NEPHELINE — KALSILITE MICROPERTHITES IN EJECTA FROM THE ALBAN HILLS (ITALY)

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Microprobe analyses carried out on exsolved nepheline and kalsilite phases of microperthites occurring in three ejecta from the Alban Hills (Roman comagmatic region) have shown: (1) a practically continuous compositional variation from Ks to Ne (bulk analysis of microperthites is lacking); (2) two areas of chemical variation according to the Ks/Ne ratio of the bulk analysis of microperthites in its relationship with the solvus of the Ks-Ne system; (3) a larger variation in the chemical compositions of the exsolved phases with regard to the above-mentioned ratio of the microperthite bulk analysis.

The lattice parameters of the two phases have been determined, and the Ks a_o value indicates a d-kalsilite for all specimens.

With reference of the high part of the Ks-Ne system, the anomalous case may be attributed to the formation of zoned crystals with large compositional variation in a non-equilibrium cooling process. From these crystals the exsolution process may give rise to Ne and Ks domains showing chemical compositions different from those expected.

Key words: nepheline-kalsilite microperthites, Ne-Ks microprobe analyses, d-kalsilite, ejecta, Alban Hills, Italy.

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Introduction

In a previous paper (Federico 1976), it was pointed out that kalsilite with perthitic structure is the dominant leucocratic constituent of the ejected block defined as a melanocratic kalsilitolite, found in the «welded scoriae» formation of Colle Cimino (Marino), Alban Hills.

Microperthitic kalsilite, occurring in Kabfumu lava, Nyiragongo area, has previously been studied by Sahama (1953, 1957, 1960, 1962), and later by Velde and Yoder (1978) in specimen Y 287, described by Washington (1927, p. 190), embedded in the «Villa Senni tuffs» formation, Alban Hills. It has not been possible to determine the composition and the percentage of the exsolved nepheline from the latter finding, but for the former one they have been estimated by an X-ray method (Smith and Sahama 1954; Smith and Tuttle 1957).

Occurrence and mineralogical associations

A marked feature of the Alban Hills area is the occurrence of ejected blocks with kaliophilite (Barbieri *et al.* 1970) or kalsilite (Federico 1976; Velde and Yoder 1978) in various associations. This paper deals with the kalsilite with nepheline exsolution found in three ejecta from the «welded scoriae» formation (Colle Cimino, Marino) mentioned above.

In the CCL1 specimen kalsilite is fine-grained, and occurs in rare small colourless to yellowish prisms up to 2—3 mm long, which are characterized by rounded edges imparting a «drop-like» aspect to the crystals. Kalsilite is associated with melilite, phlogopite, forsterite and subordinate kaliophilite and spinel. The chemical composition of kaliophilite as well as the bulk analysis of the CCL1 specimen are given in Table 1. Kaliophilite, in colourless to whitish fibrous aggregates, shows the same morphological, chemical and optical features as observed in kaliophilite from the same locality (Barbieri *et al.* 1970). No genetic relationship between Ks and Kp has been established. The kalsilite-kaliophilite association has only been found in this block and it represents the only case known to the authors.

The mineralogical association of the CCL2 specimen is represented chiefly by honey-yellow, coarse-grained melilite and colourless coarse-grained kalsilite in almost equal amounts and subordinate phlogopite. The chemical composition of melilite is given in Table 1.

A detailed macro- and microdescription of the CCA specimen has already been reported by Federico (1976). Its mineralogical association, in order of abundance, is as follows: clinopyroxene, kalsilite, phlogopite, melanitic garnet, leucite, melilite with minor apatite, opaques and fluorite. Kalsilite appears granular with rounded surfaces. The chemical composition of this specimen is shown in Table 1 for comparison.

