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Geology. — *"On peculiar sieve structures in igneous rocks, rich in alcalies"*. By Dr. H. A. Brouwer. (Communicated by Prof. G. A. F. Molengraaff).

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The following poicilitic structures, occurring in nepheline-syenitic rocks from the Pilandsbergen (Transvaal), are very instructive with regard to the insight which they allow into the order of succession of the crystallizations in magma's which are rich in alcalies.

1. *Intergrowths of dark minerals with felspars and felspatoids.*

A tardy crystallisation of the alcalipyroxenes and alcaliamphiboles is known in alcaligranites, alcalisyenites and nephelinesyenites. Sieve structures in which the crystals of the dark minerals are ramificated between the colourless ones are found e.g. in the paisanites and the alcaligraniteporphyries from Zinder (Sokota) [1]). This structure is very common in rocks from the Pilandsbergen and is beautifully developed in aegirineamphibolebiotitenephelinesyeniteporphyries from Wijdhoek (701), in which principally the alcaliamphibole is ramificated in skeletons of equal optical orientation between the elements of the groundmass: nepheline, sodalite, felspar, biotite, fluorspar, iron compounds and traces of apatite [2]). Macroscopically those crystals are visible as round spots of a few m.M. in diameter contrasting with a grey, medium- to finegrained "groundmass". The larger crystals of biotite and aegirine, which are very subordinate, show the same poicilitic structure. The biotite also occurs in small crystals in the groundmass, whilst the pyroxene, amphibole, and larger crystals of felspatoids are only crystallized after the colourless minerals.

The same sieve structures enclosing the colourless minerals, are found in crystals of molengraaffite and astrophyllite.

In lavenitebearing lujauriteporphyries from Wijdhoek (701), the larger crystals of molengraaffite and aegirine are speckled with small crystals of nepheline [1]), whilst the felsparcrystals are completely free from inclusions.

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[1]) A. Lacroix. "Sur les microgranites alcalins du territoire de Zinder." C. R. Ac. des Sciences, t. CXL, 1905 p. 22..

[2]) See Pl. IV, fig. 1 and 2 in H. A. Brouwer. "Oorsprong en samenstelling der Transvaalsche nepheliensyenieten." The Hague. Mouton and Co. 1910.

[1]) See ibid. fig. 9, p. 158.

Poicilitic intergrowths of astrophyllite with felspatoids occur in adjacent astrophyllitelujaurites, where numerous idiomorphic pseudomorphoses of zeolites and analcime after nepheline, and also aegirine are enclosed by large crystals of astrophyllite. In the lujauriteporphyries from Wijdhoek (701) which are rich in pectolite, strongly pleochroic crystals of eucolite poicilitically enclose nepheline and sodalite, whereas sometimes they are intersected by lath-shaped felspars as is found to occur with the augites of the diabases.

2. *Mutual intergrowths of felspars and felspatoids.*

In the aegirineamphibolebiotitenephelinesyeniteporphyries mentioned sub 1, we find besides the interlaced crystals of the dark minerals, numerous large crystals of idiomorphic nepheline, which only between crossed nicols contrast with the finegrained mixture. Sometimes this nepheline is free from inclusions, sometimes it is filled with short laths of felspar. Some of the crystals of nepheline are enclosed by an amphibole skeleton and themselves enclose numerous small crystals of felspar and biotite. All transitions from nepheline free from felspar to nepheline rich in felspar can be seen; in an intermediate form the inclusions are limited to the marginal parts of the crystal.

Consequently in this rock real phenocrysts of nepheline must have been crystallized before the finegrained mixture was formed.

In a lesser degree the enclosing of felspatoids by felspars, and the crystallization of nepheline with angular forms in the spaces between the felspars, is a common phenomenon in the rocks of this region. In these rocks also occur large felspatoid crystals, enclosing the smaller ones.

Macroscopically the rock is mediumgrained with lightgreen felspars and lightbrown nepheline; aegirine is very subordinate. Under the microscope we see the peculiar structure between crossed nicols: the crystals of idiomorphic nepheline and sodalite which are very abundant, the microperthitic felspar, and the aegirine enclose innumerable small idiomorphic and rounded crystals of nepheline (and sodalite); the crystals which are rich in inclusions are reduced to skeletons. The felspatoids are partly decomposed to cancrinite; we find complete pseudomorphoses, with the form of the original crystal, which consist of one crystal of cancrinite with sieve structure. It is interesting that the enclosed small crystals of felspatoids are not altered at all; there must be a cause why they could resist the CO_2 bearing agencies, may be as a result of changed chemical composition of the magma during the crystallization.

3. *Intergrowths of other minerals.*

In astrophyllitelujaurites we mentioned the poicilitic intergrowth of astrophyllite with felspatoids. In schistose lujaurites from Tusschenkomst (331) which are very rich in aegirine, crystals of astrophyllite which are allotriomorphic with regard to felspars and felspatoids, enclose innumerable needles of aegirine with different orientation; the aegirine can fill up more than half of the crystal.

Thus in these rocks astrophyllite is the latest product of crystallization, whereas it is one of the first crystallized minerals in aegirineamphibolefoyaites from Wijdhoek (701), where its idiomorphic crystals lie scattered in the other minerals. The eucolite mineral which is strongly altered to catapleite, is idiomorphic in these rocks, whereas in a lujaurite from Kruidfontein (649) it is allotriomorphic with regard to felspars and felspatoids, and encloses innumerable small crystals of aegirine.

In this rock eucolite is the latest product of crystallization just as in the astrophyllitebearing aegirineamphibolefoyaites from Wijdhoek (701), where it has been formed simultaneously with aegirinespherolites, which are younger than all other minerals.

