

Review

BENNETT, M.R. and N.F. GLASSER. 2009. *Glacial geology: ice sheets and landforms. Second edition*. Oxford, Wiley-Blackwell. 385pp. ISBN 978-0-470-51690-4, hardback, £85.00/US\$97.80; ISBN 978-0-470-51691-1, paperback, £29.95/US\$34.50.

For over 2 billion years glaciers and ice sheets have been shaping the landscape, eroding the Earth's surface, transporting the products of this erosion, and depositing these sediments as a drape across the continental lowlands and in the offshore environment. The second edition of the successful undergraduate textbook *Glacial geology: ice sheets and landforms* outlines the suite of landforms and sediments produced by erosion and deposition from glaciers and ice sheets. The appearance of the book has been thoroughly revised and updated from the first edition, not least through the addition of full-colour photographs and many redrafted colour figures.

The book begins, after a short introduction, with a chapter on 'Glaciations around the globe'. This replaces a chapter in the first edition (Bennett and Glasser, 1996) that dealt, somewhat superficially, with 'The history of ice on Earth'. The new chapter exemplifies the range of glacial environments present on Earth today. Much of the material covering the geological history of ice sheets from the first edition is moved into the last chapter, 'Palaeoglaciology', explaining how glacial landforms and sediments are used in ice-sheet reconstructions. The chapter on 'Glaciations around the globe' is an informative summary, if introductory in content, that will be of use to first- and second-year (Level 4 and 5) students on geography honours degrees. The 'Palaeoglaciology' chapter is an excellent summary, contextualizing earlier chapters in the book. These two chapters are the areas of the book that have been most significantly expanded and improved, and they produce a much neater beginning and end to the textbook than in the first edition.

The next three chapters cover 'Glacier mass balance and mechanisms of ice flow', 'Glacier hydrology' and 'The processes of glacial erosion'. Important concepts are introduced that are required for understanding the text that follows, namely the landforms and landscapes defined as glacial geology. As such, these chapters are introductory in content and style. The following two chapters, on 'Landforms of glacial erosion' and 'Glacial debris entrainment and transport', are core to the aim of the text but are virtually unchanged from the first edition. Figures and examples are improved, but the text edits have been light-touch. In 'Landforms of glacial erosion', landforms are introduced from a scale perspective (micro to macro). The glacial debris chapter covers the mechanisms for debris incorporation. This chapter is heavily reliant on Svalbard glacier systems and the authors' own work, with over one-third of the references self-citations. In the next chapter, on 'Glacial sedimentation on land', the section on glaciotectionic moraines is much improved, reflecting significant developments in this field in recent years. In contrast, the section on drumlins has not been updated to reflect recent geophysical observations of drumlins beneath ice streams, recent developments in modelling and recent remote-sensing observations on drumlin field geomorphology. Despite this somewhat inconsistent updating, the core aims of the text

are met by these chapters, with the breadth of the topic of glacial geology apparent and well exemplified.

The next two chapters cover 'Glacial sedimentation in water' and 'Landforms of glacial deposition in water'. In his review of the first edition, Dowdeswell (1997) felt that the chapter on depositional systems in water was far from comprehensive, lacking adequate 'treatment of the huge glacier-influenced submarine fans present on many glaciated continental margins, the largest of which contain over 100 000 km³ of sediment'. This remains the case, as only minor edits have been made to the text. There remains an over-emphasis on small grounding-line fans produced in fjord settings by tidewater glaciers.

As in the first edition, text boxes are used throughout to explain key concepts and to introduce students to case-study material. This is a great idea and the content of the boxes is well constructed, often giving a detailed summary of and reference to an individual paper. This is helpful to undergraduate students as it makes the journal article accessible and, it is hoped, encourages many to read the original articles. Unfortunately, the authors have not been best served by the typesetting of the book. This was the case in the first edition, and I had hoped that some thought would have been put into the text by the publishers such that the flow of the text would have been much improved. I cite two examples of obvious layout issues that the publisher could have avoided:

Box 2.1: Antarctic Peninsula ice shelves. There are four images of the Larsen B ice shelf during its break-up. The images are displayed two to a page, requiring the reader to turn a page to see the second two images. This makes direct comparison of the four images unnecessarily difficult. If the images had been on either side of a double spread they would have had significantly greater impact.

Box 2.4: Surge-type glaciers in Svalbard. The box is split over two pages but covers only half a page on each. The top half of p.31 includes a colour photograph of Kongsvegen, a surge-type glacier in Svalbard, and the bottom half of p. 32, below box 2.4, is also a photograph, showing hummocky moraines left by a retreating Svalbard glacier. It would have been relatively easy to place the two photographs on one page, allowing the text box to fill one page. Similar examples are found throughout the book. This detracts both from the flow of the general text around the boxes and the examples included in them.

At times the images and text appear a little repetitive. An example of this occurs in chapter 2 where tidewater glaciers are exemplified using a satellite image of the calving front of Pine Island Glacier (PIG), Antarctica. The terminus area of PIG is widely referred to in the broader literature as an ice shelf with an underlying ice-shelf cavity, little different to the Larsen Ice Shelf which is used as an example in box 2.1 a few pages earlier. In the same chapter, there are photographs of Kongsvegen and of San Rafael Glacier, Patagonia, both excellent examples of tidewater glaciers; indeed there is another photograph of the San Rafael in chapter 3.

Further readings are suggested at the end of each chapter. This is invaluable in an undergraduate text, providing a clear pedagogic steer. As in the first edition, the authors present

reference lists after each chapter, though these do not include the references in the text boxes. Whilst some might prefer a single, overarching reference list (e.g. Dowdeswell 1997), the format allows students to dip in and out of the book easily and should encourage further reading.

Sensibly, the authors have resisted any urge to extend the second edition considerably. This makes the book highly recommendable to undergraduate students as it is short enough not to be daunting, yet sufficiently detailed to cover many key concepts and provide sufficient depth for core teaching modules in glaciology and glacial sedimentology. I am sure this second edition will do as well as, if not better than, the first edition. From a pedagogic perspective, the text is ideal for the undergraduate market. The full-colour images in the second edition allow better figures and photographs that will make the text appealing to the undergraduate audience. Many students will, I am sure, be taught from this

text, and the authors are to be thanked for their contribution to the teaching of our discipline.

REFERENCES

- Bennett, M.R. and N.F. Glasser. 1996. *Glacial geology: ice sheets and landforms*. Chichester, John Wiley.
- Dowdeswell, J.A. 1997. Book review of *Glacial geology: ice sheets and landforms*, M.R. Bennett & N.F. Glasser, John Wiley, Chichester (1996). *Antarct. Sci.*, **9**(3), 366–367.

School of Built and Natural Environment
Northumbria University
Newcastle-upon-Tyne NE1 8ST
UK
E-mail: john.woodward@northumbria.ac.uk

John WOODWARD