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The bound interlayer H₂O content of potassic white micas: Muscovite-
hydromuscovite-hydrophyrophyllite solutions

Robert R. Loucks

For deposit: Appendices I & II

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**The Bound Interlayer Water Content of
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APPENDIX I

White mica chemical analyses utilized that meet the selection criteria 1-8 described in the text. Sums include minor constituents listed in footnotes. The listed stoichiometric proportions of H_3O^+ and H_2O° in interlayer sites are those predicted by Model 3, not calculated from the *measured* wt% $\text{H}_2\text{O}(+)$ values that appear in the upper half of this table and as the ordinate variable in Fig. 2. X_{HYD} = interlayer site mole fraction of H_3O^+ predicted by Models 2 and 3. X_{PYRO} = interlayer site mole fraction of vacancies (Model 2) or neutral water molecules (Model 3). These Model values of interlayer H_3O^+ and H_2O° or vacancies were combined with hydroxyls as the basis of *calculated* wt% $\text{H}_2\text{O}(+)$ values that are not listed here but are plotted as the abscissa variable in Fig. 2B and C.

<u>Table Entry</u>	<u>Data Source</u>
1 - 2	Brammall et al. (1937) Table V, analyses A and B.
3 - 15	Butler (1967) Table 3, analyses 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.
16 - 20	Ernst (1963) Table 1, analyses 6, 7, 9, 12, 13.
21 - 42	Foster (1964) Table 3, analyses 7, 16, 22, 23, 25, 29, 32, 33, 37, 38, 43, 44, 46, 49, 50, 53, 55, 56, 57, 59, 60, 65.
43	Fronzel (1970) Table 1, analysis 1.
44 - 45	Hower and Mowatt (1966) Table 2, "Interlake Na ₂ CO ₃ " and "Interlake 0.3-0.5".
46 - 49	Hunziker et al. (1986) Table 3, analyses 12, 14, 18, 19, all recalculated to correct for mineral impurities (6.5-12.5% quartz, 4.1-5.8% hematite, and 0-2% chlorite, in the proportions given by the authors).
50 - 54	Kodama and Brydon (1968) Table 1, size fractions (microns) <20, 20-10, 5-2, 2-1, 1-0.2.
55 - 56	Mackenzie et al. (1949) Table III, analyses 1c and 2c.
57 - 59	Neiva (1975) Table VII, samples P-XI, A-VIII, A-XI.
60 - 65	Nemec (1980) Table 1, analyses 2, 3, 4, 6, 11, 14.
66 - 68	Sudo (1978) Table 1.10, samples YO-01, MU-01, SS.
69 - 71	Weaver and Pollard (1973) Table XI, analysis 1; Table II, analyses 2 & 5
72	Wise and Eugster (1964) Table 1, analysis 16.

wt%	1	2	3	4	5	6	7
SiO ₂	46.54	48.39	47.60	46.78	47.28	46.45	47.08
TiO ₂	0.17	0.11	0.88	0.97	0.97	0.84	0.75
Al ₂ O ₃	36.37	34.64	26.02	29.48	30.28	30.70	29.41
Fe ₂ O ₃	0.72	1.15	4.86	3.85	1.52	2.02	2.93
FeO	0.36	0.27	3.16	2.01	2.78	2.73	1.90
MnO	0.00	0.00	0.00	0.05	0.05	0.04	0.05
MgO	0.50	0.44	2.00	1.15	1.78	1.78	1.99
CaO	0.14	0.18	0.21	0.09	0.28	0.12	0.24
Na ₂ O	0.46	0.22	0.25	0.25	0.53	0.29	0.44
K ₂ O	8.06	7.82	10.43	10.79	9.95	10.61	10.74
Li ₂ O	0.00	0.00	-	-	-	-	-
F	0.02	0.06	0.00	0.00	0.00	0.00	0.00
H ₂ O(+)	6.31	6.07	4.53	4.34	4.38	4.48	4.40
H ₂ O(-)	0.52	0.44	0.00	0.02	0.07	0.00	0.06
TOTAL*	100.11	99.76	100.25 ^a	100.09 ^b	100.19 ^c	100.30 ^d	100.23 ^e
<i>atomic</i>							
Si	3.065	3.189	3.250	3.168	3.172	3.131	3.181
Ti	0.008	0.006	0.045	0.049	0.049	0.043	0.038
Al	2.823	2.691	2.094	2.353	2.395	2.439	2.342
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.036	0.057	0.250	0.196	0.077	0.103	0.149
Fe ²⁺	0.020	0.015	0.180	0.114	0.156	0.154	0.107
Mg	0.049	0.043	0.204	0.116	0.178	0.179	0.200
Mn	0.000	0.000	0.000	0.003	0.003	0.002	0.003
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.010	0.011	0.015	0.007	0.020	0.009	0.017
Ba	0.000	0.000	0.005	0.005	0.007	0.005	0.005
Na	0.056	0.028	0.033	0.033	0.069	0.038	0.058
K	0.677	0.657	0.909	0.932	0.852	0.912	0.926
Rb	0.000	0.000	0.005	0.005	0.003	0.003	0.002
Li	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F	0.004	0.013	0.000	0.000	0.000	0.000	0.000
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.000	6.000	6.023	6.000	6.030	6.050	6.021
X _{PYRO}	0.014	0.148	0.000	0.000	0.000	0.000	0.000
X _{HYD}	0.240	0.156	0.033	0.018	0.050	0.034	0.000

