and the book ends with an appendix of tables for matrix corrections and an appendix which reviews pertinent statistical concepts. There is a short bibliography with emphasis on microprobe analysis and a MacPascal listing of a program for computing mass absorption coefficients.

The text is well written, if a bit repetitive, and extensively illustrated with spartan diagrams. It is a work that will support well the classroom lectures of an experienced spectroscopist, but a person who wishes to teach himself X-ray spectroscopy, will have to look elsewhere for the techniques of sample preparation, choice of standards, and lab maintenance. The book appeared in 1987, and in 1989 the treatment of X-ray tubes and analyzing crystals is already dated. The discussion of X-ray detection, however, is very good, and the lecturer and student will appreciate the thorough treatment of pulse phenomena. Throughout the book, numerical examples are well conceived and written so that the student can easily follow the computational logic. I found the treatment of errors the best so far in the general X-ray spectrometry literature. Williams' book is good and should prove popular where X-ray spectrometry is taught.

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Crust/Mantle Recycling at Convergence Zones edited by S. R. Hart and L. Gülen. Kluwer Academic Publishers, 1989, xvii + 279 p., US $79.00 (ISBN 0-7923-0066-1).

THIS VOLUME is a collection of timely review articles concerning the geochemical and geophysical characteristics of materials returned to the mantle largely via subduction, and how components derived from them might be recognized in subsequent eruptive products. It also deals with the processes affecting these materials while in transit on the ocean floor and in subduction zones. The volume is based mainly on papers presented by some world-renowned petrologists, geochemists, and geophysicists at a NATO Advanced Research Workshop held in Antalya, Turkey, in May of 1987.

That oceanic crust and, in some cases, its veneer of sediments are returned to the mantle along convergent plate margins is made implicit by the plate tectonic theory. However, the fate and importance of the subducted materials in the generation of magmas, particularly in island arc settings, remain topics of vigorous debate which is continued in this volume. This is because despite the obvious correlation between subduction and the generation of magmas along convergence zones, the role of the subducted plate appears to be by no means a simple one.

A few papers in this volume deal with trace element and isotopic (radiogenic and cosmogenic) characterizations of materials that get subducted. They focus particularly on the high and low temperature reactions associated with hydrothermal circulation and seafloor weathering which cause major chemical modifications in the top few kilometers of oceanic crust prior to subduction. It is made clear that the profound increase and decrease in some elemental ratios more than likely lead to a time integrated record of radiogenic isotope enrichment in certain mantle domains (e.g., higher $^{206}Pb/^{204}Pb$ due to U/Pb elevations in altered oceanic crust). The resulting isotopic signatures have a significant effect on mantle composition and evolution, and are a key to the recognition of components in subsequent derivative magmas.

Other papers, principally geophysical in nature, deal quantitatively with the thermal profile of convergent plate boundaries, the geodynamics of mantle flow, and the possibility of crustal recycling by lithospheric delamination. These papers are especially instructive to those of us who have concentrated on recycling using primarily geochemical considerations, and who have focused on recycling almost exclusively via subduction.

In summary, this is a useful book that specialists and generalists alike should consult for the several good review articles. The reader will find, however, that overall the quality, length, and depth of papers vary greatly which is not uncommon for multi-authored volumes. Also, imprecise and ambiguous language appears in two or three papers, and typos are surprisingly abundant.

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The Changing Atmosphere: Report on the Dahlem Workshop on The Changing Atmosphere, Berlin, 1987, November 1–6 edited by F. S. Rowland and I. S. A. Isaksen. Wiley-Interscience, 1988, 282p., US $89.95 (ISBN 0-471-92047-9).

THE CHANGING ATMOSPHERE is the seventh in a series of Physical, Chemical, and Earth Sciences Research Reports resulting from the unique Dahlem Workshops held in Berlin. This report follows the standard Dahlem format, and it includes 12 individually authored review papers that discuss issues related to the changing chemistry of the global atmosphere. There are also reports that summarize the discussions and conclusions of working groups addressing four major themes during the workshop. Many of the individually authored chapters evaluate the extent to which the concentration of specific chemical species in the atmosphere have changed over time. For example, chapters in this section include discussions on the changing atmospheric concentration of CO_2 (H. Oeschger and U. Siegenthaler), CH_4 (D. Ehhalt), halocarbons (R. Prinn), CO (R. Cicerone), and tropospheric aerosol particles (R. Charlson). There are several chapters on changing ozone, including tropospheric ozone (S. Penkett), Antarctic ozone (R. Stolarski), and aspects of the chemistry of the springtime Antarctic stratosphere (F. S. Rowland). There is also a chapter evaluating what we know about changes in atmospheric concentrations through the use of ice cores (B. Stauffer and A. Neftel) and another addressing whether the oxidizing capacity of the atmosphere is changing (I. Isaksen). Finally, there are two chapters on the radiative and climatic consequence of the changing atmospheric composition of trace gases (V. Ramanathan) and atmospheric aerosol particles (H. Grassl). These individual chapters are followed by the four group reports: (1) How Has the Atmosphere Already Changed?, (2) Oxidizing Capacity of the Atmosphere, (3) Changes in Antarctic Ozone, and (4) Trace Substances, Radiation Balance, and the Climate of the Earth.

Scientists, policy makers, and the public are all becoming increasingly aware of and concerned about the complex issues of global change, making this book particularly valuable now. While global change involves much more than just atmospheric chemistry, the most widely discussed and publicly appreciated areas of global change, e.g., climate change related to increasing radiatively active trace gases