Appendix A

Chemical Analyses

This appendix contains the results of the whole rock and isotopic chemical analyses performed at the School of Earth Sciences, Macquarie University, and the Centre of Isotope Studies, CSIRO, on the Brisbane Tuff, Chillingham Volcanics, Mount Crosby Formation Tuff, Hector Tuff, Sugars Basalt, Weir Basalt, samples from GSQ Ipswich 26, Mount Byron Volcanics, Mount Samson Granodiorite, Enoggera Granite, Samford Granodiorite, and the Dayboro Tonalite.

Unit	Brisbane Tuff							
Sample	065-01	075-01	086-01	088-01	088-02	091-01	092-01	092-03
Easting	4943	4971.5	5008	5024.5	5024.2	5023	5022.5	5022.5
Northing	69896.5	69867.5	69714	69680.5	69680.5	68681.3	69681.5	69681.5
Latitude	-27.2158	-27.2420	-27.3806	-27.4108	-27.4108	-28.3128	-27.4099	-27.4099
Longitude	152.9424	152.9712	153.0081	153.0248	153.0245	153.0235	153.0228	153.0228
SiO_2	80.85	78.04	72.8	77.08	76.56	75.82	69.37	76.96
TiO_2	0.15	0.16	0.17	0.17	0.16	0.16	0.17	0.16
Al_2O_3	10.44	12.08	12.4	11.95	11.58	11.78	13.43	11.39
Fe_2O_3	0.26	0.94	2.09	1.07	0.69	1.43	1.85	1.27
FeO	0.06	0.21	0.18	0.17	0.14	0.22	1	0.61
MnO	0	0	0	0	0	0	0.05	0.01
MgO	0.01	0.2	0.1	0.14	0.06	0.11	0.14	0.14
CaO	0.04	0.03	0.03	0.08	0.06	0.08	0.1	0.06
Na_2O	1.9	0.6	2.26	1.87	2.67	2.3	3.41	1.47
K_2O	4.55	3.64	4.17	4.83	4.04	4.32	4.85	3.99
P_2O_5	0	0.02	0.01	0.01	0.02	0.01	0.01	0.01
H_2O^+	1.24	2.02	4.61	1.43	2.45	1.57	2.78	2.54
H_2O^-	0.43	1.57	1.31	1	0.66	1.05	1.23	0.74
CO_2	0.06	0	0	0	0	0	0	0
C	0	0.1	1.58	0.52	0.89	0.79	1.65	0.88
Total	100	99.61	101.71	100.32	99.98	99.64	100.04	100.23
Ba	85	184	277	129	111	117	157	248
Cr	4	7	5	3	5	3	5	5
Cu	1	3	5	3	4	2	3	3
Ga	17	21	26	26	23	22	27	26
Nb	23	26	26	23	24	24	28	24
Ni	0	0	0	0	0	0	0	0
Pb	10	11	19	7	11	16	9	9
Rb	164	128	138	177 (183)	142	148	133 (133)	189
Sr	35	114	169	46 (45)	45	78	69 (68)	145
Th	16	20	18	17	17	17	22	18
U	4	0	3	3	3	3	4	5
V	6	9	7	6	6	4	8	12
Y	104	123	127	94	99	104	161	127
Zn	24	63	142	58	58	113	255	170
Zr	629	687	683	639	666	635	866	703
$^{87}Rb/^{86}Sr$				11.2788			5.38308	
$^{87}Sr/^{86}Sr$				0.737464			0.72375	
$^{147}Sm/^{144}Nd$				0.13464			0.154908	
$^{143}Nd/^{144}Nd$				0.512754			0.502774	

Unit	Brisbane Tuff							
Sample	092-04	093-03	098-03	099-02	099-04	118-01	127-01	129-03
Easting	5022.5	5022.5	5016	5016.5	5016.5	5030.5	5036.5	5037.5
Northing	69681.5	69680.2	69697.5	69698	68698	69659.5	69621.3	69620.2
Latitude	-27.4099	-27.4111	-27.3955	-27.3950	-28.2978	-27.4298	-27.4643	-27.4653
Longitude	153.0228	153.0228	153.0162	153.0167	153.0168	153.0309	153.0369	153.0380
SiO_2	78.98	70.63	75.12	75.47	77.56	75.27	77.57	80.11
TiO_2	0.15	0.21	0.15	0.16	0.16	0.16	0.16	0.15
Al_2O_3	10.17	14.14	12.26	11.43	12.53	11.97	11.85	10.08
Fe_2O_3	1.71	2.4	0.38	2.96	0.58	1.39	0.26	0.26
FeO	0.6	0.78	0.07	0.26	0.11	0.17	0.32	0.09
MnO	0.02	0.03	0.01	0.02	0.01	0	0.06	0
MgO	0.19	0.36	0.05	0.17	0.06	0.16	0.01	0.01
CaO	0.04	0.1	0.06	0.03	0.05	0.03	0.05	0.01
Na_2O	0.56	1.66	3.57	2.1	3.44	1.69	2.6	1.87
K_2O	4.47	4.75	3.82	4.35	3.57	4.96	4.7	3.84
P_2O_5	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
H_2O^+	2.08	2.8	3.22	1.42	0.75	3.09	1.87	2.51
H_2O^-	0.78	1.13	0.82	1	0.86	0.86	0.49	0.7
CO_2	0.16							
C		0.87	1.33	0.44	0.4	0.91	0.57	0.94
Total	99.92	99.87	100.87	99.82	100.09	100.67	100.53	100.58
Ba	471	225	185	133	233	550	224	144
Cr	5	6	5	1	4	3	7	2
Cu	2	1	1	2	3	1	2	0
Ga	27	35	23	25	22	30	22	14
Nb	21	32	22	24	29	28	27	17
Ni	0	1	0	0	0	0	0	0
Pb	4	12	8	30	9	9	30	5
Rb	218	297	115	164	114 (114)	169	139	118
Sr	39	100	102	76	100 (98)	60	91	77
Th	18	24	20	18	20	21	18	13
U	6	6	6	2	6	4	4	3
V	12	11	4	4	6	6	6	5
Y	112	185	130	95	152	136	132	77
Zn	166	264	91	157	85	107	200	50
Zr	659	936	704	674	815	764	708	460
$^{87}Rb/^{86}Sr$					3.21584			
$^{87}Sr/^{86}Sr$					0.718858			
$^{147}Sm/^{144}Nd$					0.143212			
$^{143}Nd/^{144}Nd$					0.512772			

Unit	Brisbane Tuff			Chillingham Volcanics			
Sample	156-02	157-02	166-03	191-01	192-02	204-03	210-03
Easting	5034.5	5034	5100	5180.4	5181.3	5184	5181.5
Northing	69606.5	69607.5	69577	69129.5	69129	69134	69126
Latitude	-27.4776	-27.4767	-27.5042	-27.9081	-27.9086	-27.9041	-27.9113
Longitude	153.0349	153.0344	153.1012	153.1833	153.1842	153.1870	153.1844
SiO_2	75.69	78.61	77.38	78.93	79.71	78.86	80.1
TiO_2	0.17	0.15	0.18	0.08	0.08	0.08	0.07
Al_2O_3	12.59	10.96	12.21	10.8	10.63	11.75	11.25
Fe_2O_3	1.36	0.55	0.41	0.72	0.2	0.21	0.33
FeO	0.16	0.17	0.28	0.08	0.18	0.08	0.18
MnO	0.02	0	0	0	0	0	0.01
MgO	0.01	0.03	0	0	0	0.08	0
CaO	0.02	0.02	0.03	0.02	0.03	0.07	0.06
Na_2O	2.48	1.52	0.57	2.73	1.91	2.07	5.59
K_2O	4.77	3.78	5.02	4.65	5.77	4.04	0.5
P_2O_5	0.02	0.02	0.02	0.02	0	0.01	0.01
H_2O^+	2.12	3.17	2.66	0.94	0.58	1.73	1.15
H_2O^-	0.47	0.68	0.37	0.35	0.42	1.02	0.56
CO_2			2.43	0.75	0.02	0.02	0.03
C	1.94	3.88					
Total	101.82	103.54	101.57	100.07	99.53	100.02	99.84
Ba	391	161	745	141	281	1442	298
Cr	2	4	6	3	0	0	0
Cu	1	0	2	4	3	1	4
Ga	24	27	21	15	13	12	6
Nb	21	25	19	22	19	18	20
Ni	0	0	1	0	1	1	0
Pb	19	3	8	15	14	10	12
Rb	140	141	129	167 (158)	203	121 (123)	19
Sr	114	106	76	22 (22)	20	39	49
Th	14	13	15	22	20	21	20
U	3	2	4	5	4	4	9
V	4	9	10	10	0	6	1
Y	103	94	63	58	24	22	49
Zn	100	92	47	60	22	14	59
Zr	562	570	528	232	212	210	202
$^{87}Rb/^{86}Sr$				20.192		0	
$^{87}Sr/^{86}Sr$				0.764278		0	
$^{147}Sm/^{144}Nd$				0.066986		0.116471	
$^{143}Nd/^{144}Nd$				0.512785		0.512731	

Unit	Chillingham Volcanics						
Sample	215-01	217-03	221-01	240-14	240-20	250-01	369-01
Easting	5194	5195	5194	5195.2	5196	5191.5	5200
Northing	69082	69075	69073	69006	69006	68956.5	68987.2
Latitude	-27.9510	-27.9573	-27.9591	-28.0196	-28.0196	-28.0643	-28.0366
Longitude	153.1972	153.1982	153.1972	153.1986	153.1994	153.1949	153.2035
SiO_2	78.41	77.18	78.31	80.26	75.75	70.03	77.67
TiO_2	0.09	0.1	0.09	0.12	0.08	0.53	0.09
Al_2O_3	11.48	11.58	11.26	10.3	13.77	16.09	12.54
Fe_2O_3	0.78	0.71	0.98	0.73	0.77	2.83	0.22
FeO	0.09	0.13	0.11	0.16	0.18	0.4	0.15
MnO	0.01	0	0	0	0.01	0.01	0
MgO	0	0	0	0	0	0.12	0
CaO	0.02	0.1	0.03	0.04	0.03	0.06	0.02
Na_2O	2.97	2.34	1.67	2.44	7.01	3.13	1.85
K_2O	4.61	5.43	6.3	3.2	0.58	2.47	6.55
P_2O_5	0	0	0	0.01	0	0.04	0.01
H_2O^+	0.68	1.6	0.95	1.8	0.92	3.6	1.12
H_2O^-	0.31	0.8	0.39	0.47	0.64	0.74	0.28
CO_2	0.02	1.13	0.28	1.25	0.01	1.67	0.37
Total	99.47	101.1	100.37	100.79	99.75	101.71	100.87
Ba	67	53	75	160	34	469	51
Cr	1	6	0	0	0	3	1
Cu	2	5	5	0	0	2	2
Ga	14	18	15	15	11	25	25
Nb	20	19	23	40	33	23	28
Ni	0	2	1	0	0	0	2
Pb	19	24	33	21	23	10	13
Rb	185	170	244	120	72 (71)	86	289
Sr	13	20	12	12	23 (22)	127	5
Th	20	25	26	47	22	18	23
U	2	6	1	15	5	4	6
V	2	7	3	2	2	8	2
Y	50	62	60	240	92	65	92
Zn	39	80	51	56	60	49	41
Zr	212	223	219	379	336	690	343
$^{87}Rb/^{86}Sr$					8.84459		
$^{87}Sr/^{86}Sr$					0.7544		
$^{147}Sm/^{144}Nd$					0.17614		
$^{143}Nd/^{144}Nd$					0.512771		