<i>wt%</i>	8	9	10	11	12	13	14
SiO ₂	46.78	46.55	48.32	46.98	47.34	45.85	46.19
TiO ₂	0.94	1.02	0.91	1.00	0.53	0.89	0.83
Al ₂ O ₃	28.86	33.01	29.73	31.58	31.01	34.36	32.83
Fe ₂ O ₃	4.44	1.53	2.56	2.36	2.16	1.02	1.48
FeO	1.67	1.03	2.15	1.14	2.15	0.96	1.26
MnO	0.04	0.00	0.03	0.04	0.04	tr	0.03
MgO	2.27	1.45	1.41	1.33	1.81	1.03	1.42
CaO	0.00	0.22	0.00	0.10	0.07	0.00	0.15
Na ₂ O	0.45	0.55	0.49	0.44	0.34	1.16	0.73
K ₂ O	10.44	9.93	10.32	10.52	10.55	9.05	10.23
Li ₂ O	-	-	-	-	-	-	-
F	0.00	0.00	0.00	0.00	0.00	0.00	tr
H ₂ O(+)	4.00	4.55	4.00	4.29	4.06	5.25	4.51
H ₂ O(-)	0.02	0.01	0.01	0.03	0.04	0.00	0.05
TOTAL*	100.13 ^r	100.20 ^s	100.24 ^h	100.13 ⁱ	100.32 ^j	99.90 ^k	99.99 ^l

atomic

Si	3.152	3.095	3.225	3.143	3.159	3.060	3.096
Ti	0.048	0.051	0.046	0.050	0.027	0.045	0.042
Al	2.292	2.587	2.339	2.490	2.439	2.703	2.593
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.225	0.077	0.129	0.119	0.109	0.051	0.075
Fe ²⁺	0.094	0.057	0.120	0.064	0.120	0.054	0.071
Mg	0.228	0.144	0.140	0.133	0.180	0.103	0.142
Mn	0.002	0.000	0.002	0.002	0.002	0.000	0.002
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.000	0.016	0.000	0.007	0.005	0.000	0.011
Ba	0.004	0.008	0.005	0.006	0.004	0.008	0.006
Na	0.059	0.071	0.063	0.057	0.044	0.150	0.095
K	0.897	0.842	0.879	0.898	0.898	0.771	0.875
Rb	0.003	0.003	0.005	0.004	0.003	0.002	0.002
Li	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.040	6.011	6.000	6.000	6.036	6.015	6.020
X _{PYRO}	0.000	0.000	0.014	0.007	0.000	0.000	0.000
X _{HYD}	0.037	0.061	0.034	0.021	0.046	0.070	0.012

<i>wt%</i>	15	16	17	18	19	20	21
SiO ₂	47.08	50.60	48.30	50.45	45.74	45.55	43.65
TiO ₂	0.97	0.51	0.20	0.12	0.31	0.26	0.14
Al ₂ O ₃	31.10	25.19	25.36	25.77	33.52	36.89	32.54
Fe ₂ O ₃	2.12	2.06	4.42	0.99	2.65	0.39	2.62
FeO	1.69	0.76	0.20	1.60	1.58	0.86	1.63
MnO	0.02	tr	0.38	0.05	0.06	0.02	0.00
MgO	1.65	5.54	3.96	5.02	0.76	0.58	1.06
CaO	0.00	0.07	0.10	0.29	0.08	0.04	0.00
Na ₂ O	0.26	0.93	0.50	0.56	0.67	0.80	1.05
K ₂ O	10.77	9.36	9.26	10.11	10.44	10.17	8.92
Li ₂ O	-	0.00	0.13	0.01	0.01	0.01	0.46
F	0.00	0.06	0.00	0.00	0.00	0.04	1.00
H ₂ O(+)	4.51	4.42	4.96	4.29	4.54	4.59	3.85
H ₂ O(-)	0.04	0.32	0.07	0.09	0.12	0.03	2.48
TOTAL*	100.44 ^m	99.80	99.75	99.70	100.48	100.25	99.51 ⁿ
<i>atomic</i>							
Si	3.150	3.367	3.297	3.377	3.063	3.012	3.018
Ti	0.049	0.026	0.010	0.006	0.016	0.013	0.007
Al	2.453	1.976	2.040	2.033	2.646	2.875	2.652
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.107	0.103	0.227	0.050	0.134	0.019	0.136
Fe ²⁺	0.095	0.042	0.011	0.090	0.089	0.048	0.094
Mg	0.165	0.550	0.403	0.501	0.076	0.057	0.109
Mn	0.001	0.000	0.022	0.003	0.003	0.001	0.000
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.000	0.005	0.007	0.021	0.006	0.003	0.000
Ba	0.006	0.000	0.051	0.008	0.000	0.001	0.000
Na	0.034	0.120	0.066	0.073	0.087	0.103	0.141
K	0.919	0.795	0.807	0.863	0.892	0.858	0.787
Rb	0.002	0.000	0.000	0.000	0.000	0.000	0.024
Li	0.000	0.000	0.036	0.003	0.003	0.003	0.128
F	0.000	0.013	0.000	0.000	0.000	0.008	0.219
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.019	6.063	6.047	6.061	6.029	6.027	6.144
X _{PYRO}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X _{HYD}	0.040	0.080	0.070	0.035	0.015	0.036	0.049

