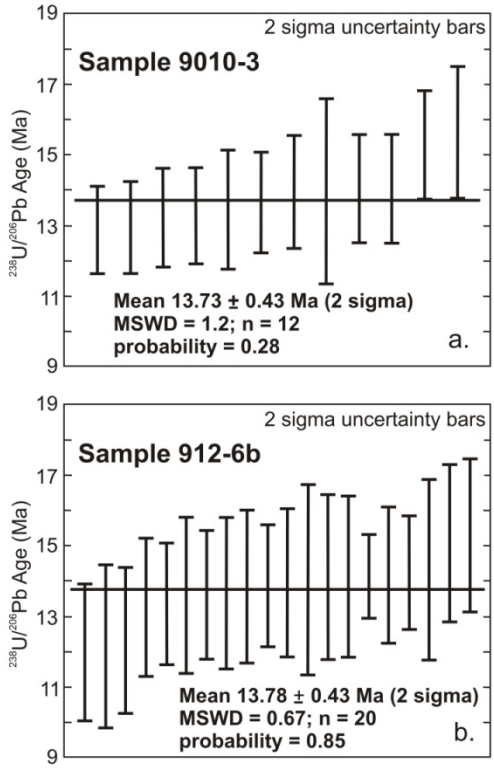

Figure DR1. Secondary ionization mass-spectrometry U-Pb zircon geochronology plots for data collected on two samples of Wilson Ridge plutonic rocks. Data presented in Table DR1.

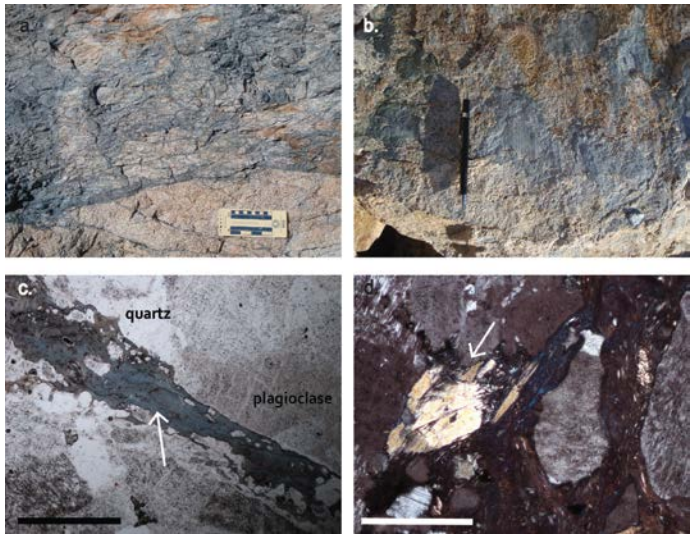

Figure DR2. Altered samples of Miocene Wilson Ridge pluton. (a) Field photo of vein network of $NaFe^{3+}$-amphibole cutting host quartz monzonite (b) Field photo of slickenlines formed in $NaFe^{3+}$-amphibole coating a fault surface. (c) Photomicrograph of vein (arrow) of fibrous $NaFe^{3+}$-amphibole cutting quartz monzonite; fibers are oriented parallel to vein margin (slip-fibers); scale bar is 1 millimeter, plane polarized light. (d) Photomicrograph of primary magmatic hornblende partially altered to fibrous $NaFe^{3+}$-amphibole (arrow); scale bar is 0.5 millimeter, crossed polars.

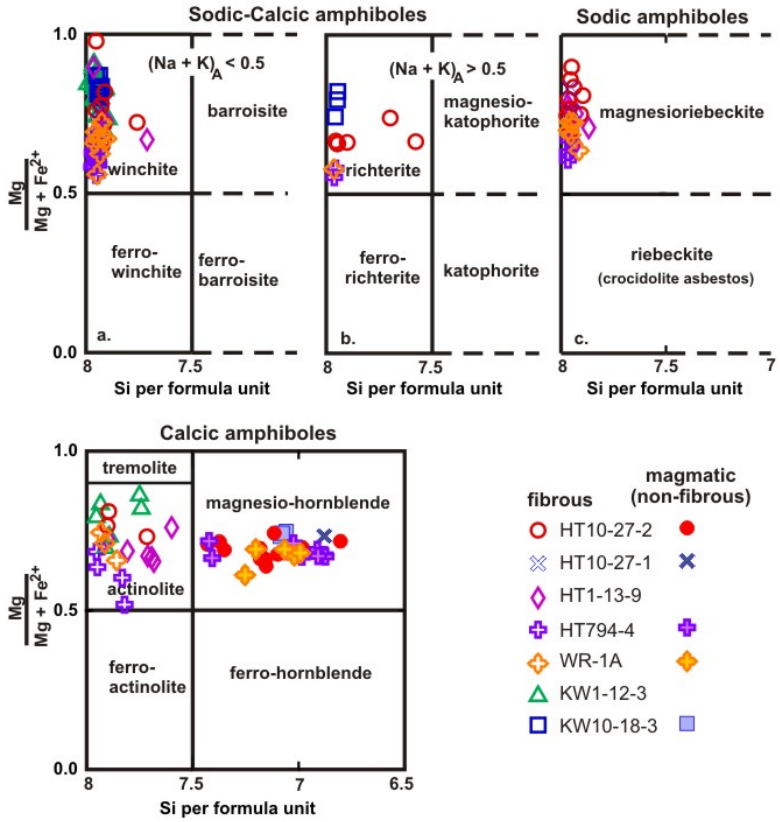

Figure DR3. Classification of amphiboles based on structural formulae calculated from electron microprobe data; classification scheme after Leake et al. (1997). Open symbols have fibrous morphology; closed symbols are primary magmatic amphibole.

