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# BOOK REVIEWS

## Fault and fold tectonics

Jaroszewski, W. (1984). *Fault and Fold Tectonics*. Ellis Horwood Limited, Chichester, England. 565 pp. Price: hardcover £47.50.

I am not one of those who continually carp about the lack of good structural geology textbooks. For the last decade I have found the steadily growing selection quite adequate for the undergraduate courses that I teach. Indeed the flutter of excitement as a new text appears on the library shelves is often modulated, even damped completely, when I delve between the covers. Familiarity so often lurks there. The same concepts and examples, the ideas skilfully restated maybe, the figures attractively redrafted, the material reorganized and re-emphasized, but in substance a book rather similar to the last structural geology text off the inexorable publishing production line. So here was the latest, *Fault and Fold Tectonics*, translated—my fluttering heart sank prejudicedly for a moment—from the Polish edition of 1980.

How do you evaluate textbooks? Not by a time-sapping cover-to-cover read I am sure. Instead I use a sampling technique based on my current interests, this year strike-slip tectonics and diapiric structures. I stand and fan the pages of Jaroszewski's book, first trying to spot the inevitable maps of the San Andreas system and the Great Glen fault. It is ten minutes before I find them. I have been diverted by maps of strike-slip faults on the Soviet coast of the Japan Sea, in the Donetz Basin, in Mongolia, and in the Świętokrzyskie Mountains of Poland. I have read Polish views about the ends of strike-slip faults, Russian data on the correlation between length and displacement on faults, and found how to tell 'conjunctive' from 'disjunctive' dislocation zones. I have sat down; this book is something out of the ordinary. Diapirs next, but these turn out to be something of a disappointment, only a few afterthought pages at the very end of the book.

Because I *have* now read Jaroszewski's book from beginning to end, I can report that my two grab samples fortuitously highlight its two main features; a strong coverage of East European and Russian ideas and a strongly selective content.

Analysis of the reference lists quantifies the cosmopolitan flavour of the book. Less than 60% of the 1200 references are in English. Over 20% are in Russian, over 10% in German, about 5% in Polish with the remainder in Czech, Hungarian, Bulgarian and Dutch. Jaroszewski admits to positive discrimination in favour of research from outside the English-speaking world and, for me, this makes the book uniquely valuable. I may never be able to read the original sources, but the ideas are well summarized here. I may find some of these ideas unusual but, assessed with an open mind, they are unusually thought-provoking. They are skilfully integrated or contrasted with research published in English. The literature is covered up to 1978. This coverage must have seemed up-to-date in the 1980 Polish edition but now, retranslated in language and time, shows just how transient is the structural *status quo*. But ignoring five years of progress has its compensations. For instance, we are spared cross-sections on which every fault shallows downwards and on which every area has to balance. Instead there is a refreshing and informed discussion of faults that steepen downwards and maybe root in the steep deep-seated faults which are such an important element in Russian structural thinking.

*Fault and Fold Tectonics* is not a uniform review of these two structural topics. Again the author states his bias at the outset; emphasis on relatively shallow level field-scale structures in deformed sedimentary rocks and omission in particular of microstructural topics and of geotectonics. This last omission is a wise one. It would probably have proved impossible to blend Eastern and Western views on plate tectonics into a coherent whole as successfully as Jaroszewski has done for smaller-scale deformation. Another omission is of detailed mathematical and physical modelling. This is cited, even developed, in its relevant place but clearly by someone who wades through more streams than computer printouts. The approach is rigorous nevertheless, helpfully firm on definitions and terminology but without ever letting jargon get the upper hand.

So much is unusual in this book, but the gross organization is predictable: Part I—essentially stress and strain, Part II—faults, Part III—folds. I found the stimulus and novelty concentrated in the second section. In Part I, for instance, I hoped for some novel East European experimental deformation results to illustrate rock rheology. But no. Here are the usual worthy, apposite but familiar data from Handin, Heard, Griggs, Price, Paterson and Schmid. In Part III I sensed some geological unease in the author. Folding is clearly not his bent. Much of the section seems derivative and is stylistically and geologically brittle. For instance the chapter on folding mechanisms encloses twenty pages on joint patterns in folded rocks. But Part II provides an accomplished core to the book, with Jaroszewski at his most effective. Anyone interested in fault tectonics will be stimulated and provoked by this section, as long as they first forget about duplexes and ductile beads, horses and riders, leading fans and lateral walls.

Anyone? Well anyone with a first degree in geology. This is not a good undergraduate text and does not set out to be. It contains too many unconventional ideas to blend with the average structural geology course in the English-speaking world. This is a book for research students, teachers and professional geologists, more able to sieve these ideas through the mesh of experience and prejudice. It deserves to be widely read as a different perspective on what structural geologists research, teach and profess.

Three compliments need paying. To Professor Jaroszewski for a brave attempt to broaden the experience of structural geologists, to Wendy Kirk, the translation editor, for producing a readable and terminologically accurate text, and to Ellis Horwood for their publishing initiative. This latest book off the production line is special.

