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BOOK REVIEWS

Strain analysis: an introductory course

Ramsay, J. G. & Huber, M. I. 1984. *The Techniques of Modern Structural Geology, Volume* 1: *Strain Analysis*. Academic Press, London. 307 pp. Price: paperback £12.50.

This is the first of a planned three volume set of books, the first two aimed at undergraduate students, the third mainly at postgraduates. It is tempting to view these books as an updating of John Ramsay's *Folding and Fracturing of Rocks*. Whilst much of the material in volume 1 is covered in the earlier book, it is much more clearly presented for student use and is based on a question/answer format. Most readers will welcome the clear, up-to-date, well structured nature of this volume and the greater size and clarity of the illustrations. One is immediately impressed by the high quality of the photographs and line diagrams; more detailed examination shows them to be well chosen, carefully drafted and concisely described.

The book is organized into fourteen chapters or 'sessions', each designed to represent a unit of instruction (about 1 lecture and 3 hours laboratory practical). Each chapter is structured carefully, involving a short introduction, in which basic concepts and terminology are discussed, followed by a graded series of questions and answers, most of which are linked to simple practical methods of analysis. The chapters end with a glossary and annotated reference list. The whole organization of the book allows a great deal of self instruction and appraisal, and I suspect most structural geologists would benefit, as I did, from working through the examples. These are carefully thought out, accurate and well explained, although I found some a little contrived and would have liked to see more 'real' examples, even if the answers would necessarily have been less clear cut.

Chapters 1–3 are an introduction to displacement and strain, and make use of simple 'experiments' with card decks. The reader is introduced gradually to the concepts of simple shear and the strain ellipse. I was slightly irritated by the sign convention used for simple shear which, although internally consistent, is the opposite to that in normal use (e.g. Ramsay & Graham 1970) and necessitates a lot of −ve signs. These three chapters contain lots of very effective teaching material and set the general style and tenor of the book. However, I was left asking the question "can all geological structures be analysed in terms of simple shear?" Chapter 4 departs somewhat from the practical, 'try-it-and-see' approach, but is a very neat attempt to introduce vector fields and matrix representation of transformations, and generalizes some of the earlier discussion.

Chapters 5–8 are concerned with the main techniques of strain determination and represent good, 'state-of-the-art' reviews of existing methods. I was pleased to see the inclusion of Fry's centre-to-centre-method, but there was little discussion of the use of line orientations. Chapter 7 includes a brief mention of deformation mechanisms in connection with strain partitioning.

Chapter 9 is an introduction to stereographic projection. This gets a fairly brief treatment, but some of the examples are interesting. I feel that most courses in structural geology would need to devote more time to this topic, which is mainly introduced at this stage in the book to facilitate the treatment of three-dimensional strain in the following chapters.

Chapters 10 and 11 discuss three-dimensional strain and the presentation is more suitable for undergraduates than that in Ramsay (1967). I found these chapters struck a nice balance between presenting a full discussion with minimal mathematics and presenting simple examples of the applicability of the strain approach to field interpretation.

Chapters 12–14 discuss progressive deformation in general terms and its measurement using veins and pressure shadows. Again the treatment is clear and extremely well illustrated, but I still find it hard to conceive of the history of the Helvetic Alps being unraveled from a few pyrite grains and would have welcomed some more straightforward examples.

It is difficult to evaluate this book without reference to volume 2 (not yet published), since we are told this will deal with the application of much of the contents of volume 1. Both volumes will undoubtedly be judged with respect to Ramsay's earlier book, which had such an impact on the subject. The new books are aimed more obviously at the undergraduate student and I think they will be used widely by both student and teacher. The examples, diagrams and photographs will be utilized, in some form or other, in most structural geology courses. There are two areas where the book requires more careful evaluation.

Firstly, is the question/answer format a success? Overall I think it is, the authers achieve many of their objectives. The book is very readable, interesting and there is a reasonable flow between questions, answers and linking comment, although I did find I was constantly shifting backwards and forwards from question to answer. The questions are interesting and the answers accurate, but I would like to see more practical and realistic examples. The earlier chapters certainly allow the reader to become familiar with the basic concepts and geometry of strain without taxing his/her mathematical abilities more than necessary. For those who like their mathematics less diluted the appendices provide a good concise concentrate.

