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Title of article Mineralogy and Geothermobarometry of Magmatic Epidote-bearing Dikes, Front Range, Colorado

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Table A1. Whole rock major element and REE chemistry

Dike	58	6	41	26	57	60	32	15	5	83
SiO_2	64.32	64.44	64.68	66.51	67.93	68.12	68.43	69.32	69.43	69.80
TiO_2	0.53	0.45	0.45	0.30	0.32	0.21	0.25	0.21	0.31	0.17
Al_2O_3	16.76	16.34	16.21	16.59	16.25	15.88	15.73	15.89	14.27	15.64
Fe_2O_3	1.99	2.07	1.87	1.25	1.36	1.31	1.02	0.78	0.72	0.53
FeO	3.21	2.25	2.35	1.73	1.79	0.74	1.61	1.33	1.74	1.06
MnO	0.09	0.09	0.10	0.10	0.09	0.04	0.11	0.05	0.09	0.05
MgO	1.82	1.34	1.34	0.78	0.88	0.49	0.64	0.63	0.85	0.25
CaO	4.98	4.04	3.96	3.47	3.79	3.14	3.25	2.71	2.38	2.24
Na_2O	2.86	3.97	4.02	3.65	3.22	4.41	3.30	2.88	3.51	4.78
K_2O	3.10	2.49	2.71	3.19	2.77	2.68	3.35	3.69	3.71	3.55
BaO	0.13	0.12	0.12	0.14	0.14	0.16	0.14	0.11	0.19	0.16
SrO	0.08	0.09	0.09	0.10	0.10	0.09	0.09	0.10	0.08	0.09
P_2O_5	0.32	0.20	*n.d.*	0.23	0.23	0.18	0.22	0.21	0.16	0.12
LOI	1.08	1.86	1.92	1.93	1.74	2.23	1.36	1.81	1.64	1.22
Total	101.27	99.75	99.82	99.97	100.61	99.68	99.50	99.72	99.08	99.66
REE (ppm)										
La	35	18	*n.d.*	31	34	10	29	22	22	6.1
Ce	67	37		53	62	18.1	52	39	42	11
Nd	31	16		25	29	9.9	23	18	19	5.5
Sm	5.9	3.2		4.2	5.1	1.5	4.1	3.6	3.3	0.93
Eu	1.6	0.94		1.2	1.4	0.52	1.1	1.1	0.94	0.32
Gd	4.8	2.4		3.4	3.7	0.90	3.1	2.7	2.3	0.80
Dy	4.9	2.4		2.6	3.2	0.84	2.9	1.6	1.7	0.69
Yb	3.0	1.4		1.3	1.5	0.56	1.5	0.60	0.62	0.58
Lu	0.46	0.22		0.19	0.23	0.08	0.22	0.08	0.08	0.09
CIPW norm										
Q	21.72	20.89	20.03	24.28	28.99	25.26	28.25	31.59	27.87	22.97
or	18.32	14.72	16.02	18.85	16.37	15.84	19.80	21.81	21.93	20.98
ab	24.20	33.59	34.02	30.89	27.25	37.32	27.92	24.37	29.70	40.45
an	22.62	18.74	18.18	15.71	17.30	14.40	14.69	12.07	10.76	10.33
C	0.41	0.25	0.00	1.37	1.61	0.45	1.29	2.73	0.54	0.15
di	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hy	8.08	5.18	5.46	3.78	3.99	1.22	3.50	3.11	4.37	1.94
mt	2.89	3.00	2.71	1.81	1.97	1.90	1.48	1.13	1.04	0.77
il	1.01	0.85	0.85	0.57	0.61	0.40	0.47	0.40	0.59	0.32
ap	0.74	0.46	*n.d.*	0.53	0.53	0.42	0.51	0.49	0.37	0.28

Note: Analyses by ICP atomic emission spectrometry, FeO by titrimetric method. Uncertainty (2 sigma deviation in oxide values 1-2% relative, except K_2O < 1%, P_2O_5 5%, LOI 5%, REE 5% when > 1.2 ppm, otherwise 10%; *n.d.* = not determined.