Table 1. Chemical analyses of CCL1 and CCA ejected blocks, of CCL1 kaliophilite and CCL2 melilite.

wt.%	1	2	3	4
SiO_2	45.67	39.41	40.42	42.54
TiO_2	0.46	—	—	0.78
Al_2O_3	10.50	32.75	12.09	12.84
Fe_2O_3	—	—	1.65	5.15
FeO	4.96	0.34	0.86	2.56
MnO	0.17	nd	—	0.20
MgO	29.25	—	6.12	7.73
CaO	3.12	—	34.60	16.37
Na_2O	0.23	3.26	3.41	1.13
K_2O	4.99	24.07	0.21	9.13
Total	99.35	99.83	99.36	98.43

1 CCL1 specimen, XRF analysis (also contains 0.05 P_2O_5).
2 CCL1 kaliophilite, WDS microprobe analysis.
3 CCL2 melilite, EDS microprobe analysis (also contains 0.44 SrO). Divalent iron determined by a microanalytic method.
4 CCA specimen, wet chemical analysis (also contains 0.71 P_2O_5, 0.09 F, 0.02 Cl, 0.12 SO_3, 0.82 H_2O^+, 0.30 H_2O^-).

Chemistry

Electron microprobe analyses (1) carried out on kalsilite and exsolved nepheline from all the microperthites examined, the number of ions on the basis of 32 oxygen atoms, and Ne—Ks—Qz percentages (2) are listed in Tables 2, 3 and 4. The results of bulk wet chemical analyses performed on microperthites from the CCL2 and CCA specimens are shown in the same Tables. Because of the scarcity of the material, wet chemical analysis could not be performed on microperthites from the CCL1 specimen.

In the CCL1 specimen the variation in chemi-

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[1] For the analyses, use was made of a Jeol JXA-50A microanalyser fitted with a Link systems Ltd. energy dispersive system type 860 with ZAF 4/FLS quantitative software. Operating conditions were: 15 kV accelerating voltage, 2 nA sample current.

The analyses marked with solid circles were obtained with the same microanalyser using two crystal spectrometers. The data were reduced using the EMPADR VII software (Rucklidge and Gasparrini, 1969). The operating conditions were: 15 kV accelerating voltage, 20 nA sample current.

[2] Compositions are given in weight per cent of standard molecules.

Table 2. Microprobe analyses of kalsilite and exsolved nepheline from CCL1 microperthites.

wt.%	1	2	3	4	5	6	7	8	9	10
SiO_2	38.05	38.57	39.01	37.76	38.75	39.37	39.12	39.59	39.53	40.36
Al_2O_3	32.38	32.20	32.40	33.22	32.31	32.51	32.69	32.95	33.59	33.71
Fe_2O_3*	0.57	0.79	0.72	0.49	0.77	0.64	0.78	0.79	0.67	0.23
MgO	—	—	—	0.42	—	—	—	—	0.58	—
CaO	—	—	—	0.22	—	—	—	—	0.58	0.52
Na_2O	1.03	0.79	0.93	1.69	2.11	3.45	5.64	7.74	8.41	9.14
K_2O	27.71	27.30	27.69	26.13	26.18	23.38	21.44	18.74	16.02	15.11
Total	99.74	99.65	100.75	99.93	100.12	99.35	99.67	99.81	99.38	99.07
Number of ions on the basis of 32 oxygens:										
Si	7.976	8.060	8.071	7.848	8.040	8.118	8.022	8.030	7.953	8.091
Al	7.991	7.922	7.892	8.129	7.893	7.892	7.892	7.868	7.956	7.956
Fe_{3+}	0.090	0.124	0.112	0.077	0.120	0.099	0.120	0.120	0.101	0.035
Mg	—	—	—	0.130	—	—	—	—	0.174	—
Ca	—	—	—	0.049	—	—	—	—	0.125	0.112
Na	0.419	0.320	0.373	0.681	0.849	1.379	2.242	3.043	3.280	3.552
K	7.409	7.277	7.308	6.928	6.929	6.150	5.608	4.848	4.111	3.864
Ne	4.79	3.71	4.30	8.06	9.78	16.27	26.20	35.80	41.06	44.15
Ks	94.50	94.01	93.80	91.23	88.94	80.79	72.96	63.51	57.29	53.47
Qz	0.71	2.28	1.90	0.71	1.28	2.94	0.84	0.69	1.65	2.38

