Vote on the alkali-lavas of Mount Nimrud, Armenia.

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THE object of this note is not to give elaborate descriptions of rock-sections, but to call attention to the fact that the old volcano of Nimrud, situated on the west side of lake Van in Armenia, was the centre of eruption of alkali-lavas presenting striking similarities to some of the alkali-rocks of the Rift Valley in East Africa.

To Dr. Felix Oswald, in his book on the geology of Armenia,[1] we owe a detailed description of this ancient volcano, of which the vast crater, now half occupied by a deep lake, is more than five miles across. An interesting series of the lavas from the volcano was collected by Dr. Oswald and was presented by him to the British Museum. On looking over thin slices of these rocks under the microscope, I was at once struck by the surprising resemblance of some of them, with their phenocrysts of anorthoclase and scattered tufts of aegirine and the soda-amphiboles, riebeckite and cossyrite, to rocks in Prof. J. W. Gregory's collection from the Rift Valley which I had described.[2] Judging from Dr. Oswald's collection, the lavas of Nimrud do not show a very great diversity in character. They are almost all of alkaline type with anorthoclase the prevailing felspar; but, like the lavas of the Rift Valley, they vary in basicity from those containing free quartz, and thus corresponding to the riebeckite-rhyolites (comendites) of Gilgil on Lake Naivasha (loc. cit., p. 242), to others resembling somewhat the kenytes of Mt. Kenya with abundant phenocrysts of corroded anorthoclase in a more or less glassy base. A characteristic feature of almost all, as of the East African rocks, is the presence in small amount of small phenocrysts of fragmental olivines (probably fayalite) and green aegirine-augite.

The oldest lavas, forming the main mass of the crater-walls on the south and south-west, and the lavas erupted from vents on the floor of

[1] F. Oswald, A treatise on the geology of Armenia. Printed and published by the author at 'Iona', Beeston, Notts., 1906.

[2] G. T. Prior, Contributions to the petrology of British East Africa. Min. Mag., 1903, vol. 13, pp. 228–263.

the crater, and thus, according to Dr. Oswald, the most recent, are of almost precisely similar type. They are soda-rhyolites (or comendites), some holocrystalline and exhibiting well-marked flow-structure, others either completely glassy obsidians or obsidians containing fairly large spherulites. Those of holocrystalline type show striking and beautiful features in thin slices under the microscope. Phenocrysts of anorthoclase and orthoclase, somewhat sparsely distributed, are seen in a felt of felspar laths through which are scattered tufts and needles of grass-green aegirine, dark reddish-brown cossyrite, and deep indigo-blue riebeckite. Quartz is present either as angular grains, sometimes surrounding the felspar phenocrysts, or in micropoecilitic patches as a sort of mosaic in which the constituents of the groundmass are embedded. In this respect these rocks resemble the 'phonolitic quartz-trachytes' of the Rift Valley (loc. cit., p. 242). The results of a chemical analysis of one of these rocks (B.M. Reg.-no. 1917, 631, 2) is as follows under I. Under II, for comparison, is given an analysis by H. S. Washington of an aegirine-pantellerite from Costa Zeneti, Pantelleria.[1]

	I.		II.
SiO_2	71·82	...	69·79
TiO_2	0·20	...	0·89
Al_2O_3	13·20	...	11·91
Fe_2O_3	1·46	...	5·35
FeO	3·07	...	1·43
MnO	0·06	...	0·20
MgO	0·03	...	0·25
CaO	0·90	...	0·25
Na_2O	6·03	...	5·66
K_2O	3·40	..	4·59
H_2O	0·27	...	0·21
P_2O_5	—	...	0·13
	100·44		100·66

The rocks of later eruption, referred to as 'cindery basalts' by Dr. Oswald, which cover the rhyolites of the crater-rim and slopes on the north and west and were poured out over the surrounding country, especially to the west of the crater, are darker and a little more basic than the rhyolites, but are alkali-rocks of somewhat similar composition. Like the kenytes of Mt. Kenya, they are characterized by very abundant phenocrysts of anorthoclase much corroded and permeated by the base, and also by the presence of fragmental and fairly large phenocrysts of olivine and aegirine-augite. In some of these rocks the groundmass is

