Palaeobiogeography and Biodiversity
Change: the Ordovician and
Mesozoic–Cenozoic Radiations
Reviewing procedures

The Society makes every effort to ensure that the scientific and production quality of its books matches that of its journals. Since 1997, all book proposals have been refereed by specialist reviewers as well as by the Society’s Books Editorial Committee. If the referees identify weaknesses in the proposal, these must be addressed before the proposal is accepted.

Once the book is accepted, the Society has a team of Book Editors (listed above) who ensure that the volume editors follow strict guidelines on refereeing and quality control. We insist that individual papers can only be accepted after satisfactory review by two independent referees. The questions on the review forms are similar to those for Journal of the Geological Society. The referees’ forms and comments must be available to the Society’s Book Editors on request.

Although many of the books result from meetings, the editors are expected to commission papers that were not presented at the meeting to ensure that the book provides a balanced coverage of the subject. Being accepted for presentation at the meeting does not guarantee inclusion in the book.

Geological Society Special Publications are included in the ISI Science Citation Index, but they do not have an impact factor, the latter being applicable only to journals.

More information about submitting a proposal and producing a Special Publication can be found on the Society’s web site: www.geolsoc.org.uk.

It is recommended that reference to all or part of this book should be made in one of the following ways:


Palaeobiogeography and Biodiversity Change: the Ordovician and Mesozoic–Cenozoic Radiations

EDITED BY

J. A. CRAME
British Antarctic Survey, Cambridge, UK

and

A. W. OWEN
University of Glasgow, UK

2002
Published by
The Geological Society
London
THE GEOLOGICAL SOCIETY

The Geological Society of London (GSL) was founded in 1807. It is the oldest national geological society in the world and the largest in Europe. It was incorporated under Royal Charter in 1825 and is Registered Charity 210161.

The Society is the UK national learned and professional society for geology with a worldwide Fellowship (FGS) of 9000. The Society has the power to confer Chartered status on suitably qualified Fellows, and about 2000 of the Fellowship carry the title (CGeol). Chartered Geologists may also obtain the equivalent European title, European Geologist (EurGeol). One fifth of the Society’s fellowship resides outside the UK. To find out more about the Society, log on to www.geolsoc.org.uk.

The Geological Society Publishing House (Bath, UK) produces the Society’s international journals and books, and acts as European distributor for selected publications of the American Association of Petroleum Geologists (AAPG), the American Geological Institute (AGI), the Indonesian Petroleum Association (IPA), the Geological Society of America (GSA), the Society for Sedimentary Geology (SEPM) and the Geologists’ Association (GA). Joint marketing agreements ensure that GSL Fellows may purchase these societies’ publications at a discount. The Society’s online bookshop (accessible from www.geolsoc.org.uk) offers secure book purchasing with your credit or debit card.

To find out about joining the Society and benefiting from substantial discounts on publications of GSL and other societies worldwide, consult www.geolsoc.org.uk, or contact the Fellowship Department at: The Geological Society, Burlington House, Piccadilly, London WIJ 0BG: Tel. +44 (0)20 7434 9944; Fax +44 (0)20 7439 8975; Email: enquiries@geolsoc.org.uk.

For information about the Society’s meetings, consult Events on www.geolsoc.org.uk. To find out more about the Society’s Corporate Affiliates Scheme, write to enquiries@geolsoc.org.uk.

Published by The Geological Society from:
The Geological Society Publishing House
Unit 7, Brassmill Enterprise Centre
Brassmill Lane
Bath BA1 3JN,
UK

(Orders: Tel. +44 (0)1225 445046
Fax +44 (0)1225 442836)
Online bookshop: http://bookshop.geolsoc.org.uk

The publishers make no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility for any errors or omissions that may be made.

© The Geological Society of London 2002. All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission. No paragraph of this publication may be reproduced, copied or transmitted save with the provisions of the Copyright Licensing Agency, 90 Tottenham Court Road, London WIP 9HE. Users registered with the Copyright Clearance Center, 27 Congress Street, Salem, MA 01970, USA: the item-fee code for this publication is 0305-8719/02/$15.00.

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library.