wt.%	11	12	13	14	15	16	17	18	19	20
SiO_2	41.31	41.66	40.70	42.01	42.46	40.86	42.18	41.39	42.98	40.74
Al_2O_3	33.30	33.88	34.89	35.32	33.86	35.08	34.87	34.60	34.95	34.86
Fe_2O_3*	0.86	0.68	0.52	0.44	0.85	0.34	0.76	0.71	0.63	0.82
MgO	0.23	—	0.61	0.28	—	—	—	—	—	—
CaO	0.45	0.46	0.46	0.23	0.16	0.37	0.27	0.45	—	0.43
Na_2O	9.66	11.06	12.16	12.60	13.53	14.93	14.75	14.83	14.29	15.91
K_2O	14.03	11.51	11.53	9.53	8.94	8.27	8.01	7.42	7.42	7.54
Total	99.84	99.25	100.87	100.41	99.80	99.85	100.84	99.40	100.27	100.30
Number of ions on the basis on 32 oxygens:										
Si	8.180	8.202	7.931	8.103	8.248	7.960	8.104	8.060	8.234	7.914
Al	7.764	7.853	8.005	8.024	7.744	8.046	7.887	7.932	7.883	7.973
Fe_{3+}	0.128	0.101	0.076	0.064	0.124	0.050	0.110	0.104	0.091	0.120
Mg	0.068	—	0.177	0.080	—	—	—	—	—	—
Ca	0.095	0.097	0.096	0.047	0.033	0.077	0.056	0.094	—	0.089
Na	3.709	4.222	4.594	4.711	5.096	5.639	5.494	5.598	5.307	5.992
K	3.544	2.891	2.866	2.345	2.215	2.055	1.963	1.843	1.813	1.868
Ne	46.56	53.99	58.14	61.00	64.25	70.72	69.49	71.47	68.07	74.23
Ks	49.53	41.16	40.38	33.79	31.10	28.69	27.65	26.20	25.90	25.77
Qz	3.91	4.85	1.48	5.21	4.65	0.59	2.86	2.33	5.94	—

* Total Fe as Fe_2O_3 — below detection limit

cal composition is practically continuous from Ks to Ne, as displayed in Table 2 and Fig. 1, ranging from Ks 94.5 Ne 4.8 Qz 0.7 to Ks 26.2 Ne 71.5 Qz 2.32.

In the CCL2 specimen the bulk chemical analysis of the microperthites indicates a composition expressed by Ks 89.8 Ne 10.2. Inspection of Table 3 and Fig. 1 shows that the variation in the chemical composition of kalsilite and exsolved nepheline in the same specimen is re-

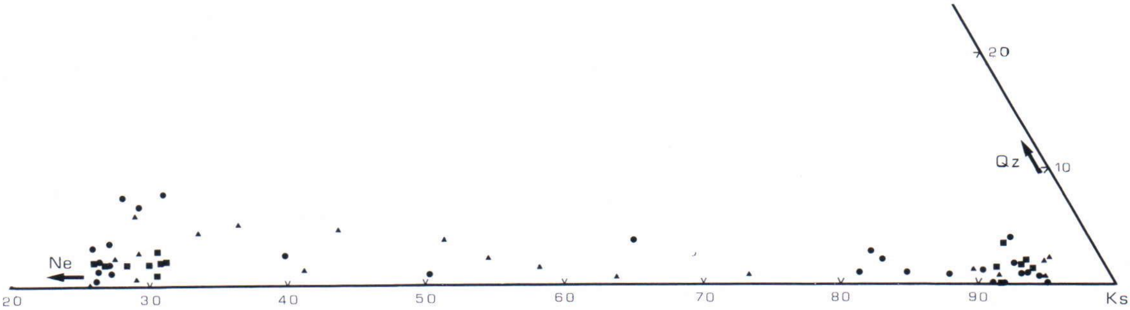

Fig. 1. Compositions of kalsilites and exsolved nephelines of microperthites in ejecta from the Alban Hills, Italy. CCL1, solid triangles; CCL2, solid squares; CCA, solid circles.

stricted to two compositional areas, the first ranging from Ks 93.3 to Ks 90.1 and the second from Ks 30.0 to Ks 24.8. Therefore the CCL2 microperthites show a bulk analysis consistent with the electron microprobe analyses of kalsilite and exsolved nepheline, according to a solvus found by Tuttle and Smith (1958) in their study of the $NaAlSiO_4$—$KAlSiO_4$ system.

