

The whole volume is an outstanding reference work that many individuals and all libraries with any interest in meteorites will wish to have available.

A. A. SMALES

CHIZHIKOV (D. M.) and SHCHASTLIVYI (V. P.). *Selenium and selenides*.

Translated from the Russian by E. M. Elkin. London (Collet), xvi+403 pp., 223 figs., 76 tables. Price 152s. 6d.

This monograph presents results of the authors' research, and reviews (with extensive bibliography) the properties and production of selenium, including single crystals, and selenides. Crystallographic and experimental data will be of interest to mineralogists. The main source of selenium is the anode slimes of electrolytic copper and nickel refineries; it is also obtained from selenium-bearing pyrite.

R. A. H.

VLASOV (K. A.), KUZ'MENKO (M. Z.), and ES'KOVA (E. M.). *The Lovozero alkali massif*. (English edition translated from the 1959 publication of the Academy of Sciences, Moscow, U.S.S.R., by D. G. Fry and K. Syers and edited by S. I. Tomkeieff and M. H. Battey.) Edinburgh and London (Oliver and Boyd), 1966, xvi+627 pp., 257 figs., 201 tables. Price £12. 12s.

The sub-title in the original edition of this monumental work makes it clear that the emphasis is on rock types and notably the pegmatites, their mineralogy, geochemistry, and genesis. The structure, petrography, and chemical and mineralogical constitution of the massif as a whole are treated in the first 67 pages; these are described in a brief, but effective form, since they were subjects of earlier accounts, chiefly by O. A. Vorob'eva, V. I. Gerasimovskii, and N. A. Eliseev, between 1938 and 1950.

The alkali massif consists essentially of a differentiated layered complex over 1000 m. in thickness, with more or less well-defined rhythms of foyaite, lujavrite, and urtite bands, surmounted by a eudialytic lujavrite complex up to 500 m. thick. A third but much subordinate member forms numerous small bodies, which collectively constitute the poikilitic syenite complex. The relations among the complexes are complicated and have led to disagreement as to their relative ages among various workers. The present authors, however, infer that the eudialytic

complex preceded the differentiated complex but endorse the more generally accepted view that the poikilitic syenites were last; all are regarded as very closely associated and related to a single major episode of magmatic invasion. While the complexes in general are characterized by a gently basined internal structure, the outer margins against Archaean gneisses are steep. Devonian sediments and volcanics occur entangled within the massif.

About 150 pages are devoted to the pegmatites, of which two extreme types are recognized: 'facies' pegmatites formed effectively by segregation in place and 'phase' pegmatites, which were injected into fissures. The pegmatites are described with a wealth of structural, mineralogical, and paragenetic detail according to a procedure that closely follows the classic work of A. E. Fersman.

The next 260 pages record the mineralogy (principal rock-forming minerals, rare-metal minerals, and 'secondary and accessory' minerals), while the final part of the work, 100 pages, is devoted to geochemistry and genesis. No other massif in the world has such a recorded wealth and variety of minerals. More than 130 species or varieties have been found, of which over 50 are either completely unknown elsewhere or have only been recorded in very small amounts. About 60 minerals contain rare elements: zirconium, niobium, titanium, rare earths, thorium, lithium, and beryllium. This exceedingly detailed study is based on very comprehensive chemical and X-ray data.

Nevertheless, no more than a dozen are principal rock-forming minerals and of these only three, nepheline, potassium feldspar, and aegirine, constitute at least 90 % of the massif. Of the recorded minerals all are found, and nearly two-thirds are only found, in the pegmatites.

Reflecting the great range of minerals in the massif is the extraordinary number of elements that are represented as major and minor constituents (cf. fig. 254). Indeed, the number is so great that those that have not been detected are of considerable interest; these include not only the platinum metals, but also mercury, indium, selenium, and most notably, boron, while carbon occurs only in very small amount.

The concluding section on the genesis of the alkali rocks is not more than 20 pages in length; it is therefore condensed and somewhat terse, but since it depends on such comprehensive data the arguments merit great attention. The composition of the immediately parental magma is ascertainable with considerable precision and the course of differentiation in all the constituent units is correspondingly precisely determinable. Factors controlling differentiation are assessed: chemical composition

of the parent magma; assimilation; emanation, crystallization, and isomorphism. Later hydrothermal processes are also important.

It is envisaged that cooling under tranquil tectonic conditions made possible the crystallization of nepheline to form urtite layers, which, by selective removal of sodium and aluminium from the immediately adjacent magma, led to the crystallization of lujavrite, rich in feldspar and aegirine; this in turn gave rise to concentrations of constituents that determined the formation of foyaïtes in the next layers. The process is thus quite different from that usually invoked to explain rhythmic layering in basic complexes.

Volatile constituents tended to migrate upwards, but the urtite horizons constituted partial traps; sharp peaks in the concentration of minor constituents around the base of the urtite layers, only partly dependent on the nature of the principal minerals, are thus explained. More generally, however, concentration of volatile constituents, by increasing mobility and lowering temperatures of crystallization, gave rise to the poikilitic syenites, and most notably the pegmatites.

The translation is very literal and agrees in meaning with the original, sentence by sentence. Nevertheless, largely by appropriate reorganization of the form of dependent clauses to English constructions, the style of the translation is clear and readable. Occasional minor oddities occur: as, for example, 'rocks and pegmatites', but the Russian 'porodi' allows of no other translation. Again the term 'emanation' acquires a somewhat different meaning in the English content, so that the original sense is often better rendered by 'migration'. This and other slight shifts of meaning arise partly from the greater facility in Russian for deriving adjectives from nouns, such as 'phase' and 'facies'.

B. C. KING

WAGER (L. R.) and BROWN (G. M.). *Layered igneous rocks*. Edinburgh and London (Oliver and Boyd), xv+588 pp., 278 figs., 32 tables. 1968. Price 168s.

The book is divided into two parts. The first presents an up-to-date account of the Skaergaard Intrusion. The second describes other layered intrusions, of which the Rhum complex, the Stillwater Intrusion, and the Bushveld Intrusion are dealt with in some detail. These are followed by shorter descriptions of other basic layered intrusions, including the Cuillins of Skye, the gabbro complex of north-east Scotland, Duluth, and the Great Dyke. One chapter is concerned with the