Secondly, does the book meet the needs of university courses and industry training? Here I think there are some serious imbalances. Initially I took the book for what it is; an introduction to strain analysis. Yet in reviewing it I cannot ignore the claim on the back cover that "the unique approach to the investigation of tectonic structures renders this book invaluable as a first substantial text for structural geology courses". I feel that as an introductory undergraduate textbook there are some obvious omissions, which volume 2 will be hard pressed to rectify. The most obvious is the lack of treatment of stress, surely as fundamental to the subject as strain. This is highlighted in chapter 9 where the reader is asked to "determine the principal stress directions", but nowhere in the book are these discussed. Even if one accepts the book purely as an introduction to strain analysis, there is still no discussion of rock rheology or deformation mechanisms. Thus the reader is asked to embark on a study of strain with little feel for how this might develop in rocks. The connection between computer cards and rocks needs to be explained—if it can! As for providing a training within industry, I feel a book on structural geology which has virtually no maps or cross-sections will have a somewhat limited appeal.

In summary this book by John Ramsay and Martin Huber is one which will be widely used by structural geologists and will have an influence on the teaching of the subject. It is a well produced and authoritative book in an area generally lacking such texts. I have some reservations about its marketing as an introductory textbook, and find the title "The Techniques of Modern Structural Geology" a little at odds with a book that is based firmly on the 19th century ideas of Mohr, Thompson, Tait and others.

David J. Sanderson

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Ramsay, J. G. & Graham, R. H. 1970. Strain variation in shear belts. *Can. J. Earth. Sci.* 7, 786–813.

Benchmark papers on ductile strain

Stauffer, M. R. (editor) 1983. *Fabric of Ductile Strain* (Benchmark Papers in Geology, Volume 75) Hutchinson Ross, Pennsylvania. 400 pp. Price: hardcover US $48.00.

The series editor, R. W. Fairbridge, explains the philosophy behind the Benchmark Series, in a foreword: "to gather into single volumes the critical material needed to reconstruct the background of any and every major topic of our discipline". Each volume consists of reprinted articles selected by the volume editor to be of benchmark status, together with 'highlight' commentary. Volume 75, *Fabric of Ductile Strain* is edited by M. R. Stauffer of the University of Saskatchewan.

The editor, in a Preface, states the purpose of the book: "... to serve as a guide to some of the main facts and concepts relating to the ductile deformation of rocks". The book continues with an Introduction which takes the form of a succinct historic review of the development of current ideas on ductile deformation. It is then divided into three parts, each beginning with editorial comment and continuing with the selected reprinted articles and extracts.

Part I, *Slaty cleavage and its relationship to strain*, is the shortest of the three sections. Only two full articles (Wood and Means) are included with extracts from Sharpe and Sorby sandwiched between. I was uneasy with this mix and felt that the selection did not do justice to this important topic. Siddans' 1972 review would have been an appropriate opening, being an invaluable summary of 19th century ideas for students, and an ideal accompaniment to the historical extracts. On the whole, I found Part I too short to be of real value, but to do the subject justice would be a volume in itself.

Part II, *Deformation textures and flow mechanisms*, is more expansive than Part I. It contains three times the references in its editorial introduction, and reprints seven articles, only one of which is an extract. Many key contributions on metamorphic textures and porphyroblasts are reproduced (one by the editor) but, unlike Part I, no truly classic papers have been selected. The seven contributions span the years 1963–1978 and despite the earliest, Spry, having built on the work of Zwart (who in turn built on Sander) no contributions from either were selected. I find this surprising. It seems particularly a pity that Zwart's work, which so influenced current interpretation of metamorphic textures and to which there is constant reference in these articles, should not be included in its original form.

Part III, *The geometry of strain*, is the last, largest, section (half the book) made up of nine articles/extracts. The topics covered range from Cloos's classic paper on Maryland and Flinn's pioneering work on three-dimensional progressive deformation, to recent techniques of strain measurement and deformation paths. The last three articles are 'odd-balls' which distort the balance. Mitra, on deformation mechanisms, seems more suited to Part II. Ramsay's shear-zone review is reproduced in its entirety despite covering rather a specific form of strain; although undoubtedly an important contribution of great teaching value, it is easily available in its original *Journal of Structural Geology* (1980) form and, arguably, is too recent for benchmark status. There must be more suitable earlier contributions by Ramsay on the geometry of strain especially from the 1967 book, which are truly benchmark, having captured a new generation of structural geologists. The final article is a one-page extract which seems an unsuitable conclusion to the book.

This volume undoubtedly reproduces important contributions to structural geology. However I am not convinced that the title "*Fabric of Ductile Strain*" is appropriate. Although slaty cleavage and metamorphic textures answer to fabric of ductile strain, many of the articles on "geometry of strain" are concerned with techniques of strain measurement from deformed objects. The volume would have been a more successful thematic book had the content been less diverse. With "fabric" in the title the reader might expect to see some of the classic fabric work extracted from, for example, Sander, Fairbairn and Voll. Clearly, with a volume which is a personal selection of articles this choice is open to debate.