In the CCA specimen the bulk chemical analysis of the microperthites gives Ks 86.5 Ne 12.4 Qz 1.1, while the variation in chemical composition found by electron microprobe analyses of kalsilite and exsolved nepheline is larger than that expected, as shown in Table 4 and Fig. 1. Indeed, the Ks/Ne ratio resulting from the bulk analysis is consistent with those, obtained by point analyses, which vary between Ks_{95}-Ks_{88} and Ks_{39}-Ks_{26}, whereas the chemical compositions identified in Table 4 by numbers 9—14 would require a bulk composition enriched with sodium. A possible explanation of this apparent discrepancy will be suggested in the final discussion.

Table 3. Microprobe analyses of kalsilite and exsolved nepheline, and bulk analysis of CCL2 microperthites.

wt.%	1•	2•	3•	4•	5•	6•	7•	8•	9•	10•	11•	12•	13•	14•	B.A.
SiO_2	38.46	39.16	39.25	38.30	38.60	39.67	41.92	41.46	41.30	42.07	41.52	41.86	41.82	41.97	38.11
Al_2O_3	32.62	31.90	32.45	33.10	33.35	31.95	34.37	34.22	33.75	34.78	34.02	34.62	34.27	34.65	32.80
Fe_2O_3*	0.27	0.48	0.52	0.29	0.35	0.59	0.47	0.37	0.37	0.43	0.43	0.68	0.40	0.63	0.23
FeO															0.16
MgO	—	—	—	—	—	—	—	—	—	—	—	0.13	—	0.10	—
CaO	—	0.26	0.18	0.46	—	0.10	—	—	0.20	0.20	—	0.83	0.40	0.76	1.44
Na_2O	1.16	1.18	1.32	1.81	1.73	1.37	14.68	14.62	14.82	14.50	14.86	14.99	14.79	15.18	2.10
K_2O	27.35	26.97	27.22	26.67	26.58	26.18	8.86	8.79	8.81	8.44	8.52	7.25	7.51	7.04	25.30
Total	99.86	99.95	100.94	100.63	100.61	99.86	100.30	99.46	99.25	100.42	99.35	100.36	99.19	100.33	100.14
Number of ions on the basis of 32 oxygens:															
Si	8.020	8.144	8.088	7.923	7.960	8.210	8.129	8.109	8.114	8.122	8.126	8.073	8.149	8.087	7.903
Al	8.008	7.810	7.873	8.061	8.097	7.785	7.847	7.880	7.806	7.905	7.839	7.861	7.862	7.861	8.008
Fe^{3+}	0.042	0.075	0.081	0.045	0.054	0.092	0.068	0.054	0.055	0.062	0.063	0.099	0.059	0.091	0.036
Fe^{2+}															0.028
Mg	—	—	—	—	—	—	—	—	—	—	—	0.037	—	0.029	—
Ca	—	0.058	0.040	0.102	—	0.022	—	—	0.042	0.041	—	0.171	0.083	0.157	0.320
Na	0.469	0.476	0.527	0.726	0.692	0.550	5.519	5.544	5.645	5.427	5.638	5.605	5.587	5.671	0.844
K	7.275	7.154	7.155	7.037	6.992	6.911	2.192	2.193	2.208	2.078	2.127	1.784	1.867	1.730	6.692
Ne	5.40	5.53	6.11	8.48	8.05	6.44	67.83	68.08	68.76	69.38	69.11	72.46	70.83	73.13	10.20
Ks	93.26	92.52	92.29	91.52	90.59	90.08	29.99	29.99	29.94	29.59	29.02	25.68	26.35	24.84	89.80
Qz	1.34	1.95	1.60	—	1.36	3.48	2.18	1.93	1.30	1.03	1.87	1.86	2.82	2.03	—