wt%	22	23	24	25	26	27	28
SiO ₂	44.73	44.85	44.87	45.03	45.12	45.18	45.24
TiO ₂	0.34	0.04	0.02	0.02	0.51	0.15	0.01
Al ₂ O ₃	30.67	37.20	37.72	36.33	34.19	35.76	36.85
Fe ₂ O ₃	3.42	0.40	0.54	0.14	0.85	0.00	0.09
FeO	1.42	0.45	0.00	0.02	0.64	1.52	0.02
MnO	0.02	0.02	tr	0.41	0.02	0.11	0.12
MgO	1.56	tr	0.32	0.05	0.92	0.07	0.08
CaO	0.00	0.22	0.36	0.09	0.12	0.00	0.00
Na ₂ O	0.53	1.10	1.04	0.69	1.21	0.88	0.64
K ₂ O	10.18	10.20	9.83	10.50	10.33	9.95	10.08
Li ₂ O	0.00	0.07	tr	0.41	tr	0.73	0.49
F	0.02	0.79	0.00	1.01	0.05	0.88	0.91
H ₂ O(+)	5.17	4.36	4.72	4.56	5.05	4.48	4.12
H ₂ O(-)	1.43	0.60	0.38	0.79	1.57	0.38	0.46
TOTAL*	100.22 ^o	99.97	100.24 ^p	100.48 ^q	100.32	100.29 ^r	99.86 ^s
<i>atomic</i>							
Si	3.095	3.002	2.979	3.030	3.069	3.027	3.027
Ti	0.018	0.002	0.001	0.001	0.026	0.008	0.001
Al	2.501	2.935	2.951	2.881	2.740	2.824	2.906
Cr	0.000	0.000	0.019	0.000	0.000	0.000	0.000
Fe ³⁺	0.178	0.020	0.027	0.007	0.044	0.000	0.005
Fe ²⁺	0.082	0.025	0.000	0.001	0.036	0.085	0.001
Mg	0.161	0.000	0.032	0.005	0.093	0.007	0.008
Mn	0.001	0.001	0.000	0.023	0.001	0.006	0.007
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.000	0.016	0.026	0.007	0.009	0.000	0.000
Ba	0.018	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.071	0.142	0.134	0.090	0.094	0.114	0.083
K	0.899	0.871	0.833	0.901	0.986	0.851	0.860
Rb	0.000	0.000	0.000	0.037	0.000	0.025	0.049
Li	0.000	0.019	0.000	0.111	0.000	0.197	0.132
F	0.004	0.167	0.000	0.215	0.011	0.187	0.193
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.034	6.005	6.009	6.060	6.009	6.153	6.085
X _{PYRO}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X _{HYD}	0.012	0.000	0.008	0.000	0.001	0.010	0.008

<i>wt%</i>	29	30	31	32	33	34	35
SiO ₂	45.54	45.60	46.10	46.17	46.55	45.50	45.66
TiO ₂	0.07	0.03	0.29	0.00	0.36	0.20	0.31
Al ₂ O ₃	36.36	35.96	34.28	35.57	36.97	33.20	31.80
Fe ₂ O ₃	0.25	0.10	0.51	0.15	0.74	1.03	2.69
FeO	0.02	0.02	1.57	0.08	0.10	1.41	1.53
MnO	0.80	0.37	0.00	0.04	0.00	0.04	0.00
MgO	0.07	0.05	1.25	0.00	0.15	0.96	0.92
CaO	0.09	0.08	0.18	0.00	0.00	0.09	0.15
Na ₂ O	0.57	0.59	0.19	1.31	1.90	0.60	1.03
K ₂ O	10.76	10.52	9.98	10.37	8.33	10.49	10.43
Li ₂ O	0.06	0.63	0.00	0.76	0.00	0.00	0.00
F	0.62	1.31	0.00	0.76	0.06	0.18	0.37
H ₂ O(+)	4.35	4.81	4.58	4.06	4.28	5.37	5.32
H ₂ O(-)	0.55	0.44	1.32	0.12	0.06	1.10	0.36
TOTAL*	99.85	99.96	100.25	99.72 ^t	99.76 ^u	100.12	99.83
<i>atomic</i>							
Si	3.051	3.057	3.081	3.086	3.059	3.106	3.119
Ti	0.004	0.002	0.015	0.000	0.018	0.010	0.016
Al	2.871	2.841	2.701	2.802	2.864	2.671	2.560
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.013	0.005	0.026	0.008	0.034	0.053	0.138
Fe ²⁺	0.001	0.001	0.088	0.005	0.006	0.081	0.087
Mg	0.007	0.005	0.125	0.000	0.015	0.098	0.094
Mn	0.045	0.021	0.000	0.002	0.000	0.002	0.000
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.007	0.006	0.013	0.000	0.000	0.000	0.007
Ba	0.000	0.000	0.000	0.000	0.005	0.001	0.000
Na	0.074	0.077	0.025	0.073	0.242	0.069	0.080
K	0.920	0.900	0.851	0.884	0.698	0.914	0.901
Rb	0.000	0.000	0.000	0.056	0.000	0.000	0.000
Li	0.016	0.170	0.000	0.204	0.000	0.000	0.000
F	0.131	0.278	0.000	0.161	0.013	0.039	0.080
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.008	6.101	6.035	6.107	5.998	6.021	6.013
X _{PYRO}	0.000	0.000	0.000	0.000	0.055	0.000	0.000
X _{HYD}	0.000	0.018	0.112	0.000	0.000	0.017	0.013

