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BOOK REVIEW

ENERGY DISPERSIVE SPECTROMETRY OF COMMON ROCK FORMING MINERALS by Kenneth P. Severin; Kluwer Academic Publishers (2004), 225 p., spiral bound hardback; $169. ISBN 978-1-4020-2840-3.

This book is a useful addition to reference works kept in geological SEM and EPMA labs that routinely use EDS detectors for phase identification. It provides a welcome update to the *SEM Petrology Atlas* (Welton, AAPG, 1984), which documented both SEM images and EDS spectra of 60 minerals that are mainly those in sedimentary rocks. Welton's spectra were acquired with Be window detectors of gold-coated specimens.

Severin, like many of us who run SEM or electron probe labs, bounces around between various projects and can have a hard time recalling the details of spectra analyzed last month, much less last year. To help his memory, he decided to record "flashcards" of various mineral spectra, and this book is the result. For a manageable suite of minerals, he started with those found in *Introduction to Rock-forming Minerals* (Deer et al. 1996). Severin provides 182 spectra covering a wide range of 171 minerals—silicates, alumino-silicates, oxides, and hydroxides, carbonates, phosphates, sulfates, sulfides, and halides. Most spectra are acquired at 15 kV with a Be-window equipped SiLi detector; samples are carbon coated. Ten of these minerals have second spectra acquired with a thin window EDS system, providing a frame of reference for comparing the heights of the lower energy peaks. For example, Durango apatite with a normal Be-window has P$K\alpha$ about 1/2 the height of Ca$K\alpha$; whereas, for a thin window detector, the P peak is almost as high as the Ca peak (strange, as Ca is around 39 wt% and P is ~18 wt%).

The book provides a branching "key" to identifying an unknown spectrum. The interrogative sequence begins with whether Si is a major component; if yes, then is there an Al peak? For the silicates, there are up to 26 branches, and for the non-silicates, 10. For the most part this seems to be well developed for the set of minerals he has chosen (recall "common" rock-forming minerals). There is also a searchable index by mineral type and by name.

Severin illustrates EDS's poor spectral resolution, which is one of its limitations, using the example of a peak at 2.32 keV where S$K\alpha$ and Pb$M\alpha$ coincide. To establish the identity of the peak an astute user would examine the spectrum for a Pb$L\alpha$ line further to the right at 10.5 keV. A logical possibility, however, is that Mo might also be present—the Mo$L\alpha$ line is at 2.42 keV. The user could then rule Mo in or out by increasing the accelerating voltage to 25 kV to look for the Mo$K\alpha$ line at 17.48 keV.

The author also answers the common user question of "how long do I have to count to get a usable spectrum" by showing that essential strong peaks can be correctly identified in 2 seconds. We commonly do this with our VP SEM where Ar-dating lab users are sorting sanidine from plagioclase phenocrysts (with no conductive coating) on stubs. On the other hand, he notes, to see 0.3 wt% Ti in an augite would take 5 minutes at 1 nA or 30 seconds at 10 nA.

Severin warns users to beware of the "Auto Peak [Mis]Identification" features present in EDS software. This is also one of my pet peeves: our top-of-the-line new software consistently misidentifies the small peak at 2.3 keV as S (or sometimes Mo or Pb), where it is obviously an artifact, the sum peak of O$K\alpha$ + Si$K\alpha$. The problem can be severe, as pointed out by Newbury (2005), where most EDS software can yield outrageous peak identifications ("blunders") that new users can unknowingly accept as truth. This is typically not too serious when we are dealing with familiar geological materials, but unknown samples particularly from non-geologic sources leave little frame of reference to judge the peak identifications. In those situations the "auto ID" is assumed to be correct, and therein lies the danger. To help with peak evaluation, he reminds users to remember that families of X-rays are produced, and this fact can be used as logical checks to verify elements present, i.e., if there is a beta peak, there must be a taller alpha peak, etc. These useful tutorial type comments make up a small amount of the book; over 80% of it consists of mineral EDS spectra.

This is an excellent and useful book for its intended audience. Future editions could be made even more useful with the inclusion of features, such as comparison of the variations in spectra from the same material that depend on sample preparation, e.g., a flat polished sample normal to the electron beam vs. a small irregular grain with the beam is positioned at different locations. This will be particularly useful to appreciate as more people opt for thin window EDS detectors where the "light elements" may be easily observed. There are also a few minor typographic errors that could be corrected such as on page 3 in Kramer's law (minus not times) and on page 11 in depth of X-ray generation (leading coefficient is 0.1 not 0.01), but these are minor issues. I highly recommend this book. Although its price is prohibitive for most individuals, it is an excellent resource for all SEM and EPMA labs, which should be able to afford it.

REFERENCES CITED

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