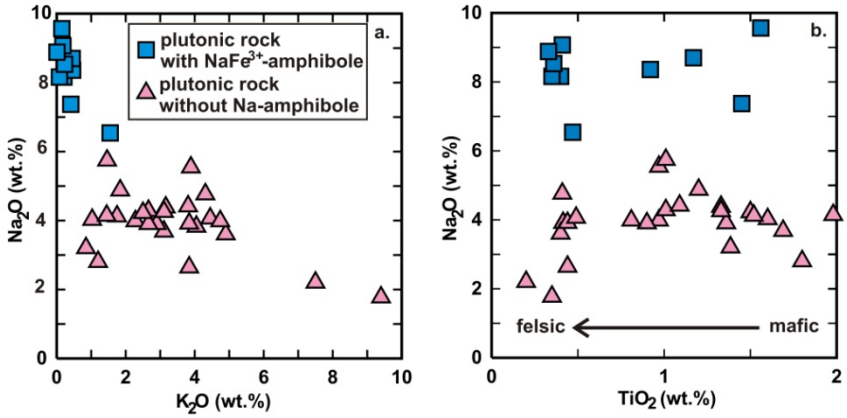

Figure DR4. Comparison of chemical composition of mineralized (Table DR 3) and unmineralized portions (Larsen and Smith, 1991) of the Miocene Wilson Ridge pluton, Arizona USA using whole-rock geochemistry. (a) Mineralized plutonic rocks containing $NaFe^{3+}$-amphibole have elevated Na_2O and depleted K_2O relative to unmineralized pluton. (b) In unaltered Wilson Ridge pluton TiO_2 is negatively correlated with SiO_2, thus TiO_2 serves as a differentiation index. Unmineralized portions of the Wilson Ridge pluton exhibit elevated Na_2O compositions independent of pluton protolith composition.

Table DR1. Zircon ion probe U-Pb geochronology data for samples from Wilson Ridge pluton, Arizona

Sample 9010-3 (35°59.970'N; 114°38.129'W)

Mean age = 13.73±0.43 Ma (2σ), MSWD = 1.2, n = 12

$^{206}Pb/^{238}U$ age (Ma)	age error (1σ)	% Radiogenic ^{206}Pb	$^{206}PB/^{238}U$	1σ error	Pb correction
13.68	0.71	93.78	0.002125	0.00011080	(206/8Pb)
12.90	0.61	93.18	0.002003	0.00009516	(206/8Pb)
14.06	0.76	99.14	0.002184	0.00011820	(206/8Pb)
14.00	1.31	91.89	0.002175	0.00020340	(206/8Pb)
13.47	0.84	95.16	0.002092	0.00012980	(206/8Pb)
14.06	0.77	94.72	0.002183	0.00011990	(206/8Pb)
13.25	0.70	94.03	0.002058	0.00010810	(206/8Pb)
15.67	0.93	101.00	0.002434	0.00014480	(206/8Pb)
13.30	0.68	90.30	0.002066	0.00010550	(206/8Pb)
12.97	0.64	94.46	0.002013	0.00009891	(206/8Pb)
15.30	0.78	100.90	0.002377	0.00012070	(206/8Pb)
13.99	0.79	97.75	0.002173	0.00012330	(206/8Pb)

Sample 912-6B (35°59.452'N; 114°35.484'W)

Mean age = 13.78±0.43 Ma (2σ), MSWD = 0.67, n = 20

$^{206}Pb/^{238}U$ age (Ma)	age error (1σ)	% Radiogenic ^{206}Pb	$^{206}PB/^{238}U$	1σ error	Pb correction
14.16	0.96	94.36	0.002199	0.00014850	(206/8Pb)
13.36	0.86	92.41	0.002074	0.00013310	(206/8Pb)
14.14	0.58	97.43	0.002196	0.00009018	(206/8Pb)
15.31	1.07	94.70	0.002378	0.00016630	(206/8Pb)
11.99	0.96	83.55	0.001861	0.00014970	(206/8Pb)
14.05	1.33	85.85	0.002182	0.00020630	(206/8Pb)
13.85	1.07	91.04	0.002151	0.00016630	(206/8Pb)
12.33	1.03	81.55	0.001915	0.00016080	(206/8Pb)
15.08	1.10	88.53	0.002342	0.00017110	(206/8Pb)
14.33	1.27	89.22	0.002225	0.00019720	(206/8Pb)
13.96	1.04	93.00	0.002168	0.00016110	(206/8Pb)
14.25	0.79	92.38	0.002213	0.00012230	(206/8Pb)
12.16	1.15	83.57	0.001888	0.00017860	(206/8Pb)
11.99	0.96	83.55	0.001861	0.00014970	(206/8Pb)
14.05	1.33	85.85	0.002182	0.00020630	(206/8Pb)
13.85	1.07	91.04	0.002151	0.00016630	(206/8Pb)
12.33	1.03	81.55	0.001915	0.00016080	(206/8Pb)
15.08	1.10	88.53	0.002342	0.00017110	(206/8Pb)
14.33	1.27	89.22	0.002225	0.00019720	(206/8Pb)
13.96	1.04	93.00	0.002168	0.00016110	(206/8Pb)
14.25	0.79	92.38	0.002213	0.00012230	(206/8Pb)
12.16	1.15	83.57	0.001888	0.00017860	(206/8Pb)
13.60	1.10	86.42	0.002113	0.00017120	(206/8Pb)
13.88	0.85	93.72	0.002156	0.00013270	(206/8Pb)
14.13	1.13	68.24	0.002195	0.00017620	(206/8Pb)
14.12	1.15	94.18	0.002193	0.00017850	(206/8Pb)
13.67	1.06	75.07	0.002123	0.00016480	(206/8Pb)
13.61	0.90	91.13	0.002113	0.00013950	(206/8Pb)
13.27	0.97	89.00	0.002060	0.00015120	(206/8Pb)

Table DR2. Representative electron microprobe analyses and structural formulae of fibrous amphiboles from the Wilson Ridge pluton, Arizona.

