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# REVIEWS

## Antarctic Marine Geology

By John B. Anderson  
*Cambridge University Press*  
 40 West 20<sup>th</sup> Street  
 New York, NY 10011-4211 U.S.A.  
 2000, 297 p. Hardcover \$US75.00

Reviewed by Nicole Januszczak  
*Department of Geology*  
*University of Toronto*  
 1265 Military Trail  
 Scarborough, ON M1C 1A4  
 janus@utsc.utoronto.ca

This is the book that I desperately looked for when I started my studies in Antarctic marine geology, although sadly it didn't exist. John B. Anderson's *Antarctic Marine Geology* fills what has been a glaring void for those studying Antarctic geology. The geographic position of Antarctica and the development of its ice sheet have had a profound influence on global climate, oceanography and sea level throughout the Cenozoic. This volume represents the first comprehensive synopsis of Antarctic geology and its unique glacial environment which serves as a living laboratory for those interested in the complicated interaction between all components of the Earth System: the cryosphere, lithosphere, atmosphere, hydrosphere and biosphere.

The geological and glacial evolution of Antarctica is a complicated story, but Anderson deftly takes the reader through, step-by-step. Firstly, he introduces the physical environment of Antarctica and describes its geological history. He then probes the sedimentology and evolution of the continental margin. Perhaps most impressive however, is the final chapter. Here he compiles proxy data, studies from the

continent, data from dozens of drill legs, and results from multiple geophysical studies around the continent, and produces a summary of the glacial history of Antarctica, including what likely got it all started. The chapter is formatted into time slices and evidence from various sources (e.g., continental record, deep sea, ice core, continental shelf) is presented. This is an invaluable summary that, before this book was published, was an arduous task to compile from the available literature.

Sedimentology is a strong focus in the volume and an entire chapter is dedicated to investigating sedimentary processes and the stratigraphic record as it relates to changes in the Antarctic environment. Anderson allocates appropriate emphasis and space in the book to the importance of the continental margin and the record of glacial activity preserved in basins around the perimeter of the continent. He also incorporates plenty of geophysical data, including figures of seismic, side-scan, and chirp sonar records that have shed much light on the dynamics of the Antarctic ice sheet.

The text is easy to read and the content logically follows from one chapter to the next. Figures are in black and white, but most relevant features are not lost in the absence of colour. Some of the seismic profiles are too dark in reproduction, leaving only blind faith at your disposal for accepting the accuracy of the accompanying line drawings. Also, some text within the figures is difficult to read; this is a problem that should have been anticipated when placing black text over a dark shade of grey. Figures however are plentiful, well constructed, and nicely supplement information presented in the text.

As a veteran researcher in the Antarctic, Anderson is the ideal person

to undertake this solo compilation of what was once a broad and disseminated literature into a complete and comprehensive volume. This is a 'must-have' for all researchers working or interested in the Antarctic and would also serve as an excellent text for graduate courses focusing on Antarctic marine geology. It also serves a broader audience however, as it discusses the influence of Antarctica and its ice sheet on global change throughout the Cenozoic and the Quaternary. The stratigraphic expression of sedimentary processes at and near an active ice margin, presented in this volume, will serve as an excellent analogue for those studying ancient glaciations. This volume also provides valuable information for those planning to execute marine geological or geophysical expeditions.

## Sediment Flux to Basins: Causes, Controls and Consequences

Edited by Stuart J. Jones and Lynne E. Frostick  
*Geological Society, London*  
 Unit 7 Brassmill Enterprise Centre  
 Brassmill Lane, Bath, BA1 3JN, U.K.  
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Reviewed by Darrel G. F. Long  
*Department of Earth Sciences,*  
*Laurentian University*  
 Sudbury, ON P3E 2C6  
 dlong@laurentian.ca

The seventeen papers in this book are intended to provide a current perspective on the controls and

constraints of sediment supply to basins on a broad range of time scales, so that long-term average controls such as tectonism and climate can be integrated with short-term geomorphic processes in numerical modeling of sedimentary basins by sequence stratigraphers.

