

Table 1: Major and trace element analysis of Black Hills schists

Sample:	81-1	95-1	96-1	97-1	98-1	99-1	104-1	82-1	82-2	90-1	94-1	108-1	109-2	110-1	111-1
Grade:*	chl	chl	chl	chl	chl	chl	chl	st	st	st	st	st	st	st	st
SiO ₂	59.94	59.25	61.56	60.9	62.82	59.38	62.5	61.07	73.39	64.89	72.7	63.76	62.82	60.46	59.33
TiO ₂	0.66	0.67	0.72	0.65	0.69	0.7	0.65	0.62	0.45	0.77	0.5	0.65	0.74	0.66	0.79
Al ₂ O ₃	19.42	17.03	18.03	16.86	16.33	18.4	15.01	15.92	12.48	16.84	13.29	16.64	16.67	17.16	19.74
FeO	7.16	9.17	7.5	8.73	7.55	7.67	7.83	9.39	3.09	6.61	3.6	7.16	6.25	9.46	8.04
MnO	0.08	0.09	0.5	0.23	0.26	0.33	1.03	2.09	0.31	0.08	0.06	0.67	0.06	0.42	0.1
MgO	2.5	3.36	2.65	3.17	2.52	2.91	3.27	2.68	1.31	2.25	1.57	2.82	2.84	2.77	2.94
CaO	0.33	0.91	0.64	0.38	0.7	0.31	1.91	1.01	2.24	0.22	1.63	0.49	0.66	0.49	0.41
Na ₂ O	0.95	2.09	2.35	1.27	2.11	2.14	2.77	1.44	4.01	0.4	3.67	1.34	1.84	1.53	1.17
K ₂ O	5.61	4.48	4.18	5.03	4.41	4.32	3.07	3.6	1.45	5.56	2.05	4.15	5.39	4.55	4.67
P ₂ O ₅	0.12	0.08	0.13	0.13	0.04	0.14	0.13	0.16	0.28	0.17	0.14	0.12	0.18	0.12	0.15
H ₂ O	2.33	1.54	0.38	1.63	1.43	2.43	0.74	1.08	0.88	1.92	0.44	1.79	1.59	1.58	1.7
Total	99.1	98.67	98.64	98.98	98.86	98.73	98.91	99.06	99.89	99.71	99.65	99.59	99.04	99.2	99.04
Rb	274	219	197	250	190	197	181	157	78	257	94	186	229	209	214
Cs	13.1	35.2	20.1	19.1	10.4	11.3	12.0	10.1	5.8	9.6	4.0	14.4	12.1	14.3	10.4
Sr	49	142	128	80	111	62	214	96	251	23	212	73	167	100	85
Ba	860	559	784	692	676	780	363	613	151	860	488	1308	666	1423	712
Th	18	12	16	16	14	14	14	13	13	16	14	14	13	16	12
U	4.3	3.4	3.0	2.6	5.2	1.4	4.6	2.5	3.0	4.3	2.8	2.7	2.1	2.2	5.9
Sc	17	19	20	18	18	21	15	18	9	15	9	18	17	18	23
Co	15	25	31	30	16	30	9	43	5	13	10	27	18	20	21
Cr	103	114	124	105	115	127	87	103	54	85	74	114	118	103	139
Pb	16	30	28	24	29	32	58	23	43	11	21	41	22	34	24
Zn	124	115	107	159	112	136	135	95	69	112	65	232	124	127	175
Ni	41	49	54	46	43	73	35	43	5	36	25	58	55	28	70
V	96	106	111	86	125	90	88	86	27	90	56	129	107	79	152
Nb	15	13	12	13	14	13	13	10	7	15	11	13	15	14	15
Ta	1.10	0.82	0.97	1.06	0.92	0.97	1.17	0.93	0.85	1.36	0.90	0.98	1.12	1.08	1.06
Hf	3.9	3.4	4.2	3.9	4.1	4.0	5.0	3.4	6.2	5.2	6.3	3.6	3.8	4.7	5.3
Zr	132	121	145	131	138	131	173	116	184	172	205	132	129	165.1	185
Y	26	15	17	22	22	24	28	28	29	29	21	24	21	27.7	30
Ga	26	23	25	25	23	26	21	20	10	24	16	23	23	25.1	26
La	53.0	35.6	44.9	48.9	39.9	41.6	15.6	39.4	33.0	42.8	42.8	42.4	34.8	49.1	46.7
Ce	100	74	96	105	85	87	33	88	70	87	87	88	74	102	96
Nd	39.9	30.2	33.6	40.6	33.0	35.1	13.1	35.6	27.2	35.0	39.5	35.9	32.9	40.9	43.9
Sm	7.73	5.74	6.45	7.23	6.53	6.45	3.03	6.78	5.93	7.29	6.23	6.79	5.93	7.64	9.07
Eu	1.31	1.21	1.29	1.25	1.16	1.27	0.86	1.12	1.07	1.07	1.19	1.22	1.15	1.33	1.62
Tb	0.81	0.64	0.76	1.10	0.76	0.70	0.52	1.08	0.98	0.91	0.33	0.90	0.66	0.93	1.13
Yb	2.71	1.95	2.99	2.81	2.51	2.68	3.24	3.21	3.53	2.64	1.93	2.38	2.05	3.10	4.34
Lu	0.39	0.35	0.42	0.48	0.44	0.35	0.52	0.46	0.44	0.42	0.30	0.44	0.27	0.41	0.61

