BOOK REVIEWS

Ahmedali, S. T., Ed. *X-ray Fluorescence in the Geological Sciences: Advances in Methodology*. (Geological Association of Canada, Short course 7), 1990, 297 pp.

This book is a collection of papers presented at a Geological Association of Canada short course aiming to bring together advances in methdology of XRF analysis of geological materials over the five years up to 1989. As such, the style varies substantially, from Abbey's almost verbatim transcript of his lecture, to highly mathematical contributions by Lachance and Rousseau, of which the latter includes 60 pages (!) of synthetic and modelled data tables. This and a lack of index, does not allow easy reference use of the book. However, the contents are wide-ranging and make for mostly interesting reading. Abbey's contribution deals with the compilation methods used in obtaining 'recommended values' for element concentrations in international standards. While this is important background knowledge for the XRF analyst, I felt that too much emphasis was placed on the minutae of the semi-statistical methods used, and far too little on the potential shortcomings of the data that the compiler has to deal with. The main problem is that different analytical techniques have very different errors, both in absolute numerical value, and in the likely *nature* of the error. Abbey shows very different histogram distributions for Eu, Sm and Th versus Ni, and Cr and Co in granite AC-E, and interpolates 'recommended values' without using an understanding of the reason for the differences. This is probably because Eu, Sm and Th will largely be INAA determinations with ca. 5% errors, while the transition elements will be mostly XRF/ICP values with perhaps 5 ppm errors at a 5 ppm concentration. I long to see a standard compilation which takes into account errors in the supplied data: this is vital as the standard data provide the only check on the accuracy of an XRF method.

Sample preparation is discussed in papers by Claisse and Kocman, the former giving details of a fusion procedure which will be of use to those starting new laboratories, but it did not appear to me to be a recent advance in methodology. Lachance and Rousseau provide complex discussions of XRF interelement correction procedures, of which I found the comparative treatment of Lachance the most interesting. Neither would be easy to apply in a new laboratory, however, and for many elements I suspect that the increased numerical refinements cannot be justified by standard data quality. In a second article, Rousseau does however continue to describe a XRF data-processing program to apply his algorithms. When this is made available, it should prove most useful: I especially enjoyed Rousseau's plea to manufacturers!

Papers by Willis and Harvey I found both interesting and potentially immediately useful. Willis gives an excellent description of the use of scattered radiation for matrix correction, and also discusses in depth problems of infinite thickness and background corrections. Harvey gives some fairly detailed suggestions on the use of XRF in exploration geochemistry, including machine conditions and interferences, for a wide variety of elements. Readers should however take note of his comment that his list of interferences is not exhaustive: he doesn't list the major interference of Ti on V! Finally, a paper by Kocman gives useful ideas for analysis of gypsums, though his section on carbonates is rather too concise.

In summary, the book contains a number of useful contributions to XRF and analytical techniques, but is rather flawed in organisation. Further, although it claims to present advances in XRF methdology, these are not very helpful when they are difficult to apply in practice. I would nevertheless recommend it for XRF analysts, and not exclusively to those with geological interests.

M. F. THIRLWALL

Geyh, M. A. and Schleicher, H. *Absolute Age Determination: Physical and Chemical Dating Methods and their Application*. Berlin, Heidelberg and New York (Springer-Verlag), 1990. xi + 503 pp., 146 figs + 1 fold-out chart. Price DM 98.00

This book is about the use of physical and chemical processes with fixed or known rates as methods for determining the age at which the process began and the relevance of that age to

some event. To call such an age 'absolute' is a bit strong since it is always dependent on model assumptions, but I suppose that it is the way such ages are known by the intended readership. This readership could be large indeed because this book is certainly not just for the specialist but for all those who need a quick introduction in dating methods. The book covers some 80 different dating methods from the commonly used, such as Rb/Sr, Sm/Nd, K/Ar and ^{14}C, to the esoteric and the obsolete. The scope includes the traditional geological applications depending on half-lives from millions to billions of years and the archaeological and palaeoclimatological ones depending on half-lives of thousands of years. Environmental research employing the short half-lives of only tens of years of both cosmogenic and man-made nuclides are also covered. Various dating methods based on the effects of radiation such as fission track, thermoluminescence and electron spin resonances are also covered, as are chemical dating methods based on more or less constant reaction rates such as amino-acid racemisation and the highly fashionable DNA clocks based on nucleotide substitution in mitochondrial DNA. Least 'absolute' are the methods based on variations in $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ with a few well-defined time markers. Arguably the 'most' absolute methods such as counting varves, tree-rings or growth-zones in corals or molluscs are only mentioned indirectly.

Treatment is highly structured in a more or less standard way which makes finding information fairly easy. Most topics include sections on age range and precision, the nature and required amount of sample and its pre-treatment, the basic concepts and the analytical techniques, scope and limitations and non-chronological applications. Clearly only limited detail can be given on each method but the basic coverage is sufficient to give non-specialists the background information that is usually left out of geochronological papers in geological journals.

There are over 50 pages with nearly 2000 references which always include the first proposal of a method and subsequent major advances; the latest references are up to 1989. A 22 page glossary and a comprehensive index further improve the accessibility for the non-specialist. The analytical section deals with standard mass-spectrometry and activity counting techniques and also laser resonance ionisation and accelerator mass spectrometry which are practised in only a handful of laboratories world-wide; there are also some useful hints on sample collection, packing and storing!

The book has some characteristics of a vademecum although my soft-bound copy may not have the durability for such use. Typographically, the layout is clear, paragraph numbers and fonts make for easy searching and only in a few figures is the finest ornamentation a bit faded. The German origin of the book is evident from the names in some figures but the text translation is excellent with very few 'germanisms' or incorrect jargon. The same is not true for typo's which occur at a rate of one per page in some chapters.

This truly compendious book belongs on the shelves of every scientist who practises dating but is, like me, not *aux fait* with the whole scope of dating methods. It is certainly a good buy for libraries in earth and environmental sciences and archaeology departments.

P. VAN CALSTEREN

Harris, D. P. *Mineral Exploration Decisions: a Guide to Economic Analysis and Modeling.* Chichester and New York (John Wiley and Sons), 1990. xviii + 436 pp. Price £59.00.

Mineral exploration is a risk business and practitioners earn their daily bread by answering questions such as . . . Should we risk the cost of another drillhole? Where is it best located? Will the resulting new data contribute critically to a decision to stop or go? Or . . . What are my chances within budget of finding more deposits within this mineralised region or geological environment? Big or small? Potential profitable producers or technical successes only?

This 418 page text demonstrates how such management decisions can be enhanced by disciplined and professional use of economic analysis and modelling. It is for digestion by specialist mineral economists, who will find a text based on theory throughout, with liberal doses of mathematics. But it is also for tasting by those many practical but perhaps less numerate explorationists who seek in one handy volume an appreciation of the capabilities and limitations of the growing discipline of economic analysis and modelling.

Two introductory chapters and a final 5 page Summary chapter—that is the one to read first for the flavour—are linked through 12 chapters devoted to statistical methods. Best practice in geology and exploration technology is assumed, and the author deals with topics such as 'geoprobability models' and economic filters, methods of accounting for the risk of loss due to exploration failure, Monte Carlo computer simulations, fre-