Sample#	KW1-12-3	KW1-12-3	KW1-12-3	KW1-12-3	KW1-12-3	KW1-12-3	KW1-12-3
Mineral classification	actinolite	winchite	actinolite	winchite	winchite	winchite	winchite
Wt.%							
Na_2O	2.24	3.30	1.973	2.79	2.43	3.02	3.10
K_2O	0.17	0.17	0.281	0.16	0.13	0.12	0.11
CaO	9.36	7.64	10.334	8.63	8.63	7.68	7.06
FeO*	7.94	12.19	7.383	9.86	9.53	10.92	11.26
MgO	19.10	16.61	19.463	18.03	18.38	17.39	16.67
MnO	0.00	0.00	0	0.02	0.05	0.04	0.08
TiO_2	0.00	0.39	0.617	0.43	0.29	0.14	0.16
Al_2O_3	0.49	0.52	1.171	0.44	0.42	0.41	0.34
SiO_2	54.59	54.71	54.096	55.17	56.19	55.99	54.44
F	n.d.	n.d.	0.54	0.73	0.42	0.19	0.27
Cl	n.d.	n.d.	0.00	0.02	0.01	0.02	0.02
Total	**94.49**	**95.54**	**95.32**	**96.29**	**96.50**	**95.91**	**93.51**
Structural Formula based on 23 oxygens							
T-site							
Si	7.750	7.953	7.758	7.953	7.965	7.966	7.970
Al	0.250	0.047	0.242	0.047	0.035	0.034	0.030
T sum	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**
C-site							
Al	0.014	0.042	0.000	0.029	0.035	0.034	0.030
Ti	0.033	0.043	0.067	0.047	0.031	0.014	0.017
Fe^{3+}	0.078	0.241	0.242	0.166	0.452	0.691	0.703
Mg	4.137	3.600	4.161	3.875	3.885	3.689	3.638
Fe^{2+}	0.739	1.074	0.531	0.884	0.598	0.571	0.612
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C sum	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**
B-site							
Mn	0.000	0.000	0.000	0.003	0.007	0.005	0.009
Fe^{2+}	0.145	0.167	0.113	0.139	0.080	0.036	0.064
Ca	1.606	1.191	1.588	1.333	1.311	1.171	1.107
Na	0.248	0.642	0.300	0.525	0.602	0.788	0.819
B sum	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**
A-site							
Na	0.296	0.289	0.249	0.255	0.064	0.046	0.060
K	0.045	0.032	0.051	0.029	0.024	0.021	0.021
A sum	0.341	**0.321**	0.300	**0.284**	**0.088**	**0.067**	**0.081**
Total Cations	**15.341**	**15.321**	**15.300**	**15.284**	**15.088**	**15.067**	**15.081**
Fe^{3+}/(total Fe)	0.08	0.16	0.27	0.14	0.40	0.53	0.51
Mg/(Mg+Fe^{2+})	0.68	0.74	0.70	0.79	0.85	0.86	0.84

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample#	KW1-12-3	KW1-12-3	KW10-18-3	KW10-18-3	KW10-18-3	KW10-18-3	KW10-18-3
Mineral classification	winchite	winchite	richterite	winchite	magnesio-hornblende	winchite	winchite
Wt.%							
Na_2O	2.68	2.60	6.49	5.84	1.43	5.74	5.36
K_2O	0.12	0.15	0.00	0.21	0.47	0.19	0.30
CaO	7.79	8.38	3.26	3.76	11.52	3.71	4.71
FeO*	10.23	10.03	13.21	13.23	12.31	12.24	11.83
MgO	16.93	17.29	16.77	16.00	15.81	16.98	16.69
MnO	0.06	0.01	0.00	0.00	0.64	0.00	0.00
TiO_2	0.22	0.33	0.24	0.28	1.06	0.59	0.00
$Al2O_3$	0.35	0.49	0.58	0.74	5.58	0.81	0.70
SiO_2	54.20	55.90	55.47	54.69	48.77	55.82	55.32
F	0.51	0.44	n.d.	n.d.	n.d.	n.d.	n.d.
Cl	0.02	0.03	n.d.	n.d.	n.d.	n.d.	n.d.
Total	**93.10**	**95.64**	**96.01**	**94.76**	**97.59**	**96.08**	**94.91**
Structural Formula based on 23 oxygens							
T-site							
Si	7.970	7.997	7.951	7.936	7.080	7.932	7.941
Al	0.030	0.003	0.049	0.064	0.920	0.068	0.059
T sum	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**
C-site							
Al	0.030	0.079	0.049	0.064	0.035	0.068	0.059
Ti	0.024	0.036	0.026	0.030	0.116	0.063	0.000
Fe^{3+}	0.651	0.526	0.662	0.766	0.294	0.763	0.903
Mg	3.712	3.688	3.583	3.462	3.422	3.598	3.571
Fe^{2+}	0.582	0.671	0.680	0.678	1.055	0.508	0.467
Mn	0.000	0.000	0.000	0.000	0.078	0.000	0.000
C sum	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**
B-site							
Mn	0.008	0.001	0.000	0.000	0.000	0.000	0.000
Fe^{2+}	0.023	0.003	0.241	0.162	0.144	0.183	0.050
Ca	1.227	1.284	0.500	0.584	1.791	0.564	0.725
Na	0.742	0.712	1.259	1.254	0.065	1.253	1.225
B sum	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**
A-site							
Na	0.021	0.010	0.545	0.390	0.337	0.329	0.268
K	0.022	0.027	0.000	0.038	0.088	0.035	0.055
A sum	**0.043**	**0.037**	**0.545**	**0.428**	**0.425**	**0.364**	**0.322**
Total Cations	**15.043**	**15.037**	**15.545**	**15.428**	**15.425**	**15.364**	**15.322**
Fe^{3+}/(total Fe)	0.52	0.44	0.42	0.48	0.20	0.53	0.64
Mg/(Mg+Fe^{2+})	0.86	0.85	0.80	0.80	0.74	0.84	0.87