Typeset by Type Study, Scarborough, UK
Printed by Hobbs the Printers, UK.
## Contents

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owen, A. W. &amp; Crame, J. A.</td>
<td>Palaeobiogeography and the Ordovician and Mesozoic–Cenozoic biotic radiations</td>
<td>1</td>
</tr>
<tr>
<td>Bassett, M. G., Popov, L. E. &amp; Holmer, L. E.</td>
<td>Brachiopods: Cambrian–Tremadoc precursors to Ordovician radiation events</td>
<td>13</td>
</tr>
<tr>
<td>Harper, D. A. T. &amp; Mac Niocaill, C.</td>
<td>Early Ordovician rhynchonelliformean brachiopod biodiversity: comparing some platforms, margins and intra-oceanic sites around the Iapetus Ocean</td>
<td>25</td>
</tr>
<tr>
<td>Cope, J. C. W.</td>
<td>Diversification and biogeography of bivalves during the Ordovician Period</td>
<td>35</td>
</tr>
<tr>
<td>Turvey, S. T.</td>
<td>Phylogeny of the Reedocalymeninae (Trilobita): implications for Early Ordovician biogeography of Gondwana</td>
<td>53</td>
</tr>
<tr>
<td>Smith, M. P., Donoghue, P. C. J. &amp; Sansom, I. J.</td>
<td>The spatial and temporal diversification of Early Palaeozoic vertebrates</td>
<td>69</td>
</tr>
<tr>
<td>Armstrong, H. A. &amp; Owen, A. W.</td>
<td>Euconodont diversity changes in a cooling and closing Iapetus Ocean</td>
<td>85</td>
</tr>
<tr>
<td>Bottig, J. P.</td>
<td>The role of pyroclastic volcanism in Ordovician diversification</td>
<td>99</td>
</tr>
<tr>
<td>Aberhan, M.</td>
<td>Opening of the Hispanic Corridor and Early Jurassic bivalve biodiversity</td>
<td>127</td>
</tr>
<tr>
<td>Cantrill, D. J. &amp; Poole, I.</td>
<td>Cretaceous patterns of floristic change in the Antarctic Peninsula</td>
<td>141</td>
</tr>
<tr>
<td>Crame, J. A. &amp; Rosen, B. R.</td>
<td>Cenozoic palaeogeography and the rise of modern biodiversity patterns</td>
<td>153</td>
</tr>
<tr>
<td>Markwick, P. J. &amp; Lupia, R.</td>
<td>Palaeontological databases for palaeobiogeography, palaeoecology and biodiversity: a question of scale</td>
<td>169</td>
</tr>
<tr>
<td>Markwick, P. J.</td>
<td>Integrating the present and past records of climate, biodiversity and biogeography: implications for palaeoecology and palaeoclimatology</td>
<td>179</td>
</tr>
</tbody>
</table>

Index 201
Preface

Biodiversity change is now one of the most important topics of investigation for biogeographer and palaeobiogeographer alike. Demonstrably, great shifts in the numbers of plant and animal taxa are occurring on certain parts of the Earth’s surface at the present day, and much effort is currently being expended to determine why this should be so. Climate change in particular is held by many to be the most likely cause of dramatic range shifts and local extinctions.

With their longer time perspective, palaeontologists are continually surveying the fossil record for signs of global biodiversity change in the past. Much attention has rightly been paid to studying the spectacular mass extinctions during the Phanerozoic, but what happens in between them? Many palaeobiologists now believe that there may have been two pronounced intervals when life radiated (i.e. diversified) spectacularly: the Ordovician Period, and the mid-Mesozoic–Cenozoic eras. These episodes mark the steepest sustained rises on the ‘curve of Life through time’; the intervening Silurian–Jurassic interval is the much flatter plateau, punctuated by mass extinctions and their recovery intervals.

Both the scale of these spectacular diversity increases and their probable causes are currently topics of intense debate. To the geologist, there is an intriguing link here between dispersed continents (as opposed to the presence of supercontinents), changing climates (both intervals ended with widespread glaciations), and the proliferation of life. We now know that the accumulation of Life on Earth is extremely complex; it is not just a matter of packing more taxa into any one habitat, but also of packing more habitats within a province, more provinces within a region, and more regions within the biosphere. Were the Ordovician and mid-Mesozoic–Cenozoic two intervals of time when there was a fundamental reorganization of biodiversity on a hierarchy of biogeographical scales?

Further study of these two great evolutionary radiations by a mixed group of geologists, palaeontologists and biogeographers was the theme of the 2001 Lyell Meeting convened on behalf of the Joint Committee for Palaeontology representing the Palaeontological Association, Geological Society of London and British Micropalaeontological Society. Entitled ‘Palaeobiogeography and Biodiversity Change’, it was held at Burlington House on 21 February 2001 and received generous financial support from the Geological Society and Palaeontological Association. Some 75 scientists attended and contributed to a lively debate on the fundamental causes of major evolutionary radiations. With half of the programme devoted to the Ordovician radiation, and half to the Mesozoic–Cenozoic one, it was possible to compare and contrast these two great evolutionary events.

The results of this meeting are presented in this volume as a series of individual papers. These represent by no means the last word on this important topic, but serve instead as an introduction to some of the key issues involved. In particular it is hoped that, collectively, they demonstrate how long periods of time and plate tectonic movements can have a fundamental influence on the generation and maintenance of major biodiversity patterns.


Alistair Crame and Alan Owen