The first set of papers demonstrates the importance of allocyclic controls on the rate and quantity of sediment supply to basins. Hall and Nichols show how enhanced rates of weathering had a direct influence on development of structural style in tropical settings. In Borneo this was sufficient to remove material from incipient mountains at a rate equal to uplift so high-level nappes and thrust sheets and associated foreland basins did not develop. The authors claim that in some cases tropical weathering can generate sediment at faster rates than tectonic processes, hence it is necessary to understand both climatic and tectonic processes in the hinterland when interpreting basin fill. On a more local scale Stokes *et al.* provide information on changes in sediment flux within a small intermountain basin in Spain related to river capture at ~100 Ka, and Thamó-Bozsó *et al.* indicate how small-scale tectonic control affected sediment supply within the Körös sub-basin, SE Hungary. Tropeano *et al.* examine the effects of tectonic controls on cannibalization of piggy-back basins during reactivation of an alpine foreland basin. This section concludes with a comprehensive review of the impact of periodicity on sediment flux in alluvial systems by Frostick and Jones. The authors demonstrate the episodic nature of sediment delivery on scales of a few seconds to millions of years, and argue that this can have a direct effect on the architecture of strata in the receiving basin.

Papers by Brewer and Passmore, Fuller *et al.*, and Milan *et al.*, deal with reach-scale delivery in gravel-bed rivers. Richards examines the role of drainage basin structure and climate change in modifying sediment delivery. Tipper discusses the application and limitations of a fractional model for sediment delivery, including a useful discussion of proximal to distal patterns of bed thickness changes in models of

sediment flux. Jones examines the effects of gradient change on sediment flux in transverse gravel-bed rivers of the Ebro basin, which are directly influenced by uplift of the Spanish Pyrenees. Bogaart *et al.* discuss the role of process-based models of climate forcing on numerical models of sediment flux.

The final series of papers deal with the downstream effects of sediment flux on depositional basins. Evans and Arche describe sediment supply from the Ebro basin to the Mediterranean, suggesting that drainage across the Catalan coastal ranges was initiated in the Miocene, rather than by headward erosion and river capture during the Messinian low-stand of the Mediterranean. McManus describes sediment flux and delta growth in Atchafalaya Bay based on historical records, a fifty-year record of sediment load and river discharge, and a thirty year record of delta development based on air-photographs and satellite imagery. The last three papers deal with aspects of sediment supply to the Mediterranean basin. Poulos and Collins discuss the effects of fluvial sediment flux from 169 rivers into the Mediterranean basin; Poulos *et al.* describe sediment supply to coastal environments in the Hellenic forearc, and Reeder *et al.* describe Late Quaternary turbidite input into the eastern Mediterranean basin.

This book should be essential reading for academic researchers in geomorphic processes. It contains much useful information on Miocene and younger systems, but does not include discussion on how the results can be applied with confidence to older systems. At CAD\$198 this book will have only limited appeal to most sedimentary geologists other than those directly concerned with numerical modeling of sedimentary sequences.

## Physique de la Terre solide: Observations et théories

By Christophe Larroque and Jean Virrieux.

Gordon and Breach Science Publisher  
2001, 360 p., 39 Euros  
ISBN: 2-84703-002-6.

Reviewed by Jean-Claude Mareschal  
*University of Québec at Montréal*  
Montréal, PQ H3C3P8.

This book is one of the few textbooks in Physics of the Earth available in French. It aims at providing an introduction both to the physical methods used in studies of the Earth's deep interior and to the physical mechanisms involved in Earth's evolution. This book probably grew out of the notes of courses that the authors taught and its purpose is to serve as a textbook for an undergraduate class in physics of the earth. The level of mathematics and physics is not very high and the book is obviously intended for geology undergraduate students.

The organization is fairly standard with chapters covering gravity, seismology, geomagnetism, geothermics, geodynamics and tectonics. Space geodesy (at least GPS and some VLBI) is included in the latter chapter. The book appears to be up-to-date and contains a description of standard radially symmetrical earth models as well as some of the recent developments in seismic tomography, satellite gravity, space geodesy, *etc.* The book is illustrated by thirty colour plates. However, one could argue that thirty colour images could have been used much more efficiently than in this book to show tomographic images of mantle convection or how satellite gravity images demonstrate plate tectonic processes. Perhaps the images presented here serve to illustrate that the book is not very well focused and seems to be some kind of hodge-podge of everything more or less connected to the physics of the earth. Some topics that are covered superficially in the text (geothermal energy, some aspects of exploration geophysics, volcanic

activity) are not relevant to and distract from the main topic of the book. In contrast, there is only one illustration and its caption to explain SAR interferometry; there is nothing on seismic anisotropy; the explanations on rheology are kept at a very bare minimum.