Unit	Chillingham Volcanics						
Sample	400-01	*401-04†*	413-01	415-01	418-01	429-01	435-01
Easting	5300.5	*5302*	5280	5273.5	5275	5361	5374
Northing	68541.5	*68542*	68545.5	68541	68540	68515	68503
Latitude	-28.4387	*-28.4382*	-28.4351	-28.4392	-28.4401	-28.4625	-28.4733
Longitude	153.3069	*153.3084*	153.2859	153.2793	153.2808	153.3687	153.3821
SiO_2	77.11	*71.72*	72.99	72.36	71.59	83.04	77.79
TiO_2	0.14	*0.34*	0.22	0.24	0.24	0.15	0.18
Al_2O_3	12.06	*11.92*	13.97	14.39	15.22	8.83	12.6
Fe_2O_3	0.94	*3.58*	2	2.06	1.92	1.36	0.32
FeO	0.64	*1.83*	0.14	0.13	0.17	0.29	0.18
MnO	0.03	*0.07*	0.06	0	0.01	0.01	0
MgO	0.07	*0*	0.09	0.02	0.03	0.02	0.02
CaO	0.06	*0.11*	0.07	0.05	0.05	0.01	0.03
Na_2O	2.41	*4.68*	2.63	1.74	0.74	0	2.19
K_2O	5.26	*4.8*	5.75	5.99	6.5	4.29	4.62
P_2O_5	0	*0*	0.01	0.01	0.01	0	0.01
H_2O^+	0.82	*1.05*	1.67	2.09	2.97	1.47	1.51
H_2O^-	0.15	*0.16*	0.29	0.77	0.27	0.21	0.22
CO_2	0.35	*0.07*	0.94	0	0.94	0.1	0.57
Total	100.04	*100.34*	100.83	99.84	100.65	99.78	100.22
Ba	378	*0*	864	641	602	787	676
Cr	2	*0*	1	1	1	1	2
Cu	3	*4*	4	4	4	2	2
Ga	22	*47*	22	15	22	25	27
Nb	25	*190*	15	16	16	21	27
Ni	0	*0*	1	2	0	0	0
Pb	12	*25*	40	18	25	11	3
Rb	191	*218*	239	225	304	118	136
Sr	32	*1*	36	37	21	8	25
Th	21	*25*	20	25	24	19	20
U	2	*7*	4	4	4	3	7
V	3	*2*	6	5	5	1	4
Y	114	*116*	42	74	79	106	122
Zn	103	*225*	51	39	42	55	48
Zr	581	*1610*	360	446	440	681	772
$^{87}Rb/^{86}Sr$							
$^{87}Sr/^{86}Sr$							
$^{147}Sm/^{144}Nd$							
$^{143}Nd/^{144}Nd$							

† Possibly an alkali rhyolite of the Mount Warning Complex.

Unit		Hector Tuff				Mt. Crosby Formation	
		GSQ Ipswich 26				GSQ NS 295	
Sample	058-01	261-01	261-04	261-06	261-05	260-01	260-02
Depth		621.95	658.4	662.1	662.6	17	90
Easting	4764	5849	5849	5849	5849	4788	4788
Northing	69512.5	69359.1	69359.1	69359.1	69359.1	69534	69534
Latitude	-27.5623	-27.6983	-27.6983	-27.6983	-27.6983	-27.5429	-27.5429
Longitude	152.7609	152.8611	152.8611	152.8611	152.8611	152.7853	152.7853
SiO_2	81.52	79.54	71.99	71.53	71.79	72.14	74.58
TiO_2	0.2	0.37	0.21	0.22	0.2	0.18	0.2
Al_2O_3	10.34	10.8	9.93	12.66	10.5	11.11	11.85
Fe_2O_3	0.66	0.66	0.63	0.63	0.77	3.48	1.63
FeO	0.27	1.04	3.06	1.66	4.58	0.52	0.54
MnO	0	0.03	0.13	0.09	0.1	0.07	0.04
MgO	0.2	0.35	0.71	0.59	0.86	0.75	0.79
CaO	0.03	0.34	3.73	2.69	2.2	2.01	1.52
Na_2O	0.07	1.47	0.21	0.41	0.29	0.48	0.4
K_2O	2.49	1.77	1.71	2.43	1.49	1.74	2.24
P_2O_5	0.01	0.02	0.01	0.01	0.02	0	0
H_2O^+	2.88	0.59	3.42	3.48	4.07	4.22	4.05
H_2O^-	1.16	0.89	1.44	1.7	1.54	2.08	2.01
CO_2	0.32	0.37	4.36	2.84	2.23	1.7	1.36
Total	100.15	98.24	101.54	100.95	100.64	100.49	101.21
Ba	197	262	539	686	460	479	520
Cr	3	29	3	6	0	4	4
Cu	1	3	3	4	2	4	3
Ga	19	12	19	26	19	26	27
Nb	16	5	14	20	14	24	25
Ni	0	4	0	1	0	0	0
Pb	6	12	14	20	18	21	27
Rb	116	67	70	96	63	82	105
Sr	14	90	173	189	139	94	95
Th	14	7	11	15	11	19	19
U	4	1	1	2	1	4	2
V	13	53	11	12	13	9	10
Y	69	19	68	47	64	105	117
Zn	29	47	87	104	102	239	126
Zr	462	113	431	512	446	622	655
$^{87}Rb/^{86}Sr$							
$^{87}Sr/^{86}Sr$							
$^{147}Sm/^{144}Nd$							
$^{143}Nd/^{144}Nd$							

Unit	Mt. Crosby Formation GSQ Ipswich 26	Sugars Basalt					
Sample	261-09B	022-01	022-05	022-06	022-07	022-09	022-11
Depth	828						
Easting	5849	4854.5	4855.5	4855.5	4855.5	4855	4855
Northing	69359.1	69528	69528	69528	69528	69529.5	69529.5
Latitude	-27.6983	-27.5484	-27.5484	-27.5484	-27.5484	-27.5471	-27.5471
Longitude	152.8611	152.8526	152.8536	152.8536	152.8536	152.8531	152.8531
SiO_2	68.64	53.34	51.95	52.18	54.88	52.88	52.64
TiO_2	0.25	1.42	1.41	1.4	1.6	1.5	1.36
Al_2O_3	15.45	16.82	16.82	16.74	18.2	17.5	17.5
Fe_2O_3	0.81	3.8	3.83	4.05	2.78	3.96	5.75
FeO	2.44	5.03	5.18	5.41	4.52	4.87	4.52
MnO	0.03	0.14	0.14	0.13	0.07	0.11	0.09
MgO	0.87	4.41	4.13	4.4	2.69	3.72	2.75
CaO	0.63	8.67	8.79	8.22	2.75	5.4	3.19
Na_2O	1.36	2.98	3.18	2.99	6.59	5.18	5.71
K_2O	2.63	1.7	1.72	1.72	1.77	1.79	1.11
P_2O_5	0.04	0.31	0.3	0.3	0.3	0.32	0.27
H_2O^+	4.38	1.88	2.04	2.13	3.33	2.82	4.35
H_2O^-	1.87	1.04	1.1	0.81	0.79	0.61	0.76
CO_2	1.08	0.29	0.34	0.03	0.29	0.28	0.28
Total	100.48	100.83	100.92	100.51	100.57	100.94	100.29
Ba	417	345	348	340	1039	561	538
Cr	5	80	75	77	117	101	95
Cu	2	26	25	23	24	24	25
Ga	32	20	19	20	15	19	15
Nb	29	6	6	7	7	6	6
Ni	0	28	29	30	54	24	37
Pb	31	9	13	9	8	10	7
Rb	96	51	50	52	37	50	23
Sr	113	462	472	449	629	446	501
Th	22	4	5	5	6	5	5
U	3	2	2	2	2	2	0
V	10	205	204	200	228	247	227
Y	131	38	36	38	41	39	40
Zn	144	75	73	80	102	92	95
Zr	790	195	195	196	219	215	180
$^{87}Rb/^{86}Sr$							
$^{87}Sr/^{86}Sr$							
$^{147}Sm/^{144}Nd$							
$^{143}Nd/^{144}Nd$							

Unit	Weir Basalt					GSQ26	
		NS295				Subunit "F"	
Sample	018-01	260-03	260-04	260-05	260-06	261-34	261-33
Depth		135	196	210	275	935	953
Easting	4792	4788	4788	4788	4788	5849	5849
Northing	69538	69534	69534	69534	69534	69359.1	69359.1
Latitude	-27.5393	-27.5429	-27.5429	-27.5429	-27.5429	-27.6983	-27.6983
Longitude	152.7893	152.7853	152.7853	152.7853	152.7853	152.8611	152.8611
SiO_2	50.92	53.36	53.08	52.45	54.76	64.81	52.91
TiO_2	1.65	1.52	1.46	1.61	1.38	0.39	0.37
Al_2O_3	17.18	16.85	16.42	17.87	15.6	15.05	16.45
Fe_2O_3	3.32	3.71	4.7	4.93	3.3	1.45	4.6
FeO	4.95	3.86	3.12	4.09	4.18	2.91	9.07
MnO	0.3	0.14	0.12	0.23	0.19	0.09	0.28
MgO	4.82	5.16	4.58	4.14	4.22	0.67	1.79
CaO	5.17	4.99	7.76	4.5	7.25	3.23	2.75
Na_2O	5.2	5.2	3.57	4.83	3.96	0.97	2.04
K_2O	0.34	0.61	1.06	0.58	0.57	3.01	2.63
P_2O_5	0.51	0.51	0.5	0.54	0.48	0.12	0.04
H_2O^+	4.01	3.37	2.9	3.62	2.63	3.72	5.07
H_2O^-	0.61	0.92	1.86	0.8	0.77	1.83	1.24
CO_2	1.67	0.16	0.17	0.07	1.04	2.27	1.36
Total	100.65	100.36	101.3	100.26	100.33	100.52	100.6
Ba	438	1573	323	1161	843	279	466
Cr	156	185	176	153	150	0	0
Cu	30	25	24	30	25	5	0
Ga	19	18	19	18	19	20	23
Nb	15	15	15	16	14	20	20
Ni	54	58	55	54	50	0	1
Pb	11	10	11	11	12	26	22
Rb	7	14 (13)	32	11	13 (13)	130	83
Sr	656	824 (824)	685	690	669 (679)	87	97
Th	5	7	7	6	7	13	14
U	0	1	0	0	0	2	1
V	185	178	181	198	176	7	11
Y	39	37	37	39	35	71	51
Zn	94	97	75	90	85	144	289
Zr	287	275	271	289	247	483	479
$^{87}Rb/^{86}Sr$		0.044503			0.051451		
$^{87}Sr/^{86}Sr$		0.705108			0.70486		
$^{147}Sm/^{144}Nd$		0.127238			0.097118		
$^{143}Nd/^{144}Nd$		0.512732			0.512744		