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## Creep of crystals

Poirier, J.-P. 1985. *Creep of Crystals: High-temperature Deformation Processes in Metals, Ceramics and Minerals*. Cambridge University Press. 260 pp. Price: paperback £10.95.

This book is a welcome addition to the geological literature. It describes the processes of plastic deformation of materials at high temperature and for this draws largely on data from metallurgy and materials science, of which the author has considerable knowledge. It is suggested that the book is directed at geologists and geophysicists who wish to know more about these processes and who would like to become more acquainted with the methods and ideas of materials scientists. In this it succeeds; there is much in the text that I found new and stimulating and which geologists will benefit from understanding. Unfortunately, the book is not easy to read from 'cover-to-cover' as the style is somewhat awkward, and I wonder whether it represents a direct translation of an earlier (French?) text. However, I doubt whether it was ever intended to be read in this manner and as a reference book it should prove very useful.

The author states very clearly that he assumes more than just a basic understanding of mathematics, physics and chemistry. This, I believe, is an adequate assumption for materials scientists, but some geologists may find the amount of background knowledge required rather extensive. In particular, it is assumed that the reader is aquainted with the primary literature of materials science. Consequently, some of the topics discussed in the book start with statements which may have to be taken on trust by the geological reader until they can be verified later from other sources. Nevertheless, I do not feel that this is a significant deficiency, especially as there is an extensive bibliography of the materials science literature included at the end of the book, and some chapters end with recommendations for further detailed reading. However, I do believe that this restricts the book in general to the

postgraduate level and beyond. Each chapter begins with an abstract, which is a useful addition.

The first chapter deals with some of the mechanical background required for the rest of the book. This is a somewhat different treatment from what is normally found in related geological texts, especially in the discussion of stress and strain, their rheological and constitutive relations, and the mechanical tests from which these are derived. I found this to be an interesting approach, although some prior knowledge is assumed even here.

The second chapter discusses 'the agents of deformation' (lattice defects), in which the author includes: vacancies (diffusional processes), dislocations (slip processes) and grain boundaries (recrystallization processes). This chapter represents a good general background to the concept of defects and their role in deformation, and is essential reading for the rest of the book. Much of this chapter is covered in other texts, but the last section on grain boundaries and recrystallization contains basic information that geologists should appreciate.

Chapter 3 is a short discussion on the phenomenological and thermodynamical analysis of quasi-steady-state creep, in which the dependence of creep rate on temperature and stress is derived, and the important concept of activation energy developed. The mechanistic rather than mechanism approach to creep deformation should interest many geologists. Again, this chapter contains basic information which is used in subsequent chapters.

Chapter 4 deals with the mechanisms of dislocation creep (glide and climb) and their relationship with each other. Various models of dislocation creep are derived, and there is an interesting review of the development of these. Geologists who use 'power-law' creep as a general term will find this chapter somewhat illuminating. The chapter ends with discussions on climb dissociation in spinel structure, and creep in olivine and ice.

The subject of Chapter 5 is the effect of hydrostatic pressure on deformation. This may seem a strange topic to the geologist since it is generally recognized that hydrostatic pressure does not cause shear strain. However, I believe that this chapter is of significant importance and deserves to be read by all geologists interested in deformation processes. The role of hydrostatic pressure in deformation arises from its effects on the individual parameters which comprise the various constitutive equations of the deformation mechanisms, and in particular the activation volume. This chapter represents a clear exposition of the problem and shows how thermally activated processes depend on the magnitude of the hydrostatic pressure via the variation of the elastic constants with this pressure. These in turn are linked to other responses, such as the creation, mobility and glide of dislocations, diffusivity (including hydrolytic weakening) and recovery rates. A concluding section discusses possible consequences of these effects to mantle deformation.

Chapters 6 and 7 concentrate on topics familiar to geologists who work on microstructures: creep polygonization and dynamic recrystallization; and diffusion creep, grain-boundary sliding and superplasticity. Nevertheless, the treatments are still substantially based on the materials-science approach and hence contain rather different insights from those gained from geological observations. However, I did find the three-line dismissal of 'pressure solution' as merely an equivalent mechanism to Coble creep a major deficiency in Chapter 7 (and the book in general). Diffusive mass transfer ('pressure solution') is an important process geologically, but its role at high temperatures has not yet been established due to the domination of dislocation-induced microstructures. I would have liked to see more discussion of this aspect.

Chapter 8 concerns the physics of phase transformations and the phenomenon of transformation plasticity, described as a weakening of the mechanical properties of a polycrystal while it is undergoing a phase transformation. It is essentially a metallurgical treatment since there have been very few geological investigations.

The final chapter is really a very short summary in which the topics discussed in the book are brought together in a general discussion about which deformation mechanism dominates, given particular conditions. It tackles the problem of comparison between different materials (scaling) and the concept of deformation mechanism maps.

The book is extremely well illustrated (144 individual figures in only 235 pages) and has both a general index and a separate materials index. There is an extensive bioliography, but this does reflect the metallurgical and materials-science basis of the book, in that only about one-quarter are geological works. At £10.95 for the paperback edition, this book represents very good value indeed.

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