B

Table 3. Representative epidote analyses

Dike	**5**	**83**	**60**	**1**	**32**	**26**	**45**	**20**	**53**	**57**	**31**	**1**	**32**	**83**
Type	I	I	I	I	II	II	II	II	III	III	III	2nd b	2nd b	2nd b
SiO_2	37.84	37.92	37.87	38.14	36.85	35.92	36.54	35.97	37.94	37.96	37.75	37.62	37.52	37.35
TiO_2	0.20	0.19	0.38	0.18	0.13	0.12	0.14	0.13	0.14	0.13	0.16	0.65	0.65	0.75
Al_2O_3	25.45	24.61	25.69	25.21	23.55	21.66	23.42	22.74	25.07	24.74	25.25	21.04	21.24	22.13
Fe_2O_3	10.50	11.36	10.09	10.62	11.03	11.43	10.70	10.41	10.59	10.71	10.75	15.21	15.21	14.55
MnO	0.37	0.42	0.36	0.41	0.34	0.57	0.39	0.22	0.37	0.26	0.31	0.20	0.20	0.21
MgO	0.09	0.10	0.16	0.10	0.38	0.75	0.40	0.95	0.13	0.11	0.10	0.02	0.02	0.01
CaO	23.12	22.84	22.62	22.88	21.04	19.54	20.65	17.99	23.03	23.40	23.19	22.99	22.99	22.94
La_2O_3	0.05	0.08	0.10	0.02	1.15	2.71	1.32	2.74	0.06	0.09	0.01	0.07	0.08	0.05
Ce_2O_3	0.07	0.15	0.18	0.04	2.60	3.54	3.05	4.49	0.12	0.15	0.01	0.15	0.15	0.10
Nd_2O_3	0.04	0.07	0.09	0.02	1.07	1.71	1.10	2.24	0.06	0.10	0.01	0.08	0.07	0.06
Sm_2O_3	0.01	0.02	0.06	0.00	0.25	0.37	0.22	0.52	0.02	0.02	0.00	0.05	0.02	0.02
ThO_2	0.06	0.01	0.05	0.03	0.09	0.10	0.07	0.09	0.09	0.08	0.06	0.02	0.01	0.01
F	0.11	0.09	0.11	0.10	0.08	0.09	0.11	0.07	0.09	0.11	0.10	0.08	0.09	0.06
Cl	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.03	0.01
H_2O	1.84	1.84	1.84	1.84	1.80	1.75	1.78	1.77	1.84	1.83	1.84	1.82	1.82	1.84
Total	99.76	99.71	99.61	99.60	100.36	100.26	99.89	100.34	99.56	99.69	99.55	100.01	100.10	100.09
-O=F,Cl	99.71	99.67	99.56	99.56	100.33	100.22	99.84	100.30	99.52	99.65	99.51	99.98	100.06	100.07
Si	2.99	3.01	3.00	3.02	2.99	2.99	2.99	2.99	3.01	3.01	2.99	3.02	3.01	2.99
Ti	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.05
Al	2.37	2.30	2.40	2.35	2.25	2.12	2.26	2.23	2.34	2.31	2.36	1.99	2.01	2.09
Fe^{3+}	0.62	0.67	0.59	0.63	0.56	0.53	0.53	0.42	0.63	0.63	0.64	0.91	0.91	0.87
Fe^{2+*}	0.00	0.01	0.01	0.00	0.11	0.19	0.13	0.23	0.01	0.01	0.00	0.01	0.01	0.01
Mn	0.02	0.03	0.02	0.03	0.02	0.04	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Mg	0.01	0.01	0.02	0.01	0.05	0.09	0.05	0.12	0.02	0.01	0.01	0.00	0.00	0.00
Ca	1.96	1.94	1.92	1.94	1.83	1.74	1.81	1.60	1.96	1.99	1.97	1.98	1.98	1.97
La	0.001	0.002	0.002	0.000	0.026	0.062	0.030	0.063	0.001	0.002	0.000	0.002	0.002	0.001
Ce	0.002	0.003	0.004	0.001	0.058	0.081	0.069	0.103	0.003	0.003	0.000	0.003	0.003	0.002
Nd	0.001	0.001	0.002	0.000	0.023	0.038	0.024	0.050	0.001	0.002	0.000	0.002	0.002	0.001
Sm	0.000	0.000	0.001	0.000	0.005	0.008	0.005	0.011	0.000	0.000	0.000	0.001	0.000	0.000
Th	0.001	0.000	0.001	0.001	0.002	0.002	0.001	0.002	0.002	0.001	0.001	0.000	0.000	0.000
F	0.028	0.023	0.028	0.025	0.021	0.024	0.028	0.018	0.023	0.028	0.025	0.020	0.023	0.015
Cl	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.004	0.001
OH	0.971	0.976	0.971	0.974	0.979	0.975	0.972	0.980	0.976	0.972	0.974	0.978	0.973	0.983
M	3.05	3.03	3.06	3.03	3.00	2.98	3.00	3.02	3.03	2.99	3.04	2.97	2.99	3.02
A	1.96	1.95	1.93	1.94	1.94	1.93	1.94	1.83	1.96	2.00	1.97	1.99	1.99	1.97
Ps	20.86	22.77	20.05	21.20	23.03	25.21	22.59	22.62	21.25	21.66	21.38	31.59	31.38	29.57

Note: Normalized to 12.5 oxygens. Fe^{2+*}: Fe^{2+} calculated assuming coupled substitution with LREE for Fe^{3+}.