Unit	GSQ Ipswich 26 (Subunit "F")						
Sample	261-32	261-31	261-30	261-29	261-27	261-26	261-24
Depth	953	968	970	980	983	985	1000
Easting	5849	5849	5849	5849	5849	5849	5849
Northing	69359.1	69359.1	69359.1	69359.1	69359.1	69359.1	69359.1
Latitude	-27.6983	-27.6983	-27.6983	-27.6983	-27.6983	-27.6983	-27.6983
Longitude	152.8611	152.8611	152.8611	152.8611	152.8611	152.8611	152.8611
SiO_2	62.51	60.39	57.67	38.51	51.21	52.95	51.72
TiO_2	1.19	1.6	1.65	0.99	1.65	1.54	1.64
Al_2O_3	13.08	17.38	18.4	11.39	18.01	16.81	13.25
Fe_2O_3	1.88	3.01	1.88	2.22	2.36	5.87	1.28
FeO	6.1	3.25	4.34	7.01	6.24	5.88	5.83
MnO	0.13	0.08	0.05	0.77	0.19	0.23	0.36
MgO	1.62	0.94	1.68	1.73	2.19	1.58	1.02
CaO	3.12	2.13	2.06	16.78	5.28	4.03	9.62
Na_2O	3.7	5.79	5.82	3.26	4.71	3.98	3.51
K_2O	0.64	1.54	1.39	0.34	1.06	1.15	0.75
P_2O_5	0.5	0.62	0.91	0.45	0.62	0.59	0.43
H_2O^+	3.4	2.69	3.67	3.59	4.2	4.1	3.57
H_2O^-	0.71	0.76	1	0.3	1.11	0.66	0.95
CO_2	1.64	0.49	0.21	13.77	1.99	1.53	6.38
Total	100.22	100.67	100.73	101.12	100.82	100.9	100.31
Ba	151	519	613	109	406	325	132
Cr	7	5	4	5	2	0	7
Cu	11	13	14	16	16	14	25
Ga	19	21	23	20	22	23	16
Nb	16	18	20	13	19	18	16
Ni	0	0	0	4	2	4	16
Pb	14	15	14	14	13	17	12
Rb	25	62	51	13	32	54	18 (18)
Sr	130	340	290	170	328	195	128
Th	10	9	10	7	9	8	4
U	1	0	2	0	0	0	0
V	93	133	139	155	145	146	200
Y	53	50	101	65	46	50	41
Zn	75	100	93	79	57	51	139
Zr	323	413	422	270	409	380	287
$^{87}Rb/^{86}Sr$							0.389608
$^{87}Sr/^{86}Sr$							0
$^{147}Sm/^{144}Nd$							0.132217
$^{143}Nd/^{144}Nd$							0.512781

Unit	GSQ Ipswich 26						
	Subunit "F"						Subunit "E"
Sample	261-23	261-20	261-19B	261-19A	261-18	261-16†	261-15
Depth	1011	1022	1027	1027	1033	1037	1064
Easting	5849	5849	5849	5849	5849	5849	5849
Northing	69359.1	69359.1	69359.1	69359.1	69359.1	69359.1	69359.1
Latitude	-27.6983	-27.6983	-27.6983	-27.6983	-27.6983	-27.6983	-27.6983
Longitude	152.8611	152.8611	152.8611	152.8611	152.8611	152.8611	152.8611
SiO_2	53.46	52.87	53.28	54.27	51.45	55.82	72.36
TiO_2	2.41	2.07	2.03	2.06	2.23	1.85	0.14
Al_2O_3	19.48	16.97	17.29	17.53	19.11	16.49	15.1
Fe_2O_3	2.24	1.81	2.35	2.34	2.77	0.83	0.41
FeO	5.83	9.06	7.69	7.4	6.44	2.61	0.9
MnO	0.07	0.18	0.14	0.12	0.17	0.23	0.04
MgO	1.29	1.39	1.23	1.15	1.28	0.65	0.05
CaO	2.17	3.29	2.97	2.15	3.01	7.51	0.54
Na_2O	5.14	4.63	4.6	4.63	6.65	6.67	5.31
K_2O	1.54	0.82	1.13	1.31	1.07	0.55	4.42
P_2O_5	0.62	0.56	0.53	0.44	0.6	0.57	0.02
H_2O^+	4.82	4.16	4.46	4.48	3.55	2.27	0.84
H_2O^-	0.52	1.02	1.25	1.4	0.95	0.61	0.17
CO_2	0.7	1.86	1.41	0.91	1.53	3.68	0.21
Total	100.29	100.69	100.36	100.19	100.81	100.34	100.51
Ba	204	68	174	184	107	184	398
Cr	13	15	14	17	30	15	1
Cu	32	28	23	27	34	23	2
Ga	23	22	22	24	23	15	15
Nb	20	17	17	17	18	18	12
Ni	11	11	14	14	15	7	0
Pb	13	14	14	13	12	7	23
Rb	38	21	49	62	40	24	103 (104)
Sr	149	109	151	146	175	327	95 (95)
Th	7	5	6	6	7	6	18
U	1	1	1	0	1	1	3
V	284	270	213	205	271	192	7
Y	52	43	60	45	51	50	24
Zn	85	82	118	114	101	109	32
Zr	412	342	342	346	359	347	192
$^{87}Rb/^{86}Sr$							2.99895
$^{87}Sr/^{86}Sr$							0.712202
$^{147}Sm/^{144}Nd$							0.370719
$^{143}Nd/^{144}Nd$							0.512828

† ARPHD0261-16 was a sample of andesitic tuff collected at 1037 m. This sample belongs to Subunit E by virtue of its depth only, which is below Almond's (1982) cut off for Subunit F (1036.7 m); however based on its composition, the sample has been included with Subunit F.

Unit	GSQ Ipswich 26 Subunit "E"		Mt. Byron Volcanics	Mt. Samson Granodiorite			
Sample	261-12	261-11	181-01	266-03	267-01	267-02	268-02A (ENCLAVE)
Depth	1067.2	1077					
Easting	5849	5849	4685	4844	4843	4843	4842
Northing	69359.1	69359.1	70022	69798	69794	69794	69791
Latitude	-27.6983	-27.6983	-27.1022	-27.3047	-27.3083	-27.3083	-27.311
Longitude	152.8611	152.8611	152.6822	152.8423	152.8413	152.8413	152.8403
SiO_2	78.79	73.62	73.26	64.59	57.04	57.21	56.93
TiO_2	0.11	0.12	0.13	0.69	0.96	0.91	0.91
Al_2O_3	10.51	13.81	13.75	16.05	17.2	17.16	17.26
Fe_2O_3	0.35	0.34	0.62	1.55	2.47	2.48	5.53
FeO	1.1	0.96	0.26	3.07	4.7	4.54	1.8
MnO	0.03	0.03	0	0.08	0.13	0.12	0.12
MgO	0.01	0	0	1.9	4.19	4.09	4.04
CaO	0.43	0.51	0.02	4.17	6.91	6.78	6.84
Na_2O	2.35	4.07	2.01	3.73	3.51	3.48	3.49
K_2O	4.66	5.07	7.07	2.88	1.85	2.05	2.05
P_2O_5	0.02	0.02	0	0.15	0.2	0.17	0.16
H_2O^+	0.95	0.96	2.05	1.14	1.12	1.12	1.05
H_2O^-	0.16	0.22	0.57	0.17	0.11	0.26	0.18
CO_2	0.1	0.25	2.5	0.08	0.05	0.04	0.1
Total	99.56	99.98	102.25	100.25	100.44	100.41	100.46
Ba	464	398	627	286	288	307	679
Cr	1	1	0	18	57	52	20
Cu	2	3	3	5	19	19	8
Ga	13	16	20	17	20	0	21
Nb	11	10	28	10	9	0	17
Ni	1	2	0	9	26	27	15
Pb	13	14	10	14	12	0	25
Rb	132	143	252	128	68	0	194
Sr	93	85	8	238	408	0	278
Th	15	17	20	17	8	0	16
U	2	3	5	4	2	0	1
V	7	5	0	87	183	177	41
Y	21	22	80	32	26	0	27
Zn	39	39	56	54	74	73	98
Zr	174	175	463	183	122	0	234
$^{87}Rb/^{86}Sr$							
$^{87}Sr/^{86}Sr$							
$^{147}Sm/^{144}Nd$							
$^{143}Nd/^{144}Nd$							

	Mt. Samson Granodiorite		Samford Granodiorite	Enoggera Granite		Dayboro Tonalite
Sample	268-02B	268-03	269-01	270-01	270-03	272-2
Easting	4842	4842	4767.5?	4669	4669	4840
Northing	69791	69791	69921?	69951	69951	69918
Latitude	-27.311	-27.311	-27.1935?	-27.1662	-27.1662	-27.1963
Longitude	152.8403	152.8403	152.7653?	152.6659	152.6659	152.8385
SiO_2	63.39	69.72	69.56	72.55	71.59	64.02
TiO_2	0.75	0.39	0.39	0.27	0.32	0.69
Al_2O_3	15.69	15.06	15.27	14.08	14.38	16.24
Fe_2O_3	1.27	0.95	0.99	0.35	0.93	1.6
FeO	3.59	1.7	1.66	1.55	1.29	3.05
MnO	0.2	0.08	0.07	0.04	0.05	0.09
MgO	2.53	0.9	0.85	0.52	0.7	2.07
CaO	3.53	2.23	2.16	1.31	1.59	3.74
Na_2O	4.36	4.27	4.56	3.87	4	3.62
K_2O	2.53	3.43	3.45	4.04	3.78	2.93
P_2O_5	0.21	0.12	0.13	0.08	0.09	0.15
H_2O^+	1.61	0.94	0.76	0.77	0.94	1.68
H_2O^-	0.22	0.19	0.24	0.2	0.34	0.38
CO_2	0.07	0.07	0.07	0.1	0.07	0.05
Total	99.95	100.05	100.16	99.73	100.07	100.31
Ba	692	717	622	537	606	427
Cr	94	16	14	5	15	21
Cu	5	5	5	22	8	7
Ga	19	18	16	15	15	16
Nb	25	13	14	11	12	9
Ni	16	6	5	3	5	8
Pb	13	18	16	18	14	15
Rb	161	154	144 (149)	152 (150)	143	109
Sr	247	231	233	147 (150)	194	278
Th	10	14	13	17	16	13
U	3	1	3	2	3	3
V	82	36	39	23	29	96
Y	47	21	23	23	20	28
Zn	105	70	51	33	33	60
Zr	192	169	177	158	157	176
$^{87}Rb/^{86}Sr$			2.07736	2.76373		
$^{87}Sr/^{86}Sr$			0	0.713734		
$^{147}Sm/^{144}Nd$				0.161248		
$^{143}Nd/^{144}Nd$			0.512652	0.512628		

Appendix B

CIPW Normative Data

This appendix contains the CIPW normative calculations for the whole rock chemical analyses performed at the School of Earth Sciences, Macquarie University on the Brisbane Tuff, Chillingham Volcanics, Mount Crosby Formation Tuff, Hector Tuff, Sugars Basalt, Weir Basalt, samples from GSQ Ipswich 26, Mount Byron Volcanics, Mount Samson Granodiorite, Enoggera Granite, Samford Granodiorite, and the Dayboro Tonalite.

Formation	Brisbane Tuff														
Sample	065-01	075-01	086-01	088-02	088-01	091-01	092-01	092-03	092-04	093-03	098-03	099-02	099-04	118-01	127-01
Quartz	52.31	60.21	43.39	45.31	47.27	45.5	30.41	52.7	58.41	41.91	39.46	46.21	43.61	46.04	44.18
Corundum	2.38	7.11	4.09	2.73	3.5	3.17	2.39	4.52	4.4	6.06	2.14	3.21	2.91	3.73	2.41
Zircon	0.13	0.14	0.14	0.13	0.13	0.13	0.17	0.14	0.13	0.19	0.14	0.14	0.16	0.15	0.14
Orthoclase	26.96	21.56	24.7	23.93	28.61	25.59	28.72	23.65	26.5	28.19	22.62	25.77	21.14	29.38	27.83
Albite	16.08	5.08	19.12	22.59	15.82	19.46	28.85	12.44	4.74	14.05	30.21	17.77	29.11	14.3	22
Anorthite	0	0.1	0.21	0.21	0.38	0.39	0.5	0.35	0	0.53	0.32	0.14	0.28	0.25	0.2
Acmite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diopside	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypersthene	0	0.5	0.25	0.15	0.35	0.27	0.47	0.35	0.2	0.9	0.12	0.42	0.15	0.4	0.24
Olivine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnetite	0	0.21	0.09	0	0.05	0.24	2.68	1.53	1.56	2	0	0.44	0	0.08	0.38
Chromite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hematite	0.26	0.79	2.03	0.69	1.03	1.26	0	0.21	0.63	1.02	0.38	2.66	0.58	1.33	0
Ilmenite	0.13	0.3	0.32	0.29	0.32	0.3	0.32	0.3	0.28	0.4	0.17	0.3	0.25	0.3	0.3
Rutile	0.08	0	0	0	0	0	0	0	0	0	0.06	0	0.03	0	0
Apatite	0	0.06	0.03	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06
Calcite	0.09	0	0	0	0	0	0	0	0.11	0	0	0	0	0	0
Magnesite	0.02	0	0	0	0	0	0	0	0.23	0	0	0	0	0	0
Siderite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	98.44	96.06	94.37	96.1	97.5	96.36	94.54	96.23	97.23	95.27	95.64	97.09	98.24	96	97.75