• WDS analyses B.A. bulk analysis * total Fe as Fe_2O_3 — below detection limit

Table 4. Microprobe analyses of kalsilite and exsolved nepheline, and bulk analysis of CCA microperthites.

wt.%	1•	2•	3•	4•	5	6	7	8	9	10	11	12
SiO_2	37.99	38.51	38.41	38.46	38.70	38.04	39.58	38.68	39.06	38.61	38.85	38.46
Al_2O_3	31.49	31.16	30.92	30.91	31.83	30.96	32.57	31.70	31.89	31.64	32.28	31.98
Fe_2O_3*	1.73	1.41	1.06	1.06	1.28	1.47	1.18	1.37	0.65	1.30	1.48	1.52
FeO												
MgO	—	0.40	0.19	0.38	0.24	0.40	—	0.21	0.54	0.25	0.62	0.50
CaO	0.12	0.38	—	—	0.13	0.17	—	0.29	0.24	0.36	—	0.28
Na_2O	1.08	1.09	1.28	1.38	1.38	1.85	1.21	1.90	2.52	3.11	3.34	3.79
K_2O	28.11	27.37	27.42	27.40	26.65	26.62	26.04	26.01	25.92	24.19	23.62	23.06
Total	100.52	100.32	99.28	99.59	100.21	99.51	100.58	100.16	100.82	99.46	100.19	99.59
Number of ions on the basis of 32 oxygens:												
Si	7.961	8.043	8.103	8.089	8.044	8.007	8.127	8.037	8.050	8.032	7.987	7.961
Al	7.769	7.662	7.679	7.654	7.790	7.673	7.873	7.755	7.738	7.749	7.813	7.793
Fe^{3+}	0.272	0.221	0.168	0.168	0.200	0.233	0.182	0.214	0.101	0.203	0.229	0.236
Fe^{2+}												
Mg	—	0.125	0.060	0.119	0.074	0.125	—	0.065	0.166	0.077	0.190	0.154
Ca	0.027	0.085	—	—	0.029	0.038	—	0.065	0.053	0.080	—	0.062
Na	0.439	0.441	0.523	0.563	0.556	0.755	0.482	0.765	1.007	1.254	1.331	1.521
K	7.514	7.292	7.379	7.351	7.066	7.148	6.820	6.894	6.814	6.419	6.194	6.089
Ne	4.98	5.12	5.94	6.38	6.49	8.66	5.72	8.96	11.64	14.79	15.81	18.00
Ks	95.02	94.18	93.10	92.78	91.73	91.21	90.15	89.81	87.75	84.23	81.88	80.25
Qz	—	0.70	0.96	0.84	1.78	0.13	4.13	1.23	0.61	0.98	2.31	1.75

