

Rock Magmas and their Products

Das Magma und seine Produkte :

unter besonderer Berücksichtigung des Einflusses der leichtflüchtigen Bestandteile. Zugleich zweite Auflage des Buches "Die leichtflüchtigen Bestandteile im Magma". Teil 1: Physikalisch-chemische Grundlagen. Von Prof. Paul Niggli. Pp. xi + 379. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1937.) 34 gold marks.

THE solid igneous rocks are the products of colossal natural processes working unceasingly within and upon the crust of the earth. The study of these phenomena forms the special province of the petrologist, who attempts to discover the manner in which an original silicate melt—the magma—becomes differentiated into the varied mineral assemblages he finds in Nature.

For more than thirty years the chief project of research of the workers of the Geophysical Laboratory of the Carnegie Institution at Washington has been the experimental investigation on quantitative lines of chemical systems embracing the common rock-forming oxides. Starting with the simplest combinations and proceeding to more complex systems, these investigators have gradually accumulated a wealth of data of fundamental importance to petrology. To this project Prof. Niggli has himself given experimental support, and he is well qualified to survey the experimental studies and the contribution they make to the problems of petrogenesis.

The present book, forming Part I of a two-volume treatise on rock magmas and their products, concerns itself with the physical chemistry of heterogeneous and homogeneous systems with special reference to experimental silicate melts. The succeeding volume will be devoted to a consideration of the phenomena of natural systems—magmatic melts and their solidified products, the igneous rocks and ore deposits.

The book opens with a historical account of the development of ideas on the role of volatile substances in the magma. There follow chapters of pure physical chemistry presenting a systematic account of phase equilibria in condensed heterogeneous systems, special attention being paid to the phenomena of petrological significance displayed by ternary silicate melts. The majority of such experimentally investigated systems is included in this survey, which gives a clear account of the alternative courses of crystallization permitted by continuous and discontinuous reactions which may prevail in ternary silicate solutions.

Some criticism may here be made of the method of presentation adopted for ternary melts. In order

to trace readily the changing composition of a residual liquid in terms of a specialized variation diagram, and presumably in preparation for more extended discussion in volume 2, the author redraws the ternary figures on a molecular per cent basis. These transformations involve considerable complication when the fundamental phases are themselves complex silicate compounds. It may well be doubted whether so cumbersome an innovation will make appeal to petrologists who have still to discover the superior convenience of the 'Niggli type' of variation diagram for which this procedure is more peculiarly fitted.

In the second half of the book, Prof. Niggli enters upon a discussion of heterogeneous equilibrium in systems containing volatile phases—a subject to which the author has himself made important original contributions. The treatment follows closely the text of his earlier published work—of which this part may be considered a revision.

Equilibria in binary and ternary mixtures involving retrograde boiling and critical phenomena in saturated solutions are thoroughly discussed. Since the experimental data on ternary silicate systems involving water comprise only those of the complex $H_2O-K_2SiO_3-SiO_2$, the importance of critical phenomena in magmatic systems has yet to be assessed. While the critical state is assigned a more important place in the history of the cooling magma than is usually conceded, the author's renewed discussion of volatile systems is a welcome contribution serving to remove from the field of contention misunderstandings which have followed the publication of his earlier work.

This account is followed by a chapter on homogeneous equilibria in silicate melts. This is a subject of great importance, but unfortunately our knowledge of it is meagre and largely confined to deductions that may be drawn from the behaviour of heterogeneous systems. Here the author rightly lays emphasis more especially on the influence of volatile constituents in modifying the chemical as well as the physical condition of the magmatic melt.

The book closes with an ingenious portrayal in ternary diagrams—admittedly schematic and immensely simplified—of the differentiation course of a typical Atlantic and Pacific rock province. Presented here without elaboration, it is presumably a signal of a more detailed treatment in the concluding volume. Comment upon it may well be deferred. The high reputation of the author is a guarantee that a stimulating and fruitful discussion of these problems is to follow.

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