace fossils in this chapter is completely useless because no real information is included. In addition, the book would not suffer if the chapter

'Section preparation' were to be deleted. The reader finds here information how to clean the outcrop wall by spade and knife, and a warning that the use of helmets is necessary.

This first 'real' chapter also proposes a coding for lithofacies, but in an extremely complicated version, so that the fundamental idea of Miall – simplicity and clearness - has been lost. Lithologic features have been mixed up with genetic terms (deltaic foresets, marine or bedload lag, cyclopsams, cyclopels); moreover complixity of symbols is sometimes confusing (e.g. GRruc = repeating upward-coarsening cycles in granules). Miall's code for architectural elements is mentioned in the subchapter on braided-river deposits, but the symbols are not explained together with adequate lithofacies descriptions and their genetic interpretation. The authors propose a new method of architectural elements application to till studies (after Boyce & Eyles, 2000). This method is exemplified by an analysis that results in the conclusion that the studied sedimentary succession consists of some deformation till horizons separated by subglacial stream deposits. The same interpretation might have been reached through standard lithofacies analysis, without involving all these strange architectural elements of the glacial environment.

Fortunately, not everything is this chapter raises questions about usefulness. The authors are to be complimented for their idea to present here the key for the preparation of logs of glacial sediments as provided by Krüger & Kjaer (2000). This key is valuable and should be the standard, worth to be used routinely. However, it is a pity that - because of lacking explanations - readers will have to consult other books and articles to find out what are the differences between stretched-out soft-sediment clasts, lenses or rafts of silt/sand/gravel, or bullet-nosed clasts.

The graphic collection of folds is useful, although the structures related to shear zones are neither named nor explained. The subchapter on lithostratigraphy is clever, but insufficiently detailed. Kinetostratigraphy, for instance, is explained in one sentence only. Definitely this subchapter provides too little information for a manual on glacial deposits.

To summarize, the chapter 'Facies description and the logging of sedimentary exposures' is the most important, but also the weakest part of this book.

Chapter 3 (by T.B. Hoey) is devoted to grain-size aspects. First, the differences between mm, phi, and psi scales are discussed comprehensively and instructively. The discrepancy between the results obtained with various scales are presented in examples of well selected illustrations. The procedures of representative sampling are discussed and the grain-size laboratory methods are briefly described. Some examples of case studies are presented at the end of the chapter. These are interpretations of subglacial transport mechanisms, fluvial transport dynamics, and beach resedimentation, based on grain-size analyses. The descriptions are, in my opinion, unfortunately too short, and too much has to be interpreted from the figures.

Chapter 4 ('Clast morphology') has been written by D.I. Benn. Shape, roundness and asymmetry of clasts, and the morphology of their surfaces are characterized. Examples of research on the character of glacial transport , based on clast shape and roundness data, are well commented and illustrated.

In chapter 5 ('Macrofabric'), written by D.I. Benn, subchapters are devoted to the orientation of cross-beds, folds and faults, and clasts. I like the entire chapter, in particular the section on clasts. It contains a detailed, although concise, introduction into directional elements of clasts, the choice of clasts to be measured, the frequency of

samples, graphic methods for data presentation, with a description of how to estimate directional parameters (eigenvalues method). The subchapter on folds and faults is somewhat less detailed. Directional features of these structures are characterized, but the author forgot to inform the reader how they might be graphically presented. Examples of case studies are well selected, exactly explained and illustrated. I found only one insufficiency here: the information is restricted to 3-dimensional data, and a 2-D directional analysis is lacking.

Chapter 6 on microstructures of tills (by S.J. Carr) is brief, but clear. It is enriched by a subchapter on scanning microscopy and by a very short subchapter about microfabrics. Although deformational microstructures of tills are illustrated properly, an explanatory text about indicatory features and about their origin is lacking.

Chapter 7, 'Particle lithology (or mineral and geochemical analysis)', was written by J. Walden. The lithologic part deals with the petrographic analysis of gravels and with heavy-mineral analysis. In my opinion, this part of book is unsuccessful: everyone knows that it is impossible to learn petrology and mineralogy from a textbook, without proper practical courses. Descriptive 'keys', prepared to help in rock and mineral identification, will never replace practice. The geochemical part of this chapter concerns the analysis of clay minerals, of the carbonate content, and of the magnetic properties of rocks in the context of solving the following problems: source-area identification of glacial deposits, till correlation, interpretation of glacial transport modes, and assessment of the weathering ratio of tills.

The author of Chapter 8 ('Engineering properties'), B.R. Rea, tackles the problems of rock porosity and the meaning of parameters such as liquid limit, plastic limit, shrinkage limit, hydraulic conductivity, consolidation ratio, and shear strength. The treatment of these, sometimes complex, parameters must be considered as insufficiently thoroughly. It is true that the general nature of engineering properties is described, and that laboratory equipment and procedure are dealt with as well. On the other hand, no advantage has been taken of quantitative engineering data to interpret the glacial transport, deformation, and deposition of tills. The paleorheology of glacial facies therefore still waits for more useful treatment.

The last part of book (by Benn and others) deals with sedimentological research of glacigenic deposits outcropping in Scotland. This study starts with a lithofacies analysis. Several lithofacies associations are subdivided and interpreted. Then some detailed genetic problems are solved through various methods. The analysis of clast petrography and magnetism of some deposits appears to make it possible to distinguish genetic differences between a glacitectonite and an overlying till. Then follows a genetic interpretation of the till, based on macrofabric and micromorphology analyses. Three successive phases of glacial deformation were investigated by means of structural analysis. The model of depositional, erosional and deformational processes of the succession under study ends this chapter. This part of the book is of great value. Most manuals deal exclusively with theory, and books combining theory and practice are very rare; this chapter is therefore most welcome. The same praise deserves the concept of the book, which has some case studies being discussed at the end of each chapter.

The manual finishes with a collection of 50 splendid color photographs of structures and microstructures of glacigenic deposits. However, the captions are rather poor. This is why the origin of some of the objects remains enigmatic for the reader.

What should be the overall judgement of this book? Its structure is correct and all problems connected with glacial facies studies are touched. On the other hand, a significant number of chapters provide insufficient detail and therefore lack essential information. As a rule, details are not discussed at all. I suggest that this 250-page manual be extended if a second edition will be published. The book is an appetizer in the beginning, but after the desert the reader is still hungry.

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