Internal coherence of Pb isotopic data and support of the fingerprint method

Although not related to the aims of this study, the Pb isotope data obtained for the Dry Valley *in situ* granites can be used to compliment published geochemistry of these plutonic rocks and support the fingerprinting method used in this study. Cox et al. (2000) measured Pb isotopes on whole rock samples of the Dry Valley granites. A comparison of these whole rock values and the alkali feldspar values from this study, shows distinctly lower $^{206}Pb/^{204}Pb$ values for the alkali feldspar samples (Fig. 1). This is expected because the alkali feldspars record the initial Pb isotope composition of the granites, which do not contain any U. In contrast, the whole rock samples show higher values of $^{206}Pb/^{204}Pb$ because a portion of the ^{238}U that was present in any U bearing minerals has subsequently decayed to ^{206}Pb over time.

There is little variation between the two data sets and the $^{207}Pb/^{204}Pb$ ratio because of relatively short half-life of ^{235}U. This means that almost all of primordial ^{235}U has decayed to ^{207}Pb. Thus, variations in the $^{207}Pb/^{204}Pb$ ratio in nature are small compared to the other two decay systems (Dickin, 2005). The distinct yet internally coherent isotopic compositions of the two datasets presented in the figure below, validates the methods and results obtained in this study.

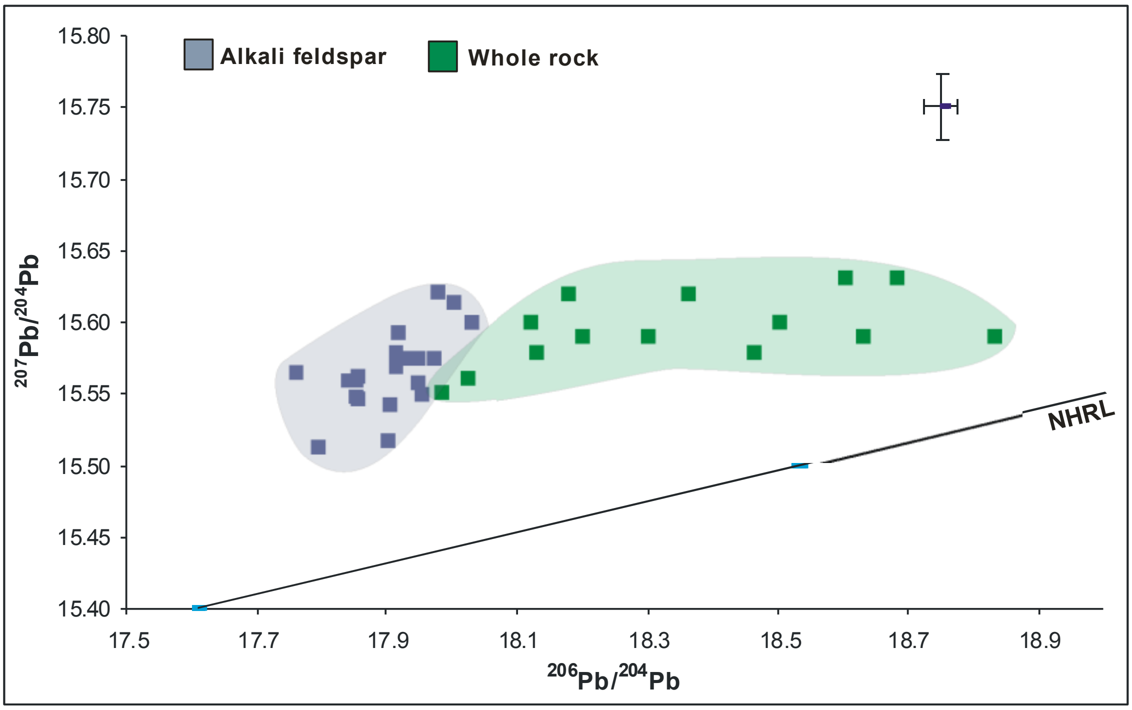

Figure 1.
Plot shows a comparison between Pb isotopic compositions of alkali feldspars (this study) and whole rock samples (Cox et al., 2000) of the Dry Valley granites. The Northern Hemisphere Reference Line (NHRL) is shown for reference (Hart, 1984). Error bars are schematic and should be represented as ellipses. Plot from (Williams, 2006).

