An olivine basalt from Mt. Eden plug, Auckland Id., Southern Ocean, was collected and examined by Dr. J. B. Wright* and the presence of both orthopyroxene and clinopyroxene as large, vitreous, corroded crystals was noted. The basalt also contains lherzolite inclusions with the typical olivine, enstatite, clinopyroxene and pale brown spinel assemblage but the "xenocrysts" contrast in size and colour with crystal fragments detached from these xenoliths.

2. Chemical compositions of xenocrysts and host magmas

Several features of the chemical and normative composition (table 1) of the host magma are worthy of comment. The norm contains a small amount of hypersthene but falls within the alkali basalt field using the criteria of POLDERVAART (1964). Petrographically it is an alkali olivine basalt in that olivine occurs as both phenocrysts and crystallites, co-precipitating with the clinopyroxene and with no evidence of a reaction relationship with the liquid. The composition also lies within the Hawaiian alkali olivine basalt field on an Na_2O+K_2O vs SiO_2 diagram. The basalt is an example illustrating the continuity of composition between the nepheline-normative alkali olivine basalts and hypersthene normative olivine tholeiites (YODER and TILLEY, 1962 p. 353). It lies close to the "plane of critical undersaturation" of the latter authors.

TABLE 1

Chemical composition of olivine basalt, Mt. Eden plug, Auckland Id. Otago University No. 19594, A.N.U. No. 2900. Analyst E. Kiss, A.N.U.

		CIPW Norm	
SiO_2	46.55		
TiO_2	3.18		
Al_2O_3	12.70	Or	5.6
Fe_2O_3	2.98	Ab	24.8
FeO	9.72	An	18.9
MnO	0.17	Di	17.7
MgO	10.63	Hy	2.7
CaO	8.66	Ol	18.8
Na_2O	2.95	Ap	1.3
K_2O	0.95	Ilm	6.1
P_2O_5	0.60	Mt	4.4
H_2O^+	0.67		
CO_2	0.24	Normative feldspar	
Cr_2O_3	0.06	$Or_{11}Ab_{51.5}An_{37.5}$	
NiO	0.04	D.I. = 30.4	
CoO	0.01		
	100.11		

$\frac{100\ Mg}{Mg+Fe^{++}}$ (atomic ratio) = 66.2

The normative plagioclase composition is andesine ($Ab_{58}An_{42}$) and is more typical of hawaiite composition than alkali olivine basalt if a comparison is made with Hawaiian lavas (MACDONALD and KATSURA, 1964). However the low SiO_2 content and high $Mg/(Mg+Fe^{++})$ ratio of the basalt is typical of alkali olivine basalts and alkali picrites. Except for normative feldspar composition, the host basalt falls close to the alkali olivine basalt point in all the criteria used by TILLEY and MUIR (1964) in their characterization of members of the alkali olivine basalt to trachyte magma series. The term "olivine basalt" is used in this paper for the magma but affinities to alkali olivine basalts are recognized. The points of similarity to some hawaiites are noted and may be linked to data (unpublished) showing that some hawaiites are magmas formed within the deep crust or mantle ($P \geq 8$ kb) and that not all hawaiites can be regarded as products of alkali olivine basalt fractionation in shallow magma chambers.

The compositions of the large phenocrysts present in the magma have been determined using the electron probe microanalyzer and empirical calibration curves based on analyzed minerals and synthetic glasses (cf. GREEN and RINGWOOD, 1967a). Analyses of several crystals and of different areas within one crystal demonstrated small but real variations in composition – the most magnesian and most iron rich compositions obtained for both pyroxenes are listed in table 2. The orthopyroxene and clinopyroxene (table 2) have a high degree of mutual solid solution (i.e. high CaO in orthopyroxene, low CaO in clinopyroxene). They differ in this respect from the co-existing pyroxenes of lherzolite inclusions in basalts (ROSS, FOSTER and MYERS, 1954) and are also more iron-rich than the lherzolite assemblages (olivines, enstatites and clinopyroxenes with $100\ Mg/(Mg+Fe^{++}) = 92–89$).

The contrast between the clinopyroxene "xenocryst" compositions and the composition of the recrystallised outermost rim, presumed to be in equilibrium with the basalt magma during crystallization at or near the surface, is clearly shown in table 2. The recrystallized rim is markedly different in TiO_2 content, CaO content and hypersthene solid solution, and shows smaller differences in Na_2O and Al_2O_3 contents.

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