<i>wt%</i>	36	37	38	39	40	41	42
SiO ₂	46.24	46.30	46.34	46.35	46.80	47.00	47.64
TiO ₂	0.10	0.00	0.06	0.28	0.01	tr	0.00
Al ₂ O ₃	32.37	33.08	32.47	29.69	35.84	30.60	34.22
Fe ₂ O ₃	1.34	0.00	0.00	0.23	0.00	0.26	0.10
FeO	1.14	1.20	1.06	0.85	0.24	0.41	0.00
MnO	0.09	0.28	0.35	0.01	0.00	2.04	0.05
MgO	0.19	0.14	0.00	1.93	0.56	0.13	0.28
CaO	0.10	0.00	0.36	tr	0.29	tr	0.00
Na ₂ O	0.79	0.63	0.50	0.78	0.60	0.77	0.47
K ₂ O	10.16	10.09	9.46	10.53	10.08	9.52	10.40
Li ₂ O	1.10	1.80	2.45	0.00	0.00	2.70	1.10
F	1.41	2.06	2.82	0.04	0.00	4.09	1.21
H ₂ O(+)	3.41	3.06	3.32	4.69	5.05	2.18	3.62
H ₂ O(-)	0.69	0.34	0.32	0.12	0.64	0.25	0.10
TOTAL*	100.04 ^v	99.89 ^w	100.02 ^x	100.29 ^y	100.11	100.34 ^z	99.78 ^{aa}
<i>atomic</i>							
Si	3.126	3.110	3.110	3.139	3.114	3.161	3.155
Ti	0.005	0.000	0.003	0.014	0.001	0.000	0.000
Al	2.579	2.619	2.568	2.369	2.810	2.426	2.671
Cr	0.000	0.000	0.000	0.246	0.000	0.000	0.000
Fe ³⁺	0.068	0.000	0.000	0.012	0.000	0.013	0.005
Fe ²⁺	0.065	0.067	0.060	0.048	0.013	0.023	0.000
Mg	0.019	0.014	0.000	0.195	0.056	0.013	0.028
Mn	0.005	0.016	0.020	0.001	0.000	0.116	0.003
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.007	0.000	0.026	0.000	0.021	0.000	0.000
Ba	0.000	0.000	0.000	0.004	0.000	0.000	0.000
Na	0.104	0.082	0.065	0.102	0.077	0.100	0.060
K	0.876	0.865	0.810	0.910	0.856	0.817	0.879
Rb	0.062	0.071	0.070	0.000	0.000	0.089	0.036
Li	0.299	0.486	0.661	0.000	-	0.730	0.293
F	0.302	0.438	0.599	0.009	0.000	0.870	0.253
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.166	6.314	6.422	6.024	5.994	6.482	6.154
X _{PYRO}	0.000	0.000	0.000	0.000	0.066	0.000	0.000
X _{HYD}	0.000	0.000	0.029	0.000	0.000	0.000	0.025

<i>wt%</i>	43	44	45	46	47	48	49
SiO ₂	47.56	51.1	50.0	51.66	49.76	48.85	52.18
TiO ₂	0.05	0.79	1.31	0.00	0.00	0.00	0.00
Al ₂ O ₃	32.09	28.2	28.1	28.46	30.52	30.27	28.33
Fe ₂ O ₃	1.04	0.54	0.79	0.62	3.22	2.18	1.81
FeO	2.46	0.91	0.89	0.13	0.58	1.03	0.33
MnO	0.06	-	-	0.00	0.02	0.00	0.00
MgO	1.06	2.7	2.7	2.77	0.94	2.05	2.17
CaO	0.04	0.06	0.05	0.12	0.07	0.04	0.04
Na ₂ O	0.31	0.14	0.17	0.35	1.05	0.50	0.61
K ₂ O	10.14	8.91	9.04	8.76	7.17	8.66	8.58
Li ₂ O	0.12	-	-	-	-	-	-
F	1.37	-	-	-	-	-	-
H ₂ O(+)	3.86	6.0	6.3	5.76	5.07	5.15	4.90
H ₂ O(-)	0.14	0.8	0.7	1.38	1.48	0.49	0.81
TOTAL*	99.90^{bb}	100.15	100.05	100.00**	100.00**	100.00**	100.00**
<i>atomic</i>							
Si	3.179	3.402	3.353	3.448	3.315	3.254	3.447
Ti	0.003	0.040	0.066	0.000	0.000	0.000	0.000
Al	2.528	2.212	2.221	2.239	2.397	2.376	2.224
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.052	0.027	0.040	0.031	0.161	0.109	0.018
Fe ²⁺	0.138	0.051	0.050	0.007	0.032	0.057	0.090
Mg	0.106	0.268	0.270	0.276	0.093	0.204	0.214
Mn	0.003	0.000	0.000	0.000	0.001	0.000	0.000
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.003	0.004	0.004	0.009	0.005	0.003	0.003
Ba	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.040	0.018	0.022	0.045	0.136	0.065	0.078
K	0.865	0.757	0.773	0.746	0.609	0.736	0.723
Rb	0.006	0.000	0.000	0.000	0.000	0.000	0.000
Li	0.032	-	-	0.000	0.000	0.000	0.000
F	0.290	0.000	0.000	0.000	0.000	0.000	0.000
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.041	6.000	6.000	6.000	6.000	6.000	5.993
X _{PYRO}	0.000	0.127	0.103	0.173	0.194	0.000	0.218
X _{HYD}	0.085	0.094	0.098	0.027	0.057	0.197	0.000