Abbreviations: 2nd b = epidote replacing biotite; M = M site cation total; A = A site cation total; Ps = pistacite content

$[Fe^{3+}/ (Fe^{3+} + Al)]$. REE minimum detection levels (oxide wt. %): La 0.06, Ce 0.05, Nd 0.05, Sm 0.02.

C

Table 4. Average Mica Analyses

Dike	20	60	32	5	1	20
Mica Type	musc igneous	musc repl. pl	musc repl. bt	musc repl. ep	bt igneous	bt igneous
SiO_2	44.46	45.22	46.93	47.09	35.60	35.72
TiO_2	0.70	0.04	0.34	0.28	2.83	2.66
Al_2O_3	32.96	37.81	28.88	27.44	16.09	18.09
FeO*	4.75	0.51	5.43	8.48	21.63	20.27
MnO	0.02	0.00	0.01	0.04	0.42	0.19
MgO	1.34	0.07	2.61	0.95	8.68	8.20
CaO	0.15	0.60	0.27	0.05	0.02	0.01
Na_2O	0.52	0.37	0.21	0.24	0.14	0.24
K_2O	10.07	10.84	10.57	10.80	9.63	9.77
BaO	0.62	0.42	0.14	0.03	0.49	n.d.
F	0.09	0.06	0.10	0.10	0.59	0.60
Cl	0.01	0.00	0.01	0.05	0.07	0.10
H_2O#	4.35	4.49	4.37	4.27	3.54	3.59
Total	100.28	100.26	99.88	99.90	99.73	99.94
-O=F,Cl	100.24	100.23	99.83	99.85	99.47	99.67
Si	3.05	3.00	3.20	3.27	2.78	2.75
Ti	0.08	0.01	0.04	0.02	0.17	0.15
Al	2.65	2.95	2.32	2.24	1.48	1.67
Fe^{3+}**	---	---	---	---	0.33	0.30
Fe^{2+}	0.27	0.03	0.31	0.49	0.98	0.90
Mn	0.00	0.00	0.00	0.00	0.03	0.01
Mg	0.13	0.01	0.27	0.10	1.01	0.96
Ca	0.01	0.04	0.02	0.00	0.00	0.00
Na	0.07	0.05	0.03	0.03	0.02	0.04
K	0.88	0.92	0.92	0.95	0.96	0.96
Ba	0.02	0.01	0.00	0.00	0.02	0.00
F	0.02	0.01	0.02	0.02	0.14	0.15
Cl	0.00	0.00	0.00	0.01	0.01	0.01
OH#	1.98	1.99	1.98	1.97	1.85	1.84

Note: Formulas based on 11 oxygens. Abbreviations: repl. = replacing; musc = muscovite; other mineral abbreviations given in Table 2.

*All Fe as FeO.
#Assumes (OH + F + Cl) = 2.00.
**Fe^{3+} in biotite based on wet chemical analysis.

Table 5(a). Average Garnet Analyses: Igneous Garnet Cores

Dike	5	15	20	26	32	58
n	24	8	10	30	10	10
SiO_2	37.92	38.01	38.30	37.87	37.47	37.81
TiO_2	0.28	0.12	0.18	0.35	0.23	0.22
Al_2O_3	20.45	20.90	20.91	20.21	20.26	20.43
FeO	25.66	28.24	27.48	24.04	24.62	25.49
MnO	3.44	1.86	1.14	4.71	5.66	4.30
MgO	3.53	5.14	5.98	2.51	2.79	4.08
CaO	8.70	5.74	5.90	10.32	8.84	7.77
Total	99.99	100.01	99.90	100.01	99.86	100.09
Si	3.01	3.00	3.00	3.01	3.00	3.00
Ti	0.02	0.01	0.01	0.02	0.01	0.01
Al	1.90	1.93	1.93	1.89	1.89	1.89
Fe^{3+}	0.08	0.06	0.06	0.09	0.09	0.09
Fe^{2+}	1.62	1.79	1.73	1.51	1.54	1.58
Mn	0.23	0.12	0.08	0.32	0.38	0.29
Mg	0.42	0.60	0.70	0.30	0.33	0.48
Ca	0.74	0.48	0.49	0.88	0.75	0.65
X_{gro}	0.213	0.134	0.138	0.257	0.210	0.177
X_{and}	0.031	0.026	0.026	0.033	0.039	0.040
X_{spe}	0.074	0.041	0.025	0.105	0.126	0.095
X_{alm}	0.543	0.599	0.579	0.506	0.516	0.529
X_{pyr}	0.138	0.200	0.231	0.098	0.109	0.158
Mg#	0.20	0.24	0.28	0.16	0.17	0.22

Note: Formulas based on 12 oxygens; Fe3+ calculated from stoichiometry. Abbreviations: n = number of analyses; X = mole fraction of subscripted end-member component; gro = grossular; and = andradite; spe = spessartine; alm = almandine; pyr = pyrope; Mg# = $Mg/(Mg + Fe^{2+})$.

