

## BOOK REVIEWS

### The Avalon Terrane

Socci, A. D., Skehan, J. W. and Smith, G. W. (editors) 1990. *Geology of the Composite Avalon Terrane of Southern New England*. Geological Society of America, Special Paper 245. Geological Society of America, Boulder, Colorado, U.S.A. 254 pp. Price \$45.00.

Most orogenic belts are complicated collages of terranes of uncertain provenance between continental forelands. Plate tectonic elements can be discerned readily but it is not clear, generally, how individual bits fit together in an evolving plate boundary system. This is a particular problem in the Appalachian-Caledonian orogen where ophiolites, andesites and rift sequences all testify to the operation of plate tectonics during the early Palaeozoic but where a massive post-Arenig sinistral component of motion is imposed upon the whole system. Southeast of the 'Central Mobil Belt' (arc and oceanic terranes) of the Appalachian core lies a series of enigmatic 'blocks' or terranes from Georgia to central England that have a number of elements in common; late Precambrian volcano-sedimentary rift sequences and a distinctive Cambrian shallow-marine clastic sequence with a so-called 'Atlantic' fauna. This zone is called, commonly, the Avalonian composite terrane, from its most spectacular development in southeastern Newfoundland. In southern New England, mainly Connecticut, Rhode Island and eastern Massachusetts, the Avalonian rocks, the subject of this volume, are splendidly displayed along fine coastal sections in tunnels, and in glaciated inland exposures (just north of the southern margin of the Laurentide ice sheet).

In the last century, C. D. Walcott recognized that fossiliferous Cambrian rocks in the Boston region bear a close resemblance to those of the Avalonian Peninsula of southeastern Newfoundland. In the 1960s, Tuzo Wilson wrote his classic paper "Did the Atlantic close and then reopen?", one of the inceptive harbingers of applying plate tectonic ideas to old rocks, partly based upon the faunal and stratigraphic similarities of terranes noted by Walcott in the southeastern Appalachians and British Caledonides. Wilson regarded terranes like southern New England and southeastern Newfoundland as "bits of Europe left on North America following the Mesozoic/Cenozoic opening of the Atlantic". In the 1920s, Edward Bailey had noted, with great perception, that eastern Massachusetts and Connecticut are where the Hercynian Belt of 'Europe' crosses the Northern Appalachian-Caledonian belts to become the Central and Southern Appalachians; that is, where an early Palaeozoic orogenic belt is 'transected clockwise' by a late Palaeozoic belt.

This set of 13 papers on the southern New England portion of the composite Avalon terrane is an authoritative, up-to-date and excellent data summary and synthesis of the Palaeozoic evolution of a small but critical part of North America southeast of the Lake Char-Clinton Newbury fault zone. It is not a volume that establishes new principles but rather constitutes an essential source book for those interested in Appalachian-Caledonian evolution. The first chapter, by Nance, is a short incisive look at the whole Avalon Belt of the Northern Appalachians with a Proterozoic volcanic arc interpretation. Skehan and Rast, in the second chapter, develop a systematic analysis of the 'Baston terrane' and a model involving sequential extensional and compressional phases. Chapters 3-5, by Socci, Smith, Thompson and Hermes, focus on the Proterozoic-earliest Palaeozoic history of the region and derive models from detailed sedimentological and volcanic data. Subsequent chapters, in various combinations of Hermes, Murray, Cardoza, Hepburn, Hon, Ross, Durham, Ambers, Wintsch, Webster, Bernitz, Fout and Andrews demonstrate the role and power of trace element geochemistry of plutonic and volcanic rocks and their metamorphic derivatives in terrane discrimination, establishing stratigraphy and characterizing tectonic regimes. The last chapter, by Skehan and Rast, is an excellent synthesis of the Avalonian 'Superterrane' of southern New England in the context of Gondwana-related tectonic fragments and tectonic cycles around the old Iapetus Ocean.

I have enjoyed reading this volume, probably because of my long-

term involvement with the Appalachian-Caledonian orogenic belt. It will form certainly an indispensable element of my library to be used as a data and ideas source book and is recommended to all those who believe that basic or orogenic geology will never be subsumed wholly by model building, and that field data still have a role to play in the Earth Sciences.

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### Computers and geology

Hanley, J. T. and Merriam, D. F. (editors) 1990. *Micro-computer Applications in Geology, II. Series: Computers and Geology, Volume 6*. Pergamon Press, Oxford, U.K. 303 pp. Price £29.95 (\$49.50) hardback.