More careful proofreading might have eliminated the countless errors and inconsistencies that mar this book. For instance, one can read that in equilibrium the maximum principal stress is vertical, that volcanic activity only occurs in tectonically active regions, or that cooling of the mantle contributes to exactly 3.8 TW to the global energy budget of the Earth. Kinematic and dynamic viscosity are expressed in the same units and the authors seem to confuse the first and second laws of thermodynamics. There are too many gross errors for this book to be suitable as a textbook. References are given in the book but there is no list of references at the end of the book, only some further readings. This is an almost fatal omission that a professional publisher should have noticed.

This may be the only introductory textbook in Physics of the Earth available in French. It is not an inspiring book at all, and one can not help but feel sorry for the French speaking students who are stuck with such a textbook because it does not even remotely compare with the many excellent textbooks available in English. Although Bott's *The Interior of the Earth* is twenty years old and predates seismic tomography and space geodesy, it remains the model that *Physique de la Terre solide* does not stand up to. Fowler's *The Solid Earth* or Turcotte and Schubert's *Geodynamics* provide the quantitative complement to Bott's. Both Stacey's *Physics of the Earth* or Davies' *Dynamic Earth* present a more personal and an infinitely more exciting approach than that used in this book. French speaking students will be much better off if they continue to use textbooks in English next year.

## **Ichnology and Sedimentology of Shallow Marginal Marine Systems: Ben Nevis and Avalon Reservoirs, Jeanne d'Arc Basin**

By S. George Pemberton, Michelle Spila, Andrew J. Pulham, Tom Saunders, James A. MacEachern, Demian Robbins and Iain K. Sinclair  
*Geological Association of Canada, Short Course Notes 15, 2001, ix + 343 p.; GAC Members Price CA \$63.00 US \$47.00 INTL \$49.00 paperback ISBN 0-919216-77-3; ISSN 1189-6094*

Reviewed by Ron K. Pickerill  
*Department of Geology  
University of New Brunswick  
Fredericton, New Brunswick E3B 5A3  
rpickeri@unb.ca*

Ichnology has undergone significant advances over the last two decades and it is now applied in a variety of interpretive tools in sedimentary geology that are being increasingly utilized in the private sector, notably the petroleum industry. The Ichnology Research Group at the University of Alberta, championed by S. George Pemberton, and certainly the most active and innovative group of its kind in North America and arguably even globally, have provided significant contributions in the latter regard and together with several alumni and others have produced this spectacular volume of Short Course Notes.

When I was cutting my teeth in the profession, Short Course Notes were exactly that – outlines and concise summaries of the topics covered in the course accompanied by lead-ins to more extensive bibliographies. The quality of short course notes has improved over the last several years and this latest GAC contribution (as with its predecessors) is no exception. It comprises 343 pages consisting of an extremely informative and detailed text accompanied by 210 figures (277 p.) followed by a comprehensively illustrated trace fossil atlas (54 p.) that

includes many examples of ichnotaxa from the Jeanne d'Arc Basin (one of several rift basins within the Hibernia Field on the Grand Banks, located 315 km east of St John's, Newfoundland), and finally 12 pages of references.

This volume, printed on high-quality glossy paper, is organized into 11 chapters. Chapter 1 presents a brief overview of the sedimentology and stratigraphic surfaces of marginal-marine siliciclastic settings including deltas, barred shorelines, strandplains and estuaries. Although there is nothing new in here, it provides a concise and useful introduction to the nature of marginal-marine settings and the physical processes active within them. Chapters 2 and 3 discuss, respectively, the general principles and conceptual framework of ichnology, and the ichnology of marine clastic environments, particularly with respect to softground ichnofacies. Inevitably there is some overlap between these chapters and the overall information could perhaps better have been provided in a single comprehensive narrative. Regardless, they form an obvious and necessary prerequisite for Chapters 4 to 6, which describe an integrated ichnological-sedimentological model of lower, middle and upper shoreface successions and variability; ichnological expressions of storm deposits; and application of ichnofacies to the evaluation of marginal marine, mainly brackish water, reservoirs. In tandem, these three chapters are particularly useful. They introduce, in admirable style, a number of concepts that collectively are serious considerations in the study of shallow to marginal marine systems, such as the distinction of proximal and distal tempestites versus turbidites and equilibrium (K-selected) versus opportunistic (r-selected) biota responsible for the production of particular ichnotaxa within a given sequence. Chapter 7, on cryptobioturbation (subtle small-scale bioturbation), I found to be somewhat of a misfit regarding the general theme of the volume as it was hardly mentioned or utilized in previous or subsequent chapters. Ironically,