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample#	KW10-18-3	KW10-18-3	HT1-13-9	HT1-13-9	HT1-13-9	HT1-13-9	HT1-13-9
Mineral classification	winchite	richterite	magnesio-riebeckite	magnesio-riebeckite	magnesio-riebeckite	magnesio-riebeckite	magnesio-riebeckite
Wt.%							
Na_2O	4.85	6.04	6.29	5.72	6.69	6.17	6.03
K_2O	0.21	0.28	0.35	0.17	0.08	0.07	0.06
CaO	4.72	3.88	1.43	1.57	0.84	1.90	2.63
FeO*	10.85	12.46	20.38	19.76	20.24	19.51	19.25
MgO	18.33	16.87	11.84	10.69	11.18	12.30	11.73
MnO	0.00	0.00	0.13	0.09	0.10	0.08	0.08
TiO_2	0.45	0.00	0.77	0.80	1.13	0.86	0.89
Al_2O_3	0.59	0.60	1.63	1.62	0.56	0.56	0.64
SiO_2	55.36	55.17	55.78	54.40	55.45	55.44	54.89
F	n.d.	n.d.	0.24	0.48	0.48	0.24	0.06
Cl	n.d.	n.d.	0.02	0.01	0.02	0.01	0.01
Total	**95.36**	**95.29**	**98.85**	**95.31**	**96.78**	**97.14**	**96.26**
Structural Formula based on 23 oxygens							
T-site							
Si	7.950	7.949	7.865	8.042	7.953	7.952	7.945
Al	0.050	0.051	0.135	0.000	0.047	0.048	0.055
T sum	**8.000**	**8.000**	**8.000**	**8.042**	**8.000**	**8.000**	**8.000**
C-site							
Al	0.050	0.051	0.135	0.282	0.047	0.048	0.055
Ti	0.049	0.000	0.082	0.089	0.122	0.093	0.096
Fe^{3+}	0.412	0.713	1.374	0.836	1.624	1.261	1.245
Mg	3.923	3.625	2.489	2.356	2.390	2.630	2.530
Fe^{2+}	0.567	0.612	0.905	1.425	0.803	0.958	1.064
Mn	0.000	0.000	0.015	0.011	0.012	0.010	0.009
C sum	**5.000**	**5.000**	**5.000**	**5.000**	**4.999**	**5.000**	**5.000**
B-site							
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe^{2+}	0.325	0.176	0.124	0.182	0.000	0.121	0.021
Ca	0.726	0.599	0.217	0.249	0.129	0.292	0.408
Na	0.949	1.225	1.660	1.569	1.861	1.587	1.571
B sum	**2.000**	**2.000**	**2.000**	**2.000**	**1.990**	**2.000**	**2.000**
A-site							
Na	0.401	0.462	0.059	0.072	0.000	0.128	0.121
K	0.038	0.051	0.062	0.031	0.015	0.013	0.012
A sum	**0.440**	**0.512**	**0.122**	**0.103**	**0.015**	**0.141**	**0.133**
Total Cations	**15.440**	**15.512**	**15.122**	**15.145**	**15.004**	**15.141**	**15.133**
Fe^{3+}/(total Fe)	0.32	0.48	0.57	0.34	0.67	0.54	0.53
Mg/(Mg+Fe^{2+})	0.81	0.82	0.71	0.59	0.75	0.71	0.70

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample#	HT1-13-9	HT1-13-9	HT1-13-9	HT1-13-9	HT10-27-2	HT10-27-2	HT10-27-2
Mineral classification	actinolite	winchite	magnesio-riebeckite	actinolite	magnesio-hornblende	richterite	magnesio-riebeckite
Wt.%							
Na_2O	0.60	3.85	6.44	0.573	1.03	7.06	6.00
K_2O	0.17	0.11	0.06	0	0.58	0.09	0.07
CaO	12.66	7.11	1.94	11.591	12.14	1.55	1.90
FeO*	10.93	15.02	19.23	15.017	14.41	17.87	17.69
MgO	17.20	14.69	12.34	14.466	13.77	13.49	12.75
MnO	0.04	0.08	0.08	0	0.49	0.05	0.04
TiO_2	0.05	0.25	0.47	0	0.94	0.68	0.72
Al_2O_3	2.92	1.13	0.42	1.956	6.14	1.11	0.77
SiO_2	53.65	56.05	56.07	51.667	48.17	53.84	55.31
F	0.12	0.15	0.14	0.14	0.07	0.06	0.21
Cl	0.04	0.02	0.01	0.01	0.04	0.20	0.10
Total	**98.40**	**98.44**	**97.21**	**95.27**	**97.78**	**96.00**	**95.56**
Structural Formula based on 23 oxygens							
T-site							
Si	7.605	7.956	7.965	7.690	7.052	7.904	7.935
Al	0.395	0.044	0.035	0.310	0.948	0.096	0.065
T sum	**8.000**	**8.000**	**8.000**	8.000	**8.000**	**8.000**	**8.000**
C-site							
Al	0.093	0.144	0.035	0.033	0.112	0.096	0.065
Ti	0.006	0.026	0.050	0.000	0.103	0.075	0.078
Fe^{3+}	0.177	0.465	1.539	0.191	0.333	0.685	1.585
Mg	3.636	3.108	2.613	3.210	3.005	2.954	2.727
Fe^{2+}	1.084	1.247	0.745	1.566	1.386	1.185	0.538
Mn	0.005	0.009	0.010	0.000	0.061	0.006	0.005
C sum	**5.000**	**5.000**	**4.992**	**5.000**	**5.000**	**5.000**	**4.998**
B-site							
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe^{2+}	0.036	0.072	0.000	0.112	0.045	0.325	0.000
Ca	1.923	1.081	0.296	1.848	1.903	0.244	0.292
Na	0.041	0.848	1.704	0.040	0.052	1.431	1.668
B sum	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**1.960**
A-site							
Na	0.124	0.210	0.069	0.126	0.240	0.579	0.000
K	0.031	0.020	0.011	0.000	0.108	0.017	0.012
A sum	**0.155**	**0.230**	**0.080**	0.126	**0.348**	**0.597**	**0.012**
Total Cations	**15.155**	**15.230**	**15.072**	**15.1267**	**15.348**	**15.597**	**14.970**
Fe^{3+}/(total Fe)	0.14	0.26	0.67	0.10	0.19	0.31	0.75
Mg/(Mg+Fe^{2+})	0.76	0.70	0.78	0.66	0.68	0.66	0.84