The first volume of this collection remains one of the few books which, having taken the trouble to write off for an inspection copy, I decided I could not justify buying and consequently sent back. Furthermore, that view was reached wearing my computer-oriented geologist's hat, whilst this review of the second collection aims to evaluate from a structural geologist's viewpoint. Not an auspicious beginning, but I did find rather more of interest in this second volume. I think that few geologists would find it a worthwhile purchase but many could benefit from browsing through it.

The book is a collection of papers describing applications across a very wide range of geological disciplines and using the two commonest types of microcomputer. Of the 22 contributions, 13 relate specifically to IBM PCs and compatibles, eight to Macintoshes and one makes no mention of machine type. The application areas range from a hydrogeologic study of a waste disposal site to the modelling of shell morphology. There are also contributions covering subjects of wide applicability such as Fourier transforms, geographic information systems and the role of microcomputers in geological education. There is just one contribution specifically related to structural geology—"STRANA: A Macintosh computer program for the representation and statistical analysis of orientation data in structural geology" by Barchi and Guzzetti.

The book aims to function on two levels. At its most obvious it provides a forum for the presentation of complete solutions. If a program in the book is exactly what you are looking for then you will want a copy of it and around 70% of the software featured is available, in the public domain, through COGS—The Computer Oriented Geological Society. (COGS Disk Series, PO Box 1317, Denver, CO 80201-1317, U.S.A.) The structural application mentioned above is one of those available from this source. On a second level the book is a store cupboard of ideas for those geologists actively using microcomputers, either by developing their own software or by the use of standard, multi-purpose packages such as spreadsheets.

The STRANA package provides most of the expected facilities for the analysis and display of directional data. Plots of three-dimensional data can be produced using either equal-area or equal-angle projection whilst two-dimensional data can be shown in rose diagram form. A simple eigen analysis of the distribution can be performed but rather surprisingly there is no facility for contouring. The data are input via standard text files. These are organized as one file per "structural station". A station can be either a physical outcrop or a wider area considered to show homogeneity. This approach could lead to a multiplicity of files for a single area and/or to some rather lengthy editing sessions to organize them into sets of homogeneous data. I would prefer to use a package which helped me to decide on areas of homogeneity rather than one which required the decisions to be made in advance.

As for the remaining contributions, I must confess that there are

several from which I could derive little of interest. However, it is in the nature of a book such as this that rewards come in the most unexpected places. I anticipated rapidly skimming through Bellotti's "Data and information management for a hydrogeologic study of a waste-disposal site". Instead I found a novel use of the histogram capabilities of a standard spreadsheet to produce cross-sections from borehole data.

With other contributions it is less surprising that the applications they describe are of interest to a structural geologist. Habesch describes image processing techniques applied to back scattered electron images of pore-geometry networks that has obvious applicability to microstructural studies. Herzfeld's paper dealing with surface modelling based on radio-echo sounding data from an Antarctic glacier describes techniques that could be applied to the modelling of any surface sampled by line surveys.

In summary, whilst I cannot urge you to rush out and buy this book, if you come across it one rainy afternoon in the library then a browse through it would benefit any potential microcomputer user. In the 1990s that surely includes all of us.

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### Computers and exploration geology

Koch, G. S., Jr 1990. *Geological Problem Solving with Lotus 1-2-3 for Exploration and Mining Geology. Computer Methods in the Geosciences, Volume 8*. Pergamon Press, Oxford, U.K. 208 pp. plus programs on disk. Prices £35 (\$60) hardback; £20.50 (\$35) softback.

This book, and accompanying 5.5" disk, presents some methods for solving problems in exploration and mining geology using the Lotus 1-2-3 spreadsheet. The reader should be familiar with basic statistics and preferably the author's earlier two-volume book (with R. F. Link) *Statistical Analysis of Geological Data* (Wiley, New York). The book also assumes a basic understanding of Lotus 1-2-3, which the reader must have access to on an IBM-compatible machine running DOS. Thus the reader will need to turn to other books and manuals for an introduction to these areas if unfamiliar with them.

The book is in two parts—Part 1, Exploration; Part 2, Evaluation, with seven chapters in each part. Chapter 1 gives an introduction to Lotus 1-2-3; somewhat irrelevant to those familiar with the spreadsheet and not sufficient for those new to it. Chapters 2-5 demonstrate how to use 1-2-3 to calculate confidence intervals, fit straight lines using linear regression, carry out simple analysis of variance and generate summary statistics (frequency distributions, histograms). In each case geological examples are provided in the form of worksheets on the accompanying disk. These examples do little more than state the obvious and printing out of the worksheets in the book, takes up valuable space which could have been better used in discussing the underlying principles of both the statistics and programming of the spreadsheet.

