

particularly the synchrotron X-ray fluorescence (SXRF) microprobe, together with brief discussions of X-ray absorption spectroscopy (XAS) and X-ray diffraction (XRD). A wide variety of examples of work in Earth and Planetary Sciences is discussed and in a final section (page 222), an invitation is issued to the interested reader to contact one of the authors (JVS). Ion-microprobe analysis is extremely well-summarized by R.W. Hinton. I found this a very instructive chapter with a lot of detail on how to cope with many of the practical problems encountered in ion-microprobe analysis and a comprehensive coverage of the literature. W.T. Perkins and N.J.G. Pearce summarize microanalysis by laser-ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS). In the last ten years, this technique has developed into a powerful millibeam to near-microbeam ($\sim 20 \mu\text{m}$) analytical method for trace elements and potentially for isotopes. The equipment is relatively inexpensive, and as emphasized by Perkins and Pearce, promises to be an analytical 'workhorse' in the years ahead. S. Kelley covers Ar-Ar dating by laser (microprobe) extraction techniques, focusing in particular on the advantages and disadvantages of the different types of lasers currently in use. Some applications are discussed, but this is a fairly mature technique and a broader section of applications would have been instructive. I have the same criticism of Chapter Nine, by I.P. Wright, on laser-microprobe analysis of stable-isotope ratios: the principles and instrumental aspects of the method are very well-covered, but a more extensive survey of the utility of the method is desirable. S. Roberts and I. Beattie describe micro-Raman spectroscopy, which must be unique among analytical methods in that it does not (generally) have an acronym attached to it. Theory and instrumentation are briefly discussed, together with some applications, particularly the rather important uses in fluid-inclusion studies of minerals.

The title of this book, "Microprobe Techniques in the Earth Sciences", can be divided into two parts. The "Microprobe Techniques..." are very well-treated in these chapters, demonstrating the acknowledged expertise of all of the authors. The "...in the Earth Sciences" is somewhat uneven from chapter to chapter; some authors do a comprehensive job of summarizing the broad impact of the technique in the Earth Sciences while others treat this part as a minor appendage to the more important experimental method. However, despite this criticism, *Microprobe Techniques in the Earth Sciences* is a very instructive book that fills a niche in the literature. I learned a lot from the book and so will my students.

FRANK C. HAWTHORNE

McGuire, W.J., Kilburn, C. and Murray, J. *Monitoring Active Volcanoes*. London (UCL Press), 1995, 432 pp. Price £65.00 ISBN 1.85728.0369.

This book covers "all of the techniques currently in use in volcano monitoring". Using mostly a case study approach after the introductory chapter, each chapter generally provides an intelligent mix of historical development, basic theory and practical application for each technique. The average chapter length is 30 pages, including ample references. Chapter 2 includes an attractively simple treatment of the theory behind analogue and digital data acquisition, conversion and telemetry. This signals the growing use of remote and electronic sensing methods in volcano observation. Chapter 3 on seismic monitoring moves comprehensively from historical development to practical network deployment criteria then explains simple source mechanisms and shows typical seismogram traces.

Chapter 4 shows how real-time ground deformation has been used to monitor vertical and lateral emplacement of dykes in Reunion island. Chapter 5 explains the principles of long term ground deformation techniques, including tilt, introduces a "Mogi" model and provides contrasting field examples in Italy, Japan, Iceland and Mexico. Chapter 6 provides a valuable explanation of new GPS techniques and survey design, with application specifically to Mount Etna. Chapter 7, on infrared thermal monitoring, provides the background physics and demonstrates a few selected responses to thermal anomalies from lava flows, lakes and domes.

Microgravity in chapter 8 is treated from scratch, with a comprehensive listing of over 20 basaltic, andesitic and rhyolitic volcanoes including source models and detailed application to the magmatic intrusive system at Poas volcano in Costa Rica. The next two chapters each cover relatively new geoelectrical (resistivity) and geomagnetic methods, both with good theory but overall with perhaps more tentative results for selected volcanic systems. Chapter 11 on remote sensing of volcanic plumes stands out in being disappointingly short (only 10 pages); it does introduce COSPEC and in particular SO_2 estimates, as well as providing many references, but it omits for example, any results from Pinatubo, precisely where these methods were so successful. Luckily, Pinatubo and Unzen are both covered in chapter 14 on forecasting. Chapter 12 on fluids and gases describes sampling methods and uses the Bay of Naples and the Aeolian islands as detailed examples. Chapter 13 provides a broad basis for forecasting the behaviour of lava flows in general, from both theoretical and observational methods. Chapter 14 gives an excellent overview of volcano