<i>wt%</i>	50	51	52	53	54	55	56
SiO ₂	46.69	46.21	46.27	46.37	46.79	51.26	50.36
TiO ₂	0.07	0.10	0.04	0.05	0.10	0.05	0.07
Al ₂ O ₃	36.30	37.05	36.71	36.62	35.90	30.15	30.26
Fe ₂ O ₃	1.16	1.19	1.35	1.41	1.23	2.36	2.36
FeO	0.01	0.01	0.01	0.01	0.00	0.59	0.72
MnO	0.00	0.00	0.00	0.00	0.01	0.04	0.05
MgO	0.37	0.24	0.45	0.43	0.39	1.37	1.56
CaO	0.03	0.01	0.02	0.03	0.03	nil	nil
Na ₂ O	0.43	0.51	0.50	0.47	0.45	0.13	0.38
K ₂ O	10.03	9.92	10.16	9.9	9.12	7.77	7.87
Li ₂ O	-	-	-	-	-	-	-
F	-	-	-	-	-	-	-
H ₂ O(+)	4.78	4.71	4.74	4.78	5.80	6.28	6.37
H ₂ O(-)	nil	nil	0.03	0.05	-	nil	nil
TOTAL*	99.87	99.50	100.28	100.12	99.82	100.00**	100.00**
<i>atomic</i>							
Si	3.080	3.040	3.042	3.048	3.096	3.373	3.327
Ti	0.004	0.005	0.002	0.003	0.005	0.003	0.004
Al	2.822	2.872	2.845	2.837	2.780	2.338	2.356
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.058	0.059	0.067	0.070	0.061	0.117	0.117
Fe ²⁺	0.001	0.001	0.001	0.001	0.000	0.033	0.040
Mg	0.036	0.024	0.044	0.042	0.039	0.134	0.154
Mn	0.000	0.000	0.000	0.000	0.001	0.002	0.003
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.002	0.001	0.001	0.002	0.002	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.055	0.065	0.064	0.060	0.057	0.017	0.050
K	0.844	0.833	0.852	0.830	0.769	0.652	0.663
Rb	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Li	-	-	-	-	0.000	0.000	0.000
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.000	6.000	6.000	6.000	6.000	6.000	6.000
X _{PYRO}	0.049	0.021	0.001	0.010	0.064	0.207	0.134
X _{HYD}	0.050	0.081	0.082	0.098	0.109	0.125	0.154

<i>wt%</i>	57	58	59	60	61	62	63
SiO ₂	45.53	44.83	44.65	47.38	47.55	47.64	47.92
TiO ₂	0.16	0.03	0.39	0.79	0.77	0.60	0.70
Al ₂ O ₃	33.16	34.50	33.42	30.19	29.73	30.01	32.13
Fe ₂ O ₃	2.42	0.88	1.24	1.4	2.42	1.74	0.99
FeO	1.63	2.20	1.45	2.86	3.25	3.25	1.39
MnO	0.10	0.15	0.08	0.09	0.12	0.14	0.02
MgO	1.01	1.64	2.36	0.62	0.88	0.61	1.03
CaO	0.09	0.00	0.41	0.18	0.32	0.15	0.32
Na ₂ O	0.40	0.48	0.48	0.46	0.46	0.48	0.70
K ₂ O	10.19	10.61	10.65	10.60	9.96	10.60	10.00
Li ₂ O	0.10	0.26	0.12	0.00	0.00	0.00	0.00
F	0.68	0.13	0.19	1.50	2.65	1.68	0.78
H ₂ O(+)	4.97	4.27	4.59	3.89	3.23	3.48	4.06
H ₂ O(-)	0.00	0.05	0.00	0.33	0.28	0.23	0.41
TOTAL*	100.22 ^{cc}	100.08 ^{dd}	100.00 ^{ee}	99.66	100.50	99.90	100.12
<i>atomic</i>							
Si	3.066	3.005	3.010	3.223	3.204	3.228	3.196
Ti	0.008	0.002	0.020	0.040	0.039	0.031	0.035
Al	2.632	2.725	2.656	2.421	2.361	2.397	2.526
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.123	0.044	0.063	0.072	0.123	0.089	0.050
Fe ²⁺	0.092	0.123	0.082	0.162	0.183	0.184	0.078
Mg	0.101	0.164	0.237	0.063	0.088	0.062	0.102
Mn	0.006	0.009	0.005	0.005	0.007	0.008	0.001
Zn	0.001	0.003	0.001	0.000	0.000	0.000	0.000
Ca	0.007	0.000	0.030	0.013	0.023	0.011	0.023
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.052	0.062	0.063	0.061	0.060	0.063	0.091
K	0.876	0.907	0.916	0.920	0.856	0.916	0.851
Rb	0.010	0.010	0.004	0.000	0.000	0.000	0.000
Li	0.028	0.070	0.033	0.000	0.000	0.000	0.000
F	0.145	0.028	0.041	0.323	0.565	0.360	0.165
Cl	0.009	0.016	0.008	0.000	0.000	0.000	0.000
OCTTET	6.057	6.144	6.106	5.987	6.004	5.998	5.988
X _{PYRO}	0.000	0.000	0.000	0.006	0.000	0.010	0.036
X _{HYD}	0.056	0.021	0.000	0.000	0.061	0.000	0.000

