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Mineral transformations

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One of the major goals of mineral science is attaining an understanding of the atomic-scale mechanisms and dynamics of minerals that control their structural transformations as a function of pressure, temperature or chemical composition in the natural environment. Examples of research programmes that sail under this heading include those devoted to observing and modelling the role of phase transformations on controlling mineral microstructures, ordering, elasticity, transport, premelting and exsolution. The geological relevance and intrinsic importance (as being representative of specific properties or thermodynamic/kinetic behaviour) of mineral transformations has long been appreciated. It prompted the recent initiation of a network on Mineral Transformations (http://www.esc.cam.ac.uk/mintrans/) under the European Union TMR Programme. In response to this development, a special session on Mineral Transformations was held at the EUG congress in Strasbourg last year. Attracting large audiences, there was frequently 'standing room only' during the talks, and the papers published in this issue of *Mineralogical Magazine* are largely associated with that symposium. The abstracts of all oral and poster presentations at the symposium were published in the *Journal of Conference Abstracts* (vol. **4**, 1999; pages 636–46).

The keynote paper at the symposium is published here as a review (Hemley *et al*., 2000), and provides examples of the advantages of a combined experimental and computational approach in elucidating mineral behaviour at conditions pertinent to the deep Earth. Novel high-pressure experimental methods associated with employing a radial geometry in the diamond anvil cell are also demonstrated, and their application to high-pressure X-ray emission spectroscopy and elasticity measurement are discussed. A further experimental novelty, pressure buffering in the diamond cell, is discussed by Arlt and Angel (2000). With dramatic images, they show that a consequence of the first order step in volume at clinopyroxene's high-pressure $P2_1/c$ to $C2/c$-transition is that the small volume change applied on the diamond cell sample chamber during pressurization is consumed by ΔV of the transition. The application of Raman spectroscopy in determining high-pressure ferroelastic behaviour is outlined by Miroshnichenko and Goryainov (2000), with their interpretation of the high-pressure behaviour of analcime.

The variety of transformation behaviour shown by minerals as a function of temperature and composition is amply illustrated in the range of topics dealt with elsewhere in this volume. High-temperature ferroelastic and coelastic transitions are considered in a series of papers detailing experimental, computational and theoretical treatments of their effects on mineral structure and microstructure (Benna *et al*., 2000; Hayward and Salje, 2000; Bismayer *et al*., 2000; Salje *et al*., 2000; Dove *et al*., 2000). These reflect the wide interest in mineral microstructure expressed at the EUG meeting, with part of the discussion of domain structure and mesoscopic domain-wall interactions extending the earlier experimental work of Hayward *et al*. (1998). Order-disorder transformation behaviour is exemplified in the studies of Reece *et al*. (2000) and Warren *et al*. (2000) while exsolution forms the theme of the paper by Grguric *et al*. (2000) and (together with the role of defects) that of Raterron *et al*. (2000). An example of reconstructive transformation behaviour is discussed by Knight (2000) while percolation transitions lurk in the background of the comparison of radiation damage in monazite and zircon structure silicates and phosphates by Meldrum *et al*. (2000). Finally, oxidation, dehydroxylation and diffusion behaviour are the theme of the final three papers by Khisina *et al*. (2000), Bray and Redfern (2000) and Gomes and Neiva (2000).

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European Mineralogical Union, the Mineral Physics Group of the Mineralogical Society, and the European Union TMR Network on Mineral Transformations (ERB-FMRX-CT97-0108). The same organizations, along with the German Mineralogical Society, are now continuing their interest in the area by lending additional support to the forthcoming Mineralogical Society of America Short Course in 'Transformation Processes in Minerals' to be held at Cambridge later this year. Should the following papers whet your appetite for more, then you might do worse than take a look at the details of that Short Course, which may be found on the world wide web at www.minsocam.org/MSA/SC_TPM.html.

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