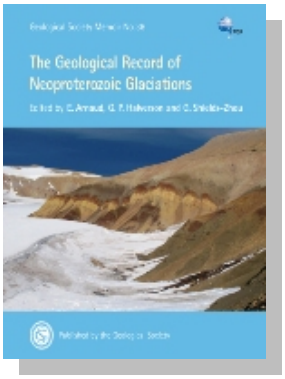

The geological record of Neoproterozoic glaciations, edited by Emmanuelle Arnaud, Galen P. Halverson & Graham Shields-Zhou, 2011. Geological Society, London, Memoirs 36. Geological Society, London (www.geolsoc.org.uk/bookshop). Hardback, 735 pages. Price GBP 180.00 (fellows GBP 90.00; members affiliated societies GBP 108.00). ISBN 978-1-86239-334-9.

The Pleistocene glaciations have had numerous predecessors. Hambrey & Harland (1981) had published an excellent work thirty years ago summarizing the results of the investigations of these glaciations carried out until then. However since then exciting new discoveries have been made. Almost 15 years ago, the geological community was surprised by a publication (Hoffman *et al*., 1998) stating that the Earth had suffered from a worldwide glaciation during the Neoproterozoic. 'Snowball Earth' was born! Even though we know now that several extremely severe glaciations took place during the Neoproterozoic, doubts have arisen about the precise character of this 'Snowball Earth'; 'Slushball Earth' now seems to have more advocates, but some people deny even such an astonishing feature.

Hot debates followed on the nature of the Neoproterozoic glaciations, which have stimulated much research. This led in 2005 to IGCP Project 512 (Neoproterozoic ice ages), focusing on the integration of all relevant aspects concerning these extremely cold times, such as geochronology, geochemistry, sedimentary geology, biostratigraphy, paleomagnetism and economic geology. Over 200 scientists from more than 30 countries were involved, and the book under review provides a state-of-the-art of all the research carried out thus far. As mentioned by the book's editors in their introductory chapter, however, much remains to be done. Fortunately, as what would future researchers otherwise do?

The approach followed by Hambrey and Harland in their famous 1981 book is also followed by the editors of the book under review: it starts with 10 introductory chapters. Then follow 8 chapters about Africa, 15 chapters about Eurasia and the Nubian Shield, 10 chapters about North America, 11 chapters about South America, 9 chapters about Europe, and 7 chapters about Australia. The book has, unfortunately, no concluding chapter or epilogue. It would have been a valuable addition, where ideas for future research might have been presented (only some very few words are devoted to this important aspect in the introductory chapter, where main problems concerning the subject are discussed), and where - in particular - views might have been expressed related to the still hotly debated 'cap carbonates' that cover the Neoproterozoic glacial sediments at so many places (and that are, in my opinion, not debated in sufficient detail in Chapter 5). The book ends with a 13-page index, which makes access to the numerous topics easy.

The ten introductory chapters must, obviously, be the most interesting for those who do not work themselves in an area with Neoproterozoic glacial sediments . I already mentioned the introductory chapter by the editors, who provide some data about IGCP-512, the contents of the book, and the current state of knowledge. Then follows a chapter by nobody less than 'Snowball Earth' Paul Hoffman, who sketches the history of Neoproterozoic glacial geology from 1871 to 1997. Chapter 3, by Emanuelle Arnaud & James Etienne, is - in my opinion - one of the most important, interesting and helpful contributions; it deals with the recognition of glacial influence in Neoproterozoic sedimentary successions. It does so in a practice-oriented way, so that workers in Pleistocene glacigenic successions can also profit from this chapter.

Chapters 4-5 are devoted to chemical aspects. These chapters ('Chemostratigraphy and the Neoproterozoic glaciations'; ‘Chemical sediments associated with Neoproterozoic glaciation: iron formation, cap carbonate, barite and phosphorite) may be less attractive than Chapter 3, but they are indispensable for a good understanding of the conditions under which the sediments accumulated. Chapter 6, dealing with the Chemical Index of Alteration (CIA) is a logical next chapter; it is the first in this book that truly deals with climate transitions, a topic that receives - surprisingly - little interest in the book.

The distribution of glacigenic deposits is fairly paradoxal, as detailed in Chapter 7 ('Neoproterozoic glacial palaeolatitudes: a global update'): they occur abundantly at tropical paleolatitudes, while they are almost completely absent between latitudes of 60^{o}and 90^{o}. Chapter 8 seems a bit out of place. Although it deals with biostratigraphy and stratigraphic subdivision, it is restricted to Cryogenian successions in Australia. The global context in which this is placed must be considered as only a partly satisfactory argument for a place among the ten introductory chapters. Chapter 9 provides a user's guide to Neoproterozoic geochronology, which can certainly help to bring some order to the often quite chaotic terminology used by regional geologists working in Neoproterozoic sediments. The final introductory chapter provides, in my opinion, ample fuel for future discussions: it is about modeling the Snowball Earth.

The Neoproterozoic glacigenic sediments in the various continents are dealt with in a most satisfactory way, as these 'regional' chapters are not just more or less haphazard reports of some regional investigation but - in contrast to so many multi-author books - good overviews of the occurrences at the various sites shown on maps in Chapter 1. Whether these represent *all* occurrences worldwide, indeed, is difficult to judge, however. I remember that, during an excursion to Normandy (France) before the 1975 IAS conference in Nice, we visited some outcrops with the 'Poudingue de Donville' (Donville conglomerate) that was dated then as 'Briovérien supérieur (a now fairly obsolete name for the upper part of the Neoproterozoic) and that was interpreted as mass-transported material of locally deposited conglomerates that contained striated pebbles, and that thus were interpreted as tills. Perhaps the age has been revised in the meantime, or the glacial striae may have disappeared … In my opinion, such occurrences deserve a place in a book like this, even if the genetic interpretation has changed in the meantime.

More research will in due time, almost inevitably, result in the finds of Neoproterozoic glacial material at hitherto unknown sites. This implies that even a book like this will never be the ultimate source of knowledge about its subject. Nevertheless, the book under review should be considered as a monumental volume that will act as a benchmark for a long time, probably some decades. As such, the editors have certainly reached their objective of preparing a high-quality successor of Hambrey & Harland's (1981) 'Bible'. It contains good texts, and technically perfect and commonly most useful line drawings, but surprisingly few photographs, while these would, in many places, have been most informative.

The price of the book is relatively high, but considering its 735 pages, its large size (the book will be too heavy for non-motorized fieldworkers) and its contents, there is little reason to complain; in fact, the price is very reasonable.

References

Hambrey, M.J. & Harland, W.B. (Eds), 1981, Earth's pre-Pleistocene glacial record: Cambridge University Press, Cambridge.

Hoffman, P.F., Kaufman, A.J., Halverson, G.P. & Schrag, D.P., 1998, A Neoproterozoic Snowball Earth: Science, v. 281, p. 1342-1346.

A.J. (Tom) van Loon
Geological Institute
Adam Mickiewicz University
Maków Polnych 16
61-506 Poznan
Poland
e-mail: tvanloon@amu.edu.pl; tom.van.loon@wxs.nl