however, although brief (10 p.) I found it to be a very interesting and informative chapter. This particular facet of ichnology has generally gone unheeded since Jim Howard and the late Bob Frey, to both of whom this book is dedicated, pioneered its concept in the 1970s. Chapter 8, which considers the significance of trace fossils to genetic stratigraphy, demonstrates the importance of recognizing substrate-controlled firmground (*Glossifungites*), hardground (*Trypanites*) and woodground (*Teredolites*) ichnofacies in delineating various types of allocyclically formed erosional discontinuities and the palaeoenvironmental implications of trace fossil suites with respect to both softground- and substrate-controlled assemblages.

And so to Chapters 9 and 10, all previous information (219 p.) setting the scene for the rationale of this contribution as included in these chapters. Chapter 9, based on previously published information, provides a brief summary of the geological setting, basin evolution and stratigraphy, exploration history and development, and production in the Jeanne d'Arc Basin. Chapter 10 describes the facies associations (4) and individual facies (19) recognized from the Avalon and Ben Nevis formations, including their detailed sedimentology and ichnology. Based particularly on the latter, the authors interpret each with respect to depositional environments that, in certain levels of the cored sequence, are demonstrated to differ from previous interpretations. The book concludes with Chapter 11, a trace fossil atlas, that includes description, interpretation, trophic analysis and environmental considerations of the 20 ichnotaxa identified from the Jeanne d'Arc Basin, each accompanied by several photographs from both outcrop and core.

As noted, the main text is accompanied by 210 figures, many of which combine both line drawings and plates. The plates are generally of excellent quality but many lack a scale. The line drawings, one of which adorns the front cover, are presumably the work of Tom Saunders. These are quite

spectacular and more than a match for the illustrations of two other well-known ichnophiles with considerable artistic expertise, Richard Bromley and Dolf Seilacher.

Regrettably, the volume could have benefitted from more careful editing as it is pervaded by numerous orthographic and other inconsistencies both within and between individual chapters. Although most of these are minor, some cause considerable teeth clenching and are totally unnecessary. For example, one of the authors is thanked in the acknowledgements; Figure 68 is labeled as 19; cross-stratification, -laminae, - bedding versus cross stratification, laminae, bedding (are the latter angry?); *Glossifungites* versus *Glossifungites* etc. What a pity such a splendid contribution is marred by such oversights and lapsus calami.

These irritants aside, what we have here is a splendid and up-to-date volume on the current understanding of the ichnology and sedimentology of marginal-marine systems utilizing both modern and ancient analogues. The science is excellent, the writing lucid and informative and the quality and presentation of the figures have to be seen to be believed. The book could be easily adopted for senior level undergraduate and graduate courses. Professionals working in broadly comparable research should definitely purchase it – a bargain for the price. The GAC and Pemberton *et al.* have produced a real winner.

## Genetics, Paleontology, and Macroevolution

By Jeffrey S. Levinton

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New York, NY 10011-4211 USA  
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Reviewed by Robert B. MacNaughton

Geological Survey of Canada (Calgary)  
3303 - 33rd Street NW  
Calgary, Alberta T2L 2A7  
romacnau@NRC.gc.ca

Jeffrey Levinton begins the second edition of his textbook in visionary terms (p. 1): "The field of macroevolution embraces the excitement of seeking an understanding of the breadth of life. . . No mystery is more intriguing than why we have amoebas and horses, or dandelions and palms." There are indeed many questions that arise from our contemplation of the living world and many of these remain the subjects of vigorous, even rancorous, debate. Can speciation and biological diversity be explained by natural selection alone, or do other processes play a role? What controls the tempo of evolution? Shall we be phyletic gradualists or enthusiasts for punctuated equilibria? What exploded in the Cambrian: fossils or phyla?