Chapter 6 is entitled *Exploration models*, but simply outlines how to use 1-2-3 to simulate a drilling programme on a square grid—basically the user selects values from a hidden matrix as siting drill holes. Despite the inclusion of some real data, I found this exercise to be extremely simplistic: I wonder what an economic geologist would think! The final chapter in Part 1 presents probability and related calculations and demonstrates how to plot log-log graphs on 1-2-3, not one of the most straightforward features of the basic spreadsheet.

Part 2 deals with 'evaluation' of mineral deposits, particularly the financial aspects. Chapters 8-10 present details of compound interest, depreciation and depletion, and discounted cash flow rate of return. These topics obviously have a wider application than in geology, but are dealt with fairly simply. Chapter 11 shows how to calculate the grade and tonnage of a deposit from data obtained in development workings. Chapter 12 provides worksheets to block ore from drillhole data utilizing quadratic regression equations. These last two chapters were the first to convince me than an explorationist might get something useful from the book, but the methods used are simple and have largely been superseded by geostatistical methods (kriging, etc.). Chapter 13 uses spreadsheets to calculate ore concentration after

milling and payments made by smelters for the concentrated products. The book concludes with a spreadsheet version of Peters' model for mineral and property evaluation.

From this brief review of the contents you will see that there is not much in this book of direct interest to the structural geologist, but given the book's title that should not be a surprise. It would be wrong of me to attempt to evaluate the book from the viewpoint of a practising geologist engaged in mineral exploration and mining. I did, however, turn to this book in the hope of gaining some insight into the numerical methods used in this field and was disappointed; I certainly learned more from the earlier books by Koch and Link. I had also hoped that being shown new ways of applying spreadsheets to geological problems, especially with access to these on disk, would provide a stimulus to applications in my own research and teaching; again I was disappointed. Indeed I left this book fairly convinced that, whilst one can do a lot with spreadsheets such as Lotus 1-2-3, there are software packages with greater functionality available for statistical analysis and graphical display of geological data, and a lot to be said for standard programming languages when it comes to more specific applications.

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### Oil provinces

Brooks, J. (editor) 1990. *Classic Petroleum Provinces*. Geological Society Special Publication 50. The Geological Society, London, U.K. Price £89.00.

*Classic Petroleum Provinces* contains 31 papers geographically spread from Brazil, Venezuela, through the U.S. Gulf Coast to Canada and Alaska, then an eclectic group of papers from the Middle East and one from the Niger Delta, followed by five from the North Sea basin and surrounding areas. The book concludes with two papers from Siberia, and one each from Pakistan, Australia and China.

Despite the geographical spread, the balance of the book does not adequately reflect the promise of the title. Saudi Arabia features in only one paper, against Venezuela's four. This prompts the question: what constitutes a "classic petroleum province"? To include the onshore U.K. Carboniferous Basins and the Gippsland Basin of Australia, but nothing from Indonesia and Burma, and only abstracts from the Niger Delta, seems mildly eccentric. There has been no attempt to group like with like, either on a topic basis or on the basis of basin classification. The Editor, J. Brooks, uses the Bally and Snelson classification scheme as a basis of his own opening contribution, so perhaps this should have been used to arrange the papers in the whole volume.

*Classic Petroleum Provinces* should provide state-of-the-art ideas and data on some of the world's most important hydrocarbon-producing areas. It does contain some potentially useful new contributions from Siberia and South America, and students will be grateful of reviews on the Siberian Basin appearing alongside the U.S. Gulf Coast. However, this is an uneven volume which I cannot recommend for many reasons.

Most of the authors have tried to present reviews or overviews of their "province", or of problems peculiar to their area. I am not sure why a paper on seismic modelling of salt structures finds a place here, although the area to which it has been applied is arguably a "Classic Province". It would be fine if there were other papers on this basin. This paper is a case in point, where structural geologists have much to contribute to the oil industry. There can be no sense in making synthetic seismic models from a geological cartoon section which does not balance in any way. Matters are made worse by having sequential sections at different scales so that they cannot be overlain for comparison.

Most of the review articles provide a good source of the more recent views and literature. However, *The Middle East Basin: a summary and overview* only found three papers of significance in the last 7 years, two written by the author himself and one of these itself a review paper for a similar special volume. References to reports not in the public domain should not have been permitted, particularly where the author cites only one other reference in the last 5 years to support his views on the history and future development of Pakistan. It is additionally surprising in this paper that no-one spotted the author's own name