wt.%	13	14	15	16	17	18	19	20	21	22	23	B.A.
SiO_2	40.85	39.78	41.10	43.67	41.43	40.99	41.45	41.14	39.93	42.07	41.70	38.65
Al_2O_3	33.13	33.38	33.61	33.39	34.46	33.91	33.84	34.56	35.05	34.35	34.15	30.31
Fe_2O_3*	1.09	1.13	1.29	1.82	1.59	0.70	1.13	1.05	1.39	1.30	1.67	2.31
FeO												0.26
MgO	—	0.45	—	—	—	—	—	0.44	0.70	—	0.22	0.14
CaO	—	0.50	0.34	0.64	—	0.13	—	0.35	0.68	0.22	0.36	1.53
Na_2O	7.02	10.19	12.33	13.19	15.55	15.79	15.44	15.09	14.68	14.90	15.03	2.44
K_2O	18.31	14.14	11.03	7.45	7.83	7.60	7.57	7.28	6.99	7.21	6.90	23.21
Total	100.40	99.57	99.70	100.16	100.86	99.12	99.43	99.91	99.42	100.05	100.03	98.85
Number of ions on the basis of 32 oxygens:												
Si	8.171	7.959	8.097	8.386	8.004	8.047	8.098	7.985	7.798	8.129	8.071	8.098
Al	7.802	7.862	7.796	7.549	7.838	7.834	7.784	7.898	8.059	7.814	7.781	7.477
Fe^{3+}	0.164	0.170	0.191	0.263	0.231	0.103	0.166	0.153	0.204	0.189	0.243	0.364
Fe^{2+}												0.046
Mg	—	0.134	—	—	—	—	—	0.127	0.204	—	0.063	0.044
Ca	—	0.107	0.072	0.132	—	0.027	—	0.073	0.142	0.045	0.075	0.343
Na	2.722	3.952	4.709	4.910	5.824	6.009	5.848	5.678	5.558	5.582	5.640	0.991
K	4.672	3.609	2.772	1.825	1.930	1.903	1.886	1.802	1.742	1.777	1.703	6.203
Ne	32.99	49.11	58.91	65.21	72.10	73.63	72.19	72.46	73.26	71.13	72.48	12.40
Ks	63.03	49.93	38.60	26.99	26.59	25.96	25.92	25.61	25.55	25.21	24.37	86.46
Qz	3.98	0.96	2.49	7.80	1.31	0.41	1.89	1.93	1.19	3.66	3.15	1.14

• WDS analyses B.A. bulk analysis * total Fe as Fe_20_3 — below detection limit.

9 includes MnO 0.32, 11 includes Cl 0.13, 21 includes TiO_2 0.46, B.A. includes H_2O 0.54.

Microscopic description

Microperthitic kalsilite generally forms large areas; sometimes elongated idiomorphic crystals and hexagonal basal sections have been observed. Exsolved nepheline appears more frequently as strips crossing kalsilite (Fig. 2 c, d) or as small square or rectangular areas (Fig. 2 b), whereas the CCL1 microperthites show a very regular exsolution, which imparts a characteristic fibrous aspect to the crystals (Fig. 2 a). In all cases with the same optical orientation, the two phases are characterized by slightly different refractive index values, those of the exsolved nepheline being higher as indicated by Sahama (1960) and confirmed by Velde and Yoder (1978).

Refractive indices of the kalsilite have not been determined in that they could not be referred to a specific composition, as shown in the former paragraph.

Lattice parameters

Microperthitic crystals from all specimens have been submitted to X-ray study using the single crystal method. The CCL2 and CCA microperthites have also been examined by the powder diffractometer method, which revealed that the most part of the spacings refer to the Ks phase and only a few weak ones to the exsolved nepheline. It is worth noting that the CCA nepheline (20.2) reflection is clearly split, indicating a larger variation in its composition than in the one shown by the CCL2 nepheline, as was previously indicated. Sahama (1957) observed a similar behaviour in the powder pattern from the core of a nepheline phenocryst heated for twelve hours at 510°C and quenched in water.

A parallel intergrowth between kalsilite and exsolved nepheline has been established by the single crystal method, confirming what had been shown optically and described by Sahama (1957).

Table 5. Lattice parameters of kalsilite and exsolved nepheline.

Specimen	a_o	c_o
Ks CCL1	5.152 ± 0.004	8.684 ± 0.002
Ks CCL2	5.148 ± 0.001	8.676 ± 0.001
Ks CCA	5.163 ± 0.002	8.689 ± 0.003
Ne CCL2	10.026 ± 0.008	8.413 ± 0.008
Ne CCA	10.046 ± 0.009	8.402 ± 0.009

The kalsilite lattice parameters have been determined with the least-squares refinement program elaborated by De Angelis et al. (1977) using ϑ values of 15 reflections for each specimen in the range $4 < \vartheta < 34$ obtained by a Philips PV 1100 single crystal diffractometer (graphite filtered Mo Kα radiation).

The a_o and c_o values are given in Table 5. It is worth stressing that the a_o value of the kalsilite corresponds to the lattice parameter of a disordered phase in all specimens and the increase in both the a_o and the c_o values seems to be correlated with the Fe content, which is particularly high in the CCA kalsilite.