To answer these questions, Levinton compiles and synthesizes an impressive amount of data from a wide range of disciplines. Thematically, the book can be divided into four parts. The first consists of the opening chapter, which provides a useful historical overview of macroevolutionary studies. This leads into three chapters with (for lack of a better phrase) a strong neontological theme. These consider the interplay among genealogy, systematics, and evolution (chapter 2); discuss issues of genetics, speciation, and transpecific evolution (chapter 3); and examine the relationship between developmental biology and evolution (chapter 4).

In the next four chapters, the fossil record plays a central role in the

discussion. After an engaging discussion of constructional and functional morphology (chapter 5), the text swings into a discussion of patterns of morphological change in fossil lineages (chapter 6). This really takes flight with a discussion of the much-debated theory of punctuated equilibria (of which more below). The text then discusses patterns of diversity, origination, and extinction in the fossil record (chapter 7), complete with diversity curves, evolutionary faunas, and mass extinctions. (In answer to the question, "Are mass extinctions real?", Levinton might answer, "Well, the one at the end of the Permian probably was...".) This section concludes with a treatment of the Cambrian explosion (chapter 8). Although the author does not see this event as nearly so explosive as some would have it be, I was impressed with his even-handed presentation of the different views. His summation, that the Cambrian explosion suffers from "too many hypotheses chasing too few data" (p. 493), may fetch a rueful grin from more than a few of us involved in this area of research. Happily, the amount of data grows steadily!

The final section of the book (chapter 9) consists of ten theses that the author hopes will provide some guidance for future research. Some of these will certainly be controversial, at least in some circles, and so much the better.

Levinton writes from a resolutely neo-Darwinian perspective. Even the title of his book is reminiscent of one of the classics of neo-Darwinian literature: *Genetics, Paleontology, and Evolution*, by Jepsen, Mayr, and Simpson (1949). With this in mind, I doubt that it will spoil any surprises when I report that this book is unremittingly harsh in its treatment of a number of ideas and people on the current paleobiological scene. Gould, Eldredge, Stanley, and others come in for repeated, vigorous criticism. Happily, Levinton is more polite and good-natured than some other critics of these gentlemen have been, even defending Gould against a particularly captious criticism of his "spandrels of San Marco" paper. Nevertheless, he is blunt in his assessment. While he acknowledges the

salutary role that the theory of punctuated equilibria has played in encouraging research into transitional evolution, that is about as much credit as he gives it. Indeed, he views it largely as an exercise in political-style rhetoric that seeks to account for patterns that are better explained by combining natural selection with current knowledge of phylogenetics. Species selection fares little better. For Levinton, phyletic gradualism provides an adequate explanation of the fossil record. I will leave it to the reader to decide whether or not Levinton's arguments are convincing (not least because I am still digesting them myself) but I do recommend that interested parties take the time to read them.

This is emphatically not a book for readers seeking an entry-level treatment of the field. Levinton writes for specialists, and even specialists may find themselves scrambling for their undergraduate textbooks as they encounter yet another unfamiliar term. Paleontologists without a strong background in genetics may find chapters 2 to 4 to be particularly heavy going. Undergraduates will very likely founder upon the technical detail, although carefully chosen reading assignments could be used in upper-year courses. For graduate students with time to spend reading and pondering, this book should be a boon: there is material here to provoke any number of stimulating seminars and arguments with one's supervisor.

The presentation of the book is generally attractive, with an easy-to-read typeface and well-reproduced figures. Unfortunately, scale bars are only sporadically present on diagrams. (In some cases, scale bars are provided without any indication of the scale they represent.) The writing style moves back and forth between two extremes. In some places, it is engagingly conversational, locally even a bit too colloquial. In others, the style is very dense and highly technical. These sections can be heavy going and the chattier sections provide a welcome relief. A glossary and index are provided, although there are more than a few technical terms in the text that are not included in either. The reference list

is extensive and reasonably well balanced between recent works and older studies.

I give Levinton high marks for producing a thorough, thought-provoking treatment of a complex subject. Granted, it will be the rare paleontologist who does not scratch her or his scalp more than once while perusing Levinton's book. Equally rare, however, will be the paleontologist who does not feel synapses sparking in interesting new ways in the course of reading it.