Formation	Brisbane Tuff				Chillingham Volcanics										
Sample	129-3	156-2	157-02	166-03	191-01	192-02	204-03	210-03	215-01	217-03	221-01	240-14	240-20	250-01	369-01
Quartz	54.45	42.89	55.17	54.79	45.2	46.4	51	45.6	43.44	42.73	44.41	53.77	32.68	42.31	41.75
Corundum	2.83	3.31	4.35	5.83	1.27	1.2	3.8	1.47	1.59	1.84	1.68	2.82	1.57	8.26	2.39
Zircon	0.09	0.11	0.11	0.11	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.08	0.07	0.14	0.07
Orthoclase	22.74	28.25	22.4	29.72	27.55	34.18	23.92	2.96	27.32	32.16	37.33	18.96	3.46	14.63	38.82
Albite	15.82	20.98	12.86	4.82	23.1	16.16	17.51	47.3	25.13	19.8	14.13	20.64	59.31	26.48	15.65
Anorthite	0.04	0.1	0.04	0	0	0.09	0.53	0.13	0	0	0	0	0.1	0	0
Acmite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diopside	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypersthene	0.02	0.02	0.07	0	0	0.03	0.2	0	0	0	0	0	0	0	0
Olivine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnetite	0	0.09	0.11	0	0	0.29	0.03	0.41	0.05	0	0	0	0.38	0	0
Chromite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hematite	0.26	1.3	0.47	0.41	0.72	0	0.19	0.05	0.74	0.71	0.98	0.73	0.51	2.83	0.22
Ilmenite	0.19	0.32	0.28	0.34	0.15	0.15	0.15	0.13	0.17	0.19	0.17	0.23	0.15	0.87	0.17
Rutile	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0.07	0
Apatite	0.03	0.07	0.06	0.07	0.06	0	0.03	0.03	0	0	0	0.03	0	0.12	0.03
Calcite	0	0	0	0.1	0	0.06	0.07	0.08	0.05	0.19	0.07	0.07	0.02	0.08	0.02
Magnesite	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0
Siderite	0	0	0	0.19	0.01	0	0	0	0	0.06	0.05	0.08	0	0	0.11
Others	0	0	0	2.33	0.74	0	0	0	0	1.02	0.24	1.19	0	1.51	0.32
Total	96.53	97.44	95.93	98.71	98.85	98.61	97.48	98.2	98.54	98.76	99.1	98.59	98.25	97.55	99.56

Formation	Chillingham Volcanics							Hector Tuff					Mt. Crosby Formation		
									GSQ Ipswich 26				NS 295		GSQ Ipswich 26
Sample	400-01	*401-04*†	413-01	415-01	418-01	429-01	435-01	058-01	261-01	261-04	261-06	261-05	260-01	260-02	261-09B
Depth									621.95	658.4	662.1	662.6	17	90	828
Quartz	42.88	*26.55*	35.61	39.06	42.31	66.55	47.29	71.53	63.46	62.78	58.81	60.29	61.65	62.63	48.55
Corundum	2.39	*0*	3.41	4.91	6.95	4.18	3.99	7.52	6.46	7.73	9.35	8.41	8.43	8.76	10.36
Zircon	0.12	*0.32*	0.07	0.09	0.09	0.14	0.16	0.09	0.02	0.09	0.1	0.09	0.13	0.13	0.16
Orthoclase	31.16	*28.45*	34.08	35.49	38.53	25.4	27.36	14.76	10.49	10.13	14.4	8.83	10.32	13.28	15.58
Albite	20.39	*34.52*	22.25	14.72	6.26	0	18.53	0.59	12.44	1.78	3.47	2.45	4.06	3.38	11.51
Anorthite	0	*0*	0	0.36	0	0	0	0	0	0	0	0	0	0	0
Acmite	0	*4.47*	0	0	0	0	0	0	0	0	0	0	0	0	0
Diopside	0	*0.09*	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypersthene	0	*1.2*	0	0.05	0	0	0	0	1.42	3.07	2.14	8.62	1.63	1.64	4.23
Olivine	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnetite	0.63	*2.95*	0	0	0	0.3	0	0	0.96	0.91	0.91	1.12	1.38	1.29	1.17
Chromite	0	*0*	0	0	0	0	0	0	0.01	0	0	0	0	0	0
Hematite	0.5	*0*	2	2.06	1.92	1.16	0.32	0.66	0	0	0	0	2.53	0.74	0
Ilmenite	0.27	*0.65*	0.42	0.27	0.38	0.28	0.34	0.38	0.7	0.4	0.42	0.38	0.34	0.38	0.47
Rutile	0	*0*	0	0.1	0.04	0	0	0	0	0	0	0	0	0	0
Apatite	0	*0*	0.03	0.03	0.03	0	0.03	0.03	0.05	0.02	0.02	0.05	0	0	0.1
Calcite	0.17	*0.16*	0.22	0	0.15	0.13	0.12	0.06	0.61	6.74	4.91	3.97	3.67	2.8	1.11
Magnesite	0.15	*0*	0.19	0	0.06	0.04	0.04	0.42	0.21	1.48	1.23	0.96	0.2	0.28	1.16
Siderite	0.56	*0*	0	0	0	0.12	0.03	0.15	0	1.69	0.17	0	0	0	0
Others	0	*0*	0.77	0	0.86	0	0.5	0.03	0	0	0	0	0	0	0
Total	99.22	*99.36*	99.05	97.15	97.58	98.29	98.71	96.21	96.83	96.83	95.94	95.17	94.34	95.32	94.41

† - Possibly an alkali rhyolite of the Mount Warning Complex.

Formation	Sugars Basalt						Weir Basalt					GSQ IPSWICH 26 Subunit "F"			
								NS 295							
Sample	022-01	022-05	022-06	022-07	022-09	022-11	018-01	260-03	260-04	260-05	260-06	261-34	261-33	261-32	261-31
Depth								135	196	210	275	935	953	953	968
Quartz	6.63	4.43	5.31	0	0	4.97	5.06	3.23	8.43	7.27	11.12	44.5	20.33	31.66	17.36
Corundum	0	0	0	1.68	0	2.3	3.84	0	0	2.4	0	9.83	8.44	5.6	4.86
Zircon	0.04	0.04	0.04	0.04	0.04	0.04	0.06	0.06	0.05	0.06	0.05	0.1	0.1	0.06	0.08
Orthoclase	10.07	10.19	10.19	10.48	10.6	6.57	2.01	3.61	6.28	3.43	3.37	17.84	15.58	3.79	9.13
Albite	25.21	26.91	25.3	55.76	43.83	48.31	44	44	30.21	40.87	33.51	8.21	17.26	31.31	48.99
Anorthite	27.53	26.57	27.2	10.34	19.26	12.61	12.09	20.97	25.69	18.91	23.17	0.98	4.92	1.92	3.65
Acmite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diopside	9.55	10.64	9.42	0	3.2	0	0	0.12	6.86	0	2.83	0	0	0	0
Hypersthene	10.41	9.45	10.95	9.18	9.8	8.32	16.18	14.56	8.23	11.51	12.18	5.34	17.22	11.96	3.33
Olivine	0	0	0	0.73	0.95	0	0	0	0	0	0	0	0	0	0
Magnetite	5.51	5.55	5.87	4.03	5.74	8.34	4.81	5.38	6.2	7.15	4.78	2.1	6.67	2.73	4.36
Chromite	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.04	0.04	0.03	0.03	0	0	0	0
Hematite	0	0	0	0	0	0	0	0	0.43	0	0	0	0	0	0
Ilmenite	2.7	2.68	2.66	3.04	2.85	2.58	3.13	2.89	2.77	3.06	2.62	0.74	0.7	2.26	3.04
Rutile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatite	0.74	0.71	0.71	0.73	0.76	0.65	1.22	1.23	1.19	1.3	1.15	0.29	0.1	1.19	1.49
Calcite	0.66	0.78	0.07	0.67	0.64	0.64	3.83	0.37	0.39	0.16	2.38	5.18	3.12	3.74	1.13
Magnesite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Siderite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	99.07	97.95	97.72	96.7	97.69	95.35	96.25	96.44	96.76	96.15	97.19	95.1	94.43	96.22	97.41

Formation	GSQ Ipswich 26														Mt. Byron Volcanics
	Subunit "F"											Subunit "E"			
Sample	261-30	261-29	261-27	261-26	261-24	261-23	261-20	261-19A	261-19B	261-18	261-16	261-15	261-12	261-11	181-01
Depth	970	980	983	985	1000	1011	1022	1027	1027	1033	1037	1064	1067.2	1077	
Quartz	12.87	12.15	9	18.41	21.41	12.4	14.8	15.8	15.14	3.31	8.75	23.34	45.85	29.49	34.42
Corundum	6.16	5.66	5.54	6.6	4.96	8.49	8.12	7.72	7.6	6.49	1.11	1.09	1.05	1.28	2.78
Zircon	0.08	0.05	0.08	0.08	0.06	0.08	0.07	0.07	0.07	0.07	0.07	0.04	0.03	0.04	0.09
Orthoclase	8.23	2.01	6.28	6.82	4.44	9.12	4.85	7.77	6.7	6.34	3.26	26.16	27.59	30.02	41.88
Albite	49.24	27.58	39.85	33.67	29.7	43.49	39.17	39.17	38.92	56.26	56.43	44.93	19.88	34.44	17.01
Anorthite	3.18	0	9.77	6.61	4.65	2.38	0.95	2.13	2.45	1.42	10.42	1.35	1.52	0.94	0
Acmite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diopside	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypersthene	7.97	12.73	12.59	7.77	10.15	8.22	15.52	11.34	12.15	9.36	3.1	1.28	1.63	1.34	0
Olivine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magnetite	2.73	3.22	3.42	8.51	1.86	3.25	2.62	3.39	3.41	4.02	1.2	0.59	0.51	0.49	0
Chromite	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
Hematite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.62
Ilmenite	3.13	1.88	3.13	2.92	3.11	4.58	3.93	3.91	3.86	4.23	3.51	0.27	0.21	0.23	0.25
Rutile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatite	2.19	1.07	1.48	1.4	1.02	1.48	1.33	1.05	1.26	1.43	1.35	0.05	0.05	0.05	0
Calcite	0.49	28.93	4.55	3.5	14.52	1.6	4.24	2.08	3.22	3.49	8.39	0.49	0.24	0.59	0.13
Magnesite	0	2.02	0	0	0	0	0	0	0	0	0	0	0	0	0
Siderite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.23
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.38
Total	96.27	97.31	95.69	96.29	95.89	95.09	95.61	94.43	94.77	96.43	97.6	99.59	98.56	98.9	99.78

Formation	Mount Samson Granodiorite						Samford Granodiorite	Enoggera Granite		Dayboro Tonalite
	266-03	267-01	267-02	268-02A (ENCLAVE)	268-02B	268-03	269-01	270-01	270-03	272-2
Quartz	19.29	8.24	8.33	10.21	15.56	25.19	23.58	30.39	29.2	19.59
Corundum	0	0	0	0	0	0.63	0.5	1.32	1.12	0.72
Zircon	0.04	0.02	0	0.05	0.04	0.03	0.04	0.03	0.03	0.04
Orthoclase	17.07	10.96	12.12	12.19	15.01	20.33	20.45	23.94	22.4	17.36
Albite	31.56	29.7	29.44	29.53	36.89	36.13	38.58	32.74	33.84	30.63
Anorthite	18.56	25.74	25.17	25.4	15.8	10.11	9.67	5.54	7.09	17.48
Acmite	0	0	0	0	0	0	0	0	0	0
Diopside	0.66	5.79	5.82	5.57	0.14	0	0	0	0	0
Hypersthene	7.77	12.88	12.38	7.49	10.9	4.08	3.83	3.48	2.91	8.46
Olivine	0	0	0	0	0	0	0	0	0	0
Magnetite	2.25	3.58	3.6	3.56	1.84	1.38	1.44	0.51	1.35	2.32
Chromite	0	0.01	0.01	0	0.02	0	0	0	0	0
Hematite	0	0	0	3.08	0	0	0	0	0	0
Ilmenite	1.31	1.82	1.73	1.73	1.42	0.74	0.74	0.51	0.61	1.31
Rutile	0	0	0	0	0	0	0	0	0	0
Apatite	0.36	0.48	0.4	0.38	0.5	0.29	0.31	0.19	0.22	0.36
Calcite	0.18	0.11	0.09	0.23	0.16	0.16	0.16	0.23	0.16	0.11
Magnesite	0	0	0	0	0	0	0	0	0	0
Siderite	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0
Total	99.05	99.34	99.08	99.4	98.3	99.08	99.31	98.88	98.92	98.38

Appendix C

Previously Published Chemical Analyses

This appendix contains the results of the previously published whole rock chemical analyses performed on the Brisbane Tuff, Sugars Basalt, Weir Basalt, NS 93, and QAO "The Overflow" No. 1. Precision for all analyses is reproduced as reported in literature.