References

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Supplementary Table 1. Clast count data

Beacon Valley transect locations and results. See Figure 3 for locations. (Data from Williams, 2006)

Transect	GPS location	Dolerite	Sandstone	Sand	Granite G1	Granite G3	Granite G4	Total granite	% granite
T1	S77 85 72.9 E160 63 11.5	26	3	18	3	0	0	3	6
T2	S77 85 36.3 E160 64 64.5	18	16	12	4	0	0	4	8
T3	S77 84 66.1 E160 66 80.9	13	24	9	4	0	0	4	8
T4	S77 84 10.6 E160 68 24.0	12	15	14	9	0	0	9	18
T5	S77 83 75.1 E160 69 27.3	20	14	5	10	0	1	11	22
T6	S77 83 29.2 E160 70 64.0	16	14	10	10	0	0	10	20
T7	S77 82 75.3 E160 72 13.3	29	11	5	5	0	0	5	10
T8	S77 82 48.5 E160 70 78.3	28	9	4	9	0	0	9	18
T9	S77 82 86.7 E160 69 48.3	34	10	2	4	0	0	4	8
T10	S77 83 33.8 E160 67 74.9	32	11	3	4	0	0	4	8
T11	S77 83 84.3 E160 65 78.8	23	15	5	7	0	0	7	14
T12	S77 83 16.8 E160 66 54.3	26	16	5	3	0	0	3	6
T13	S77 82 51.3 E160 68 04.3	32	9	6	3	0	0	3	6
T14	S77 81 48.1 E160 71 09.8	35	4	10	1	0	0	1	2
T15	S77 80 35.1 E160 71 54.5	39	5	6	0	0	0	trace	0
T16	S77 80 35.8 E160 73 00.7	35	0	11	4	0	0	4	8
T17	S77 80 12.2 E160 69 34.0	38	1	10	0	1	0	1	2
T18	S77 82 31.2 E160 68 68.1	29	11	7	3	0	0	3	6
T19	S77 82 08.6 E160 66 98.2	40	3	3	3	1	0	4	8
T20	S77 81 79.8 E160 64 60.2	35	8	5	2	0	0	2	4
T21	S77 82 56.0 E160 62 24.8	31	9	4	6	0	0	6	12
T22	S77 82 83.1 E160 64 00.4	34	6	7	3	0	0	3	6
T23	S77 83 15.3 E160 65 85.4	36	8	4	2	0	0	2	4
T24	S77 83 99.5 E160 64 07.9	28	10	6	6	0	0	6	12
T25	S77 83 81.1 E160 62 12.9	42	1	6	1	0	0	1	2

Transect	GPS location	Dolerite	Sandstone	Sand	Granite G1	Granite G3	Granite G4	Total granite	% granite
T26	S77 83 56.1 E160 60 20.5	41	3	6	0	0	0	0	0
T27	S77 84 26.5 E160 57 39.2	44	1	5	0	0	0	0	0
T28	S77 84 46.4 E160 59 61.3	42	1	7	0	0	0	0	0
T29	S77 84 92.7 E160 61 83.8	36	7	5	2	0	0	2	4
T30	S77 85 64.3 E160 59 91.9	42	1	7	0	0	0	0	0
T31	S77 85 40.9 E160 56 94.1	43	1	6	0	0	0	0	0
T32	S77 85 18.5 E160 54 53.0	46	2	2	0	0	0	0	0
T33	S77 83 88.5 E160 71 57.9	18	24	4	4	0	0	4	8
T34	S77 84 28.0 E160 73 81.8	39	4	7	0	0	0	0	0
T35	S77 84 87.0 E160 74 04.7	43	3	4	0	0	0	0	0
T36	S77 84 73.3 E160 72 16.0	43	3	4	0	0	0	0	0
T37	S77 84 23.9 E160 70 76.7	13	25	3	9	0	0	9	18
T38	S77 84 79.6 E160 69 14.3	21	19	3	6	0	1	7	14
T39	S77 85 15.8 E160 70 49.6	44	3	3	trace	0	0	trace	0
T40	S77 85 78.7 E160 71 26.8	28	17	5	0	0	0	0	0
T41	S77 85 42.2 E160 69 21.6	37	8	4	1	0	0	1	2
T42	S77 85 12.7 E160 67 70.7	20	20	2	8	0	0	8	16
T43	S77 80 92.0 E160 72 15.9	38	3	9	0	0	0	0	0
T44	S77 80 70.7 E160 70 46.2	39	4	6	1	trace	0	1	2
T45	S77 80 51.5 E160 68 16.9	39	5	6	0	trace	trace	trace	0
T46	S77 81 27.8 E160 65 72.9	39	3	7	1	trace	trace	1	2
T47	S77 81 59.7 E160 67 68.0	31	10	6	3	0	0	3	6
T48	S77 81 88.2 E160 69 35.9	34	6	7	3	0	0	3	6
T49	S77 85 83.3 E160 65 63.6	35	11	1	3	0	0	3	6
T50	S77 86 61.9 E160 65 37.2	38	7	5	0	0	0	0	0
T51	S77 87 22.8 E160 67 39.7	34	12	4	0	0	0	0	0
T52	S77 87 74.3 E160 65 64.6	44	3	3	0	0	0	0	0
T53	S77 87 35.8 E160 63 50.4	44	3	3	0	0	0	0	0
T54	S77 83 15.0 E160 73 37.2	26	9	5	10	trace	trace	10	20
T55	S77 82 84.9 E160 74 96.0	31	7	5	6	1	trace	7	14
T56	S77 83 13.7 E160 77 12.6	31	10	5	3	1	trace	4	8