[1] H. S. Washington, Journ. Geol., 1913, vol. 21, p. 703.

glassy, but in others it has characters somewhat similar to those of the rhyolites and shows densely crowded grains of aegirine or aegirine-augite with, in some specimens, tufts of altered cossyrite and a little interstitial quartz between the felspar laths. Some of these rocks, found as loose blocks on the floor of the crater and on the north-east rim, are brecciated and consist of fragments of trachyte or rhyolite in a glassy base.

The results of an analysis of one of these kenyte-like rocks (B.M. Reg.-no. 1917, 631, 36) is as follows under III. For comparison, under IV is given an analysis by H. S. Washington of a trachyte from Mt. Gibele, Pantelleria.[1]

	III.		IV.
SiO_2	63·07	...	63·30
TiO_2	0·51	...	0·71
Al_2O_3	18·31	...	16·38
Fe_2O_3	2·04	...	2·54
FeO	2·41	...	2·36
MnO	0·08	...	—
MgO	0·49	...	0·84
CaO	2·25	...	1·62
Na_2O	6·27	...	6·36
K_2O	4·63	...	4·41
H_2O	0·13	...	0·93
P_2O_5	—	...	0·30
	100·19		99·75

The analysis shows that this more kenyte-like rock does not differ in chemical composition very much from the rhyolite except in the lower percentage of silica and rather higher percentages of lime and magnesia. It may be described as a pantelleritic trachyte.

Of rocks making a closer approach to basalts, as they contain phenocrysts of a more basic felspar showing well-marked twin-striations, instead of anorthoclase, there are three specimens in Dr. Oswald's collection. One of these is from the shelf projecting into the crater-lake on the north, another from Kizvag on Lake Van, and the third from Morkh in the Musch Plain. Under the microscope these rocks show abundant phenocrysts of felspar, with well-marked twin-striations having symmetrical extinctions of from 20° to 30°, in a base of felspar laths with only a few small interstitial grains of olivine and augite and some magnetite. A chemical analysis of the somewhat altered rock from Kizvag (B.M. Reg.-no. 1917, 631, 44) gave the following result under V. Under VI,

[1] H. S. Washington, Journ. Geol., 1913, vol. 21, p. 688.

for comparison, is given an analysis by H. N. Stokes of a trachyandesite from Elkhorn Mt., Montana, U.S.A.[1]

	V.		VI.
SiO_2	58·80	...	59·64
TiO_2	1·16	...	1·08
Al_2O_3	16·94	...	16·64
Fe_2O_3	3·76	...	2·33
FeO	4·00	...	4·35
MnO	0·08	...	—
MgO	1·77	...	2·10
CaO	4·79	...	4·59
Na_2O	4·07	...	3·31
K_2O	3·50	...	4·16
H_2O	1·83	...	0·83
P_2O_5	—	...	0·49
	100·70		99·68

The analysis shows that this rock differs from the preceding trachyte mainly in a further slight decrease in silica and corresponding further increase in lime and magnesia. It may be described as a trachyandesite.

Judging from the published descriptions, many of the lavas from Armenian volcanoes show a tendency to alkaline characters, but in none does this appear to be so marked as in these rocks from Mt. Nimrud. In this connexion the tectonic position of the volcano may have some significance. As stated by Dr. Oswald (loc. cit., p. 151), Nimrud is situated on the great line of fracture which cuts across the Armenian folds and extends through the Red Sea to the Rift Valley, exactly at the point of intersection of this fracture with the great fracture running SE. to NW. which delimits Lake Van and the Musch Plain on the south.

[1] J. S. Barrell, Ann. Rep. United States Geol. Survey, 1901, no. 22, p. 525.