American Mineralogist, Volume 59, pages 615–617, 1974

New X-ray and Chemical Data on C. G. Hewlett's Feldspar Suite

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Abstract

Hewlett (1959) presented optical, X-ray, and compositional data for fifteen alkali feldspars. The optical data were unusually detailed and of very high quality, but the X-ray and compositional data were not of comparable quality. This paper presents new X-ray and compositional data to complement Hewlett's optical data.

Introduction

Hewlett (1959) described optical, X-ray, and compositional data for fifteen alkali feldspars and attempted correlations between these properties and Al/Si ordering. The optical data were unusually detailed and of very high quality, but the *b* and *c* cell parameters were determined from single reflections in X-ray powder patterns. Moreover, chemical analyses for some samples showed a marked discrepancy between the values obtained by spectrographic and by flame photometric methods. In making use of Hewlett's data, Stewart (1973) recognized the desirability of obtaining modern X-ray and compositional data in order to utilize fully the optical data of Hewlett. The Hewlett specimens (purified, crushed mineral separates) are in the University of Wisconsin collection, and Stewart suggested that we describe them further. The X-ray study has been done primarily by Emerson as part of a senior thesis. Starting cell parameters for the least-squares refinement were based upon the *b* and *c* values obtained from Table 9 of Hewlett (1959). The starting values of *a* were based upon the *a* cell edges predicted by plotting *b* and *c* on Figure 2b of Wright and Stewart (1968). Other details of our X-ray procedures are given in Guidotti, Herd, and Tuttle (1973). The analytical work was performed by Guidotti, and conditions for the electron microprobe analyses are also given in Guidotti *et al.* (1973).

Results

Table 1 lists the chemical data obtained in this study. Analyses were made only for K, Ca, and Na. Agreement with Hewlett's values (also presented in Table 1) for K_2O, CaO, and Na_2O is quite good for specimens 1–10. For specimens 11–15 the agreement is not as good because Hewlett used an average of spectrographic and flame photometer results and the two methods gave values differing by as much as two percent (See Table 1).

Most specimens appear to be quite homogeneous with respect to K, Ca, and Na. Relatively little variation occurs in the probe counts from grain to grain or within a grain (see Table 1). To check the intra-grain variability, a single grain in each sample was analyzed at 10–12 different points. The counting variability and composition obtained were similar to the sample average. In no cases were any Ab-rich points found.

One adularia specimen (#6) was noticeably inhomogeneous. The microprobe analyses clearly indicated that two populations of grains are present, one of which fluoresces in the electron beam and one of which does not. Each population is compositionally homogeneous and distinct from the other (see Table 1).

Table 2 presents the results of the lattice parameter refinement for each specimen. In general, except for specimens #10 and #14, the diffraction patterns used were of good quality and showed little or no evidence of the albite $\bar{2}01$ peak. This observation coincides well with the microprobe analyses which showed no evidence of exsolution at the micron scale. (See Table 2 of this study and Table 7 of Hewlett, 1959). Specimen #6 (adularia) is also notable in that, despite its bimodal composition (discussed above), the powder diffraction pattern appears to have sharp unresolved peaks, including $\bar{2}01$.

TABLE 1. Analytical Data on Alkali Feldspars of Hewlett (1959)

	Oxide weight percent						Mole percent						Weight percent			% Variation	
	This report			Hewlett (1959)			This report			Hewlett (1959)			This report			This report	
No.*	K_2O	CaO	Na_2O	K_2O	CaO	Na_2O	Or	An	Ab	Or	An	Ab	Or	An	Ab	K_2O	Na_2O
1	13.53	.28	1.92	12.98	.31	2.16	81.15	1.40	17.46	78.55	1.58	19.87	79.86	1.39	16.23	.5	2.5
2	12.68	.17	2.79	12.50	.17	2.76	74.28	.85	24.87	74.24	.8	24.91	74.84	.84	23.58	.5	2.7
3	11.77	.10	2.81	11.64	.03	2.98	73.01	.51	26.48	71.83	.15	28.03	69.47	.49	23.76	.2	1.5
4	9.81	.45	4.19	9.73	.41	4.33	59.29	2.27	38.44	58.37	2.07	39.58	57.90	2.23	35.42	1.9	3.1
5	11.91	.37	2.62	11.37	.36	2.97	73.52	1.92	24.56	70.19	1.86	27.93	70.29	1.83	22.15	.6	1.5
**6	16.41	00	.37	15.11	.02	1.08	96.67	00	3.33	90.08	.11	9.81	96.85	00	3.13	.3	6.3
***6	15.23	.02	1.08	15.11	.02	1.08	90.16	.11	9.73	90.08	.11	9.81	89.89	.10	9.13	1.1	10.6
7	15.78	.02	.62	15.44	.02	.73	94.29	.09	5.63	93.17	.11	6.72	93.13	.10	5.24	.4	4.5
8	15.48	.03	.68	15.20	.02	.87	93.58	.14	6.28	91.87	.11	8.01	91.36	.15	5.75	.5	7.1
9	15.87	.02	.68	15.41	00	.93	93.79	.09	6.12	91.58	00	8.41	93.66	.10	5.75	.3	4.7
10	4.47	.34	8.17	4.85	.29	7.94	26.02	1.69	72.30	28.21	1.43	70.38	26.38	1.69	69.07	2.3	1.5
11	13.98	.11	1.30	14.2† 12.6††	.35†	1.40† 2.01††	87.10	.57	12.33				82.51	.55	10.99	.3	2.8
12	13.46	.33	1.94	14.0† 12.35††	.45†	1.9† 2.03††	80.64	1.66	17.70				79.44	1.64	16.40	.5	2.7
13	12.97	.20	2.60	11.2† 11.5††	.35†	3.5† 3.61††	75.92	.98	23.10				76.55	.99	21.98	.4	2.1
14	11.19	.09	3.73	10.3† 10.38††	.13†	4.35† 4.22††	66.10	.43	33.47				66.04	.45	31.53	.6	2.4
15	9.70	.43	4.25	10.3† 9.04††	.65†	4.9† 4.74††	58.68	2.19	39.13				57.25	2.13	35.93	1.8	3.7