<i>wt%</i>	64	65	66	67	68	69	70
SiO ₂	45.40	47.70	47.65	47.17	48.44	53.12	50.72
TiO ₂	0.16	0.97	0.10	0.00	tr	0.00	0.45
Al ₂ O ₃	34.38	34.30	37.03	38.04	33.84	27.36	25.84
Fe ₂ O ₃	1.32	0.96	0.01	0.17	0.49	2.64	4.57
FeO	1.88	0.35	tr	-	-	1.06	1.21
MnO	0.11	0.03	tr	n.d.	tr	-	
MgO	0.16	0.58	0.04	0.28	0.95	2.62	2.65
CaO	0.09	0.17	tr	0.36	0.11	0.53	0.15
Na ₂ O	0.66	1.25	0.76	0.25	0.50	0.49	0.17
K ₂ O	9.44	9.02	9.02	6.75	9.40	3.51	6.14
Li ₂ O	0.39	-	-	-	-	-	-
F	1.25	0.05	-	-	-	-	-
H ₂ O(+)	4.32	4.53	4.97	6.22	5.42	8.60	8.28
H ₂ O(-)	0.42	0.29	0.73	0.36	0.60	0.00	0.21
TOTAL*	99.46	100.18	100.31	99.60***	99.75***	99.93	100.39
<i>atomic</i>							
Si	3.055	3.144	3.127	3.058	3.224	3.459	3.385
Ti	0.008	0.048	0.005	0.000	0.000	0.000	0.023
Al	2.727	2.664	2.864	2.907	2.655	2.100	2.032
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe ³⁺	0.067	0.048	0.001	0.008	0.025	0.129	0.230
Fe ²⁺	0.106	0.019	0.000	0.000	0.000	0.058	0.068
Mg	0.016	0.057	0.004	0.027	0.094	0.254	0.264
Mn	0.006	0.002	0.000	0.000	0.000	0.000	0.000
Zn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.007	0.012	0.000	0.025	0.008	0.037	0.011
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.086	0.160	0.097	0.031	0.065	0.062	0.022
K	0.810	0.758	0.755	0.558	0.798	0.292	0.523
Rb	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Li	0.106	0.000	-	-	-	0.000	0.000
F	0.266	0.010	0.000	0.000	0.000	0.000	0.000
Cl	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCTTET	6.091	5.981	6.000	6.000	5.997	6.000	6.000
X _{PYRO}	0.000	0.070	0.128	0.056	0.130	0.184	0.087
X _{HYD}	0.097	0.000	0.020	0.329	0.000	0.426	0.358

<i>wt%</i>	71	72
SiO ₂	51.64	56.02
TiO ₂	0.44	0.43
Al ₂ O ₃	25.29	17.83
Fe ₂ O ₃	4.32	1.14
FeO	0.72	2.79
MnO	-	0.03
MgO	2.9	5.21
CaO	0.11	0.52
Na ₂ O	0.19	0.00
K ₂ O	6.31	9.17
Li ₂ O	-	0.00
F	-	-
H ₂ O(+)	7.70	5.03
H ₂ O(-)	0.30	1.51
TOTAL	99.92	99.68

atomic

Si	3.445	3.803
Ti	0.022	0.022
Al	1.988	1.427
Cr	0.000	0.000
Fe ³⁺	0.217	0.058
Fe ²⁺	0.040	0.158
Mg	0.288	0.527
Mn	0.000	0.002
Zn	0.000	0.000
Ca	0.008	0.038
Ba	0.000	0.000
Na	0.025	0.000
K	0.537	0.794
Rb	0.000	0.000
Li	0.000	-
F	0.000	0.000
Cl	0.000	0.000
OCTTET	6.000	5.998
X _{PYRO}	0.146	0.168
X _{HYD}	0.285	0.000

FOOTNOTES

*Total corrected for F + Cl = O

**Normalized total after correction for contaminants

***total iron as Fe₂O₃

Analyses include:

- a 0.20% BaO and 0.11% Rb₂O
- b 0.20% BaO and 0.11% Rb₂O
- c 0.26% BaO and 0.07% Rb₂O
- d 0.17% BaO and 0.07% Rb₂O
- e 0.20% BaO and 0.04% Rb₂O
- f 0.16% BaO and 0.06% Rb₂O
- g 0.29% BaO and 0.06% Rb₂O
- h 0.20% BaO and 0.11% Rb₂O
- i 0.23% BaO and 0.09% Rb₂O
- j 0.16% BaO and 0.06% Rb₂O
- k 0.29% BaO and 0.04% Rb₂O
- l 0.23% BaO and 0.05% Rb₂O
- m 0.22% BaO and 0.04% Rb₂O
- n 0.53% Rb₂O
- o 0.66% BaO and 0.02% V₂O₃
- p 0.27% Cr₂O₃ and 0.09% V₂O₃
- q 0.79% Rb₂O and 0.06% Cs₂O
- r 0.57% Rb₂O
- s 0.93% Rb₂O and 0.20% Cs₂O
- t 1.10% Rb₂O and 0.30% Cs₂O
- u 0.19% BaO
- v 1.3% Rb₂O and 0.2% Cs₂O
- w 1.37% Rb₂O and 0.41% Cs₂O
- x 1.5% Rb₂O and 0.2% Cs₂O
- y 4.60% Cr₂O₃ and 0.15% BaO
- z 1.93% Rb₂O and 0.18% Cs₂O
- aa 0.35% Rb₂O and 0.75% Cs₂O
- bb 0.05% BaO, 0.12% Rb₂O, 0.01% Cs₂O
- cc 0.08% Cl
- dd 0.14% Cl
- ee 0.07% Cl

