In the common well-known atypical complexes of the *B*-form we never see this recurrent wave and in the rare clinical cases with recurrent auricle wave it is seen after the *R*-wave. Though this seeming discrepancy can be accounted for, we may perhaps find a fuller explanation after a continued research.

**Geology.** — "*On homoeogeneous inclusions of Kawah Idjen, Goentoer and Krakatau and their connection with the surrounding eruptive rocks.*" By H. A. BROUWER. (Communicated by Prof. G. A. F. MOLENGRAAFF.)

(Communicated in the meeting of February 28, 1914).

From the study of homoeogeneous inclusions of eruptive rocks it is apparent which rocks of great depth may crystallize out of the mothermagma, and to which differentiations this magma was subject during the formation of a certain volcanic complex, even when the eruptive aequivalents of certain products of differentiation, occurring among the inclusions, are not known among the volcanic rocks of the complex. Further, they show us the conditions of crystallization of certain minerals, which only under special conditions can be formed out of a magma of a certain chemical constitution [1]). For the determination of the relative age of rocks of the same volcanic complex the study of inclusions is an important resource, especially for the Indian volcanoes, which for the greater part are built up from loose rolled material, natural denudations being of little occurrence.

*Kawah Idjen.*

The volcanic products of the Kawah Idjen [2]) consist chiefly of cinders and stones, which are partly hardened into a conglomerate and are beautifully denudated in the precipitous walls that surround the lake of the crater. Somewhat above the locks of the irrigation which when the level is high unloads the lake, there begins a flow of lavas that follows the left shore of the drainage. Along the precipitous slope to the locks and in the stream of lavas, during a short visit in August 1912, some homoeogeneous and enallogeneous inclusions were collected. The enclosing rocks are hypersthene-augite-andesytes, in which numerous light-coloured phenocrists of plagioclase form a contrast with the gray to grayish black glassy groundmass.

[1]) A. LACROIX, Les enclaves des roches volcaniques Mâcon 1894 Id. La Montagne Pelée et ses éruptions, Paris. 1904.

[2]) R. D. M. VERBEEK and FENNEMA, Java en Madoera. I. p. 81. Amsterdam 1896.

Microscopically examined these plagioclases show kernels from labradorite to bytownite, and a repeated alternation of more basic and acidic layers; besides pale green augite which sometimes occurs as twin crystals according to (100), and hypersthene with a distinct pleochroism in pale green and pale brownish-yellow colours, we occasionally also remark small ore-crystals among the phenocrists. The glassy base is partly unglassed, and contains edges of plagioclase, small pillars of both augite and hypersthene, and ore-crystals.

The homoeogeneous inclusions are partly holocrystalline micropyroxene diorites, partly they only differ from the surrounding rocks by the strong increase of the crystals of plagioclase, augite, hypersthene and ore in the groundmass, whereas the glass only occurs caught between the crystalline constituents; they apparently have formed crystalline parts in the rising magma, their total crystallisation occurring simultaneously with that of the surrounding lavas. The microdiorites are partly rather abundant of ore and then appertain to a cleavage product more basic than the surrounding lavas. Exceptionally olivine, in a small quantity, was found among the constituents of these inclusions while it is wholly absent in the examined samples of the surrounding pyroxene andesites. The occurrence of olivine indicates cleavage products of the common mothermagma in which this mineral may crystallize, these cleavage products being known to us from the olivine-containing pyroxene andesites and basalts of volcanoes of the same complex [1]). (Merapi, Raoeng, Gd. Pondok, Koekoesan).

*Goentoer.*

During the ascension of the Goentoer in April 1913 a scattered vegetation turned out to have reached the very top, whereas VERBEEK, on the smooth cone that has but few incisions even now, did not meet with a single trace of vegetation above the limit af 1000 m. The rocks of the Goentoer complex, as far as they have been examined by LORIÉ, BEHRENS, VERBEEK, and myself, are chiefly basalts, that sometimes graduate into olivine-containing andesites, andesites without olivine also occurring. The products of the youngest point of eruption (the Goentoer properly speaking) which now only at the northwestern side shows some vapor of water and $SO_2$ rising from it, but which during the preceding century was frequently very active, consist of streams of lavas and gravel, or big blocks of often very porous rocks, which entirely cover the upper part of the streams of lava. As far as they have been examined, they are all found to be olivine basalts,

[1]) R. D. M. VERBEEK and FENNEMA, loc. cit.

usually with numerous phenocrists of plagioclase, sometimes besides green augite also hypersthene occurring among the phenocrists.

The homoeogeneous inclusions have been gathered in porous fragments along the slope above the hot springs of Tjipanas, near the brink of the crater. They are chiefly rather fine-granular olivine gabbroes, which by their pale colour distinctly contrast with the dark lava. The percentage of olivine varies, but is usually rather high. Some of the inclusions consist of basic plagioclase, green augite, olivine and magnetite; the olivine crystals with more or less rounded edges are often entirely surrounded by the augites, the latter being angularly bounded with respect to the plagioclases. Hypersthene being among the constituents there arise graduations into particular inclusions in which augite is absent among the constituent minerals, a strong brownish-black to brownish-yellow pleochroitic amphibole and hypersthene both occurring in its place. In these inclusions also, the plagioclase is rather well idiomorphically developed with respect to amphibole and hypersthene, whereas olivine-crystals with rounded edges and sometimes irregularly shaped are entirely enclosed by amphibole and hypersthene. All these rocks represent shapes of different depths of olivine-basalts, the amphibole seems to be absent in the effusive aequivalents and was either not produced, the circumstances of crystallization being different, or it was wholly resorbed after crystallization. On the contrary, the rounded shape of the olivine-crystals with their spread framing by amphibole, indicates a resorption of the first-mentioned mineral in the holocrystalline rocks. The inclusions without augite show a rare combination of minerals by the absence of monoclinic pyroxene and the presence of olivine, this mineral generally being absent in amphibole gabbroes and similar rocks.