Unit	Brisbane Tuff Levers Quarry	Brisbane Tuff NS15	NS295 (Weir Basalt)		NS256 (Sugars Basalt)			
Reference	Briggs (1928)	Houston (1967a)	Houston (1965)		Houston (1965)			
Depth			136'6"	200'5"	150'1"	179'4"	314'	396'
SiO_2	75.52	72	53.6	50.7	48	74.4	51.8	47.6
TiO_2	0.3	1.3	1.72	1.8	1.77	0.23	2.32	1.77
Al_2O_3	12.73	10	17	17.1	17.8	6.9	19.8	17.6
Fe_2O_3	2.18	4.3	5.8	5.9	6.6	4.5	6	6.3
FeO	1.43	0	3.1	3.2	3.3	2.3	3.3	4.2
MnO	0.01	0.05	0.16	0.31	0.25	0.17	0.09	0.21
MgO	0.27	0.6	4.5	5.1	5.2	2	1.3	6.8
CaO	0.28	1.3	6	6.2	5.3	2.3	6	9.5
Na_2O	2.3	2.56	3.9	4.3	4.3	0.6	4.3	2.3
K_2O	3.47	3.6	0.66	0.65	0.84	0.6	0.65	0.62
P_2O_5	0.16	0.08	0.3	0.53	0.32	0.01	0.22	0.22
H_2O^+	1.2	1.55	2	3	4	3.1	3.7	2.2
H_2O^-	0.48	0.45	0.38	0.44	0.8	0.54	0.58	0.38
CO_2	0	2.7	1.04	0.94	0	0	0	0
Total	100.33	100.49	100.16	100.17	98.48	97.65	100.06	99.7

Unit	NS93				Queensland American "The Overflow" No 1					
Reference	Houston (1965)				(Houston, 1967b)					
Depth	237'6"	2628'2"	3425'	2535'	1638'	1747'	1856'	2656'	2803'	2991'9"
SiO_2	60.9	55.1	49.6	57.6	54.8	52.9	53.7	70	50.2	65.6
TiO_2	0.18	2.46	2.28	1.86	1.33	1.59	1.65	0.36	2.6	0.54
Al_2O_3	17.8	18	18	19	17.8	18.4	17.7	10.3	17.3	15.5
Fe_2O_3	3.2	5	7.5	5.3	5.24	6.9	5.7	2.81	7.6	4.6
FeO	0.37	2.6	2	2.6	2.51	2.2	2.98	3.02	3.2	2.35
MnO	0.06	0.19	0.21	0.18	0.18	0.13	0.26	0.29	0.25	0.01
MgO	0.05	2.45	4.9	1.4	4.19	3.68	3.52	0.42	3.66	0.36
CaO	5.2	4.2	4.6	3.4	7.6	4.6	7.1	1.91	5	1.96
Na_2O	4.5	5.3	5.4	4.8	3	4.4	3.4	3.12	4	3.9
K_2O	0.03	1.2	0.32	0.67	0.65	1.72	1.41	4.87	1.53	4.05
P_2O_5	0.06	0.69	0.4	0.45	0.17	0.26	0.55	0.01	0.71	0.01
H_2O^+	5.3	1.25	3	1.2	1.68	1.88	1.4	0.26	1.92	0.68
H_2O^-	0.86	0.53	0.5	0.1	0.52	1.12	0.6	0.34	1.08	0.32
CO_2	0.07	1.08	1.13	1.08	0.05	0.12	0.06	2.6	0.39	0.15
Total	98.58	100.05	99.84	99.64	99.72	99.9	100.03	100.31	99.44	100.03

Appendix D

Plagioclase Microprobe Analyses

Unit	Sugars Basalt							Weir Basalt			
Sample	22-01				22-06			5-01	18-04		
Count	1	2	3	4	2	1	2	3	3	1	3
SiO_2	64.80	49.33	49.17	49.77	50.56	50.08	49.32	51.86	52.27	52.24	51.33
Al_2O_3	22.17	31.14	31.38	30.48	30.64	30.85	31.33	29.35	29.35	29.22	29.94
FeO	0.45	0.63	0.65	0.62	0.68	0.65	0.60	0.63	0.69	0.73	0.67
MgO	0.21	0.01	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.60	15.11	15.37	14.77	14.37	14.73	15.17	12.92	12.69	12.77	13.29
Na_2O	9.86	3.07	2.86	3.24	3.37	3.11	2.88	4.11	4.20	4.05	3.91
K_2O	1.82	0.23	0.19	0.27	0.23	0.23	0.21	0.36	0.38	0.33	0.35
Total	99.91	99.52	99.61	99.15	99.86	99.65	99.49	99.22	99.57	99.34	99.49
[O=32] Si	11.46	9.09	9.05	9.19	9.26	9.20	9.08	9.52	9.55	9.57	9.41
Al	4.62	6.76	6.81	6.64	6.61	6.68	6.80	6.35	6.32	6.31	6.47
Fe	0.07	0.10	0.10	0.10	0.10	0.10	0.09	0.10	0.11	0.11	0.10
Mg	0.06	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.11	2.98	3.03	2.92	2.82	2.90	2.99	2.54	2.49	2.51	2.61
Na	3.38	1.10	1.02	1.16	1.19	1.11	1.03	1.46	1.48	1.44	1.39
K	0.41	0.05	0.04	0.06	0.05	0.05	0.05	0.08	0.09	0.08	0.08
Sum	20.11	20.08	20.06	20.08	20.05	20.03	20.04	20.05	20.04	20.01	20.06
An	3	72	74	70	69	71	74	62	61	62	64
Ab	87	27	25	28	29	27	25	36	37	36	34
Or	11	1	1	2	1	1	1	2	2	2	2

Sample refers to the polished section analyses, and *count* refers to the number of determinations undertaken on each grain.

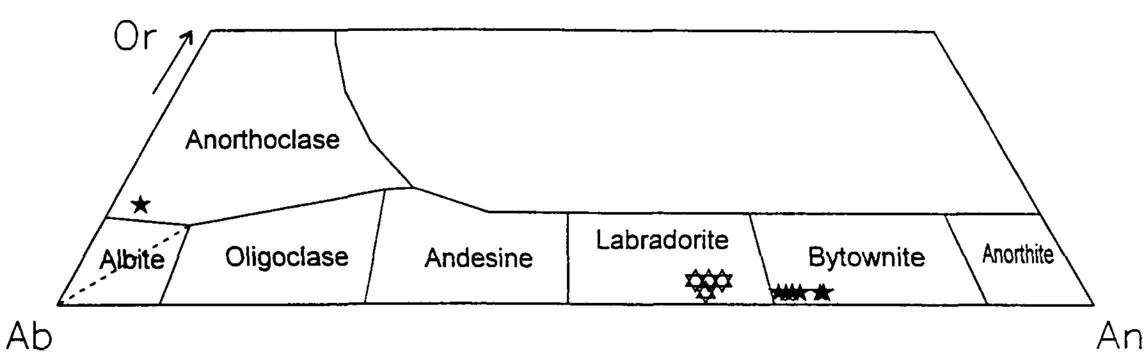


Figure D.1 Feldspar tetrahedra of Deer *et al.* (1978) showing the compositions of Ipswich Basin plagioclases. (✡=Weir Basalt; ★=Sugars Basalt; ▲=GSQ26 Subunit F)

Appendix E

Clinopyroxene Microprobe Data

This appendix contains the clinopyroxene microprobe data performed at the School of Earth Sciences on the Cameca Camebax SX50 electron microprobe. In the table, *Sample* refers to the polished section analyses, and *count* refers to the number of determinations undertaken on each grain

Unit	Sugars Basalt														
Sample	22-01			22-03						22-06					
Count	2	2	3	2	2	2	1	2	2	2	2	2	3	1	2
SiO_2	51.11	48.78	49.36	50.32	49.57	50.52	50.65	51.03	48.61	52.35	52.07	49.20	49.36	48.99	51.42
TiO_2	1.07	1.17	1.11	1.01	1.33	1.19	0.86	1.04	1.43	0.61	0.65	1.43	1.29	1.25	0.68
Al_2O_3	1.85	4.89	4.34	3.60	4.25	4.36	2.14	2.17	5.13	2.06	2.09	4.63	4.64	5.01	2.75
Cr_2O_3	0.03	0.91	0.54	0.48	0.42	0.49	0.34	0.17	0.58	0.38	0.31	0.49	0.45	0.78	0.57
FeO	9.66	7.44	7.23	7.52	7.87	7.10	10.89	9.61	7.61	7.14	6.95	7.61	7.58	7.52	7.13
MnO	0.31	0.14	0.19	0.22	0.24	0.15	0.29	0.26	0.20	0.20	0.21	0.24	0.18	0.15	0.20
MgO	15.11	14.72	15.06	15.79	14.49	15.03	14.14	14.90	14.26	16.89	16.95	14.12	14.89	14.61	16.19
CaO	20.00	21.08	21.42	20.54	20.58	21.68	18.99	19.70	21.18	20.24	20.32	21.77	20.58	21.00	20.58
Na_2O	0.27	0.31	0.29	0.28	0.28	0.26	0.31	0.27	0.30	0.18	0.20	0.29	0.28	0.28	0.24
K_2O	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00
NiO	0.00	0.02	0.00	0.03	0.06	0.02	0.01	0.03	0.06	0.02	0.04	0.01	0.01	0.00	0.03
Total	99.42	99.47	99.54	99.76	99.06	100.78	98.61	99.16	99.34	100.03	99.75	99.79	99.26	99.59	99.75
Mg#	0.74	0.78	0.79	0.79	0.77	0.79	0.70	0.73	0.77	0.81	0.81	0.77	0.78	0.78	0.80
Si	1.92	1.83	1.84	1.87	1.86	1.86	1.93	1.92	1.82	1.93	1.92	1.84	1.85	1.83	1.91
Al	0.08	0.22	0.19	0.16	0.19	0.19	0.10	0.10	0.23	0.09	0.09	0.20	0.20	0.22	0.12
Ti	0.03	0.03	0.03	0.03	0.04	0.03	0.02	0.03	0.04	0.02	0.02	0.04	0.04	0.04	0.02
Cr	0.00	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.02	0.02
Fe	0.30	0.23	0.23	0.23	0.25	0.22	0.35	0.30	0.24	0.22	0.21	0.24	0.24	0.24	0.22
Mn	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Mg	0.85	0.82	0.84	0.87	0.81	0.82	0.80	0.84	0.80	0.93	0.93	0.79	0.83	0.81	0.89
Ca	0.81	0.85	0.86	0.82	0.83	0.85	0.77	0.79	0.85	0.80	0.80	0.87	0.82	0.84	0.82
Na	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
Sum	4.02	4.03	4.03	4.03	4.01	4.02	4.01	4.01	4.02	4.01	4.02	4.02	4.02	4.02	4.02
F_1	-0.8427	-0.8312	-0.8353	-0.8226	-0.8499	-0.8575	-0.8185	-0.8367	-0.8547	-0.8002	-0.8015	-0.8713	-0.8395	-0.8386	-0.8063
F_2	-2.4774	-2.3971	-2.4116	-2.4471	-2.4521	-2.4642	-2.4521	-2.4718	-2.4212	-2.4797	-2.4705	-2.4389	-2.4399	-2.4178	-2.4506

