Feldspars and Their Reactions

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Feldspars and Their Reactions

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15. FELDSPARS IN WEATHERING**595**

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Preface

The title of this volume harks back to a seminal paper in mineralogy, 'Chemical reactions in crystals', written by J B Thompson more than 20 years ago (*American Mineralogist*, 1969, **54**, 341-375). The concept of intercrystalline reactions between crystals, and between crystals and melts or aqueous solutions was commonplace, but the notion that intracrystalline phenomena constituted chemical reactions, if not new, was presented in an arresting and rigorous way. Chemical reactions in crystals include a variety of styles of polymorphic transformation and exsolution phenomena which the feldspars illustrate *par excellence*. Indeed, it is true to say that the previous three NATO-sponsored volumes on Feldspars (following meetings in Oslo, 1962, Manchester, 1972, and Rennes 1983) were largely concerned with Thompson's intracrystalline reactions. The Fourth meeting, in Edinburgh, reported here, was concerned with both inter- and intracrystalline reactions, and with the unbreakable connection between them. I hope this volume is seen to stand firmly astride the boundary between, on the one hand crystallography and phase behaviour of feldspars (usually regarded as in the domain of mineralogy) and, on the other the interactions between feldspars and other crystalline phases, melts, solutions and even gases (in the domains of petrology and geochemistry). I interpret *reaction* as meaning any response of a feldspar to an *action*, be it change in P, T or X in its vicinity; and changes in X may include the minute changes in the relative concentrations of trace elements and isotopes which can be so informative in petrology.

The book sets out with reviews of crystal structure and cell parameters and leads *via* treatments of crystalline phase transitions into phase relationships involving melting and reactions at very high pressure. The non-equilibrium feature of chemical zoning provides a bridge with chapters on diffusion in feldspars, including oxygen and argon, and on the role of hydrogen in promoting feldspar reactions. From here we head into petrology, recognising the overwhelming importance of reactions between feldspar and silicate liquids in igneous petrogenesis, and the role of water activity. The special case of pegmatites is covered. Penultimately we return to aspects of structure, this time at the surface of the crystals, critical to the ultimate fate of feldspar in the weathering cycle which is the subject of the final article. Although each contribution is entirely individualistic I hope the student reader, in particular, will gain new insights, through the medium of one mineral species, into the interconnections between some of the scientific compartments to which we often adhere. Despite the specialised title, this is actually a very 'interdisciplinary' book, and this interdisciplinarity has always been one of the great strengths of the series of NATO meetings on feldspars. It is my belief that the meetings and the resulting volumes have made a really significant contribution to the development of mineralogy and indeed to petrology and geochemistry. It was the intention of the organisers that the 1993 meeting would further illuminate the connection between crystallography, thermodynamics, geochemistry and petrology and I hope the reader will find that this comes over clearly from the articles which follow.

The four volumes reporting advances in the feldspar field communicated through the medium of the NATO ASI's provide a fascinating record of the evolution of mineralogy over a thirty year period. New techniques have constantly provided new insights and the meetings have been important in their dissemination. These ten-yearly conclaves have certainly been a major factor in my own scientific development (this was my third, only Bill Brown, Paul Ribbe and Joe Smith, of this year's participants, have been to them all) and I sense that this is true for a number of the older members. I hope there will be a fifth NATO meeting, in 2003, so that old friends may meet and new younger friendships begin. Collaboration, not competition, has been the key factor in the astounding successes of science. Long may the feldspars remain a focus for such collaboration; there are many problems remaining.

**Ian Parsons, Department of Geology and Geophysics, The University of Edinburgh.
5th November 1993**

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'Feldspars and Their Reactions' was largely supported by the Advanced Study Institutes programme of the North Atlantic Treaty Organisation. It was the fourth meeting on the feldspar minerals sponsored by NATO and the continuing success of these meetings confirms the constructive character of the NATO support for science, for which organisers and participants are sincerely grateful. We also thank the Mineralogical Society of Great Britain and the Royal Society of Edinburgh for contributing to the costs of scientists from outside the NATO alliance, and the Royal Society of London and International Science Foundation, New York, for support for participants from the former Soviet Union.

Sincere thanks are also due to the organising committee, W L Brown, M A Carpenter, B J Giletti and W Johannes, for support both before and during the meeting. They, and the invited lecturers, all gave excellent keynote addresses, sustaining the interest of everyone throughout the entire 10-day meeting. Participants, young and old, must be thanked for their lively involvement and good humoured enthusiasm. Peder Aspen worked extremely hard at providing practical support, and leading field excursions, and my current research colleagues, Martin Lee, Mark Hodson and Pauline Thompson were willing and efficient stewards. Aided by Adrian Finch, Kim Waldron and Ray Burgess, they were able to introduce younger members of the Institute to aspects of Scottish culture guaranteed to make the meeting a success.

Many other people made invaluable behind-the-scenes contributions. Isobel Johnstone was the Co-ordinator at Heriot Watt Conference Centre, on the outskirts of Edinburgh, where the meeting was held. Lecture facilities, accommodation and the quality of meals were widely commended by participants. Secretarial assistance of the greatest efficiency was provided by Lucian Begg, who also worked on the preparation of this volume. Ned Pegler used his computer skills to redraw some of the figures. Patricia Stewart assisted at registration, and Helena Jack helped with the production of the programme and abstracts. Heather Hooker helped with production of the final manuscript, and Peter Symms made some of the social arrangements. Last, but by no means least, I would like to thank my wife, Brenda, for her support during the build-up to the meeting, and her tolerance during what, at the end, naturally became an all-consuming event.

Ian Parsons, 1st November 1993

Frontispiece. Secondary electron Scanning Electron Microscope image of the (010) and (001) cleavage surfaces of a fragment of alkali feldspar from a large phenocryst in the Shap granite, northern England, lightly etched in HF vapour. The upper surface, (001), shows lenticular exsolution lamellae of albite at a variety of scales; on (010) (lower part of micrograph) the lamellae are extended sub-parallel to c . The edge running from left to right is the a -axis and the lamellae lie in the Murchison plane, near $\{601\}$. Etch-pits at the interfaces of the larger lamellae are sites of dislocations; large lamellae are semicoherent while small lamellae are fully coherent. Etching has also preferentially attacked volumes of structure affected by elastic strain leading to grooves along the lamellar interfaces, and to depressions around dislocations with two-fold symmetry on (010) and mirror symmetry on (001). (Photograph by Martin Lee. See Waldron *et al.*, submitted, and Chapter 12 in the present volume).

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'Feldspars and Their Reactions', Edinburgh, June 29 - July 10, 1993**

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