* Grade symbols: chl = chlorite + garnet; st = staurolite; sil = first sillimanite

Table 1 (continued)

Sample:	111-2	137-1	138-1	139-1	140-1	84-1	84-2	86-1	86-2	112-1	142-1	145-1	156-2	157-1
Grade:*	st	st	st	st	st	sil	sil	sil	sil	sil	sil	sil	sil	sil
SiO ₂	69.93	61.88	59.56	61.3	57.02	69.34	77.27	77	59.8	73.15	83.53	53.26	55.96	63.89
TiO ₂	0.65	0.64	0.66	0.67	0.76	0.7	0.51	0.42	0.64	0.58	0.37	0.95	0.7	0.8
Al ₂ O ₃	14.06	18.07	18.72	18.15	22	14.67	10.98	10.36	14.99	13.19	8.2	20.85	23.04	17.39
FeO	4.99	6.97	7.27	7.21	6.99	5.14	3.31	3.44	10.33	4.43	2.24	7.38	7.28	6.14
MnO	0.04	0.17	0.07	0.15	0.17	0.06	0.04	0.22	0.82	0.03	0.03	0.08	0.09	0.08
MgO	1.92	2.74	2.39	2.83	2.5	1.75	1.14	1.31	3.22	1.67	0.64	3.22	2.55	2.15
CaO	1.29	0.51	0.26	0.46	0.69	0.65	0.59	1.3	1.2	0.58	1	2.25	0.26	0.76
Na ₂ O	4.19	1.31	0.5	1.13	1.76	1.73	1.84	3.04	1.76	1.17	2.62	5.16	0.74	1.9
K ₂ O	1.99	4.79	7.4	5.08	4.95	3.57	2.37	1.46	4.6	2.97	1.06	3.96	5.93	4.31
P ₂ O ₅	0.03	0.11	0.14	0.11	0.11	0.17	0.16	0.09	0.11	0.18	0.11	0.12	0.16	0.17
H ₂ O	0.47	1.9	2.19	1.9	2.24	1.4	1.24	0.88	1.24	1.43	0.36	1.51	2.14	1.44
Total	99.56	99.09	99.16	98.99	99.19	99.18	99.45	99.52	98.71	99.38	100.16	98.74	98.85	99.03
Rb	135	243	335	252	234	188	116	89	193	135	52	152	272	206
Cs	15.0	17.0	49.3	17.2	15.6	32.8	14.2	35.3	17.0	15.0	3.0	7.3	15.4	12.2
Sr	84	88	35	64	126	98	102	169	247	84	118	324	41	114
Ba	635	706	806	887	794	711	494	254	1338	635	178	845	923	911
Th	12	14	19	15	20	17	13	15	18	12	25	11	21	17
U	3.6	4.4	3.0	3.2	2.7	4.2	3.3	3.6	4.5	3.6	2.3	3.7	5.2	4.7
Sc	11	19	16	20	22	14	8	7	16	11	4	26	15	18
Co	10	25	13	15	18	14	9	5	16	10	3	24	18	14
Cr	89	115	89	122	139	98	68	44	93	89	37	191	116	121
Pb	18	21	15	18	32	17	15	52	47	18	14	31	14	21
Zn	61	85	106	115	327	66	53	65	144	61	45	137	172	100
Ni	29	41	42	34	43	29	15	13	32	29	11	74	42	43
V	76	93	91	103	104	74	56	44	126	76	31	158	94	111
Nb	11	13	15	13	14	14	9	10	12	11	9	13	12	16
Ta	0.82	1.00	1.27	1.02	1.21	1.23	0.88	0.81	0.98	0.82	0.69	0.88	1.10	1.14
Hf	6.0	3.9	4.9	3.9	4.8	6.7	6.9	6.2	4.5	6.0	8.6	4.7	4.5	5.7
Zr	195	126	161	132	152	182	231	198	153	195	243	169	152	192
Y	18	22	31	22	28	23	17	15	27	18	16	21	34	23
Ga	16	24	27	25	31	17	13	11	20	16	9	26	31	23
La	37.5	45.8	39.6	47.0	61.2	46.9	34.4	43.8	51.5	37.5	39.2	34.7	59.5	50.9
Ce	76	89	73	95	119	99	72	83	113	76	75	73	117	101
Nd	32.7	40.6	33.5	39.7	75.2	40.4	37.6	36.6	38.9	32.7	47.0	37.2	46.8	40.2
Sm	6.00	7.07	6.21	6.91	9.42	7.74	5.62	5.55	7.73	6.00	5.02	6.85	9.69	7.50
Eu	1.04	1.33	0.94	1.13	1.55	1.35	1.04	0.97	1.41	1.04	0.72	1.58	1.35	1.32
Tb	0.31	0.83	0.95	1.05	1.16	0.46	0.65	0.28	0.82	0.31	0.26	1.00	0.85	0.64
Yb	1.67	2.85	2.73	2.89	3.21	2.93	1.77	1.57	2.92	1.67	1.77	2.49	2.62	2.76
Lu	0.29	0.45	0.44	0.43	0.48	0.46	0.27	0.26	0.44	0.29	0.27	0.42	0.42	0.43

* Grade symbols: chl = chlorite + garnet; st = staurolite; sil = first sillimanite