In the molengraaffitebearing lujaurites from the southwestern part of Wijdhoek (701), crystals of a pectolite mineral occur, which are crystallized in angular forms between the other minerals, and enclose numerous needles of aegirine. Between crossed nicols the aegirine contrasts against a strongly birefringent back-ground showing equal optical orientation over a large distance whereas the connection between different parts of one single crystal is often broken.

In a lujauriteporphyry from Wijdhoek (701) which is rich in pectolite, this mineral is either jammed in angular form between the other minerals, or it encloses poicilitically the felspatoids and aegirine of the groundmass, whilst lath-shaped felspars occur in them with idiomorphic forms. Especially with the felspatoids it is often interlaced with sieve structure. In the same rock both the felspatoids are enclosed by eucolite, and the sodalite principally is enclosed by the felspars.

The crystallization of the pectolite already belongs to the pneumatolytic period in which the material for the growth of the minerals was partly given by reabsorption of these minerals which had been crystallized previously. According to this we see it accompanied by abnormal analcime, spherical aegirine, albite and fluorspar.

All that has been said above, tends to prove that the order of succession of the crystallization is not constant in these rocks, and gives an illustration of the strong force of crystallization of some minerals under certain circumstances, which enables them to crystallize in large crystals still in a nearly completely solidified magma. For the development of large crystals, the circumstances must have been most favourable shortly before the end of the crystallization, because the same minerals were often already formed in small crystals before. Further the richness in pneumatolytical and thermal minerals is characteristic for all the rocks of this region; according to this the loss on ignition is always very considerable.

Probably under certain definite pressures and temperatures the above described structures can be formed in magma's which, in consequence of their richness in pneumatolytical gases, are very fluid, whilst the changes in the succession of crystallization are principally determined by the chemical composition of the magma.

In connection with this, we find that in rocks rich in nepheline, although they may have widely different structures, nepheline is constantly the first mineral to crystallize, whereas in rocks poorer in nepheline this mineral has crystallized after the felspars. This we see as well in rocks in which the felspar encloses the nepheline, as in rocks in which the nepheline encloses the felspar. In lujaurite-porphyries from Wijdhoek (701) the felspars enclose numerous needles of aegirine, whilst the felspatoids contain those sometimes, but only in the marginal zone. After the crystallization of the larger felspatoids, a mosaic of small idiomorphic crystals of felspatoids was formed, still later the crystals of molengraaffite and aegirine enclosing the small felspatoids poicilitically.

These rocks are relatively rich in nepheline; after a period of crystallization of larger crystals of felspatoids followed the crystallization of the larger felspars and small needles of aegirine, while the crystals of felspatoids grew on slowly. Then the principal part of the felspatoids crystallized as a mosaic, probably under suddenly changed conditions, and at last the larger perforated crystals of aegirine and molengraaffite were formed.

In the aegirineamphibolebiotitenephelinesyeniteporphyries which are rich in nepheline and poor in dark minerals, a period of crystallization of felspatoids free from inclusions, and of some felspar was followed by the crystallization of small short felsparlaths and some biotite, while the larger crystals of nepheline grew on simultaneously; smaller crystals of this latter mineral were not formed, which is evident from the occurrence of perforated crystals of nepheline englobing the felspars only. The inclusions are often limited to their marginal zone. The amphiboles and pyroxenes have been formed only in large crystals, and exclusively after the colourless minerals.

In the aegirinenephelinesyeniteporphyries from Olivenfontein (145), which are very rich in nepheline, the first crystallized mineral is the apatite; it was followed by small crystals of nepheline and sodalite, still later by larger crystals of perforated nepheline, sodalite and felspar, simultaneously with the enclosed small needles of aegirine; finally the perforated aegirines could still be formed in large crystals.

On account of the tardy crystallization of the larger crystals the order of succession of the crystallizations can be studied more easily in these rocks than in their normalgrained equivalents.

The sieve structures described above, can be distinguished from those of the contactrocks and crystalline schists by the occurrence of exclusively idiomorphic or rounded inclusions, according to their relative age. From the real phenocrysts of the porphyric rocks the larger crystals here described differ in this respect that the inclusions are not ranged after the laws of crystallization of the enclosing crystal.

As the perforated crystals usually show a perfectly idiomorphic form, we see that the rule according to which the relative age of the crystals in igneous rocks is proportional to their idiomorphism, does not hold good here.

Mathematics. — "*An extension of the integral theorem of* FOURIER." By Mr. J. DROSTE. (Communicated by Prof. J. C. KLUYVER).

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As is known, for an extensive class of functions $f(x)$ the equation

$$f(x) = \int_0^\infty d\alpha \int_a^b \psi(x, y, \alpha) f(y)\, dy$$

becomes an identity in x, if we put $b = -a = \infty$ and $\psi(x, y, \alpha) = \cos \alpha(x - y)$; in this way we find the integral theorem of FOURIER which can be regarded as a limiting case of the series of FOURIER.

In the theory of the integral equations HILBERT and SCHMIDT have proved developments in series of which those of FOURIER are special cases. The following is a theorem which is in such a manner an extension of the integral theorem of FOURIER.

Let $K(x,y)$ be a continuous symmetrical kernel, $\varphi_1(x), \ldots, \varphi_\nu(x), \ldots$ a complete system of normalized orthogonal functions of that kernel and belonging to the limits of integration a and b, and $\lambda_1, \ldots, \lambda_\nu, \ldots$ the corresponding roots ("Eigenwerte").