Unit	Sugars Basalt										Weir Basalt				
Sample	22-06							22-12			5-01				18-03
Count	2	2	2	1	2	2	3	3	2	3	2	4	4	3	3
SiO_2	51.29	49.57	50.52	50.65	51.03	48.61	51.44	51.44	50.32	49.84	50.51	50.96	49.92	48.86	50.88
TiO_2	0.92	1.33	1.19	0.86	1.04	1.43	0.81	0.81	1.01	0.97	0.91	0.83	1.15	1.29	0.74
Al_2O_3	1.94	4.25	4.36	2.14	2.17	5.13	2.22	2.22	3.60	3.68	3.24	2.81	3.61	4.68	3.42
Cr_2O_3	0.16	0.42	0.49	0.34	0.17	0.58	0.20	0.20	0.48	0.50	0.42	0.39	0.49	0.49	0.59
FeO	9.54	7.87	7.10	10.89	9.61	7.61	8.21	8.21	7.52	7.06	7.63	7.39	8.15	7.90	6.97
MnO	0.26	0.24	0.15	0.29	0.26	0.20	0.23	0.23	0.22	0.19	0.25	0.22	0.22	0.23	0.18
MgO	15.25	14.49	15.03	14.14	14.90	14.26	16.21	16.21	15.79	15.45	16.07	16.17	15.01	14.45	16.21
CaO	19.44	20.58	21.68	18.99	19.70	21.18	19.91	19.91	20.54	21.21	20.40	20.54	20.83	21.51	20.07
Na_2O	0.28	0.28	0.26	0.31	0.27	0.30	0.22	0.22	0.28	0.28	0.24	0.23	0.28	0.27	0.40
K_2O	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.00
NiO	0.02	0.06	0.02	0.01	0.03	0.06	0.01	0.01	0.03	0.00	0.02	0.03	0.01	0.01	0.02
Total	99.07	99.06	100.78	98.61	99.16	99.34	99.46	99.46	99.76	99.17	99.68	99.57	99.69	99.72	99.48
Mg#	0.74	0.77	0.79	0.70	0.73	0.77	0.78	0.78	0.79	0.80	0.79	0.80	0.77	0.77	0.81
Si	1.93	1.86	1.86	1.93	1.92	1.82	1.92	1.92	1.87	1.87	1.88	1.90	1.87	1.83	1.89
Al	0.09	0.19	0.19	0.10	0.10	0.23	0.10	0.10	0.16	0.16	0.14	0.12	0.16	0.21	0.15
Ti	0.03	0.04	0.03	0.02	0.03	0.04	0.02	0.02	0.03	0.03	0.03	0.02	0.03	0.04	0.02
Cr	0.00	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Fe	0.30	0.25	0.22	0.35	0.30	0.24	0.26	0.26	0.23	0.22	0.24	0.23	0.25	0.25	0.22
Mn	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.85	0.81	0.82	0.80	0.84	0.80	0.90	0.90	0.87	0.86	0.89	0.90	0.84	0.81	0.90
Ca	0.78	0.83	0.85	0.77	0.79	0.85	0.80	0.80	0.82	0.85	0.81	0.82	0.83	0.86	0.80
Na	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Sum	4.01	4.01	4.02	4.01	4.01	4.02	4.02	4.02	4.03	4.03	4.03	4.02	4.03	4.03	4.02
F_1	-0.8242	-0.8499	-0.8575	-0.8185	-0.8367	-0.8547	-0.8100	-0.8100	-0.8226	-0.8250	-0.8118	-0.8122	-0.8410	-0.8496	-0.8032
F_2	-2.4721	-2.4521	-2.4642	-2.4521	-2.4718	-2.4212	-2.4663	-2.4663	-2.4471	-2.4120	-2.4485	-2.4484	-2.4399	-2.4172	-2.4439

Unit	Weir Basalt															
Sample	18-03							18-04								
Count	2	3	2	2	3	4	4	3	2	2	1	3	3	3	3
SiO_2	51.46	50.82	51.19	51.74	50.90	51.01	51.05	50.02	51.76	50.88	50.72	50.51	50.24	51.03	50.54
TiO_2	0.67	0.72	0.76	0.63	0.65	0.82	0.82	0.93	0.61	0.72	0.82	0.83	0.84	0.79	0.78
Al_2O_3	2.94	2.61	2.91	2.57	3.15	3.02	3.37	3.85	2.90	2.96	3.63	3.80	3.94	3.52	3.47
Cr_2O_3	0.49	0.16	0.32	0.35	0.57	0.37	0.43	0.24	0.51	0.59	0.37	0.56	0.66	0.32	0.54
FeO	7.33	4.29	7.79	7.12	6.75	7.90	7.03	7.98	6.80	7.59	6.95	6.97	7.39	7.35	7.15
MnO	0.19	0.13	0.19	0.29	0.21	0.22	0.22	0.21	0.21	0.19	0.19	0.18	0.20	0.19	0.26
MgO	16.46	16.26	16.13	16.78	16.17	15.88	16.07	15.59	16.71	16.03	15.85	15.66	15.85	16.11	16.08
CaO	19.94	19.77	19.86	20.00	20.40	19.84	20.41	20.16	19.83	20.31	20.57	20.38	19.96	20.02	20.29
Na_2O	0.35	0.35	0.34	0.36	0.38	0.39	0.33	0.34	0.37	0.36	0.38	0.39	0.36	0.36	0.37
K_2O	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.01
NiO	0.03	0.01	0.05	0.03	0.01	0.01	0.01	0.05	0.03	0.00	0.00	0.05	0.01	0.06	0.01
Total	99.85	95.13	99.52	99.84	99.18	99.44	99.73	99.36	99.73	99.62	99.48	99.31	99.45	99.74	99.49
Mg#	0.80	0.88	0.79	0.81	0.81	0.78	0.80	0.78	0.81	0.79	0.80	0.80	0.79	0.80	0.80
Si	1.90	1.94	1.90	1.91	1.89	1.90	1.89	1.87	1.91	1.89	1.88	1.88	1.87	1.89	1.88
Al	0.13	0.12	0.13	0.11	0.14	0.13	0.15	0.17	0.13	0.13	0.16	0.17	0.17	0.15	0.15
Ti	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Cr	0.01	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.02
Fe	0.23	0.14	0.24	0.22	0.21	0.25	0.22	0.25	0.21	0.24	0.22	0.22	0.23	0.23	0.22
Mn	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.91	0.93	0.89	0.92	0.90	0.88	0.89	0.87	0.92	0.89	0.88	0.87	0.88	0.89	0.89
Ca	0.79	0.81	0.79	0.79	0.81	0.79	0.81	0.81	0.78	0.81	0.82	0.81	0.80	0.79	0.81
Na	0.03	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sum	4.02	3.99	4.02	4.02	4.02	4.02	4.02	4.03	4.02	4.03	4.02	4.02	4.02	4.02	4.03
F_1	-0.7998	-0.7930	-0.8060	-0.7987	-0.8002	-0.8125	-0.8145	-0.8121	-0.7949	-0.8057	-0.8155	-0.8126	-0.8026	-0.8071	-0.8050
F_2	-2.4599	-2.4077	-2.4553	-2.4750	-2.4320	-2.4575	-2.4609	-2.4346	-2.4705	-2.4337	-2.4436	-2.4370	-2.4382	-2.4598	-2.4420

Unit	Weir Basalt								GSQ26 sub-unit F							
Sample	18-04	260-06							261-19							
Count	4	2	3	2	2	3	2	2	3	4	2	6	5	2	3	3
SiO_2	50.58	50.48	50.03	49.14	49.14	49.39	51.63	49.45	50.97	50.47	50.57	50.09	50.30	50.63	50.30	50.30
TiO_2	0.86	0.97	0.99	1.28	1.28	1.12	0.60	1.22	0.76	0.84	0.84	0.88	0.89	0.83	0.93	0.93
Al_2O_3	3.15	3.34	3.92	4.56	4.56	4.45	2.12	4.06	3.18	3.81	3.47	3.71	3.63	3.42	3.14	3.14
Cr_2O_3	0.36	0.54	0.78	0.69	0.69	0.57	0.26	0.30	0.44	0.58	0.49	0.39	0.34	0.25	0.24	0.24
FeO	7.90	7.39	7.41	7.08	7.08	7.26	7.37	7.86	7.77	7.39	7.50	7.42	7.41	7.46	8.72	8.72
MnO	0.23	0.21	0.18	0.14	0.14	0.23	0.24	0.19	0.20	0.23	0.22	0.20	0.20	0.21	0.29	0.29
MgO	15.86	15.89	15.61	14.56	14.56	14.76	16.93	14.90	16.84	16.02	16.16	15.92	15.92	15.99	15.72	15.72
CaO	19.91	20.57	20.35	21.76	21.76	21.30	19.97	21.00	19.05	20.04	20.05	20.21	20.27	20.50	19.69	19.69
Na_2O	0.37	0.28	0.28	0.31	0.31	0.28	0.23	0.28	0.33	0.41	0.35	0.36	0.35	0.36	0.36	0.36
K_2O	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01
NiO	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.02	0.05	0.02	0.04	0.04
Total	99.22	99.67	99.54	99.54	99.54	99.36	99.36	99.27	99.57	99.83	99.66	99.20	99.35	99.66	99.43	99.43
Mg#	0.78	0.79	0.79	0.79	0.79	0.78	0.80	0.77	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76
Si	1.89	1.88	1.86	1.84	1.84	1.85	1.92	1.85	1.89	1.87	1.88	1.87	1.88	1.88	1.88	1.88
Al	0.14	0.15	0.17	0.20	0.20	0.20	0.09	0.18	0.14	0.17	0.15	0.16	0.16	0.15	0.14	0.14
Ti	0.02	0.03	0.03	0.04	0.04	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03
Cr	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Fe	0.25	0.23	0.23	0.22	0.22	0.23	0.23	0.25	0.24	0.23	0.23	0.23	0.23	0.23	0.27	0.27
Mn	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.88	0.88	0.87	0.81	0.81	0.82	0.94	0.83	0.93	0.89	0.89	0.89	0.88	0.89	0.88	0.88
Ca	0.80	0.82	0.81	0.87	0.87	0.85	0.80	0.84	0.76	0.80	0.80	0.81	0.81	0.82	0.79	0.79
Na	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sum	4.02	4.02	4.02	4.03	4.03	4.02	4.02	4.03	4.02	4.03	4.03	4.03	4.03	4.03	4.03	4.03
F_1	-0.8102	-0.8211	-0.8159	-0.8553	-0.8553	-0.8365	-0.7901	-0.8418	-0.7861	-0.8078	-0.8063	-0.8069	-0.8110	-0.8135	-0.8117	-0.8117
F_2	-2.4442	-2.4446	-2.4341	-2.4082	-2.4082	-2.4219	-2.4562	-2.4246	-2.4629	-2.4493	-2.4469	-2.4272	-2.4358	-2.4421	-2.4506	-2.4506

Appendix F

Anisotrophy of Magnetic Susceptibility Data

Table F.2. Sample localities and results for AMS study.

