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BOOK REVIEWS

Tributes and transformations

Boland, J. N. and Fitz Gerald, J. D. (editors) 1993 *Defects and Processes in the Solid State: Geoscience Applications* (The McLaren Volume) Elsevier, Amsterdam. Price: 140 Dutch Guilders.

The volume is a tribute to the work of Alex McLaren on his retirement. The volume starts with a jesuitical homily to Alex by James Boland. It is a personal tribute, quite at home in the setting of a family celebration. But a tribute by Alex's "family" of former Monash and ANU colleagues and students is certainly not what this volume is about. There is a range of contributions from non family members which help to give the volume some breath and depth. Nor is the volume totally dedicated to electron microscopy; there are also papers devoted to optical microscopy, to crystallography and to mineral deformation.

The book is sub-divided into three sections. The first on deformation is the largest, and with twelve contributions covers half the book. Phase transformations and exsolution, with five contributions, is the second topic to be covered. The third on defects, mechanisms and microstructures contains six papers. It differs from the first section in that its contents are more mineralogically orientated.

It is the first section that is of greatest interest to structural geologists. It begins with a review of transformation plasticity by Meike. Much of the article is devoted to a search for a definition of the phenomena encompassed by transformation plasticity, and for the micromechanisms that are responsible for it. Speculation is raised as to what micro-mechanisms actually occur during a phase transformtion that can lead to the enhanced plasticity. But no clear answers are given. Are these not the answers that electron microscopy should provide? Perhaps a better opening to this section would have been an overview of the contributions that electron microscopy has made to structural geology since Alex's initial contributions in the early 1970s. Several of the following contributions cover topics that were first researched in the 1970s, but this should not be taken to indicate that there has been little progress in this subject since then. Amongst the old favourites for TEM studies are papers on water-weakening in quartz (Gerretsen *et al.*), the Fish Hole ribbon quartz mylonites (Mawer and Fitz Gerald), deformation lamellae (Drury), and amorphous deformation zones in materials deformed both naturally (White) and experimentally (Dell'Angelo) at high stresses/strain rates. There is also a good sprinkling of contributions based mainly on traditional optical microscopy. They include CPO development in naturally deformed plagioclase (Kruhl) and the interplay between cataclastic and crystal–plastic processes in gabbroic mylonites (Stünitz; Lafrance and Vernon). Towards the end of this section, the contributions are more directed to experimental deformation. Ponozzo Heilbronner reports that in low strain experimental deformation of gypsum there is no evidence for strain localization, reconfirming the long held view that strain localization is a strain dependent phenomenon. Metal deformation is not overlooked, with a paper on the shear mode inelasticity of Fe under conditions of high pressure and temperature (Jackson).The final contribution presents a theory for the time dependent failure of fractal porous aggregates (Cook).

The second section of the book starts with the study of exsolution in two minerals; pyroxenes in the Whin Sill (Smith and Champness), and alkali feldspars (Brown and Parsons). The first is, again, a further look at a topic popular in the 1970s. The second is a consideration of the linked secondary exsolution effects due to strain and void formation brought about by primary exsolution in alkali feldspars. The third paper deals with phase transitions and domain growth in a feldspar analogue (Müller and Vojdan-Shemshadi). Together, these three papers provide excellent examples of the application of TEM to mineralogical research. They are followed by a paper on what could be regarded as an alkali feldspar analogue, namely the tweed microstructure of PbO (Withers *et al.*). The high standard of the contributions in this section is continued with the final contribution (Hyde) on the treatment of open and dense crystalline framework structures, to be found in a range of materials including many minerals, as hyperbolic films.

The third part of the book is more of a hotch-potch with the linking theme being mineral defect studies. The exception is the study of U and Pb diffusion in zircon (Lee) which, although not a defect study, is one where defects are intrinsically important. Instead of water in quartz, there is water in hydrothermally grown sapphire (Mainprice *et al.*) which, in this aspect, appears to be just like quartz. Quartz is, itself, treated in this section with a paper on the annealing of the Heavitree quartzite under controlled atmospheric conditions (Wang *et al.*). Some deformation was then done on the treated samples which may have made this contribution a candidate for the first section. Other papers deal with the planar defects in chalcedony (Cady *et al.*), and on the structure in hematite–magnetite interfaces (Bursill and Lin). The remaining paper deals with the structure and alteration of the major minerals in Synroc (Smith and Lumpkin), the Australian contribution to high level radioactive waste disposal. This is very much a topic of the 1990s and one in which TEM is expected to contribute much as the next millenium begins.

The volume will have appeal to those structural geologists who are actively engaged in electron microscopy applications. It gives a good, but limited, insight into the capabilities of TEM, but does not provide an overview of the subject or an indication of future advances. There is no article dedicated to SEM and the powerful techniques that this stablemate to TEM offers to structural geology, especially when the considerable capabilities of both are applied, hand in hand, to microstructural research. The book is, above all, a deserved tribute to the considerable contributions of Alex McLaren to the quantification of the micro-microstructural studies of minerals.

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Transformations in deformation

Oertel, G. 1996. *Stress and Deformation.* Oxford University Press. Price £49.50.

As stated in the Preface, "Stress and Deformation" arose from a series of lecture notes at University of California, Los Angeles. The need for the courses was simple – to introduce geologists to the principles of continuum mechanics. And, it is a cause that has been championed by Gerhard Oertel throughout his career. The book is a review of the continuum mechanics most relevant to structural geologists.

The eight chapters follow a traditional approach to continuum mechanics: 1. Vectors, 2. Fields, 3. Matter Tensors and Coordinate Transformations, 4. Stress, 5. Infinitesimal Strain, 6. Finite Strain, 7. Effects of Stress, 8. Strain History and Polar Decomposition. These chapters do not have equal emphasis in the book. The longest chapter, Matter Tensors and Coordinate Transformations is 33 pages long. Chapter on Fields (2) and Strain History and Polar Decomposition (8) are 3 pages each. The contents of the chapters do a good job of distilling the basic aspects of continuum mechanics that are useful for structural geology and geodynamics.

Because of its inception as a series of lecture notes, the format of "Stress and Deformation" is a bit unusual. Each of the eight