Nepheline lattice parameters have been obtained from the values of only a few weak reflections, as mentioned above, and for this reason their values are less reliable.

Because of the variation in the chemical composition, the lattice parameter values obtained must clearly be considered as mean values.

Discussion

The nepheline-kalsilite microperthites found in the ejecta of the Alban Hills are characterized by a total composition corresponding to 87—90 wt % of kalsilite. The chemical compositions of both exsolved (Ne) and host (Ks) phases in the specimens studied are shown in Tables 2, 3 and 4.

In the CCL1 microperthites there is a practically continuous variation from Ks to Ne. The CCL2 microperthites, on the other hand, show a range of compositions of both Ne and Ks

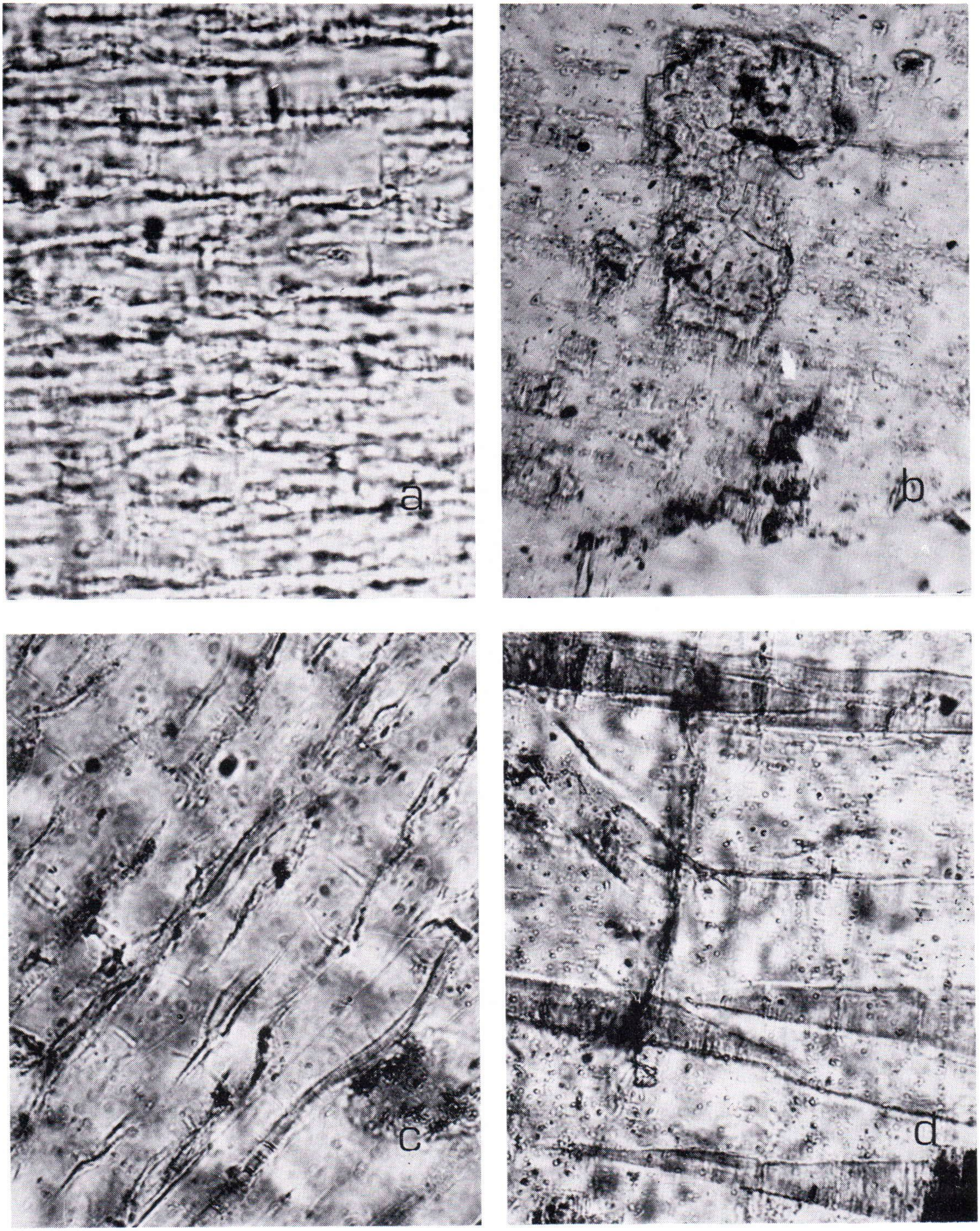

Fig. 2. a) CCL1 microperthite showing a regular nepheline exsolution, ×940; b) CCL2 microperthite displaying small rectangular areas of exsolved nepheline, ×188; c) CCA exsolved nepheline strips in kalsilite host phase, ×188; d) magnification of CCA exsolved nepheline strips, ×470.

phases that are consistent with the Ks/Ne ratio found in the bulk analysis in its relationship with the solvus of the Ks-Ne system (Tuttle and Smith 1958). The chemical compositions of the Ne and Ks phases in the CCA microperthites show the same consistency; a few of them however seem to be inconsistent with what would be expected from the bulk composition.

With reference to the last case, note that: (1) the above-mentioned bulk composition refers to the mean composition of the microperthites present in the ejected block and not to the bulk composition of the single crystals in which the exsolved phases have been analysed; (2) in the non-equilibrium cooling process, with reference to the Ks-Ne diagram, zoned crystals with a large compositional variation could originate at temperatures corresponding to the $L+O_1$ stability field. During further cooling, the outer sodium rich zones would cross the solvus near the top and give rise to exsolved