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Alkali feldspars from the Kazi Nag Granites, Baramulla District, J & K State, India

WADIA (1934) draws attention to a ring of granite bodies occurring around the Palaeozoic basin of Kashmir. Among these is the Kazi Nag Granite body, which falls in the Baramulla district of Kashmir and occupies parts of survey of India toposheet Nos. 43 J/3 and 43 J/4 (1:50 000). The eastern part of the granite massif lying on the Indian side of the India–Pakistan border has been studied. It is approachable from Chananwari, on the Srinagar–Uri road, and has for the purpose of the present study been classified according to the proposals of Streckeisen (1976). Three main types of granite observed in the area are: (*a*) granodiorites; (*b*) monzogranites; and (*c*) syenogranites. The granodiorites are restricted to the outermost part of the granite body. The monzogranites form an intermediate zone between the syenogranites in the centre and the peripheral granodiorites.

In thin section the alkali feldspars are seen to be in the form of microclines, microcline-microperthites, and microperthites.

Seven samples of alkali felspar concentrates (four from marginal granodiorites, two from intermediate monzogranites and one from syenogranites) were chemically analysed by the wet method and the results listed in Table I. The structural formulae based on 32(O) atoms were computed and it is seen that the formulae fit very well with the standard structural formula for alkali feldspars. Minor quantities of Fe^{3+} would occur as impurities in the alkali feldspar structure substituting for $Al:Fe^{+2}$ and Mg for Ca (Deer *et al.*, 1963).

Based on chemical analyses, normative orthoclase, albite, and anorthite were calculated for the seven samples of alkali feldspars under study. The total normative alkali feldspars range from $Or_{77.65}Ab_{15.21}An_{7.14}$ to $Or_{84.78}Ab_{10.34}An_{4.46}$. If the data are recomputed to orthoclase + albite = 100%, the range is from $Or_{83.61}Ab_{16.39}$ to $Or_{89.12}Ab_{10.88}$.

Orville (1967) and Jones *et al.* (1969) devised an X-ray method to determine the alkali feldspar bulk composition. The sample is heated with $KBrO_3$ to a temperature of 1050 °C in a muffle furnace for 48 h to homogenize the alkali feldspars with albitic inclusions and X-rayed with $KBrO_3$ as the internal standard. The separation of the $\bar{2}01$ peak of alkali feldspar from the 101 peak of $KBrO_3$ is taken as a measure of orthoclase content of the alkali feldspars. A calibration curve is constructed from standards for the estimation of the orthoclase content of an unknown alkali feldspar sample (adapted from Hutchison, 1974, fig. 7.3, page 185, after Jones *et al.*, 1969). The results are given in Table I. From an inspection of the table, it may be seen that orthoclase content of the samples under study varies from 82 to 93% and conversely albite from 18 to 7%. Wright and Stewart (1968) proposed an X-ray method for determining the structural state of alkali feldspars. Wright (1968) proposed a calibration diagram wherein 2θ angles for the $\bar{2}01$,060 and $\bar{2}04$ reflections are used to determine the structural state of the alkali feldspars. Seven samples of the Kazi Nag Granite body were studied by these methods using Phillips X-ray diffractometer model number 1050/25 with nickel filtered Cu-$K\alpha_1$ radiation and a scanning speed of $\frac{1}{4}°$ per min. The results have been plotted on Wright's diagram (adapted from Hutchison, 1974, fig. 7.6, page 196). An inspection of the figure shows that the alkali feldspars under study classify as intermediate to maximum microcline and are triclinic.

Goldsmith and Laves (1954) proposed a measure of triclinicity (Δ) of alkali feldspars in terms of the 131 and $1\bar{3}1$ *d* spacings:

$$\Delta = 12.5(d_{131} - d_{1\bar{3}1})$$

If $\Delta = 0$, the alkali feldspar is monoclinic (fully disordered) and $\Delta = 1$, triclinic (fully ordered). Dietrich (1961) gives 0.25 as the dividing value between orthoclase (or sanidine) and microcline. Lower values indicate the monoclinic form and those with higher values are triclinic alkali feldspars. On the other hand Rhodes (1969) proposed 0.3 as the discrimination value. In the Kazi Nag Granites Δ varies from 0.3712 to 0.7612 (Table I). This suggests that the alkali feldspars of the Kazi Nag Granite body are triclinic in nature. It may be observed, however, that the alkali feldspars from the border zone of the granite body have relatively lower Δ values compared with those of the central part, suggesting that the periphery cooled at a relatively faster rate than the central part of the granite body.

TABLE I. *Chemical analyses of alkali feldspars from the Kazi Nag Granites*

Sample number	K79	K55	K59	K89	K50	B22	B13
SiO_2	62.33	62.50	63.40	64.18	64.50	64.85	65.00
Al_2O_3	19.46	20.02	19.82	18.05	18.02	17.28	17.32
Fe_2O_3	1.20	1.02	1.11	1.63	1.08	1.32	1.81
FeO	0.85	0.51	0.51	0.59	0.36	0.43	0.79
TiO_2	—	—	—	0.15	tr.	0.21	0.09
MgO	0.64	0.64	0.80	0.19	0.80	0.86	0.52
CaO	0.89	1.40	1.33	0.80	0.91	0.88	0.91
Na_2O	2.06	1.51	1.61	1.31	1.61	1.61	1.15
K_2O	12.78	12.74	11.82	13.32	13.00	12.19	13.12
H_2O^+	0.08	0.09	0.11	0.13	0.09	0.12	0.10
H_2O^-	0.06	0.07	0.06	0.06	0.05	0.05	0.06
Total	100.35	100.50	100.57	100.41	100.42	99.80	100.87
Δ	0.3712	0.4175	0.7712	0.5875	0.4462	0.7612	0.3925
Or	93.00%	88.8	86.00	90.00	82.00	82.50	93.00
	Numbers of ions on the basis of 32(O)						
Si	11.47	11.36	11.97	11.75	11.71	11.85	11.89
Al	4.19	4.38	3.54	3.95	3.94	3.73	3.74
Fe^{3+}	0.17	0.13	0.16	0.22	0.18	0.17	0.22
Fe^{2+}	0.11	0.08	0.08	0.09	0.05	0.07	0.11
Ti	—	—	—	0.02	—	0.04	0.02
Mg	0.22	0.22	0.23	0.05	0.22	0.22	0.11
Ca	0.22	0.33	0.34	0.22	0.22	0.22	0.22
Na	0.66	0.44	0.68	0.44	0.66	0.66	0.44
K	3.08	3.06	2.94	3.09	3.06	2.86	3.08
OH	0.08	0.10	0.14	0.08	0.10	0.16	0.14
Or	82.81	79.59	77.65	84.29	81.90	80.00	84.78
Ab	12.63	13.15	15.21	11.83	14.54	15.07	10.34
An	4.56	7.26	7.14	3.88	3.56	4.93	4.88
Ab	13.24	14.17	16.39	12.30	15.07	15.85	10.88
Or	86.76	85.83	83.61	87.70	84.93	84.15	89.12
X (Ca, Na, K, Mg, and Fe^{2+})	4.29	4.13	4.27	3.89	4.21	4.03	3.96
Z (Si, Al, Fe^{3+}, and Ti)	15.83	15.87	15.67	15.92	15.83	15.75	15.85

The Or and Δ values are calculated from the X-ray diffraction method.

Conclusion. The alkali feldspar bulk compositions computed from chemical and X-ray studies for the Kazi Nag Granite body have been found to agree well. The feldspars are triclinic and have been classed as intermediate to maximum microcline.

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