

BOOK REVIEW

A HANDBOOK OF SILICATE ROCK ANALYSIS. By P. J. Potts. Blackie, Glasgow and London, available in the U.S.A. from Chapman and Hall, New York, 1987. 622 + ix pages. \$175.

In this impressive encyclopedia, the author surveys the principal methods of chemical analysis that are currently used in geology and geochemistry. One chapter is devoted to each technique, including wet chemistry, optical spectrometry, atomic absorption spectrometry, inductively coupled plasma-atomic emission spectrometry (ICP-AES), ion-selective electrodes, X-ray fluorescence (XRF), electron microprobe analysis (EMPA), neutron activation, ion exchange techniques, thermal ionization and gas source mass spectrometry (MS), and ICP-MS. Several other analytical methods, including emission spectrometry, fire assay, spark source MS, SIMS, PIXE, ESCA, and TEM, are briefly discussed. The introductory chapter on the concepts of analytical chemistry alone covers such diverse topics as definitions, physical units, counting statistics, detection limits, sampling strategies, problems of contamination, reporting of analytical data, comparisons of different analytical techniques, methods of standard additions, rock reference materials and their reliability, all in only 46 pages. These listings should give some insight into the exhaustive coverage of this book.

I have chosen to review Chapter 10 on EMPA in detail to illustrate the type of coverage provided in most chapters. The major topics of this chapter include instrumentation and design, electron-matter interactions, production of X-rays, ZAF corrections, characteristic X-ray interferences, routine analysis conditions, and energy dispersive spectrometry (EDS). The design and operation of EDS, fluorescence, pulse height analysis (PHA), and characteristic X-ray excitation and absorption are more fully covered in the chapters on XRF. This overlap in topics among various techniques could have been handled more efficiently had the author written a general introduction to the properties of photons, spectra, and photon-matter interactions before considering each technique that involves these topics.

In Chapter 10 the author has overemphasized the problems related to peak interferences from $n\lambda$ overlaps, such as those involving $CaK\alpha$ vs. $PK\alpha$ vs. $FK\alpha$. When proper pulse height settings are applied, the $n\lambda$ interferences are usually eliminated. In any case, most of the interferences listed in Table 10.9 are negligible for peak readings on the newer Cameca and JEOL microprobes but offer potentially serious overlaps for background determinations. The much more serious interferences of $TiK\beta$ for $VK\alpha$ and $VK\beta$ for $CrK\alpha$ that are not resolved by PHA are neglected. Some of the standards chosen for routine electron microprobe analysis in Tables 10.10 and 10.11 are not optimal

for routine analyses of silicates and oxides. Metal standards will need large dead-time and atomic number corrections that would be minimized with oxide or silicate standards. The importance of using standards with similar compositions to unknowns to minimize the still approximate ZAF corrections should have been emphasized. The use of pyrite as a standard for S in analysis of sulfates or sulfate-bearing silicates will produce large systematic errors caused by significant characteristic wavelength shifts due to bonding differences between sulfides and sulfates. The standards CaF_2 , LiF, and KCl are rapidly damaged under an electron beam. The selection of 20 kV rather than 15 kV for routine EMPA in Table 10.10 is also unfortunate, as absorption corrections are increased with increasing operating voltage. In addition to the standards listed in Table 10.12 that are available from the Smithsonian Institution, a wide variety of natural and synthetic standards may be purchased commercially. On the other hand, the review of REE, U, and Th analyses is an excellent exposition of a difficult analytical problem that most workers have neglected. Finally, the importance of back-scattered electron imaging in revealing chemical variations, producing excellent photomicrographs, and identifying additional phases is not adequately discussed. I raise these concerns to alert the reader that, as good as this book is, it should not be relied on for all the particulars of any one analytical technique. In contrast, the experiences of my colleagues with the chapters on mass spectrometry and on detectors is uniformly positive. The experienced scientist will not be led greatly astray by such oversights but will find new insights on any particular analytical method.

In a brief review, it is impossible to indicate the depth and breadth of the coverage contained in this tome. The amount of material that is packed into the 622 pages is maximized by the use of small print that may prove to be a challenge for older eyes. An extensive list of some 1200 references is cited, subdivided by chapter for the convenience of the reader. The index seems to be comprehensive and should allow the user to locate rapidly a specific topic. A principal use for this reference is to provide insights into the values and limitations of a given analytical technique, as well as to provide an introduction to methods new to the reader. This textbook should provide valuable assigned readings in an analytical methods course. I congratulate P. J. Potts for the generally excellent quality and remarkable coverage of this book. It is strongly recommended for every science library and for the serious analyst—it is well worth the substantial cost.

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