Sample	Grid Reference (Easting Northing)	n	D_1	I_1	α_{95}	Bulk susceptibility μG/Oe	Anisotropy	Lineation	Foliation
ARPHD0086-01	5008 69714	9	70.7	37.9	11.0	7.00	1.026	1.019	1.007
ARPHD0088-02 ARPHD0088-05	5024.2 69680.5	14	24.9	24.4	8.9	4.2	1.036	1.023	1.013
ARPHD0090-03	5023.5 69681.3	4	12.6	30.3	24.9	8.0	1.023	1.015	1.008
ARPHD0092-03	5022.5 69681.5	4	349.5	39.1	7.0	9.4	1.023	1.019	1.004
ARPHD0097-01	5017.5 69699	3	113.9	71.8	35.2	6.7	1.018	1.012	1.005
ARPHD0098-01 ARPHD0098-02	5016 69697.5	10	5.8	28.5	15.1	7.6	1.020	1.013	1.007
ARPHD0099-01 ARPHD0099-02 ARPHD0099-05	5016.5 69698	32	335.6	57.7	15.2	7.7	1.032	1.021	1.011
ARPHD0100-01	5017.5 69698	8	92.3	40.7	14.0	7.1	1.034	1.019	1.015
ARPHD0111-01	5049.5 69655	5	261.4	38.9	12.4	2.7	1.034	1.027	1.006
ARPHD0121-01	5043.5 69622.5	5	261.4	38.9	39.0	2.7	1.034	1.027	1.006
ARPHD0156-01	5034.5 69606.5	9	222.4	2.1	20.2	1.7	1.027	1.016	1.011
ARPHD0166-01	5100 69577	8	322.1	74.7	6.4	3.8	1.027	1.021	1.006

Declination (D_1) and inclination (I_1) are for the maximum principal axes of the samples. α_{95} is the radius of confidence cone (Fisher, 1953), values less that 20 can be considered statistically good. n is the number of measurements on each sample. Anisotropy, lineation, and foliation are defined below.

Definitions (from Tarling & Hrouda, 1993)

k_1 = the maximum principal axis

k_2 = the intermediate principal axis

k_3 = the minimum principal axis

Bulk susceptibility (k) is defined as: $k = \frac{k_1 + k_2 + k_3}{3}$

Lineation magnitude is defined as: $L = \frac{k_1}{k_2}$

Foliation magnitude is defined as: $F = \frac{k_2}{k_3}$

Degree of anisotropy is defined as: $A(P) = \frac{K_1}{K_3}$

t (shape parameter) is defined as: $t = \frac{(2\eta_2 - \eta_1 - \eta_3)}{(\eta_1 - \eta_3)}$ (where η is the natural log of k)

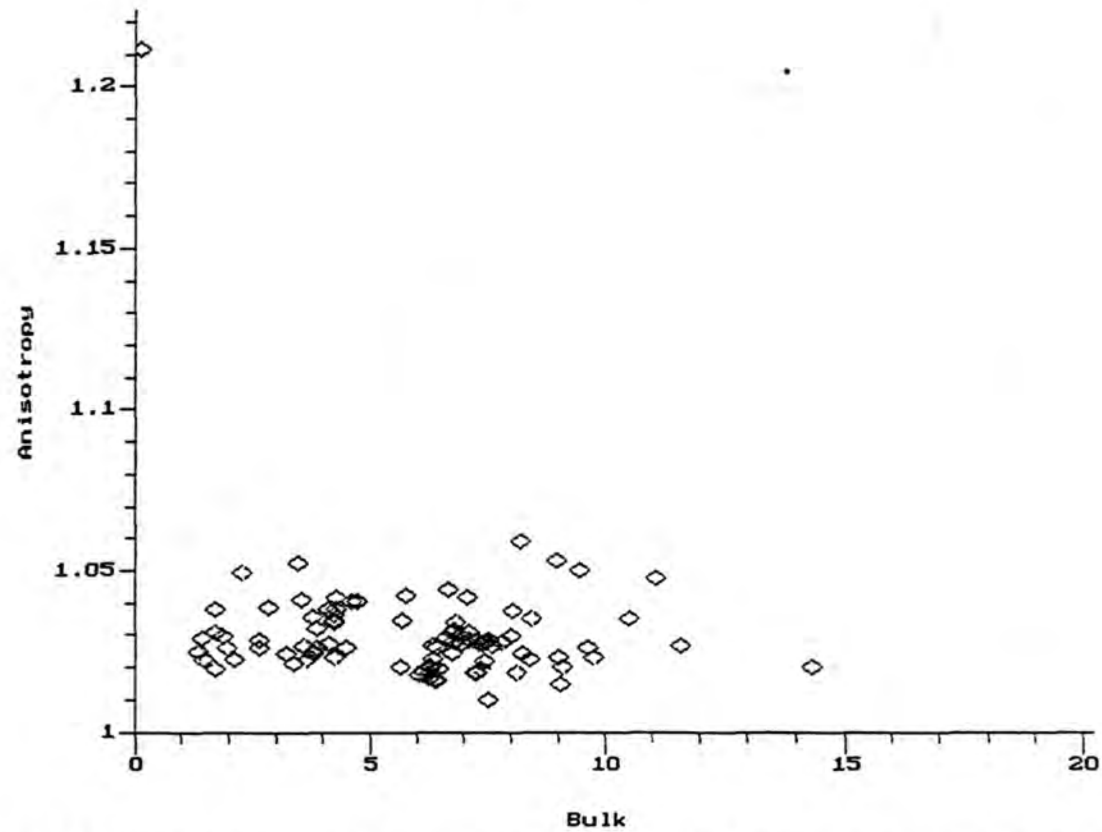


Figure F.1 Graph of anisotropy v bulk susceptibility showing the low anisotropy of the samples, which indicates negligible magnetite in the samples. The anomalous sample with the anisotropy of 1.21 was from a part of the Brisbane Tuff extensively affected by fumarolic activity.

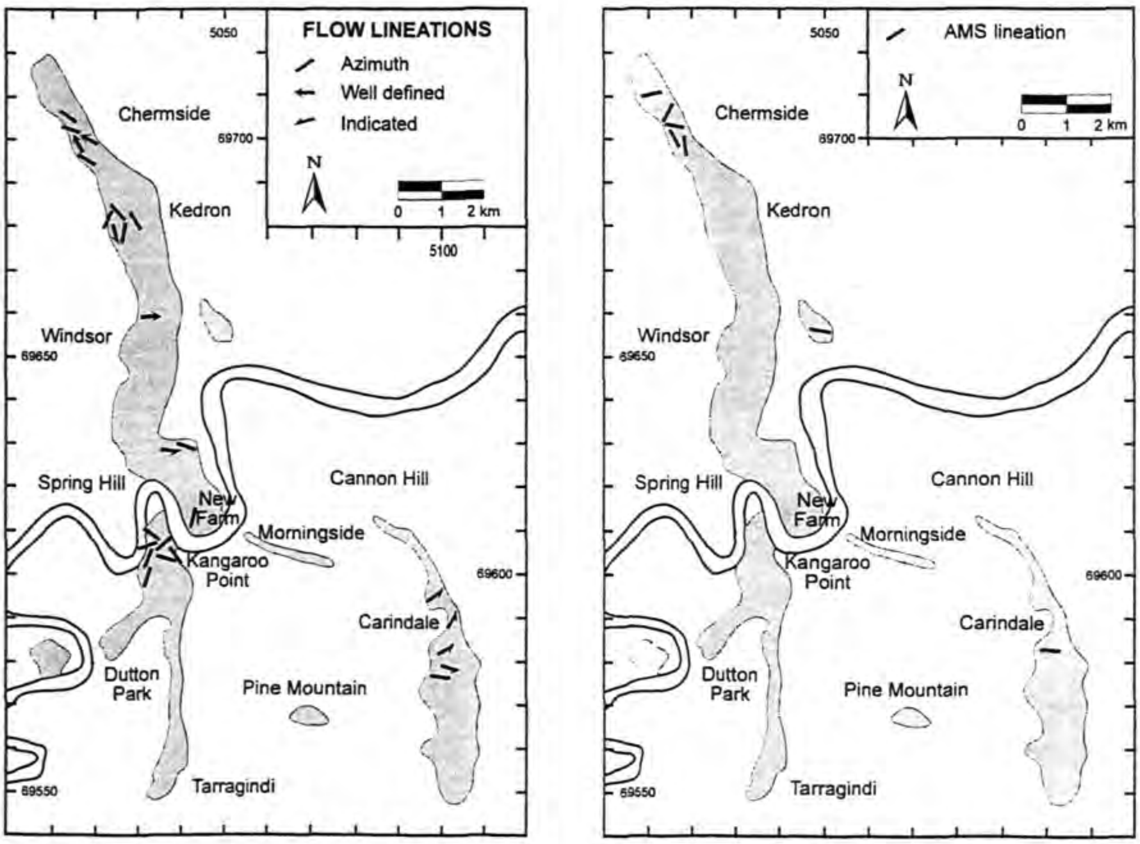


Figure F.2 Comparison between the rock fabric method (left) and the AMS method (right) for determining flow direction.