Transect	GPS location	Dolerite	Sandstone	Sand	Granite G1	Granite G3	Granite G4	Total granite	% granite
T57	S77 83 45.7 E160 76 14.6	31	12	2	4	1	0	5	10
T58	S77 83 54.6 E160 78 44.2	38	7	2	3	0	0	3	6
T59	S77 81 56.1 E160 85 76.7	37	7	2	3	1	0	4	8
T60	S77 81 59.1 E160 74 46.7	33	15	0	2	0	0	2	4
T61	S77 86 18.3 E169 59 84.9	34	14	2	0	0	0	0	0
T62	S77 86 38.5 E160 61 88.6	27	17	6	0	0	0	0	0

WILLIAMS, G. 2006. *Tracing the source of granite clasts in the Beacon Valley, Antarctica, using lead isotopes as a geochemical fingerprint*. BSc Honours, Victoria University Wellington, NZ, 80 pp.

Table S2 Major element contents (wt%) for the Beacon Valley granite clasts (Williams, 2006).

Sample	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	Total
G3-3	57.16	1.13	17.95	7.30	0.10	2.31	5.03	3.57	3.62	0.28	98.44
G3-T19	64.15	0.74	17.46	4.81	0.09	1.58	4.24	4.08	1.85	0.18	99.16
G3-5	64.76	0.71	16.93	4.89	0.08	1.40	3.97	4.11	2.20	0.18	99.22
G4	70.57	0.31	14.75	2.84	0.06	0.31	1.48	3.64	5.46	0.09	99.50
G4-2	70.96	0.26	14.72	2.51	0.05	0.26	1.54	3.55	5.49	0.08	99.42
G4-4	66.99	0.34	14.82	2.80	0.06	0.48	1.59	3.16	5.76	0.10	99.11
G1-T4	73.58	0.19	14.29	1.54	0.04	0.24	1.07	4.17	4.35	0.06	99.51
G1-T6	72.74	0.18	14.69	1.42	0.03	0.25	1.78	3.71	4.25	0.06	99.11
G1-T9	70.56	0.21	16.15	1.63	0.03	0.36	1.97	4.46	3.72	0.06	99.14

Table S3 Trace element concentrations (ppm) for Beacon Valley granite clasts (Williams, 2006).

Sample	Ba	Ni	Cu	Zn	Pb	Th	Rb	Sr	Y	Zr	Nb
G3-3	953.9	5.9	1.8	116.0	18.7	18.9	174.0	528.2	21.1	313.1	17.1
G3-T19	537.3	4.6	1.5	97.2	13.4	13.8	131.6	582.1	15.8	230.5	14.6
G3-5	552.9	5.4	nd.	95.1	18.8	15.1	129.0	453.3	25.3	228.8	16.8
G4	472.6	5.2	nd.	64.8	30.5	25.2	245.3	236.6	31.3	273.2	16.5
G4-2	558.2	4.1	1.5	55.0	31.3	21.2	241.2	248.4	30.1	262.3	15.8
G4-4	833.2	5.4	1.3	59.2	28.6	26.1	255.1	277.7	32.7	291.8	16.6
G1-T4	867.3	3.3	nd.	43.4	28.9	10.8	179.2	312.7	12.5	131.4	8.8
G1-T6	881.7	1.6	nd.	39.8	29.4	10.8	165.8	412.8	10.5	133.1	7.8
G1-T9	1329.9	nd.	nd.	43.4	21.5	10.2	122.4	675.9	7.3	153.8	5.6

