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Mineral chemistry and thermobarometry of a southern Appalachian amphibolite
with epidote + quartz symplectite

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For deposit: Tables 2,3,5

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Table 2. Representative electron-microprobe analyses of plagioclase

	HRA-1		HRA-3		HRA-4			HRA-5			HRA-7			DMA-5	DMA-6	DMA-11	DMA-12	DMA-13	DMA-16	LC-1		LC-2
	Core	Rim	Core	Rim	Core	Inter.	Rim	Core	Inter.	Rim	Core	Inter.	Rim	Avg(4)	Avg(6)	Avg(3)	Avg(7)	Avg(4)	Avg(8)	Core	Rim	Avg(2)
SiO ₂	57.59	56.50	61.58	57.11	48.84	50.28	47.38	59.56	57.39	54.06	47.77	47.39	46.93	61.68(0.50)	59.94(0.73)	60.37(1.40)	60.31(0.61)	60.57(0.72)	49.79(2.18)	54.69	58.42	52.77(0.72)
Al ₂ O ₃	26.98	27.83	24.65	27.18	33.06	32.53	34.11	26.11	27.49	28.30	33.79	34.19	34.47	24.05(0.47)	24.96(0.57)	23.72(0.45)	24.42(0.30)	25.14(0.51)	31.54(1.30)	28.73	26.62	29.89(0.55)
FeO	0.23	0.20	0.30	0.64	0.28	0.30	0.38	0.22	0.41	0.51	0.29	0.47	0.29	0.45(0.05)	0.28(0.13)	0.27(0.12)	0.39(0.12)	0.40(0.17)	0.40(0.20)	0.39	0.35	0.35(0.03)
MnO	n.d.	n.d.	n.d.	n.d.	n.d.	0.17	0.22	n.d.	0.16	n.d.	0.27	n.d.	n.d.	0.13(0.01)	0.14(0.03)	0.14(0.05)	0.14(0.10)	0.16(0.03)	0.21(0.09)	0.18	0.16	0.14(0.01)
MgO	n.d.	n.d.	n.d.	n.d.	0.13	0.22	0.15	n.d.	n.d.	n.d.	0.19	0.15	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.12(0.05)	n.d.	n.d.	0.07(0.01)
CaO	9.52	10.45	6.83	9.57	16.58	15.78	17.75	7.83	9.52	11.03	17.74	17.75	18.22	5.62(0.58)	6.81(0.61)	5.80(0.16)	7.29(0.42)	6.89(0.33)	15.40(1.70)	11.47	8.67	13.15(0.54)
Na ₂ O	6.07	5.74	7.53	6.26	2.32	2.88	1.65	6.65	5.86	5.45	1.74	1.67	1.34	8.54(0.30)	7.77(0.51)	7.63(0.44)	7.79(0.39)	7.87(0.26)	2.86(0.98)	5.07	6.49	4.06(0.44)
K ₂ O	0.08	0.09	0.12	n.d.	0.07	0.08	n.d.	n.d.	0.10	0.09	n.d.	n.d.	0.07	0.05(0.01)	0.07(0.004)	0.04(0.01)	0.06(0.04)	0.07(0.02)	0.05(0.02)	0.08	0.08	0.09(0.01)
Total	100.47	100.81	101.01	100.76	101.28	102.24	101.64	100.37	100.93	99.44	101.79	101.62	101.32	100.52	99.97	97.97	100.40	101.10	100.37	100.63	100.79	100.52
Cations per 8 oxygens																						
Si	2.571	2.522	2.711	2.550	2.212	2.253	2.148	2.642	2.553	2.461	2.162	2.148	2.130	2.730	2.675	2.734	2.686	2.675	2.271	2.459	2.565	2.385
Al	1.421	1.466	1.280	1.432	1.766	1.719	1.825	1.367	1.443	1.520	1.804	1.828	1.853	1.256	1.314	1.267	1.283	1.310	1.697	1.524	1.428	1.594
Fe	0.008	0.008	0.011	0.024	0.011	0.011	0.014	0.008	0.015	0.019	0.010	0.018	0.011	0.017	0.012	0.010	0.015	0.015	0.015	0.015	0.013	0.013
Mn	n.d.	n.d.	n.d.	n.d.	n.d.	0.007	0.009	n.d.	0.06	n.d.	0.010	n.d.	n.d.	0.005	0.005	0.005	0.005	0.006	0.008	0.007	0.006	0.005
Mg	n.d.	n.d.	n.d.	n.d.	0.009	0.015	0.010	n.d.	n.d.	n.d.	0.013	0.010	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.008	n.d.	n.d.	0.005
Ca	0.455	0.449	0.322	0.458	0.805	0.758	0.863	0.372	0.454	0.538	0.861	0.862	0.890	0.267	0.326	0.282	0.348	0.326	0.753	0.553	0.422	0.637
Na	0.525	0.497	0.643	0.542	0.204	0.250	0.145	0.572	0.506	0.481	0.153	0.147	0.118	0.733	0.673	0.670	0.673	0.674	0.253	0.442	0.572	0.356
K	0.005	0.005	0.007	n.d.	0.004	0.005	n.d.	n.d.	0.006	0.005	n.d.	n.d.	0.004	0.003	0.004	0.002	0.003	0.004	0.003	0.005	0.005	0.005
Sum	4.985	4.997	4.974	5.006	5.011	5.018	5.041	4.961	4.983	5.024	5.013	5.013	5.006	5.011	5.009	4.970	5.013	5.010	5.008	5.005	5.011	5.000
X _{an}	0.46	0.50	0.33	0.46	0.79	0.75	0.86	0.39	0.47	0.53	0.85	0.86	0.88	0.27	0.33	0.30	0.34	0.32	0.75	0.55	0.42	0.64

