

REVIEW

GURNELL, A.M. and M.J. CLARK, eds. 1987. *Glacio-fluvial sediment transfer: an alpine perspective*. Chichester, etc., John Wiley and Sons Ltd.

THIS volume aims to present an integrated, state-of-the-art review of research into sediment transfer in glaciated Alpine basins. The aim is achieved in 18 contributions, all by European authors, which gives the volume a strong European bias with particular emphasis on the results obtained from Tsidjiore Nouve glacier in the Swiss Alps. The editors give no assistance towards the pronunciation of this oft-quoted name. The book is conveniently organized into four sections: a background, glacial sediment transfer, fluvial sediment transfer, and a final section on implications. An excellent table of contents allows the reader to establish at a glance the content of each chapter, each section and the volume as a whole, or to select quickly any particular topic. Each chapter also begins with an abstract which further assists in the selection of topics. References are listed at the end of each chapter and there is a subject index at the back of the book.

The first section attempts a general review to give a background of sediment systems, periglacial processes, sediment transfer by ice and water, and hydro-geomorphology in Alpine pro-glacial areas. The aim of these introductory chapters should be to establish a conceptual framework of these systems as a whole, and be given in a clear and concise manner, easily read and understood. Unfortunately, this section, shared by the editors Gurnell and Clark, fails in this aim in presentation rather than content. The writing is characterized by verbose jargon and laboured sentences, to the extent that the reader, in a struggle to translate the text into plain English, soon loses sight of the objectives. An example from p.10 reads "However, it is inherent to systems thinking that the complexity inevitably produced by a holistic viewpoint can be assimilated by the twin strategies of generalising the linking structures and analysing the detailed sub-systems". Unless the reader is particularly interested in ponderous theoretical discussions, this section should definitely be avoided, as these first three chapters are a slog and serve only to discourage the reader from continuing to the good information that follows. Fortunately, the day is saved in chapter 4, where C.R. Fenn covers much the same ground as Gurnell and Clark, and does so in a few lucid pages. This section also contains a chapter by M.J. Clark on cryogenic processes and their associated land forms ranging from talus slopes to rock glaciers, but after struggling through the text, the reader's perspective on these processes remains unenlightened. The irregular but very significant contribution to sediment transfer by rock avalanches is not mentioned.

The second section on glacial sediment transfer contains chapters on englacial and supraglacial sediment transport and deposition, the subglacial sediment system, and moraine sediment budgets. The treatment of the topic is thorough and well illustrated with clear diagrams and photographs. These first two chapters give an explicit and comprehensive treatise on debris transport. However, occasional errors ("former" instead of "latter" on p.136 when describing moraine types) and in the concept of processes, e.g. on p.117 — "sediment is subsequently re-exposed at the surface ... as a result of *squeezing out* as the crevasse becomes closed" — unfortunately mar the chapter.

R.J. Small's treatment of englacial and supraglacial sediment and of moraine sediment budgets is informative and well written with good examples as case studies drawn

from a variety of glaciers. R.A. Souchez and R.D. Lorrain contribute a chapter on the subglacial sediment system which is also very informative, but tends to remain in the realms of classical concepts of glacial erosion. The authors, for example, do not venture into discussions of problems like how the highest rates of erosion occur at the base of headwalls, causing cirques to accentuate their characteristic shape. The chapter also suffers from its main points being hidden in long paragraphs; fortunately these are clearly emphasized in the short conclusion.

The final chapter, titled moraine sediment budgets, also by Small, promises but fails to tie together the preceding four chapters and, although it is a good summary, it is really a continuation of Small's exposition on supraglacial sediment. He gives a very useful summary of erosion rates in the universally comparable terms of mm per year and the rare detailed description of the formation of lateral moraines is a gem, as these features have a world-wide occurrence but are rarely observed during formation in the present era of glacial withdrawal. He does not make clearly the distinction between dry-based, wet-based, and polythermal glaciers, so important to basal sediment processes.

Glacial hydrology is introduced by H. Röthlisberger and H. Lang in chapter 10 with an excellent dissertation on the interaction of glaciers and climate. Here the various fundamental glacial balances of water, mass, and heat are clearly explained, values are given for standard parameters, and a precis of recent glacial fluctuations puts the behaviour of present glaciers into perspective with their environment. All equations and units for basic calculations are clearly laid out and defined, making the chapter a very good reference for glaciologists of all calibres.

Souchez and Lemmens' treatment of solutes, or the chemistry of melt water, is also well organized, clear, and instructive. This chapter gives a valuable, but sometimes detailed and complex, contribution on a part of the glacial system which is not commonly studied and infrequently published.

A.M. Gurnell provides an excellent, well-balanced review and discussion on suspended sediment in pro-glacial streams. B. Gomez's chapter on bed load, while being a well-written up-to-date review of bed-load transport in gravel rivers, does not focus at all on glacial environments. This is disappointing, given the obvious importance of bed load in pro-glacial channel processes. The expected references to bed-load sources and sinks, and the sediment-supply variations associated with retreating and advancing glaciers are not mentioned. C.R. Fenn provides a chapter examining the ways that electrical conductivity has been used in hydroglaciological studies. It is clearly written, giving a good background to the subject as well as a good focus on glacial applications. A.M. Gurnell uses the final chapter of this section to draw together and consider the relative importance of the components of total sediment load from Alpine glacial catchments. This includes a useful global comparison of sediment yields from alpine and polar catchments, although it is far from a comprehensive list.

Section IV claims to look at the implications of Alpine glacial sediment transfer as applied to pro-glacial channel processes and examines a case study of a hydro-electric power scheme in the Swiss Alps. Fenn and Gurnell discuss pro-glacial channel processes. Their emphasis is on rates, modes, and forms rather than on sedimentary aspects. There is a need for additional diagrams to assist with explanations and definitions particularly in the section on braided channels. Section 16.5, looking at adjustments in channel cross-sections, is out of proportion to the remainder of the

book. Here, 18 pages are given to detailed diagrams, and a rambling presentation of what is clearly the author's own field work. At 50 pages, this chapter is too long for easy reading.

The case study by A. Bezingé of melt-water streams influenced by the Grande Dixence HEP scheme adds little to the book but another 25 unnecessary pages. It provides less detail and less pointed case examples than can be found in the preceding specialist chapters. The only new material is on suspended sediment deposition in "near-glacial" HEP lakes. Also, the abstract is not an abstract but an introduction.

The final chapter of the book by M.J. Clark discusses and evaluates the state of research in the study areas of Alpine sediment systems, contemporary processes, sediment budgets, palaeoenvironmental reconstructions, and practical studies such as water quality and quantity, and mountain hazards. Some interesting discussion is presented but, as

with other chapters by Clark, the style is bombastic and the reader has to work hard to interpret the message.

Overall, the book is well presented with an appropriate cover photograph of Tsidjiore Nouve glacier. Typographical and grammatical errors are few, but present and significant. Illustrations are printed to a high standard and are most useful. Most redundant figures belong to the editors.

I would recommend this book to any serious student or researcher of either Alpine glacial or Alpine sediment systems. It collects together a large variety of useful information, experience, and ideas for anyone involved with these areas of research. To a large degree it meets its aims, with the main shortcomings being its accent on European results and the unnecessarily bombastic style of the editors in the introduction and concluding chapters.

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