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample#	HT10-27-2	HT10-27-2	HT10-27-2	HT10-27-2	HT10-27-2	HT10-27-2	HT10-27-2
Mineral classification	magnesio-riebeckite	winchite	actinolite	actinolite	winchite	winchite	magnesio-riebeckite
Wt.%							
Na_2O	6.31	4.92	0.50	0.59	3.41	4.42	6.50
K_2O	0.07	0.20	0.14	0.30	0.09	0.12	0.06
CaO	1.99	4.44	12.43	12.00	5.86	5.90	1.68
FeO*	16.42	17.03	9.84	11.71	14.40	14.46	17.53
MgO	14.61	13.79	17.85	16.24	14.98	14.40	13.42
MnO	0.12	0.19	0.10	0.41	0.12	0.16	0.04
TiO_2	0.66	0.51	0.25	0.12	0.54	0.51	0.33
Al_2O_3	0.86	2.37	0.66	2.18	0.76	0.76	0.57
SiO_2	55.47	54.88	55.70	53.72	54.67	55.08	56.04
F	0.51	0.55	0.49	0.26	0.38	0.21	0.54
Cl	0.02	0.01	0.00	0.01	0.04	0.02	0.00
Total	**97.04**	**98.89**	**97.98**	**97.53**	**95.26**	**96.05**	**96.70**
Structural Formula based on 23 oxygens							
T-site							
Si	7.892	7.765	7.912	7.723	7.935	7.935	7.952
Al	0.108	0.235	0.088	0.277	0.065	0.065	0.048
T sum	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**
C-site							
Al	0.037	0.159	0.023	0.093	0.065	0.065	0.048
Ti	0.071	0.054	0.027	0.013	0.059	0.055	0.035
Fe^{3+}	1.220	0.917	0.040	0.157	0.828	0.862	1.611
Mg	3.099	2.909	3.781	3.482	3.240	3.094	2.838
Fe^{2+}	0.559	0.938	1.117	1.206	0.792	0.880	0.464
Mn	0.014	0.023	0.012	0.050	0.015	0.020	0.004
C sum	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**4.975**	**5.000**
B-site							
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe^{2+}	0.175	0.161	0.011	0.044	0.127	0.000	0.005
Ca	0.303	0.673	1.892	1.848	0.912	0.911	0.256
Na	1.522	1.166	0.097	0.108	0.960	1.089	1.739
B sum	**2.000**	**2.000**	**2.000**	**2.000**	**1.999**	**2.000**	**2.000**
A-site							
Na	0.218	0.182	0.042	0.056	0.000	0.144	0.048
K	0.012	0.035	0.025	0.055	0.017	0.023	0.011
A sum	**0.231**	**0.217**	**0.067**	**0.111**	**0.017**	**0.167**	**0.059**
Total Cations	**15.231**	**15.217**	**15.067**	**15.111**	**15.016**	**15.142**	**15.059**
Fe^{3+}/(total Fe)	0.62	0.46	0.03	0.11	0.47	0.50	0.78
Mg/(Mg+Fe^{2+})	0.81	0.73	0.77	0.74	0.78	0.78	0.86

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample#	HT10-27-2	HT10-27-1	HT10-27-1	HT10-27-1	HT10-27-1	HT10-27-1	HT10-27-1
Mineral classification	magnesio-riebeckite	magnesio-hornblende	winchite	winchite	winchite	magnesio-riebeckite	magnesio-riebeckite
Wt.%							
Na_2O	6.91	1.60	5.70	5.92	6.69	6.54	6.55
K_2O	0.07	0.75	0.24	0.00	0.16	0.22	0.12
CaO	1.49	11.37	3.61	1.92	2.02	2.07	2.07
FeO*	18.44	13.21	14.26	17.63	17.79	15.13	17.21
MgO	13.16	14.64	14.65	13.56	13.94	14.47	13.85
MnO	0.03	0.64	0.00	0.00	0.00	0.26	0.00
TiO_2	0.67	1.15	0.80	0.32	0.47	0.36	0.42
Al_2O_3	0.45	6.84	0.67	0.65	0.56	0.54	0.65
SiO_2	56.74	46.88	53.90	53.34	55.66	54.66	55.14
F	0.26	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Cl	0.07	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Total	**98.29**	**97.08**	**93.83**	**93.34**	**97.29**	**94.25**	**96.00**
Structural Formula based on 23 oxygens							
T-site							
Si	8.072	6.880	7.942	7.943	7.953	7.953	7.945
Al	0.000	1.120	0.058	0.057	0.047	0.047	0.055
T sum	**8.072**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**
C-site							
Al	0.076	0.063	0.058	0.057	0.047	0.047	0.055
Ti	0.071	0.127	0.088	0.036	0.050	0.040	0.045
Fe^{3+}	0.851	0.445	0.768	1.010	1.012	1.196	1.123
Mg	2.791	3.204	3.218	3.010	2.970	3.138	2.975
Fe^{2+}	1.206	1.082	0.867	0.887	0.920	0.548	0.802
Mn	0.004	0.079	0.000	0.000	0.000	0.032	0.000
C sum	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**
B-site							
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe^{2+}	0.136	0.094	0.122	0.298	0.193	0.098	0.148
Ca	0.227	1.788	0.569	0.307	0.309	0.323	0.320
Na	1.637	0.118	1.309	1.395	1.498	1.580	1.532
B sum	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**
A-site							
Na	0.268	0.336	0.320	0.313	0.356	0.264	0.297
K	0.012	0.140	0.044	0.000	0.030	0.040	0.021
A sum	**0.280**	**0.476**	**0.364**	**0.313**	**0.385**	**0.305**	**0.318**
Total Cations	**15.352**	**15.476**	**15.364**	**15.313**	**15.385**	**15.305**	**15.318**
Fe^{3+}/(total Fe)	0.39	0.28	0.44	0.46	0.48	0.65	0.54
Mg/(Mg+Fe^{2+})	0.68	0.73	0.77	0.72	0.73	0.83	0.76