monitoring, and demonstrates how practical and logistic criteria can be prioritized as eruptions are predicted, with successful examples from Unzen and Pinatubo, and sadly unsuccessful hindsight explanations of, for example, Nevado del Ruiz. The final short chapter (15) places volcanoes back in a global and humanitarian perspective. There follows a summary Appendix of safety measures for volcanologists and a useful 7 page index. The book is well illustrated, and the editors have produced a cohesive text from the 28 contributors. Anyone with an active interest in volcanoes will almost certainly already be aware of the vast and growing array of electronic information available on the internet, and some of those links are mentioned by these authors (e.g. Chapter 7). This book is very readable, most chapters are excellent, and it is strongly recommended. However, the essential base of geological mapping, including geochemical and petrological volcano-stratigraphy, (from which may be deduced power of eruptions and geological-scale periodicity) is not covered, which perhaps underplays the vital role of national geological surveys. Nonetheless, for those directly involved with research in the subject it is essential, but it also forms a valuable teaching resource for earth science courses which include active volcanoes.

A. P. JONES

Khomyakov, A.P. *Mineralogy of Hyperagpaitic Alkaline Rocks*. Oxford and New York (Clarendon Press, Oxford), 1995. x + 223 pp. Price £60.00 (Hardback). ISBN 0-19-854836-2.

Agpaitic rocks form part of the peralkaline rock series which comprise a minor proportion of igneous rock types. In this book, Khomyakov further divides the agpaitic rocks into four groups based on chemical and mineralogical criteria, and it is a description of the most extreme category, i.e. the hyperagpaitic rocks, that this book addresses. These rocks are also arguably the most mineralogically interesting because of the exceptionally large number of different mineral species present, a significant proportion of which are water-soluble, and the spectacular pegmatites that they form. Classical localities of agpaitic rocks include Mont Saint-Hilaire (Canada), Ilfmaussaq (Greenland) and Langesundfjord (Norway). However, the subject of this book is a detailed mineralogical description of the largest intrusions of these rocks at the Khibina and Lovozero massifs, Kola Peninsula, Russia. The author, Professor Khomyakov, has devoted his life to collecting and studying minerals from these massifs. With his publication record, which numbers well in excess of 100 papers, including descriptions of more

than 60 new mineral species he has discovered, he is ideally placed to bring to the attention of western scientists the mineral paradise that comprises these two massifs.

Although more than 223 pages in length, the book is divided into only four chapters. The first chapter provides an introduction to the classification of agpaitic rocks, their characteristic minerals and their mode of formation, followed by a brief geological description of the Khibina and Lovozero massifs. The second chapter describes the water-soluble and unstable minerals occurring in the magmatic rocks, together with some of their phase relationships. A unique feature of these rocks is the large number of such minerals, in excess of 40, and their description merits this separate chapter.

By far the bulk of the book and its central theme, is contained in the third chapter. This is a systematic description of the minerals found in the Khibina and Lovozero massifs. Remarkably, some 500 mineral species have been identified from these massifs, although only about a third are described in detail in this book, of which more than 109 are listed as having been established as new minerals. The author stresses the high probability that many more new minerals will continue to be found within these massifs. The descriptive mineralogy is a mixture of classical typomorphic descriptions based on parameters such as crystal morphology, colour, density, lustre and traditional wet chemical analyses, coupled with some modern microprobe data. Scattered throughout these descriptions are many crystal line drawings and stereograms of selected minerals. This chapter will prove to be an invaluable source of reference to those who work in the field of alkaline rocks.

The final chapter outlines those minerals associated with hyperagpaitic rocks which have an economic potential. In addition to current exploitation of niobium, rare earths, nepheline and phosphate from these rocks, Khomyakov points to potential new prospects such as natural sodium carbonate deposits and zeolites becoming economically viable. The references relating to the geology and mineralogy of the Kola Peninsula are extensive, and although some may not be readily available to many Western scientists, they are accessible and should be consulted.

This book inevitably will have only a limited market, and individual purchasers are likely to be confined to researchers into alkaline rocks. But because of the wide range of rare and unusual minerals these rock types cover, and the proposed new rock classification, this book should also be available for reference purposes in institutional libraries.

C. T. WILLIAMS