domains displaying compositions apparently not consistent with the Ks/Ne ratio of the bulk analysis. In contrast, the prevailing inner potassium rich areas would cross the solvus limb in its lower part and in this case the composition of the resulting domains would not be in conflict with the bulk analysis. The sodium map supports this hypothesis in that, as can be seen in Fig. 3, the sodium distribution is far from being homogeneous; (3) the a_o lattice parameter determined indicates a disordered structure for all kalsilites examined. Dollase and Freeborn (1977) have pointed out that a positionally disordered oxygen atom arrangement occurs in a disordered kalsilite, produced from nepheline by alkali exchange and attributed to a domain structure.

In summary, the analyses of the Ne and Ks exsolved phases indicate that the various blocks examined had different thermal histories as would be expected from ejecta representing fragments of subvolcanic bodies.

As for the process according to which the exsolution takes place, recent studies on kinetics and the mechanism of exsolution in silicates are pertinent (Yund and McCallister 1970). In the case of alkali feldspars, Christie (1968) has recognized a spinodal model of decomposition of albite and K-feldspar.

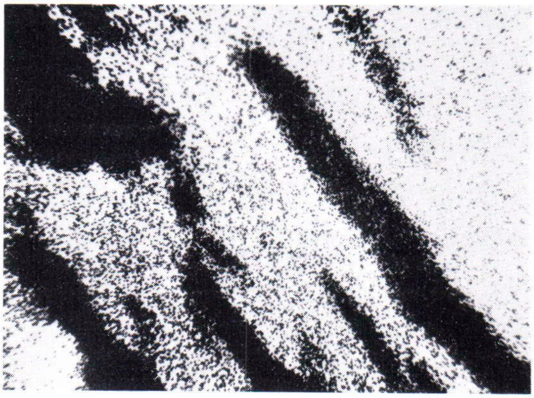

Fig. 3. X-ray Na K_α map of CCA microperthite showing domains with different sodium content, ×1000.

For the exsolution of kalsilite from a nepheline host phase, Yund et al. (1972) have assumed a continous mechanism of classical nucleation. In the opinion of the authors, whether in this case a spinodal decomposition replaces classical nucleation it has still to be solved.

The above exsolution reaction was studied considering compositions on the Ne—Ks join from 65.0 to 42.6 Mol % Ne. An extension of the study to the compositions richest in kalsilite would be of great interest to verify to what extent the proposed model is also valid for the exsolution of nepheline from a Ks host phase.

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