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample	HT794-4	HT794-4	HT794-4	HT794-4	HT794-4	HT794-4	HT794-4
Mineral Classification	winchite	richterite	magnesio-riebeckite	magnesio-riebeckite	actinolite	winchite	winchite
Wt%							
Na_2O	4.410	6.602	6.982	6.944	0.629	4.993	3.784
K_2O	0.077	0.065	0.040	0.067	0.226	0.083	0.129
CaO	5.351	2.334	1.297	1.388	12.080	3.800	5.962
FeO*	18.602	21.667	22.292	20.702	13.846	18.769	18.379
MgO	12.745	12.129	11.850	11.675	15.664	12.334	12.867
MnO	0.115	0.061	0.014	0.069	0.517	0.109	0.149
TiO_2	0.319	0.447	0.234	0.396	0.274	0.321	0.236
Al_2O_3	0.617	0.398	0.330	0.369	3.483	0.451	0.526
SiO_2	53.564	54.457	55.415	54.883	51.642	53.269	53.797
F	0.014	0.001	0.015	0.036	0.068	0.034	0.008
Cl	0.493	0.197	0.057	0.000	0.248	0.156	0.049
Total	**96.307**	**98.358**	**98.526**	**96.529**	**98.678**	**94.318**	**95.886**
Structural Formula based on 23 oxygens							
T-site							
Si	7.946	7.966	7.972	7.968	7.420	7.960	7.954
Al	0.054	0.034	0.028	0.032	0.580	0.040	0.046
T Sum	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**
C-site							
Al	0.054	0.034	0.028	0.032	0.010	0.040	0.046
Ti	0.036	0.049	0.025	0.043	0.030	0.036	0.026
Fe^{3+}	0.484	0.514	1.039	1.267	0.332	0.884	0.551
Mg	2.819	2.645	2.541	2.527	3.355	2.748	2.836
Fe^{2+}	1.607	1.758	1.366	1.131	1.273	1.293	1.540
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C Sum	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**
B-site							
Mn	0.014	0.007	0.002	0.008	0.063	0.014	0.019
Fe^{2+}	0.216	0.379	0.276	0.115	0.059	0.169	0.181
Ca	0.850	0.366	0.200	0.216	1.860	0.608	0.944
Na	0.919	1.248	1.522	1.660	0.019	1.209	0.856
B Sum	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**
A-site							
Na	0.349	0.624	0.425	0.294	0.156	0.237	0.228
K	0.015	0.012	0.007	0.012	0.041	0.016	0.024
A Sum	**0.364**	**0.636**	**0.432**	**0.307**	**0.198**	**0.253**	**0.253**
Total Cations	**15.364**	**15.636**	**15.432**	**15.307**	**15.198**	**15.253**	**15.253**
Fe^{3+}/(total Fe)	0.210	0.194	0.388	0.504	0.199	0.377	0.243
Mg/(Mg+Fe^{2+})	0.607	0.553	0.607	0.670	0.716	0.653	0.622

* total iron as FeO; n.d. = not determined

Table DR2. continued

Sample	WR-1A	WR-1A	WR-1A	WR-1A	WR-1A	WR-1A	WR-1A
Mineral Classification	winchite	winchite	magnesio-riebeckite	actinolite	actinolite	actinolite	magnesio-riebeckite
Wt.%							
Na_2O	5.888	2.363	6.187	1.067	1.522	0.245	6.373
K_2O	0.081	0.110	0.051	0.125	0.139	0.048	0.030
CaO	1.514	8.287	1.275	11.237	10.608	12.568	1.473
FeO*	20.302	15.755	21.134	12.994	11.804	10.180	19.635
MgO	11.346	15.215	11.373	16.210	16.985	18.285	11.654
MnO	0.000	0.094	0.091	0.097	0.087	0.306	0.086
TiO_2	0.568	0.188	0.528	0.143	0.411	0.043	0.587
$Al2O_3$	1.075	0.571	0.367	0.699	0.614	0.729	0.417
SiO_2	53.207	55.437	54.994	55.230	55.900	55.681	54.261
F	0.031	0.000	0.056	0.012	0.019	0.000	0.000
Cl	0.629	0.541	0.140	0.079	0.171	0.014	0.083
Total	**94.640**	**98.559**	**96.195**	**97.892**	**98.259**	**98.098**	**94.598**
Structural Formula based on 23 oxygens							
Si	7.906	7.952	7.969	7.906	7.924	7.845	7.964
Al	0.094	0.048	0.031	0.094	0.076	0.155	0.036
T Sum	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**	**8.000**
Al	0.094	0.048	0.031	0.024	0.027	0.000	0.036
Ti	0.063	0.020	0.057	0.015	0.044	0.005	0.065
Fe^{3+}	1.293	0.289	1.507	0.140	0.155	0.214	1.446
Mg	2.513	3.254	2.457	3.459	3.590	3.841	2.550
Fe^{2+}	1.036	1.389	0.948	1.361	1.184	0.941	0.904
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C Sum	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**	**5.000**
Mn	0.000	0.011	0.011	0.012	0.010	0.036	0.011
Fe^{2+}	0.193	0.212	0.106	0.055	0.060	0.045	0.061
Ca	0.241	1.273	0.198	1.723	1.611	1.897	0.232
Na	1.566	0.504	1.685	0.210	0.319	0.022	1.697
B Sum	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**	**2.000**
Na	0.130	0.154	0.053	0.086	0.099	0.045	0.116
K	0.015	0.020	0.010	0.023	0.025	0.009	0.006
A Sum	**0.146**	**0.174**	**0.063**	**0.109**	**0.124**	**0.054**	**0.122**
Total Cations	**15.146**	**15.174**	**15.063**	**15.109**	**15.124**	**15.054**	**15.122**
aver%Fe3	0.513	0.153	0.588	0.090	0.111	0.178	0.600
Mg#	0.672	0.670	0.700	0.710	0.743	0.796	0.726