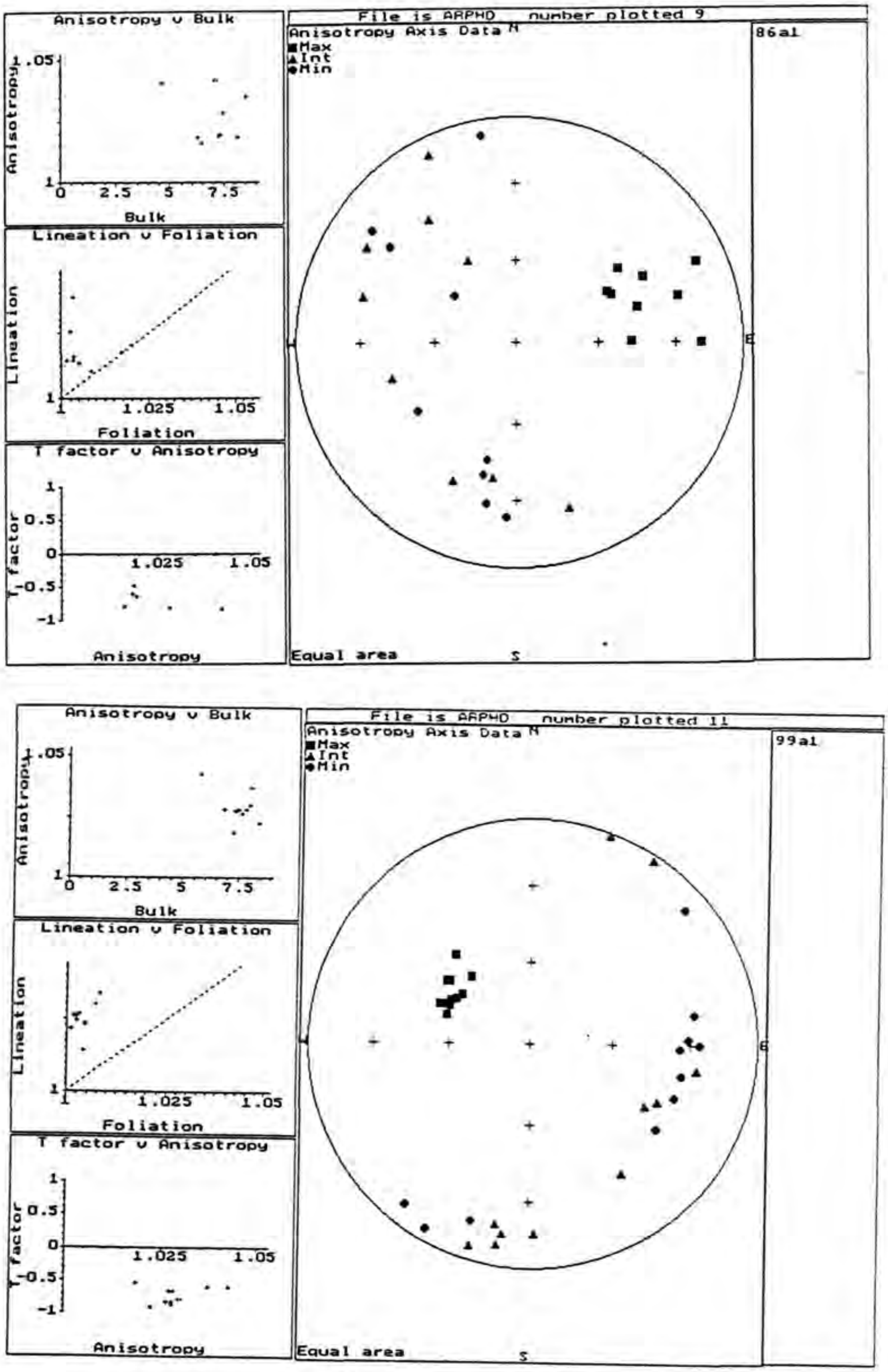


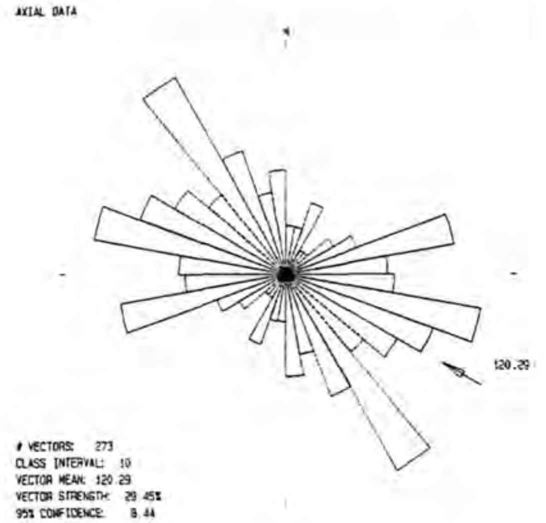
Figure F.3 Typical AMS results from sites ARPHD0086-01 and ARPHD0099-01. The stereonet plots the maximum axis (k_1), the intermediate axis (k_2), and the minimum axis (k_3). The plot of mean anisotropy versus bulk susceptibility is used to visually quantify the scatter of results. The graph of lineation versus foliation determines the shape of the ellipsoid. Points plotting above the dotted line are said to be *prolate*, or rod like, while those plotting below the line are *oblate*, or disk shaped. The "t factor" (t) versus anisotropy graph is a quantitative way of measuring how prolate or oblate the sample is, with negative values being prolate, and positive values oblate.

Appendix G

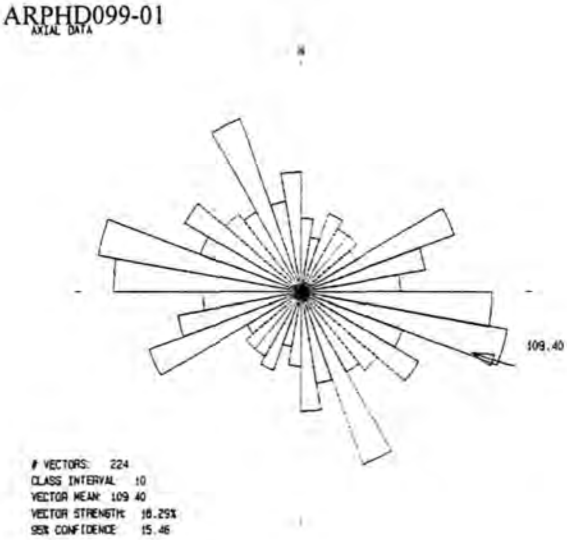
Rock Fabric Data

Sample	Vector Mean
ARPHD0086-01	140
ARPHD0088-02	29
ARPHD0092-01	166
ARPHD0092-03	11
ARPHD0093-02	133
ARPHD0093-03	120
ARPHD0098-02	137
ARPHD0098-03	152
ARPHD0099-01	120
ARPHD0099-04	114
ARPHD0118-01	86
ARPHD0130-01	109
ARPHD0133-02	15
ARPHD0134-02	108
ARPHD0135-01	20
ARPHD0156-01	109
ARPHD0156-02	25
ARPHD0157-01	143
ARPHD0157-02	30
ARPHD0161-01	59
ARPHD0162-02	40
ARPHD0163-01	60
ARPHD0166-01	109
ARPHD0166-03	96
ARPHD0286-04	74
ARPHD0287-01	145

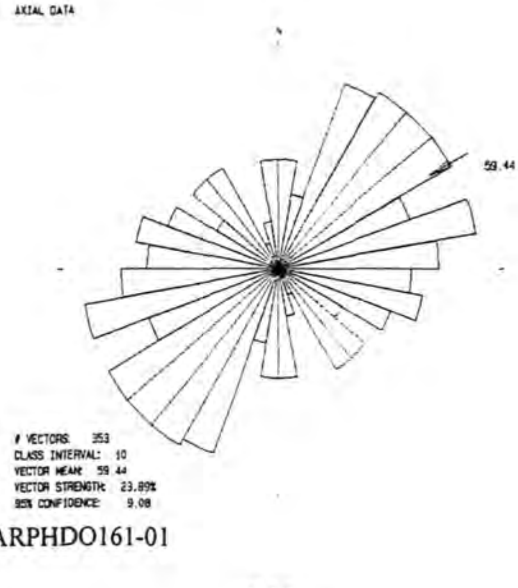
Examples of Flow Lineation Rose Diagrams



ARPHD099-01



ARPHD0130-01



ARPHDO161-01

Appendix H
GCPLOT

H.1 Introduction

GCPLOT is an "ANSI C" computer program written for producing the geochemical plots used in the thesis. The program makes use of *Plplot Plotting Library*, available from anonymous ftp at hagar.ph.utexas.edu (IP=128.83.179.27). The program, in various versions, has been successfully compiled and executed on the following platforms:

Linux
Unix System V running on SunOS 5.5
MS-DOS
Amiga DOS

Plots are generated by parsing a script language which contains the plot definitions. In addition to producing simple binary plots, the program is capable of producing ternary and logarithmic plots, all of which can have discrimination fields and text added to them. Up to 2000 different plotting symbols can be used to discriminate amounts individual or groups of samples, and output is to a variety of high quality devices.

H.2 Command Line Usage

```
GCPLOT [input file] [-g [graph file]] <options>
```

Options

-p sets x by y sub-pages
-g input file for types of graph to plot
-f input file for sample filter
-s scale point by a factor of []
-x used extended font [] as default font
-d prints out all data to STDIO
-v operate in verbose mode
-P Show progress
-o orientation Horz < Vert
-nz don't plot zeros
-np don't plot graphs

`[input file]` is a variable length multicolumar text file which contains the data to be plotted. The first line contains unique case insensitive labels for each of the columns, and the last line of the file contains the terminating character "Z". The following labels are reserved for special use:

SAMPLE - The sample number/ text

CODE or **SYMBOL** - The symbol plotted on the graph (default to a cross)

COLOUR or **COLOR** - The colour of that particular plot symbol (not needed)

`-g [graph file]` is the file name of the script file which contains the instruction defining how the graphs should be plotted.

`-f [filter file]` is an exclusion file which is used to select which samples are not plotted. All samples listed in the file will be ignored when plotting is done.

`-p [x] [y]` sets the number of plots in the x and y dimension to be drawn on each page.

`-s [num]` sets the scaling factor for the plot symbols by factor *num*.

`-x [num]` use extended font [num] as default where:

1 = normal font

2 = Roman font

3 = Italic font

4 = Script font

`-v` when the program is running this option will display data about the graph about to be plotted.

`-P` show progress.

`-o` Forces the plots to be made in portrait mode rather than landscape.

`-nz` forces the computer to skip any zero values when plotting.

H.3 Graph File Script Language

The graph file contains the data which tells defines how the plots are produced. It usually contains a couple of lines of commands (preceded by a "#") and then a line detailing what is being plotted against what. The graph is not plotted until the plot "expression" is specified.

H.3.1 Line Comment

#

Anything can be put on the line for comments, or just spacing, but it must have a space following the "#".

H.3.2 Axis Captions

#x #y #a #b #c

#x and #y are used for binary plots, while #a, #b, and #c are used for ternary plots. The format is the command followed by a space, then the rest of the line is read in and used for the caption, so it is possible to include spaces etc.

Special codes can be included within any text (ie all other text functions in the program support it), they are:

#u move up (superscript, or return to normal from subscript)
#d move down (subscript, or return to normal from superscript)
#b backspace
the "#"
#+ overline
#- underline
#g[x] Greek character corresponding to roman letter x *

For example,

#x SiO#d2#u

will produce:

SiO_2

H.3.3 Title Caption

#t <Title text including spaces>

eg.

#t This is the Title of the Graph

The format is the command followed by a space, then the rest of the line is read in and used for the title.

H.3.4 Axis or Box Options

#xa <options> #ya <options>

eg.

#xa bctns

The command consists of one word, which is made up of the following letters:

a : Draws axis
b : Draws bottom (X) or left (Y) edge of frame
c : Draws top (X) or right (Y) edge of frame
g : Draws a grid at the major tick intervals
I : Inverts tick marks, so they are drawn outwards, rather than inwards.
l : Label axis logarithmically
m : Writes numeric labels at major tick intervals in the unconventional locations (above for X, right for Y)
n : Writes numeric labels at major tick intervals in the conventional locations (below for X, right for Y)
s : Enables sub-ticks between major ticks (only if t is specified)
t : Draw major ticks

The default is "bctns". By selecting an "l" the program will use logarithmic scales on the axis specified.

H.3.5 Default X and Default Y Scaling Factors

#dx <min> <max> or #dy <min> <max>

eg.

#dx 0 150

The command has two parameters, min and max, which will set the scales of the graph. Auto scaling is usually performed.

H.3.6 Draw A Vector

#v

The draw a vector command has no command after it. It is used to introduce a sub-set language which is used for drawing vectors on discrimination fields. The first line immediately following the command specifies the line type to use (there are eight pre-defined line types, 1 is solid 2 - 8 are dashed). All subsequent lines contain pairs of numbers defining the next point in the line to be drawn. When one line segment is finished, and a new once begins, a "#n" is placed on the command line. When all vectors are finished a "#z" is placed after the last co-ordinate.

eg.

```
#v
1       (line type)
41 .5   (start point)
41 7    (end of first line)
52.5 14
57.6 11.7
63 7.7
63 2
#n      (start drawing next vector)
2       (dashed line)
63 2
63 .5
#n
1
41 3
45 3
#z      (finish vector drawing)
```

H.3.7 Print Line

#p <x> <y> <dx> <dy> <just> <Text>

This command is used for printing text anywhere on the graph. It plugs all the data that you enter straight into the plplot text functions.

<x> <y> coordinates of reference point of strings
<dx> <dy> Specifies the inclination of the string. The baseline of the string is parallel to a line joining (x,y) (x+dx, y+dy)
<just> Justification. 0 = left justified, 1= right, anything in between is, well - in between (0.5 is centred)
<text> The text
eg.

#p 65 5 5 0 .5 Dacite
#p 73 8 5 0 .5 Rhyolite
#p 61 11 5 0 .5 Trachyte

H.3.8 Load File

#l <file name>

This command loads a file containing a set of instructions in the *Graph File Script Language*.

eg. #l boo.flt

H.3.9 Operators

Anything which is not preceded by a "#" is treated as a command for specifying the plot. The following operators are legal within the command : "+", "-", "*", "/", "(", ")", and "v". