

Book Reviews

A reassessment of the Southern Ocean biochronology

A.T.S Ramsey & J.G. Baldauf

Kluwer, London. Memoir No. 18 of Geological Society of London (1999)

122 pages. Price £45. ISBN 1 86239 027 4

By the early 1830s Charles Lyell had recognised that Tertiary stratigraphic successions of the Paris Basin could be characterized and correlated according to their fossil content. He concluded that progressive modifications in fossil assemblages reflect successive, time-dependent geologic epochs. These principles are the foundation of biostratigraphy.

Biostratigraphy remains a vital field, and is central to the study of deep-sea drill cores recovered by the Deep Sea Drilling Project (DSDP) and the subsequent Ocean Drilling Program (ODP), as well as other stratigraphic studies. Biostratigraphy of DSDP/ODP materials is based almost entirely on microfossils, and biostratigraphic approaches remain largely qualitative observations of fossil occurrence and relative abundance. Unlike in Lyell's day, absolute chronologies are now possible, especially when the assemblages are tied to the palaeomagnetic reversal time scale. Reversals are radiometrically-dated on lava flows, and the same reversal pattern is identified from magnetic minerals that accumulate in sedimentary sequences.

Herein lies the inherent problem in biostratigraphy: we use earlier notions of the ages of certain fossils to guide correlation to the palaeomagnetic record; we then use the palaeomagnetic record to determine the absolute age of the strata. This circular argument is inherent and unavoidable. Nevertheless, there is a large body of compelling evidence supporting the accuracy of the biostratigraphic approach. The devil remains in the details, and where the details are few, the devil (i.e. chronostratigraphic uncertainty) can be quite nasty. To maximize accuracy, biostratigraphical studies must be iterative. Unfortunately, few of us have the luxury of time or funds to continuously revise our "initial" reports to comprehensive and definitive documents. Every biostratigrapher is aware of these potential pitfalls, and all others who refer to these reports should be equally aware. In some parts of the world, biostratigraphy, especially low-latitude calcareous nannofossil biostratigraphy, has been shown to be highly, even remarkably, accurate. Other regions, notably the polar oceans, have vast areas lacking data, and biota typically are highly endemic, which limits correlation with the lower latitudes.

The Southern Ocean is a massive swathe of sea encircling the continent and spanning more than 25 degrees of latitude. It is defined not by a distinct basin but on the basis of oceanographic fronts. Like the cycle of growth and decay of

the annual ice pack, oceanographic fronts can migrate with the climate cycles. Shifting water masses make developing a coherent stratigraphy all the more difficult. Despite the size of this ocean, and its importance in regulating global climate, to date there have been only 48 Southern Ocean deep-sea (>1000 m water depth) drill core sites with magnetostratigraphic control, including 15 sites drilled during the last two years. Three Southern Ocean ODP legs are scheduled for December 1999–May 2000.

This book summarizes and assesses published Southern Ocean diatom, radiolarian, and nannofossil biochronologies of DSDP Leg 71 and ODP Legs 113, 114, 119, and 120, and recalibrates the published absolute ages, by interpolation, to the improved Magnetic Geopolarity Timescale of Cande & Kent (1995). Despite the fact that the number of holes revised is limited to 18, and no new data are included, this work constitutes a significant commitment of effort (as revealed by the reflective apology to the author's families in the Acknowledgements section).

New age calibrations for upper-upper Eocene to upper Quaternary sediments are summarized in useful tables, and new age-depth plots are constructed for the 18 best Southern Ocean cores drilled up through Leg 120, in 1988. These holes are all between 46° and 65°S, and between 43°W and 86°E longitude, which leaves 65% of the ocean's longitude unrepresented!

The authors do an admirable (and unenviable) job of putting the available data into a chronostratigraphic framework, and as such provide a useful service for the biostratigraphers toiling on newly and yet-to-be recovered cores. Unfortunately, many details in their book are, by necessity, glossed over, and published data are presented without critiquing their specific quality (e.g. no error bars on the age-depth plots). The reader should be aware, for example, that taxonomic errors in the published literature can lead to unreasonably large stratigraphic uncertainty for certain potentially useful taxa. Furthermore, many taxa that show promise, but are not yet cross-calibrated, are ignored completely. To the authors' defence, had they attempted to right every potential published wrong, and list and assess every potential, then they would have grown old and tired before the job was completed!

Hole summaries are presented in the order in which they were recovered. It would have been nice to have them presented by latitude, since environmental exclusion is an important control on endemic polar plankton populations. The reader can easily investigate these issues from the tables, but, in my opinion, it would have been nice to have the data plotted that way in the first place. The reader should also beware of rather numerous, usually minor and mostly editorial errors. I noted several errors in reference citation and figure

captions. More significant are the errors in taxonomic usage and spelling, and errors on the tables, such as the reporting of first occurrences (FO) as last occurrences (LO), as in the case of *Rhizosolenia oligocaenica*. The reader is well-advised to double-check critical ages.

This volume is strictly a reference work, with only sparse and direct text. But their analyses, if true, lead to two startling conclusions. Their first conclusion is that the biostratigraphic community has generally overestimated the reliability of Southern Ocean datums. Of 136 published Southern Ocean datums, most of which are diatom-based, only 13 are determined to be essentially isochronous! An additional 20 may ultimately be determined to be reliable markers, but too few records are available to date to permit a necessary level of confidence. The second surprising conclusion is that the abundance of hiatuses in the Southern Ocean may have been overestimated. The record seems to be more complete than previously believed. The first conclusion urges considerable caution, but the latter conclusion offers significant hope. The stratigraphic archive that already exists at the ODP curatorial facilities is far better than we thought. As such, it has not nearly reached its potential for further scientific advancement.

The problem with these conclusions is that if the first is wrong, then the second may also be wrong. Many in the community reject the approach of drawing such large-scale conclusions based on simply merging the data sets of different workers onto a standard age model. Combining data from individual taxa, rather than considering whole assemblages, will maximise biostratigraphic uncertainty. Moreover, selection of FO and LO is not a simple task. Each datum must be assessed for accuracy. Many *a priori* facts must be considered, such as whether an occurrence is *in situ* or reworked. Should one use FO/LO or FCO/LCO (first/last common or consistent occurrence)? As far as I can tell, the authors generally adhered to maximum possible range. Selecting the maximum range of taxa, rather than their acmes, may force the rejection of otherwise useful datums. Consequently, in my opinion, their thesis is not satisfactorily demonstrated.

Despite its flaws, this book is a must-have for stratigraphers working on materials recovered during ODP Legs 177, 178, 180 and 183, and must be on board for upcoming legs 187, 188 and 189, and just about all other Antarctic stratigraphic studies, such as the Cape Roberts Project. It should be on the shelves of anyone working on Southern Ocean stratigraphic problems, and should be a part of every public and private DSDP/ODP library. The price of the book (£45.00) will, I fear, severely limit its legal distribution. Cash-strapped scientific libraries may consider the book too specialised to justify the expense, especially considering it is paper-bound, entirely monochromatic, and without photographs. Despite my reservations, my hat's off to authors Ramsay & Baldauf for taking on a distinctly unromantic, but critical part of scientific

advancement from stratigraphic drilling in the Southern Ocean. I, for one, will often find myself referring to and citing this work.

REED SCHERER

References

- CANDE, S.C. & KENT, D.V. 1995. Revised calibration of the geomagnetic polarity timescale for the Late Cretaceous and Cenozoic. *Journal of Geophysical Research*, **100**, 6093-6095.

Paralelo 62°: Uruguay en la Antártida

A.M. de Salvo

Archivo General de la Nacion, Montevideo (1998). 257 pages. No price given. ISBN 9974 7518 9 6.

Uruguay has been interested in the Antarctic for some time. Indeed, it was a Uruguayan ship, *Instituto de Pesca No 1*, which made the first attempt to rescue Shackleton's men from Elephant Island in 1916. Ana Maria de Salvo provides us here with the rest of the story – the Antarctic visit by two Uruguayan naval officers in 1963 aboard HMS *Protector*, the first organised expedition in 1984; the establishment of Artigas station and the development of the science programme. All this is well illustrated with colour photographs, and the book contains a glossary as well as a bibliography. Getting a journalist to write the book rather than a scientist will, I am sure make it much more accessible not only to South Americans but also to those who read Spanish as a second language. Uruguay is proud of its efforts in the Antarctic – this volume documents the history fully for the first time.

DAVID W.H. WALTON

Iceman: a history of the Arctic and its explorers

M. Conefrey & T. Jordan

Boxtree Publishing (1999).

189 pages. £6.99. ISBN 0 7522 1341 5.

Originally issued as a hardback in 1998 this is the book of the BBC TV series. A lightly written account which will certainly make the complex history of the Northwest Passage accessible to many who might not otherwise have bothered. However, the Northeast Passage and Siberia seem to have been completely overlooked! Be warned the book is a science-free zone!

DAVID W.H. WALTON