Note: Analyses in weight percent. n.d. = not detected. Avg = average composition for unzoned crystals from non-symplectite domains with number of analyses next to Avg. 1 S.D. in parentheses. Inter. = intermediate between core and rim.

Table 3. Representative electron-microprobe analyses and structural formulae for amphiboles.

	HRA-1	HRA-3	HRA-4	HRA-5	HRA-7	HRA-8	HRA-9	HRA-10	HRA-11	DMA-1	DMA-2	DMA-3	DMA-4	DMA-5	DMA-6	DMA-11
N	7	6	6	7	6	6	5	5	7	6	6	7	5	5	5	4
SiO ₂	40.90(0.49)	41.82(0.60)	42.20(0.30)	40.82(0.39)	42.05(0.25)	42.42(0.26)	42.09(0.32)	41.46(0.14)	42.21(0.59)	42.00(0.65)	42.38(0.88)	42.07(0.31)	42.52(1.48)	42.12(1.53)	41.75(0.22)	42.10(0.42)
Al ₂ O ₃	15.17(0.75)	14.70(1.00)	14.70(0.80)	14.42(0.15)	14.62(0.27)	15.09(0.69)	14.40(0.35)	14.79(0.22)	12.73(0.57)	11.45(0.87)	12.28(0.26)	12.55(0.62)	11.46(1.46)	11.28(1.14)	12.14(0.35)	12.45(0.59)
FeO	18.55(0.51)	17.81(0.34)	17.22(0.48)	17.65(0.54)	17.52(0.27)	18.04(0.30)	17.48(0.25)	17.18(0.23)	16.21(0.40)	17.57(0.25)	17.82(0.46)	16.30(0.27)	17.17(0.46)	15.81(0.22)	17.40(0.32)	18.03(0.57)
MnO	N.A.	N.A.	0.29(0.05)	0.33(0.05)	0.33(0.04)	0.42(0.02)	0.38(0.04)	0.33(0.06)	0.21(0.09)	0.5(0.13)	0.24(0.02)	0.15(0.02)	0.45(0.07)	0.42(0.02)	0.47(0.06)	0.64(0.10)
MgO	8.02(0.24)	8.82(0.11)	9.13(0.20)	8.38(0.37)	8.91(0.16)	8.91(0.25)	8.39(0.31)	8.81(0.17)	10.33(0.26)	9.5(0.25)	10.47(0.25)	9.98(0.25)	10.09(1.04)	12.09(0.74)	9.61(0.15)	9.36(0.59)
TiO ₂	0.62(0.21)	1.08(0.17)	0.62(0.10)	0.86(0.14)	0.78(0.12)	0.64(0.10)	0.75(0.11)	0.91(0.11)	0.71(0.07)	0.2(0.19)	1.01(0.22)	0.40(0.08)	0.51(0.16)	0.52(0.24)	0.82(0.20)	0.75(0.16)
CaO	11.44(0.21)	11.62(0.51)	11.65(0.21)	11.33(0.25)	11.62(0.11)	11.31(0.12)	11.38(0.12)	11.22(0.18)	12.04(0.15)	12.7(0.26)	11.48(0.31)	11.42(0.22)	12.02(0.12)	11.67(0.22)	11.61(0.11)	11.23(0.22)
