SHORT COMMUNICATIONS

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Alkali amphiboles in the Eocene high-level granites of Skye, Scotland

IT has been known for a long while that some of the Skye Eocene granites contain alkali amphibole, traditionally referred to as riebeckite (Geikie, 1894). Thompson (1969) noted that the optical properties of alkali amphiboles within granites of the Marsco area, Western Redhills, were more appropriate to arfvedsonite than riebeckite. The analytical data presented here show that the compositions of these amphiboles range between ferro-richterite and arfvedsonite.

Two samples were studied: one from the peralkaline Maol na Gainmhich Epigranite (SK 887), the other from a local peralkaline facies of the chemically variable Southern Porphyritic Epigranite (SK 213). Both plutons are in the Western Redhills intrusive complex (Wager *et al.*, 1965). Their predominant minerals are perthitic alkali feldspar and quartz, with alkali amphibole and associated minerals clustered together in interstitial patches and forming about 5 % of the rock. In SK 887 the amphibole occurs in anhedra up to 2 mm, which enclose traces of Fe–Ti oxides, allanite, and zircon. Its pleochroism is: α pale brown $\leqslant$ β dark yellowish-green to greenish-blue $<$ γ very dark greenish-blue. There is patchy colour variation in prism sections, with a tendency for bluer tints to occur near crystal margins. In SK 213 the amphibole anhedra are up to 1 mm and intergrown with an approximately equal amount of aenigmatite, together with accessory Fe–Ti oxides, sodic pyroxene remnants enclosed in amphibole crystals, and allanite. The pleochroism of the SK 213 amphibole is very similar to that in SK 887, except that it lacks the yellowish tint in β and the greenish tint in γ of the latter. SK 213 amphibole shows slight patchy colour variation with a similar distribution to that seen in SK 887.

The chemical analyses were made using the computer-automated MAC model 400 electron microprobe of the Geophysical Laboratory, Carnegie Institution of Washington (Thompson, 1974). Analyses illustrating the range of compositions in each sample are given in Table I. The remaining data are available from the author on request. (OH) and F contents of the amphiboles are undetermined and all Fe has been reported as Fe^{2+}, although it is clear from considerations of charge balance that some Fe^{3+} is present.

Surprisingly, the slight compositional zoning within the amphiboles (Table I) does not correlate with either the positions of the analysed points within the crystals or the patchy colour variations described above. The only element showing systematic variation is K, which is slightly enriched in the crystal rims. The average volatile-free

TABLE I. *Microprobe analyses and ions to 23 oxygen for alkali amphiboles in Skye granites*

	SK 213		SK 887	
SiO_2	47.2	48.7	49.3	49.6
TiO_2	1.66		1.28	1.27
Al_2O_3	1.71	1.11	0.99	0.70
FeO*	34.4	35.4	33.8	33.4
MnO	0.78	0.73	0.98	0.94
MgO	0.13	0.30	0.25	0.18
CaO	5.07	3.78	3.06	2.17
Na_2O	4.73	5.39	5.89	7.22
K_2O	1.20	1.10	1.33	1.44
Total	96.9	97.9	96.9	96.9

	SK 213		SK 887	
Si	7.74	7.89	8.02	8.06
Al^{iv}	0.26	0.11	-	-
Al^{vi}	0.07	0.10	0.19	0.13
Ti	0.20	0.17	0.15	0.15
Fe	4.72	4.79	4.60	4.54
Mn	0.11	0.10	0.13	0.13
Mg	0.03	0.07	0.06	0.04
Ca	0.89	0.65	0.53	0.38
Na	1.50	1.69	1.86	2.28
K	0.25	0.22	0.27	0.30
$\underline{Z}$	8.00	8.00	8.02	8.06
$\underline{Y}$	5.13	5.23	5.13	4.99
$\underline{X}$	2.64	2.56	2.66	2.96

* All Fe assumed to be FeO.

SK 213: Southern Porphyritic Epigranite. 80 m north of Fiaclan Dearg at 480 m a.s.l., west face of Marsco, Western Redhills, Skye (NG 503255).

SK 887: Maol na Gainmhich Epigranite. Allt Darach, between Maol na Gainmhich and Meall Buidhe, Western Redhills, Skye (NG 555314).