nd = not detected

Major Elements

Major element compositions of the Beacon Valley granite are shown in Table 4.2. Of the three Beacon Valley granite clasts, BV-G3 is the least silicic, and appears to have more intermediate composition, with silica content ranging from 57.16wt% to 64.76 wt%. However, the BV-G3-3 sample with 57.16wt% SiO2 has significantly lower total and more variable major element contents than all other sample analyses and may not be representative of the true composition. This is supported by the other two BV-G3 samples which have more comparable major element contents. The BV-G3 sample also seems to be the least evolved (high MgO, Fe2O3, TiO2 and Al2O3 contents) of all the Beacon Valley clasts, consistent with the low silica contents. The BV-G1 samples are the most silicic and have the smallest range of SiO2 contents (70.56wt% to 73.58wt%). They also have the lowest MgO, TiO2, Fe2O3 and MnO contents. The BV-G4 samples have the highest K2O contents, an observation consistent with the presence of large K-feldspar phenocrysts in the granite clasts. In all other major element compositions the BV-G4 samples are intermediate between the high silica BV-G1 and low silica BV-G3 granites.

Trace Elements

Trace element compositions for the Beacon Valley granite clasts are presented in Table 4.3. Six analyses were below the LLD for Cu and Ni, with the BV-G1 granite samples recording no Cu. Barium concentrations are the most variable, the result of a low-energy spectrum line used for the quantitative analysis. The BV-G1 samples display the lowest concentrations for both the rare earth elements (REE), Th and Y, and the high field strength elements (HFSE), Nb and Zr, whereas the BV-G4 samples have the highest concentrations for these two trace element groups. BV-G3 samples have REE and HFSE concentrations intermediate to BV-G1 and BV-G4. The lowest concentrations of large ion lithophile elements (LILE) occur in the BV-G4 samples and may be the consequence of the higher K2O contents.

References

Williams, G. 2006. *Tracing the source of granite clasts in the Beacon Valley, Antarctica, using lead isotopes as a geochemical fingerprint*. BSc Honours, Victoria University Wellington, NZ, 80 pp.

Supplementary Table 4. Major and Minor elements of granite bedrock samples used in this study. Data from Allibone et al. (1993a).

