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Book Reviews

Physics and Chemistry of the Earth, Vol. VII. L.H. Ahrens, F. Press, S.K. Runcorn and H.C. Urey (Editors). Pergamon Press, London, 1966, 338 pp., 92 illus., 50 tables, £5.5.0, $16.00.

Volume VII of this well-known series contains the following articles:

(1) Orogenic fold-belts and a hypothesis of earth evolution, by R. Dearnly. Students of convection current theory and continental drift will find many points to their interest. The article mainly deals with fold belts of the Grenville system. It is to be regretted that some figures (fig.24 and plate 3) are obscured by too many details. A very extensive reference list may be helpful to those interested in these much discussed subjects, in particular as far as the earlier history of the continents is concerned.

(2) Earthquake energy and magnitude, by M. Bath. This paper gives a review of the current state of determination of earthquake energy, with emphasis on methods and principles. It brings together the theoretical aspects and the empirical approach to calculations of magnitude and energy.

(3) Meteoritic, solar and terrestrial rare-earth distribution, by L.A. Haskin, F.A. Frey, R.A. Schmitt and R.H. Smith. The present review will be confined to this paper, which is of particular interest for readers of *Chemical Geology*.

The article on the cosmochemistry and geochemistry of the rare-earth elements (R.E.E.), defined by the authors for their review as the lanthanides and Y (while also considerable attention is given to Sc), gives a wealth of information about the knowledge up to 1965. A very extensive list of references likewise testifies of the thoroughness of the authors' compilation work. The rare-earth elements are not really rare, but well dispersed lithophile elements. It was this dispersion that hampered their detection and technological applications considerably. Moreover, the severe analytical difficulties made it necessary to wait until such new analytical techniques as radiochemical activation and isotope dilution analysis became available, before it was possible to study the abundance patterns of this coherent group of elements. As a first surprise it was found that this so-called coherent group does not only exhibit a large degree of absolute concentration as a group, but also a relative fractionation towards each other in terrestrial materials.

Few readers might have the perseverance to struggle through 150 pp. of condensed information, but astronomers, cosmochemists, geochemists and petrologists alike can find large sections of special interest to them. One outstanding conclusion of the paper is that the composition and variation of R.E.E. in chondritic meteorites (primordial matter) are fairly uniform, which leads the authors to the conclusion that the physico-chemical history of the meteoritic parent was not very complicated. All the more intriguing in connection herewith is the second main observation that not only the crust of the earth, but also most of the accessible mantle material is highly enriched in, especially, the light R.E.E.

The graphic representation of the composition differences in the materials analyzed is quite original. Not the usual two-component variation

diagrams, but plots of all 16 elements normalized to Yb = 1.00 and divided, element by element, by the Yb-normalized average for chondritic meteorites. Relative enrichments and deflections in terrestrial materials are demonstrated most effectively in this way.

The discussion on ultrabasic rocks and basalts, assumed by most petrologists to be melting products of the upper mantle of the earth, raises some very intriguing points. Of all basic rocks analyzed, only a few high-temperature peridotites and some mid-oceanic tholeiitic basalts have a relative R.E.E. distribution similar to the chondritic pattern. All other ultrabasites and basalts have patterns highly fractionated towards the light R.E.E. and are thus similar to the crust of the earth in this respect. This would imply that a fair amount of crystallization-differentiation for these mantle products has taken place. There can be little doubt that R.E.E. abundance distributions can be used as a geochemical tool (though a very laborous one) to study the history of the upper mantle.

Less convincing is the chapter on R.E.E. distribution in granitic rocks. The authors complain that R.E.E. distribution patterns could be explained better, if only the problems connected with the genesis of different types of granites could be stated more distinctly. Petrologists might wish to reverse the problem. Nevertheless, some very illustrative cases of fractional crystallization of granitic and alkaline suites are given.

Only brief paragraphs deal with the R.E.E. contents of individual minerals. The main conclusion is that R.E.E. in rocks are for a considerable part concealed in the major rock-forming minerals, and not in mineralogical curiosities with high to very high contents of R.E.E. A peculiarity is that the element Eu is strongly enriched in the feldspar component, at the expense of the mafic components of rocks. The paper continues with a description of sedimentary and biological R.E.E. distribution patterns and fractionations, which as a whole vary only slightly from the general crustal distribution. Concentration of R.E.E. into phosphatic sedimentary materials is common. Some marine sediments are enriched in R.E.E. whereas seawater seems to have a notably low content of these elements. It is no great surprise to find at the end of a paper of this kind a small paragraph about the R.E.E. pattern in tektites, showing a strong enrichment in light R.E.E. and, therefore, possibly of terrestrial origin.

As a general point the question may be raised, whether it would not be better to combine more related subjects in one volume than is the case in volume VII. This might be more valuable considering the prospective private buyer.

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Atomic Absorption Spectrometry in Geology - Methods in Geochemistry and Geophysics, 7. E.E. Angino and G.K. Billings. Elsevier, Amsterdam, 1967, 144 pp., 14 illus., 37 tables, Dfl.32.50.

The present publication offers a comprehensive review of atomic absorption spectroscopy as applied to analytical problems in geochemistry. Information in this field which is at present widely scattered in journals outside the sphere of a geologist's interest has been compiled into a single vol-