Na ₂ O	1.49(0.11)	1.40(0.14)	1.32(0.16)	1.49(0.04)	1.36(0.14)	1.41(0.21)	1.31(0.14)	1.39(0.14)	1.57(0.11)	1.2(0.20)	1.54(0.09)	1.38(0.27)	1.32(0.17)	1.11(0.15)	1.37(0.17)	1.59(0.13)
K ₂ O	0.52(0.05)	0.91(0.04)	0.27(0.05)	0.70(0.05)	0.39(0.05)	0.23(0.04)	0.42(0.02)	0.53(0.05)	0.8(0.07)	0.5(0.06)	0.58(0.07)	0.64(0.09)	1.17(0.18)	0.72(0.29)	0.90(0.10)	0.50(0.05)
Total	96.62	98.16	97.40	95.89	97.50	98.47	95.60	96.60	96.60	96.57	97.25	95.82	96.72	96.57	96.08	96.65
Cations per 20 oxygens																
Si	6.101	6.177	6.216	6.170	6.206	6.187	6.205	6.178	6.440	6.328	6.300	6.332	6.413	6.442	6.314	6.297
⁶³ Al	1.869	1.823	1.784	1.830	1.794	1.823	1.795	1.822	1.540	1.872	1.700	1.668	1.587	1.558	1.686	1.703
⁶⁹ Al	0.813	0.738	0.770	0.741	0.751	0.746	0.770	0.762	0.418	0.508	0.478	0.560	0.451	0.428	0.479	0.430
Fe ³⁺	0.725	0.594	0.772	0.678	0.750	0.790	0.707	0.733	0.447	0.474	0.775	0.647	0.521	0.534	0.681	0.523
Ti	0.070	0.120	0.069	0.098	0.087	0.061	0.085	0.102	0.040	0.016	0.111	0.091	0.058	0.032	0.094	0.059
Mg	1.729	1.942	2.004	1.888	1.959	1.887	1.888	1.957	2.121	2.305	2.107	2.229	2.268	2.410	2.166	2.682
Fe ²⁺	1.590	1.606	1.345	1.553	1.412	1.404	1.501	1.400	1.746	1.945	1.459	1.417	1.644	1.552	1.520	1.267
Mn	-	-	0.036	0.042	0.041	0.053	0.049	0.042	0.018	0.042	0.068	0.046	0.057	0.043	0.06	0.039
Ca	1.837	1.839	1.839	1.835	1.837	1.797	1.841	1.808	1.914	1.914	1.833	1.876	1.944	1.859	1.881	1.800
²³ Na	0.163	0.161	0.161	0.165	0.163	0.203	0.159	0.192	0.016	0.076	0.167	0.124	0.056	0.150	0.199	0.200
²⁴ Na	0.244	0.240	0.215	0.245	0.226	0.205	0.225	0.209	0.210	0.352	0.277	0.278	0.330	0.235	0.283	0.261
K	0.099	0.171	0.051	0.135	0.056	0.053	0.081	0.101	0.111	0.182	0.110	0.125	0.225	0.136	0.174	0.095
A sum	0.343	0.411	0.267	0.380	0.282	0.253	0.306	0.310	0.541	0.574	0.287	0.403	0.555	0.331	0.457	0.256
Total	15.343	15.411	15.267	15.380	15.282	15.359	15.306	15.311	15.541	15.864	15.287	15.403	15.554	15.231	15.457	15.355

