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Average calc-alkali basalt

SIR – There is much discussion at present on the nomenclature of igneous rocks, in particular that of the I.U.G.S. Subcommission on the Systematics of Igneous Rocks (Streckeisen, 1976*a*), and we feel it may aid discussion to clarify the term '*Central*' *basalt* and to present a revised average chemical composition for calc-alkali basalts.

Le Maitre (1976*a*) and Streckeisen (1976*b*) discussed methods of classifying the rocks of the calc-alkali volcanic suite, and one problem encountered is to decide what is understood by the term *calc-alkali basalt*. In 1954 the term '*Central*' *basalt* was introduced by Nockolds for basaltic rocks with labradorite or more calcic plagioclase, which are found in association with typical calc-alkali andesites, dacites and rhyolites such as occur at Lassen Peak and Mount Shasta in the Cascades, and in other central volcanic complexes of the Caribbean Arc and the circum-Pacific belt. It did not include the Mull Porphyritic Central Magma (or high-alumina) type of Bailey *et al.* (1924). The purpose was to distinguish calc-alkali basalts from the tholeiitic and alkaline basalts of anorogenic regions. The main features were higher SiO_2 and Al_2O_3, and lower MgO and total Fe.

The term '*Central*' *basalt* is now considered to serve no further useful purpose, and it is recommended that the term be abandoned. The basalts of this group should be and are better known as *calc-alkali basalts.*

A new average chemical composition of calc-alkali basalt has been compiled (by S.R.N.). It is calculated from 48 mostly newer analyses than were used for the 1954 average, and only those with a low H_2O content, fresh mineralogy, reliable alkali determination, and with normative plagioclase An_{53} or greater are included. The new figures are only slightly different, and still indicate that calc-alkali basalts have relatively high SiO_2 and Al_2O_3, and low MgO and total Fe figures compared with other basalts, but that the silica saturation, Fe/Mg ratio, and iron oxidation ratio (Fe^{2+}/total Fe atoms = 0.70) are about the same as non-alkaline basalts (Le Maitre, 1976*b*).

The composition of the normative plagioclase is An_{59}, the differentiation index (Thornton & Tuttle, 1960) is 30.1, and the crystallization index (Poldervaart & Parker, 1964) is 51.7. The latter index may serve to distinguish calc-alkali basalt from overall average basalts which have c.i. < 50, but the d.i. is the same (Le Maitre, 1976*b*). The normative colour index is 34 which, when plotted against normative plagioclase composition, is below that for 'within plate' tholeiitic basalts (commonly in range 40–60), but coincides with that given for basalts from the Aleutians and Cascades by Irvine & Baragar (1971).

The new average composition for calc-alkali basalts also responds well when subjected to principal component analysis using the three eigenvectors given by Le Maitre (1976*a*, table 1). The resulting three

eigenvectors for the average calc-alkali basalt composition are −37.1, −7.5 and −9.9 respectively, and plot just off-centre, towards andesite, in both the basalt fields given in Le Maitre's density plot of basalts, andesites, dacites and rhyolites (1976*a*, Fig. 1).

Table 1

	Av. 'Central' basalt (1954)	New average for calc-alkali basalt		
SiO_2	51.33	51.31	qz	0.83
TiO_2	1.10	0.88	or	4.39
Al_2O_3	18.04	18.60	ab	24.86
Fe_2O_3	3.40	2.91	an	35.52
FeO	5.70	5.80	di wo	6.24
MnO	0.16	0.15	di en	3.95
MgO	6.01	5.95	di fs	1.89
CaO	10.07	10.30	hy en	10.91
Na_2O	2.76	2.93	hy fs	5.22
K_2O	0.82	0.74	mt	4.23
H_2O+	0.45	0.30	il	1.68
P_2O_5	0.16	0.12	ap	0.28
	100.00	99.99		100.00

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