* *Specimen numbers as given in Table 1 of Hewlett (1959, p. 513).*
** *Non-fluorescing population.*
*** *Fluorescing population.*
† *Spectrographic analysis.*
†† *Flame photometer analysis.*

Plotting of the *a* cell dimension or cell volume versus weight percent Or for the data in Tables 1 and 2 produces curves similar to those in Figure 1A of Wright and Stewart (1968). However, specimen #14 appears to be an exception inasmuch as it lies well above either curve (*e.g.*, the ΔV (cell volume observed minus that predicted from curve) is $\sim$5.8 Å^3). This is probably expectable in view of the quality of the pattern indicated in Table 2 for this specimen.

TABLE 2. Summary of New X-Ray Data for Hewlett (1959) Specimens

No*	a(Å)	b(Å)	c(Å)	α(°)	β(°)	γ(°)	Vol.(Å^3)	Pk.acc / Pk.ent	Std. error 2θ	Remarks
1	8.514(2)**	13.017(2)	7.173(1)	90.0	115.98(1)	90.0	714.6(2)	24/24	.013	No Ab $\bar{2}01$ peak
2	8.487(1)	13.010(1)	7.174(7)	90.0	116.02(1)	90.0	711.8(1)	20/20	.007	Hint of Ab $\bar{2}01$ peak
3	8.476(2)	13.002(2)	7.175(1)	90.0	115.95(1)	90.0	711.0(2)	21/21	.011	Minor Ab $\bar{2}01$ peak
4	8.432(3)	12.999(2)	7.170(1)	90.0	116.09(3)	90.0	705.8(2)	17/17	.013	Minor Ab $\bar{2}01$ peak
5	8.453(4)	12.998(4)	7.169(2)	90.0	116.02(3)	90.0	707.8(3)	19/20	.021	Slight Ab $\bar{2}01$ peak
6	8.576(2)	12.976(2)	7.204(1)	90.0	116.04(1)	90.0	720.3(2)	27/29	.016	No Ab $\bar{2}01$ peak
7	8.566(3)	12.959(3)	7.217(1)	90.60(3)	115.94(2)	87.73(2)	719.9(2)	22/24	.015	Hint of Ab $\bar{2}01$ peak
8	8.564(3)	12.963(3)	7.219(2)	90.66(3)	115.95(2)	87.65(2)	720.1(2)	19/21	.015	Minor hint of Ab $\bar{2}01$
9	8.565(2)	12.952(3)	7.218(1)	90.68(3)	115.94(1)	87.65(2)	719.5(2)	20/24	.012	No Ab $\bar{2}01$ peak
10	8.272(5)	12.935(3)	7.149(1)	91.53(3)	116.39(3)	90.23(3)	684.9(3)	14/19	.013	†Possible Ab $\bar{2}01$ peak
11	8.527(2)	13.015(2)	7.175(1)	90.0	115.95(2)	90.0	716.1(2)	27/27	.016	No Ab $\bar{2}01$ peak
12	8.514(1)	13.018(1)	7.171(1)	90.0	116.00(1)	90.0	714.4(8)	27/27	.007	No Ab $\bar{2}01$ peak
13	8.487(1)	13.010(2)	7.174(9)	90.0	115.98(1)	90.0	712.0(1)	22/22	.010	No Ab $\bar{2}01$ peak
14	8.528(3)	12.988(2)	7.172(1)	90.0	116.05(2)	90.0	713.8(2)	19/20	.012	††Fair Ab $\bar{2}01$ peak. I~1***
15	8.411(3)	12.984(2)	7.166(1)	90.0	116.08(2)	90.0	702.9(2)	14/15	.009	Minor Ab $\bar{2}01$ peak

* Specimen numbers as given in Table 1 in Hewlett (1959, p513)
** Estimated standard errors are in parentheses and refer to the last decimal place
*** I = Intensity of Ab$\bar{2}$01 peak of K phase on a scale of 1-10)
† Some broadening and merging of peaks
†† Other peaks also present. K-spar peaks a bit broadened

Acknowledgments

The writers are indebted to Drs. S. W. Bailey, W. A. Dollase, and D. B. Stewart for advice and discussions about procedures used. They and J. T. Cheney also aided by critically reviewing the manuscript. Dr. Bailey is particularly thanked for generously allowing us to use his specimens of Hewlett's feldspar collection.

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Manuscript received, November 19, 1973; accepted for publication, January 16, 1974.