* total iron as FeO; n.d. = not determined

Table DR3. Whole rock (x-ray fluorescence) analyses of mineralized and unmineralized Wilson Ridge pluton, Arizona

SAMPLE	HT1-13-9 mineralized granitoid	HT1-13-11 mineralized granitoid	HT10-27-1 mineralized dike	HT10-27-2 mineralized granitoid	KW10-18-1 mineralized dike	KW5-396-1 mineralized granitoid	KW-BD mineralized dike
SiO_2	60.28	68.67	70.49	62.13	72.93	63.68	69.66
TiO_2	1.45	0.47	0.40	0.92	0.35	1.17	0.36
Al_2O_3	14.03	15.30	15.27	16.60	15.02	17.18	13.95
FeO*	7.27	2.74	1.97	5.14	1.92	2.25	2.03
MgO	3.93	1.21	0.66	2.56	0.57	3.01	0.71
MnO	0.06	0.01	0.00	0.06	0.01	0.02	0.00
CaO	3.79	1.28	0.65	2.42	0.25	2.56	0.33
K_2O	0.41	1.55	0.21	0.46	0.08	0.45	0.23
Na_2O	7.37	6.54	8.16	8.36	8.16	8.70	8.53
P_2O_5	0.36	0.19	0.13	0.33	0.10	0.55	0.10
Total	98.95	97.96	97.94	98.98	99.39	99.57	95.90

SAMPLE	KW10-18-3 mineralized dike	KW10-18-2 mineralized granitoid	KW1-12-3 mineralized granitoid	9010-1 unmineralized granitoid	9010-3 unmineralized granitoid	9010-3e unmineralized granitoid	912-6b unmineralized granitoid
SiO_2	73.40	71.44	62.65	54.63	53.52	48.25	59.30
TiO_2	0.41	0.42	1.56	1.39	1.20	1.69	0.97
Al_2O_3	15.83	15.45	15.27	13.75	19.53	19.61	19.05
FeO*	2.26	2.52	3.12	7.98	6.53	8.97	5.33
MgO	0.68	1.16	3.80	6.68	2.99	4.91	2.42
MnO	0.02	0.01	0.01	0.14	0.09	0.14	0.08
CaO	0.58	2.08	2.38	9.68	7.42	7.30	5.22
K_2O	0.18	4.05	0.15	0.85	1.84	3.11	2.28
Na_2O	9.07	3.90	9.56	3.20	4.87	3.68	3.98
P_2O_5	0.10	0.11	0.58	0.48	0.54	0.54	0.50
Total	102.53	101.14	99.08	98.77	98.53	98.20	99.13

*Total iron as FeO

Table DR4. Locations and descriptions for samples from the Wilson Ridge pluton and Black Mountains conglomerate.

Sample	GPS Zone 11S Easting	Northing	EPMA	thin-section	field sites	XRF	U-Pb ages	Lithology
KW1-12-3	709487	3989695	X	X		X		mineralized hornblende quartz monzonite; Na-amphibole present as breccia vein networks (~20% of sample) and as partial replacement of magmatic hornblende
KW5-396-1	710372	3990415		X		X		mineralized biotite-bearing hornblende quartz monzonite; Na-amphibole present as mm-scale veins (<5% of sample) and as partial replacement of magmatic hornblende
KW10-18-1	710370	3990445		X		X		altered/mineralized rhyolite dike with phenocrysts of plagioclase, biotite and hornblende; Na-amphibole present as (1) overgrowth on hornblende, (2) alteration of hornblende, (3) radiating clusters of needles in groundmass
KW10-18-2	710445	3990478		X		X		unmineralized hornblende-bearing biotite quartz monzonite
KW10-18-3	711432	3991119	X	X		X		altered/mineralized rhyolite dike with phenocrysts of plagioclase, biotite and hornblende; Na-amphibole present as (1) overgrowth on hornblende, (2) alteration of hornblende, (3) radiating clusters of needles in groundmass
KW-BD	710371	3990446		X		X		altered/mineralized rhyolite dike with phenocrysts of plagioclase, biotite and hornblende; Na-amphibole present as (1) overgrowth on hornblende, (2) alteration of hornblende, (3) radiating clusters of needles in groundmass
HT1-13-9	713349	3986447	X	X		X		mineralized fine-grained hornblende quartz monzonite; Na-amphibole present a smm-scale veins vein networks (~10% of sample) and as partial replacement of magmatic hornblende