Table 5(b). Average Garnet Analyses: Xenocryst Garnet Cores

Dike	6	10	41	60	83	41px*
n	12	10	11	6	10	16
SiO_2	39.17	39.11	39.01	39.56	39.09	39.04
TiO_2	0.02	0.02	0.02	0.04	0.02	0.02
Al_2O_3	21.70	21.58	21.62	21.89	21.80	21.68
FeO	26.99	27.27	27.28	25.93	26.44	26.85
MnO	0.44	0.40	0.34	0.29	0.54	0.40
MgO	9.87	10.07	10.14	10.56	10.25	10.46
CaO	1.83	1.59	1.69	1.63	1.67	1.59
Total	100.02	100.04	100.10	99.89	99.80	99.96
Si	3.01	3.00	2.99	3.02	3.00	2.99
Ti	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.96	1.95	1.94	1.98	1.93	1.95
Fe^{3+}	0.04	0.05	0.05	0.01	0.03	0.05
Fe^{2+}	1.69	1.70	1.69	1.65	1.66	1.70
Mn	0.03	0.03	0.02	0.02	0.03	0.03
Mg	1.13	1.15	1.15	1.21	1.17	1.15
Ca	0.15	0.13	0.14	0.13	0.14	0.13
X_{gro}	0.032	0.019	0.020	0.037	0.030	0.017
X_{and}	0.018	0.025	0.026	0.004	0.016	0.026
X_{spe}	0.010	0.009	0.007	0.006	0.012	0.009
X_{alm}	0.565	0.565	0.562	0.548	0.553	0.552
X_{pyr}	0.376	0.383	0.384	0.401	0.389	0.396
Mg#	0.39	0.40	0.40	0.42	0.41	0.41

*Garnet from pelitic xenolith in dike 41.

E

Table 6. Representative Hornblende Analyses

Dike	6	6	32	32	58	58
	core	rim	core	rim	core	rim
SiO_2	41.97	41.02	41.20	39.73	41.38	40.09
TiO_2	1.22	0.87	0.83	1.00	0.96	1.13
Al_2O_3	13.17	14.90	14.61	15.72	13.61	15.70
FeO*	18.32	18.95	19.80	20.02	19.09	19.67
MnO	0.25	0.57	0.54	0.52	0.60	0.58
MgO	9.06	8.65	7.55	7.32	8.77	7.64
CaO	10.95	10.42	10.82	10.92	10.62	10.51
Na_2O	1.85	1.79	1.49	1.44	1.39	1.36
K_2O	0.92	0.92	1.05	1.30	1.39	1.36
F	0.13	0.12	0.11	0.13	0.44	0.20
Cl	0.02	0.01	0.01	0.01	0.03	0.06
OH#	1.90	1.91	1.90	1.89	1.74	1.85
Total	99.76	100.12	99.92	100.01	100.02	100.15
-O=F,Cl	99.70	100.07	99.87	99.94	99.83	100.05
Si	6.34	6.19	6.26	6.06	6.29	6.09
Ti	0.14	0.10	0.09	0.11	0.11	0.13
Al	2.35	2.65	2.62	2.83	2.44	2.81
Fe*	2.32	2.39	2.51	2.55	2.42	2.50
Mn	0.03	0.07	0.07	0.07	0.08	0.07
Mg	2.04	1.95	1.71	1.66	1.99	1.73
Ca	1.77	1.68	1.76	1.78	1.73	1.71
Na	0.54	0.54	0.44	0.43	0.41	0.40
K	0.18	0.18	0.20	0.25	0.13	0.13
F	0.06	0.06	0.05	0.06	0.21	0.10
Cl	0.01	0.00	0.00	0.00	0.01	0.02
OH#	1.93	1.94	1.94	1.93	1.78	1.89
Mg#	0.47	0.45	0.40	0.39	0.45	0.41

Formulas based on 23 oxygens.

*All Fe as FeO.

#Assumes (OH + F + Cl) = 2.00.