Note: Fe³⁺ calculated; see text for method. N = no analysis. N = number of analyses for ungrouped crystals from non-synplectite domains. Value in parentheses represents one standard deviation from the mean.

Table 5. Representative electron-microprobe analyses of garnet

	HRA-5	HRA-8c	HRA-8r	HRA-10c	HRA-10r	HRA-9c	HRA-9r	HRA-16c	HRA-16r	DMA-1x	DMA-2c	DMA-2r	DMA-11
SiO ₂	38.49	38.09	38.01	38.64	38.62	37.87	37.76	38.02	38.23	37.25	37.67	37.74	37.27
Al ₂ O ₃	20.58	20.54	20.33	20.63	20.99	20.07	20.51	20.33	20.57	20.40	20.81	20.33	20.11
FeO	27.47	26.95	27.52	27.60	28.12	26.41	27.09	26.62	26.95	23.25	25.57	23.52	23.11
MnO	1.91	3.58	5.05	2.22	2.33	4.72	4.72	3.98	2.08	1.31	3.86	5.98	8.42
MgO	4.25	3.22	2.90	3.74	4.58	2.71	3.32	2.92	4.14	2.47	2.94	2.33	1.92
TiO ₂	0.07	0.00	0.00	0.18	0.00	0.00	0.12	0.00	0.00	0.00	0.17	0.00	0.44
CaO	7.86	8.56	7.34	8.46	6.57	7.35	6.34	8.31	8.14	14.03	9.46	10.41	8.94
Total	100.63	100.94	101.15	101.47	101.21	99.13	99.86	100.18	100.11	98.71	100.48	100.31	100.21
Cations per 12 oxygen													
Si	3.022	3.006	3.011	3.018	3.015	3.045	3.091	3.024	3.017	2.983	2.982	3.002	2.989
Al	1.906	1.912	1.900	1.901	1.933	1.904	1.881	1.907	1.915	1.927	1.944	1.908	1.902
Fe	1.804	1.779	1.824	1.803	1.836	1.776	1.761	1.771	1.779	1.557	1.693	1.565	1.550
Mn	0.127	0.239	0.339	0.147	0.154	0.322	0.311	0.268	0.139	0.089	0.259	0.403	0.572
Mg	0.479	0.379	0.342	0.435	0.533	0.325	0.385	0.346	0.487	0.295	0.347	0.276	0.229
Ti	0.004	0.00	0.00	0.011	0.00	0.00	0.007	0.00	0.00	0.00	0.010	0.00	0.027
Ca	0.661	0.724	0.623	0.708	0.550	0.633	0.528	0.708	0.689	1.204	0.803	0.888	0.767
X _{Mg}	0.422	0.176	0.158	0.194	0.225	0.155	0.179	0.163	0.215	0.159	0.170	0.150	0.129
a _{Alm}	0.19	0.17	0.19	0.18	0.20	0.19	0.19	0.18	0.17	0.11	0.15	0.12	0.12

Note: c = core; r = rim; a_{Alm} calculated using Hodges and Spear (1982) solution model.