Table DR4 continued

Sample	GPS Zone 11S Easting	Northing	EPMA	thin-section	field sites	XRF	U-Pb ages	Lithology
HT1-13-11	713398	3986448		X		X		mineralized fine-grained hornblende, biotite quartz monzonite; mineralization is very minor, incipient alteration of magmatic hornblende
HT10-27-1	713441	3986758	X	X		X		altered/mineralized rhyolite dike with phenocrysts of plagioclase, biotite and hornblende; Na-amphibole present as (1) overgrowth on hornblende, (2) alteration of hornblende, (3) radiating clusters of needles in groundmass
HT10-27-2	713441	3986758	X	X		X		mineralized biotite-bearing hornblende quartz monzonite; Na-amphibole present as mm-scale veins & vugs (<5% of sample) and as extensive replacement of magmatic hornblende
HT-794-4	713450	3986443	X	X				mineralized hornblende quartz monzonite; Na-amphibole present as breccia vein networks (~20% of sample) and as partial replacement of magmatic hornblende; magnetite alteration to hematite
CL5-15/4	718374	3994936		X				mineralized hornblende quartz monzonite; Na-amphibole present as breccia vein networks (~10% of sample) and as partial replacement of magmatic hornblende; magnetite alteration to hematite; hematite + fibrous Na-amphibole veins
CL5-15/5	717824	3993896		X				mineralized hornblende quartz monzonite; Na-amphibole present as breccia vein networks and as partial replacement of magmatic hornblende; magnetite alteration to hematite; hematite + fibrous Na-amphibole veins

Table DR4. continued

Sample	GPS Zone 11S Easting	Northing	EPMA	thin-section	field sites	XRF	U-Pb ages	Lithology
WR-1A	707259	3983830	X	X				sample is a clast from Quaternary alluvium, mineralized biotite-bearing hornblende quartz monzonite; Na-amphibole present (1) as mm-scale veins (<5% of sample), as partial replacement of magmatic hornblende, and (3) as overgrowths on magmatic hornblende
9010-1	713222	3986482		X		X		unmineralized biotite-bearing hornblende quartz diorite
9010-3	713128	3986478		X		X	X	unmineralized hornblende quartz diorite
9010-3e	713128	3986478		X		X		unmineralized hornblende-bearing biotite quartz diorite, mafic enclave hosted in sample 9010-3
912-6b	717126	3985618		X		X	X	unmineralized honblende, biotite quartz monzodiorite
MMW-nbca-cc4	706437	3986475			X			Black Mountian conglomerate, clast count by Williams (2003), contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts
MMW-nbca-cc10	708116	3985929			X			Black Mountain conglomerate, clast count by Williams (2003), contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts
MMW-93-cc1	707952	3984208			X			Black Mountain conglomerate, clast count by Williams (2003), contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts
MMW-93-cc2	708272	3983661			X			Black Mountain conglomerate, clast count by Williams (2003), contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts

Table DR4. continued

Sample	GPS Zone 11S Easting	Northing	EPMA	thin-section	field sites	XRF	U-Pb ages	Lithology
MMW-93-cc6	711831	3981321			X			Black Mountain conglomerate, clast count by Williams (2003), contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts
MMW-wr-cc10	710645	3984836			X			Black Mountain conglomerate, clast count by Williams (2003), contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts
KW213	705530	3986745			X			Black Mountain conglomerate, contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts
KW614	712540	3986196			X			Black Mountain conglomerate, contains $NaFe^{3+}$-amphibole bearing Wilson Ridge pluton clasts

Methods

Electron microscopy work was carried out at the Electron Microscopy and Imaging Laboratory at University of Nevada Las Vegas. Amphibole mineralogical classification was based on quantitative chemical analyses of four polished thin-sections measured on a four-wavelength dispersive spectrometer (WDS), automated JEOL 8900 electron probe microanalyzer (EPMA) in the Electron Microanalysis and Imaging Laboratory at the University of Nevada, Las Vegas. Polished sections were examined on a polarizing optical microscope to identify target areas for analysis prior to EPMA data collection. Selection of analytical sites in the EPMA was guided by backscatter electron images collected in scanning mode. Analytical conditions for EPMA quantitative analyses were 10 nA current at 20 kV accelerating voltage potential using 1 micrometer focused beam for smaller fibre bundles and 5 micrometer beam for larger fibre bundles, peak and background counting times of 30 seconds and 10 seconds, respectively. Alkali elements Na and K were counted on the first WDS cycle to minimize potential element migration from the beam damage for the sample. Analyses were calibrated using well-characterized natural silicate and oxide standards. Matrix corrections used a ZAF correction program package on the JEOL 8900. Analytical precision based on replicate analyses of standards showed standard deviations less than 0.5 for major, and less than 0.1 for minor elements.

Scanning electron microscopy (SEM) and field-emission SEM (FE-SEM) imaging of mineral fibres was performed using a JEOL SEM (JSM5600) and FESEM (JSM6700F). The SEM was operated under the following conditions: 20kv, beam saturation 38-42, spot size 40, aperture 2. Fibre dimensions were measured using imaging software on the FE-SEM. Samples were prepared by scraping material from exposed vein walls, mounting that material on carbon tape on an aluminum stub and carbon coated a DV-520 evaporating coater and an ultrapure C rod as carbon source; coating was performed at 50 mA under $8x10^{-5}$ torr vacuum.

Whole-rock geochemical data were collected at UNLV on powered samples using standard techniques of x-ray fluorescence spectrometry. Samples were prepared as fused disks fluxed with lithium tetraborate. Data collection was calibrated using U.S. Geological Survey rock standards.

Zircon U-Pb dating was conducted by secondary ionization mass spectrometry using a CAMECA ims-1270 ion probe in the SIMS Lab at the University of California Los Angeles under guidance of laboratory scientists. Zircon separates were mounted in epoxy, polished to expose grain interiors and imaged using cathodoluminescence on an SEM at the UCLA facility. Ion probe spot selection was guided by CL images. Zircons exhibited fine-scale oscillatory magmatic zoning and lacked inherited cores. Data were collected from both grain cores and rims. Details of analytical setup and data reduction can be found at http://sims.ess.ucla.edu/.