However, the other personal aspect of the book, Stauffer's editorial commentary, is its most positive element in my view. Between the three sections is a well-written linking commentary, a refreshing and enlightening discussion of the articles and other contributions which were not included, plus a comprehensive reference list. Such reviews are educational for students and teachers alike.

On the whole, my views on this volume are coloured by its very nature, one in a series "Benchmark Papers in Geology". There seems a real danger that what starts as a personal selection of important contributions becomes the established view, on publication. By making this selection of articles more accessible to North American students than the original diverse articles, is the editor unwittingly discouraging the student from reading other relevant contributions which are not included and require a little more effort? Might the end result be a narrowing, rather than broadening, of the student's repertoire?

If the term "benchmark" must be used (jargon, like "keynote address" which implies superior status) I would prefer it to be applied to classic and historic work which, on consensus opinion, has endured at least a generation (20 years) and preferably more. There must be sufficient contributions which answer this description to fill a volume, *Fabric of Ductile Strain*. Many would certainly be inaccessible in modern libraries, so well worth reproduction. This is not true of most of Stauffer's collection. In my view, it is poor value at $48 since more than half the contents appeared in 1970s leading journals which are surely available in original form. Students should be encouraged to read these articles in the journals, along with many other equally important papers, rather than be spoon fed from a prepacked selection.

Susan H. Treagus

Mesozoic geology of the World viewed stratigraphically

Moullade, M. & Nairn, A. E. M. (editors) 1983. *The Phanerozoic Geology of the World II, The Mesozoic, B.* Elsevier, Amsterdam. 450 pp. Price: hardcover US $111.75 (in U.S.A. and Canada), Dfl. 265.00 (rest of the world). In the U.S.A. and Canada the book is available from Elsevier Science Publishing Co. Inc., P.O. Box 1663, Grand Central Station, New York, NY 10163, U.S.A.

Earth scientists construct their edifice mainly on the foundation of regional data. Since its birth, geology has been mainly a regional science and its greatest achievements frequently have come from critical evaluations of some aspect of global geology. In addition to its academic appeal, an accurate and detailed knowledge of world regional geology has become also an economic and social necessity, especially in the course of the last two decades. As a consequence, both academic and industrial interest in the regional geology of the Earth has experienced a recent boom, particularly when compared with the stagnant decades from about 1930 to 1960, when, in the absence of a unifying theoretical framework, regional geological studies had come to be viewed as being little more intellectual than postage-stamp collecting, compared with the challenges offered by experimental and theoretical studies. Needless to say, in this re-awakening of interest in global geology the advent of the theory of plate tectonics, itself a child of regional considerations, has played a major role. For the first time, since the glorious days of the Viennese school's world-wide syntheses under the leadership of Suess, regional geology has begun to make sense: it has become predictable. This was rarely the case only two decades ago and earlier, when geologists were always ready to describe, but were seldom prepared to predict.

One of the discouraging aspects of pursuing regional geologic research, especially on a large scale, is the immensity of the available information and, ironically, the grave difficulties in obtaining it. Not only are the data scattered throughout countless local journals, government or company reports, and books of limited circulation, but also difficult to use owing to language barriers, even if one could gather all the local sources of information. Thus, readily available, authoritative reviews and syntheses of regional geology written in a major international language (now mainly English) have become indispensable to students of global geology.

The Phanerozoic Geology of the World series was conceived as an answer to this demand and was intended to "provide a comprehensive description of the regional geology of the world for the Palaeozoic, Mesozoic and Cainozoic eras respectively." The first volume of the series, *The Mesozoic, A*, was published seven years ago in 1978 and covered Africa, Australasia, and northern, central and southeastern Asia together with the European provinces of the U.S.S.R. The present volume deals with the Americas in part, Antarctica, and with the two south Asian countries of Pakistan and India. The third volume of the Mesozoic is planned to cover the rest of Europe, northwest African maritime countries, the Mesozoic ocean floor, and some of the broader issues of the Mesozoic geology of our planet.

As they had done for its predecessor, the editors invited contributions for this volume stressing the desire for a more palaeogeographically orientated approach and for a clear distinction between data and interpretations. This basic outline probably accounts for the initial choice of authors (mainly stratigraphers and biostratigraphers), the dominantly stratigraphic treatment, the emphasis of palaeontology, the sparsity of structural information, and the gross inadequacy of the tectonic histories of the areas dealt with in the individual chapters.

The first two chapters of the book are devoted to North America and Greenland. An international team of geologists from the U.S.A., Canada and Denmark describe the Mesozoic sedimentary history of northern and central Alaska, the Canadian Arctic islands and northern Greenland, emphasizing the subdivision of the Phanerozoic rocks in these regions into three tectono-stratigraphic assemblages of approxi-