Olivine-free inclusions are the aequivalents of more andesitic rocks, which we know from other parts of the Goentoer complex. In a similar inclusion there were recognized: plagioclase, both hypersthene and augite, and magnetite. As a rule the plagioclases form the bigger individuals not limited idiomorphically, which in a very large number poikilitically surround small pyroxene crystals.

### *Krakatau.*

During a visit to Krakatau in the beginning of May 1913, in one of the basaltic windings west of the great winding of hypersthene andesite [1]) angular fragments were collected of a light-coloured fine- to coarser-granular rock, which microscopically examined turned

[1]) R. D. M. VERBEEK, Krakatau, II, p. 160. Batavia 1885

out to contain much quartz. Although acidic hypersthene andesites mark the first and third period that VERBEEK distinguishes in the history of the volcano, the quartz has not been able to develop itself as such, under the circumstances in which these rocks crystallized, and is found in virtual state in the glass of the groundmass.

The surrounding basalt contains phenocrists of basic plagioclase and a small quantity of olivine in a glassy mass with crystals of more acidic plagioclase, augite and ore. The holocrystalline inclusions of which the largest dimension measures 10 cm. consist of strongly zonair plagioclases, quartz (a good deal of it fine-granophyrically grown together with feldspar), worn dark minerals and ore. In the fine-granophyrical conglomerations also kali-feldspar may be found. The $SiO_2$ percentage varies, the chemical constitution of one of the inclusions appearing from the following analysis (analyst F. G. MANNHARDT):

| | |
|---|---|
| $SiO_2$ | 64,14 |
| $TiO_2$ | 4,86 |
| $Al_2O_3$ | 14,91 |
| $Fe_2O_3$ | 3,41 |
| FeO | 3,64 |
| CaO | 5,69 |
| MgO | 0,82 |
| $Na_2O$ | 1,67 |
| $K_2O$ | 0,91 |
| $H_2O$ | 0,68 [1] |
| Sum total | 100,73 |

Calculating the analyses according to the American system we find a remarkable high percentage of $SiO_2$ that is not bound as a silicate (about 38 %).

It appears from the above-said that the homoeogeneous inclusions of the Kawah Idjen, according to their chemical constitution, show but a few varying types; in connection with this fact the chemical constitution of the andesites and basalt of the Idjen complex differ but slightly. [2])

[1]) Loss by ignition.

[2]) The basalt of the stream of lavas of the Merapi which flows into the sea near Batoe Dodol on the straits of Bali contains (according to STÖHR) 54 % $SiO_2$; two pyroxene andesites of the Kawah Idjen contain 58 % and 60 % $SiO_2$; and among the rocks that were gathered by me during the eruption of the Raoeng in 1913; on the northern slope of the volcano near the brink of the crater, some amphibole-hypersthene-augite-andesites with 63 % $SiO_2$ occur. Also the olivine-containing basaltic cinders of the youngest Raoeng-eruption have a high $SiO_2$ percentage (54 %).

Various aequivalents of the basalts and aequivalents of the andesitic rocks of the Goentoer in a broader sense were found among the homoeogeneous inclusions of the youngest eruptive products of the Goentoer properly speaking.

The quartz-containing inclusions of the basalts of Krakatau illustrate the presence of virtual quartz in the groundmass of the hypersthene andesites of the first period, and would as well be the only traces of differentiation in the mother-magma before the basaltic eruptions, if not, not only the greater part, but all traces of the former basic eruptions had disappeared by a fall-down.

The occurrence of augitefree plagioclase-hypersthene-amphibole-olivine rocks as homoeogeneous inclusions in the products of the Goentoer teaches us that such combinations of minerals may at a greater depth crystallize out of the basaltic magma.

It appears from the calculation of the norm that also the quartz-containing inclusions of Krakatau belong to the rare combinations of minerals because, according to the analyses calculated by WASHINGTON no other rock belongs to the sub-class (II. 3, 4, 3).

**Chemistry.** — *"On the pyrophoric phenomenon in metals"*. By Prof. A. SMITS, A. KETTNER, and A. L. W. DE GEE (A preliminary communication). (Communicated by Prof. J. D. VAN DER WAALS).

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In a previous communication [1]) it was pointed out that the pyrophoric phenomenon would possibly have to be explained by this that the metals obtained in the reduction of certain compounds are comparatively far from the state of internal equilibrium and show an abnormally great power of reaction in consequence of an abnormally large content of the simpler kind of molecule.

The explanation for this phenomenon prevalent up to now, which is of more frequent occurrence than is perhaps supposed (we found it with Cu, Bi, Pb, Ni, Fe) attributed the great reactive power to the very finely divided state; so an explanation which is perfectly analogous to that of the so called "chemical flag" for phosphorus

Now the possibility might also be considered that in the liberation of the metal a pyrophoric admixture is formed, or that the hydrogen

[1]) These Proc. XVI, p. 699.