APPENDIX II

Computer program in BASIC for calculating structural formulas and water contents of white micas according to Models 2 or 3.

```
10 REM THE NAME OF THIS PROGRAM IS MUSCOV.BAS
20 INPUT "LABEL=";LAB$
30 INPUT "WT% SI02=";SI
40 INPUT "WT% TIO2=";TI
50 INPUT "WT% AL2O3=";AL
60 INPUT "WT% CR2O3=";CR
70 INPUT "WT% FE2O3=";FE3
80 INPUT "WT% FEO=";FE2
90 INPUT "WT% MGO=";MG
100 INPUT "WT% MNO=";MN
110 INPUT "WT% ZNO=";ZN
120 INPUT "WT% CAO=";CA
130 INPUT "WT% BAO=";BA
140 INPUT "WT% NA2O=";NA
150 INPUT "WT% K2O=";KK
160 INPUT "WT% RB2O=";RB
165 INPUT "WT% LI2O=";LI
170 INPUT "WT% F=";F
180 INPUT "WT%CL=";CL
190 SI1=SI/60.084
200 TI1=TI/79.899
210 AL1=AL/50.9805
220 CR1=CR/75.987
230 FE31=FE3/79.846
240 FE21=FE2/71.85
250 MG1=MG/40.304
260 MN1=MN/70.937
270 ZN1=ZN/81.379
280 CA1=CA/56.079
290 BA1=BA/153.33
300 NA1=NA/30.9895
310 K1=KK/47.098
320 RB1=RB/93.47
325 LI1=LI/14.941
330 F1=F/18.9984
340 CL1=CL/35.453
350 YY=1
360 K=1
370 C=1
```

```

380 SUM=SI1+TI1+AL1+CR1+FE31+FE21+MG1+MN1+ZN1+(LI1/2)
390 AA=(6/SUM)
400 NSI=SI1*AA*K
402 NTI=TI1*AA*K
404 NAL=AL1*AA*K
406 NCR=CR1*AA*K
408 NFE3=FE31*AA*K
410 NFE2=FE21*AA*K
412 NMG=MG1*AA*K
414 NMN=MN1*AA*K
416 NZN=ZN1*AA*K
418 NCA=CA1*AA*K
420 NBA=BA1*AA*K
422 NNA=NA1*AA*K
424 NK=K1*AA*K
426 NRB=RB1*AA*K
428 NLI=LI1*AA*K
430 NF=F1*AA*K
432 NCL=CL1*AA*K
440 NFE3=FE31*AA*K
450 IF C<3 GOTO 550
455 NSI=NSI*K
458 NTI=NTI*K
460 NAL=NAL*K
462 NCR=NCR*K
464 NFE3=NFE3*K
466 NFE2=NFE2*K
468 NMG=NMG*K
470 NMN=NMN*K
472 NZN=NZN*K
474 NCA=NCA*K
476 NBA=NBA*K
478 NNA=NNA*K
480 NK=NK*K
482 NRB=NRB*K
484 NLI=NLI*K
486 NF=NF*K
488 NCL=NCL*K
550 IF NLI=0! GOTO 560
552 IF YY>4 GOTO 560
554 AA=(6+NLI/2)/SUM
556 YY=YY+1
558 GOTO 400
560 IVAC=NBA+NCA+NSI+NTI-NFE2-NMG-NMN-NZN-NLI-3
570 IF IVAC >=0! GOTO 590
580 IVAC=0
590 SMI=NK+NNA+NRB+NCA+NBA+IVAC
620 IF SMI<=1! THEN NH30=1-SMI ELSE NH30=0!
630 CHG=4*(NSI+NTI)+3*(NFE3+NAL+NCR)+2*(NFE2+NMG+NMN+NZN+NBA+NCA)
640 CHG=CHG+NK+NNA+NRB+NH30+NLI
642 DIFF=CHG-22
645 OCTTET=NFE2+NFE3+NMG+NMN+NZN+NCR+NAL+NSI+NTI+NLI
650 IF DIFF <=.005 AND DIFF >=-.005 GOTO 735