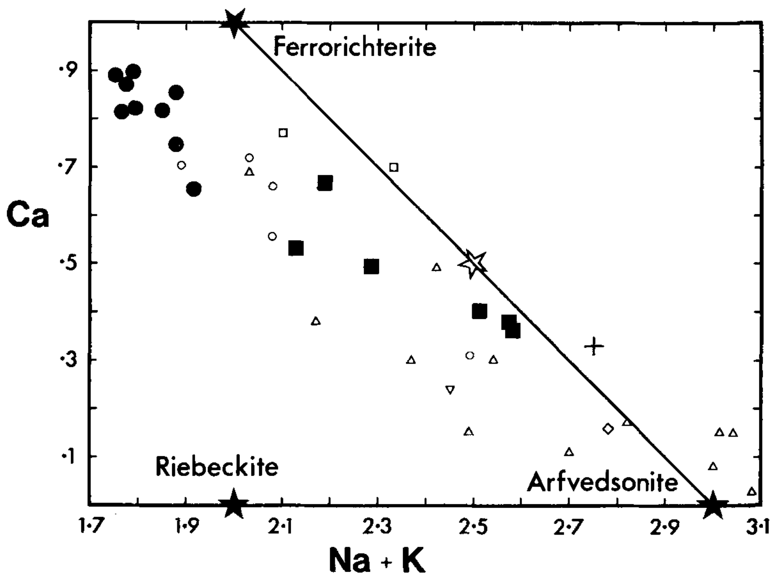

FIG. 1. Ca versus (Na+K) for Skye granite alkali amphiboles and comparable Fe-rich, Al-poor examples. Ions are calculated on the basis of 23 oxygens. Filled stars indicate Fe-amphibole end-members, as labelled. The open star is the arfvedsonite formula suggested by Miyashiro (1957). Note that this contains 0·5 atoms of Al in *Z*, whereas the labelled end-members are all Al-free. Key to analyses: filled circles = Southern Porphyritic Epigranite (SK 213), Skye; filled squares = Maol na Gainmhich Epigranite (SK 887), Skye; open squares = pantellerite, Lake Naivasha, Kenya, and open diamond = comendite, Opo Bay, New Zealand (Nicholls and Carmichael, 1969); open circles = Golden Horn Batholith, Washington, U.S.A. (Stull, 1973); open upright triangles = peralkaline granites, Nigeria (Borley, 1963); open inverted triangle = granite, Hinchinbrook Island, North Queensland, Australia (de Keyser, 1966); cross = protruding into a vug in lunar basalt 10058 (Gay *et al.*, 1970).

formulae of the amphiboles from the two specimens are $(K_{0\cdot25}Na_{1\cdot57}Ca_{0\cdot82})(Mg_{0\cdot04}Fe_{4\cdot72}Mn_{0\cdot11}Ti_{0\cdot20}Al_{0\cdot08})(Si_{7\cdot78}Al_{0\cdot22})O_{23}$ for SK 213 and $(K_{0\cdot29}Na_{2\cdot09}Ca_{0\cdot47})(Mg_{0\cdot07}Fe_{4\cdot57}Mn_{0\cdot12}Ti_{0\cdot15}Al_{0\cdot19})Si_{8\cdot00}O_{23}$ for SK 887. It is apparent that the Mg/(Mg+Fe) ratios and amounts of Al in Z are so low in both these amphiboles that their compositions may be treated in terms of the end-members ferro-richterite $Na_2CaFe_5^{2+}Si_8O_{22}(OH)_2$, arfvedsonite $Na_3Fe_4^{2+}Fe^{3+}Si_8O_{22}(OH)_2$, and riebeckite $Na_2Fe_3^{2+}Fe_2^{3+}Si_8O_{22}(OH)_2$. Fig. 1 is a plot of Ca versus (Na+K), which shows the projected compositions of the Skye amphiboles relative to these three end-members and other comparable naturally occurring amphiboles. It is clear from fig. 1 that the Southern Porphyritic Epigranite amphibole is close to ferro-richterite in composition, while the Maol na Gainmhich Epigranite amphibole analyses lie midway between the ferro-richterite and arfvedsonite end-members, near to the projected composition of the arfvedsonite formula proposed by Miyashiro (1957).

Dept. of Geology
Imperial College of Science and Technology
London SW7 2AZ

R. N. THOMPSON

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Erratum: Table **I**, SK 213, 2nd anal., TiO_2 1·43.

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Wroewolfeite and other langite-group minerals from Blackcraig, Kirkcudbrightshire

THE East and West Blackcraig mines and dumps (O.S. one-inch sheet 73, 445 645) are situated some two and a half miles south-east of Newton Stewart and the mines produced primarily lead and zinc ore. The main vein occupied a shatter belt with country