Sample	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	Nb	Y	Rb	Ba	Sr	Zr	Pb
OU30818	57.01	0.47	19.83	4.28	0.1	2.76	8.14	4.77	1.76	9	17	101	335	808	89	17
OU30821	66.13	0.57	15.92	4.51	0.08	1.33	3.66	3.6	3.59	17	30	147	786	390	183	23
OU30823	63.41	0.6	16.76	4.92	0.08	1.79	4.11	3.59	3.81	19	45	150	807	420	191	27
OU56854	71.48	0.27	15.41	2.24	0.03	0.48	2.35	3.73	4.17	8	9	133	209	409	182	21
OU56855	73.58	0.14	14.58	1.32	0.02	0.26	1.84	3.6	4.53	8	5	133	903	408	117	24
OU60557	68.17	0.3	16.49	2.39	0.03	0.56	2.95	3.81	3.27	17	17	95	1415	674	195	24
OU60745	62.65	0.78	15.93	5.45	0.08	1.84	4.31	4.29	3.68	16	37	140	800	479	207	19
OU60746	62.88	0.86	16.47	6.27	0.09	1.98	4.59	3.16	3.11	18	43	120	599	443	233	19
OU60749	63.31	0.83	16.44	5.59	0.08	1.96	4.32	3.05	3.68	14	26	156	947	483	203	20
OU60750	63.89	0.78	16.14	5.13	0.08	1.65	4.07	3.17	3.98	15	20	184	729	422	219	23
OU60752	70.05	0.38	14.76	2.98	0.05	0.88	2.77	2.51	5.06	13	20	184	1380	469	134	26
OU60757	57.36	1.05	19.81	6.8	0.08	2.16	5.65	4.05	2.61	25	19	124	557	587	295	15
OU60760	67.34	0.54	15.95	3.76	0	1.11	3.4	2.74	4.28	12	17	119	1646	563	199	21
OU60761	72.56	0.24	14.23	1.68	0	0.42	1.9	2.28	5.86	6	5	118	1910	512	104	22
OU60762	64.38	0.7	16.55	4.99	0.06	2.17	4.19	3.53	2.4	18	12	105	300	434	165	14
OU60763	64.73	0.66	16.96	4.41	0.06	1.47	4.46	3.47	3.14	14	17	100	847	499	211	17
OU61037	71.02	0.31	14.42	2.43	0.04	0.48	1.83	3.26	4.9	15	22	180	835	291	180	24
OU61038	65.25	0.5	16.71	3.82	0.07	0.79	2.44	3.51	6.11	20	25	166	1699	615	320	25
OU61118	71.38	0.39	14.04	2.63	0.04	0.78	2.51	2.85	4.49	18	20	36	656	382	152	22
OU61128	60.53	0.89	17.06	6.39	0.1	2.25	4.87	3.85	3.03	24	38	54	850	496	234	19
OU61133	70.96	0.42	15.4	2.79	0.03	0.79	2.61	3.88	3.04	19	7	92	1152	542	136	22
OU61134	64.93	0.63	16.62	4.56	0.06	1.3	3.84	3.24	3.78	22	27	23	1021	481	228	20
OU61135	64.73	0.58	16.79	4.45	0.05	1.55	3.81	3.11	4.12	23	33	63	935	442	211	23
OU61136	64.31	0.66	15.13	5.83	0.1	1.94	3.78	2.99	3.85	23	54	35	1041	437	214	18
OU6178	72.38	0.25	13.91	1.79	0.02	0.36	1.92	2.72	5.97	19	25	148	1821	526	324	24
OU62291	74.05	0.17	13.61	1.81	0.04	0.24	1.38	3.47	6.09	10	10	135	700	211	106	22
OU62292	72.4	0.16	14.66	1.72	0.03	0.2	1.33	3.22	6.03	10	11	152	953	248	104	25
P49909	69.94	0.28	14.55	2.67	0.04	0.38	1.58	3.27	5.6	19	32	235	653	282	287	28
P49911	68.35	0.55	14.95	3.48	0.06	1.37	3.26	3	4.27	12	24	138	1217	417	161	20
P49932	70.13	0.28	15.59	1.95	0.03	0.46	2.42	3.62	4.08	9	8	114	1247	578	172	20
P49933	71.44	0.31	14.29	2.4	0.04	0.49	1.84	3.52	4.65	14	21	184	794	282	183	19
P49934	70.4	0.32	15.38	2.18	0.03	0.5	2.44	3.85	3.83	9	9	151	1150	557	172	18
P49935	65.7	0.66	15.83	4.42	0.06	1.56	3.76	3.89	3.98	16	23	139	861	485	182	20
P49935	70.5	0.29	15.46	2.01	0.03	0.47	2.34	3.72	4.07	8	9	111	1183	653	169	20
P49945	71.45	0.24	14.67	2.03	0.03	0.4	2.41	3.22	4.43	9	9	121	1044	445	145	20
P49948	73.58	0.14	14.58	1.32	0.02	0.26	1.84	3.6	4.53	10	10	144	908	347	134	23
P49962	71.48	0.27	15.41	2.24	0.03	0.48	2.35	3.73	4.17	9	11	124	829	363	122	24
P50158	68.91	0.3	15.12	2.84	0.05	0.45	1.75	3.79	6.09	17	32	207	492	218	298	29
P50159	67.12	0.35	15.72	3.27	0.06	0.43	1.89	4.07	6.03	20	31	212	634	292	345	28
P50161	72.56	0.23	13.96	2.12	0.04	0.32	1.69	3.38	4.45	14	23	158	513	198	162	23
P50164	69.67	0.32	14.95	2.9	0.05	0.4	1.59	3.3	5.97	18	31	223	587	267	276	29
P50165	68.59	0.3	15.44	2.81	0.05	0.44	1.73	3.98	5.91	19	34	208	662	282	314	28
P50173	70.33	0.3	14.44	2.67	0.05	0.43	1.65	3.86	5.43	18	28	227	618	266	263	31
P50174	70.91	0.24	14.36	2.27	0.04	0.27	1.48	3.27	5.82	20	34	263	570	236	210	31
P50184	72.78	0.22	13.66	2.37	0.04	0.33	1.44	3.31	4.44	16	27	141	625	185	190	25
P50185	72.31	0.2	14.01	2.07	0.04	0.28	1.45	4.22	4.79	15	27	157	580	174	159	27
P50190	72.33	0.28	13.78	2.52	0.05	0.51	1.71	3.89	4.48	14	25	185	638	210	181	27
VU30871	72.9	0.24	13.67	2.2	0.02	0.44	1.77	3.48	5.91	10	15	123	1170	311	151	25

Major element compositions of *in situ* Dry Valley granites from Allibone et al. (1993a). All compositions are wt%. Fe_2O_3 is total

Trace element compositions of *in situ* Dry Valley granites used in this study. All compositions are in ppm. Data are from Allibone et al. (1993a)

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