```

```

651 IF C>20 GOTO 700
654 IF C>10 GOTO 685
660 I=(DIFF)/((CHG-2*NBA-2*NCA+NLI)/OCTTET)
665 K=(OCTTET-I)/OCTTET
670 C=C+1
680 IF C<3 GOTO 400 ELSE GOTO 455
685 SUMION=OCTTET+NK+NNA+NRB+NCA+NBA
687 I=DIFF/(CHG/SUMION)
688 K=((SUMION-I)/SUMION)+K)/2
690 C=C+1
695 IF C<21 GOTO 455
700 LPRINT
710 LPRINT
715 SMI=NK+NNA+NRB+NCA+NBA
730 LPRINT USING "    SMI=##.#### ";SMI
735 NOH=2-NF-NCL
740 OCTTET=NFE2+NFE3+NMG+NMN+NZN+NCR+NAL+NSI+NTI+NLI
750 FERIC=NFE3/(NFE3+NFE2)
770 WTOXS=.5*(NF+NCL)*15.994*SI/(60.084*NSI)
780 WTH2O=18.0153*(1.5*NH3O+.5*NOH)*(SI)/(60.084*NSI)
790 NH2O=(WTH2O/18.0153)*AA*K
800 NEWSUM=WTH2O+SI+TI+AL+CR+FE3+FE2+MG+MN+ZN+BA+NA+KK+F+CL+CA+RB-WTOXS+LI
820 SUM2=NCR+NFE3-NFE2-NMG-NMN-NZN+NTI
830 IF SUM2 > 0 GOTO 870
840 XFECLD=NFE3
850 XFEMUS=0
860 GOTO 890
870 XFECLD=NFE2+NMG+NMN+NZN-NTI-NCR
880 XFEMUS=.5*(NFE3-XFECLD)
890 XALCLD=NMG+NMN+NZN+NFE2-NTI-XFECLD-NCR
900 XCRCLD=NCR
905 XPLITH=NLI/2
910 XRBMUS=NRB
920 XCELAD=XFECLD+XALCLD+XCRCLD
930 XMUSC=NK-NTI-XFEMUS-XCELAD-XPLITH
940 XBAM=NBA
950 XPYRO=IVAC
960 XPARA=NNA
970 XMARG=NCA
980 XHYD=NH3O
985 INTCAT=NH3O+NK+NNA+NRB+NCA+NBA
987 NH2O=NH2O+IVAC
989 WTH2O=WTH2O+(18.0153*IVAC*SI)/(60.084*NSI)
990 REM PRINT OUT ALL DATA
1000 LPRINT LAB$
1010 LPRINT USING "WT% SIO2=##.## ";SI,
1020 LPRINT USING "WT% TIO2=##.## ";TI,
1030 LPRINT USING "WT% AL2O3=##.## ";AL,
1040 LPRINT USING "WT% CR2O3=##.## ";CR,
1050 LPRINT USING "WT% FE2O3=##.##";FE3
1060 LPRINT USING "WT% FEO=##.## ";FE2,
1070 LPRINT USING "WT% MGO=##.## ";MG,
1080 LPRINT USING "WT% MNO=##.## ";MN,
1090 LPRINT USING "WT% ZNO=##.## ";ZN,
1100 LPRINT USING "WT% CAO=##.## ";CA
1110 LPRINT USING "WT% BAO=##.## ";BA,

```

```

1120 LPRINT USING "WT% NA2O=##.## ";NA,
1130 LPRINT USING "WT% K2O=##.## ";KK,
1140 LPRINT USING "WT% Rb2O=##.## ";RB,
1145 LPRINT USING "WT% LI2O=#.## ";LI
1150 LPRINT USING "WT% F=##.## ";F,
1160 LPRINT USING "WT% CL=##.## ";CL
1170 LPRINT
1180 LPRINT USING "WT% O XS=##.## ";WTOXS,
1190 LPRINT USING "WT% H2O=##.## ";WTH2O
1200 LPRINT USING "NEW TOTAL=###.### ";NEWSUM
1210 LPRINT
1220 LPRINT USING "n SI=#.#### ";NSI,
1230 LPRINT USING "n TI=#.#### ";NTI,
1240 LPRINT USING "n AL=#.#### ";NAL,
1250 LPRINT USING "n CR=#.#### ";NCR,
1260 LPRINT USING "n Fe2=#.#### ";NFE2
1270 LPRINT USING "n Fe3=#.#### ";NFE3,
1280 LPRINT USING "n MG=#.#### ";NMG,
1290 LPRINT USING "n MN=#.#### ";NMN,
1300 LPRINT USING "n ZN=#.#### ";NZN,
1310 LPRINT USING "n CA=#.#### ";NCA
1320 LPRINT USING "n BA=#.#### ";NBA,
1330 LPRINT USING "n NA=#.#### ";NNA,
1340 LPRINT USING "n K=#.#### ";NK,
1350 LPRINT USING "n Rb=#.#### ";NRB,
1355 LPRINT USING "n LI=#.#### ";NLI
1360 LPRINT USING "n F=#.#### ";NF,
1370 LPRINT USING "n CL=#.#### ";NCL,
1372 LPRINT USING "n OH=#.#### ";NOH,
1374 LPRINT USING "n H3O=#.#### ";NH3O,
1380 LPRINT USING "n H2O=#.#### ";NH2O
1390 LPRINT
1400 LPRINT USING "X FECLD=#.#### ";XFECLD,
1410 LPRINT USING "X FEMUS=#.#### ";XFEMUS,
1420 LPRINT USING "X ALCLD=#.#### ";XALCLD
1430 LPRINT USING "X CRCLD=#.#### ";XCRCLD,
1440 LPRINT USING "X CELAD=#.#### ";XCELAD,
1450 LPRINT USING "X MUSC=#.#### ";XMUSC,
1455 LPRINT USING "X RBMUS=#.#### ";XRBMUS,
1460 LPRINT USING "X BAM=#.#### ";XBAM
1470 LPRINT USING "X PYRO=#.#### ";XPYRO,
1480 LPRINT USING "X PARA=#.#### ";XPARA,
1490 LPRINT USING "X MARG=#.#### ";XMARG,
1500 LPRINT USING "X HYD=#.#### ";XHYD,
1505 LPRINT USING "X PLITH=#.#### ";XPLITH
1510 LPRINT USING "SUM INTCAT=#.#### ";INTCAT,
1530 LPRINT USING "OCT + TET=###.#### ";OCTTET,
1535 LPRINT USING "CHG=##.#### ";CHG
1540 LPRINT USING "nFe3/(nFe3 + nFe2) =###.##### ";FERIC
1545 LPRINT USING "C=## ";C,
1547 LPRINT USING " IVAC =#.#### ";IVAC,
1548 LPRINT USING "AA=##.#### ";AA,
1549 LPRINT USING "K=##.#### ";K
1550 LPRINT
1553 LPRINT
1556 LPRINT
1560 LPRINT
1570 END

```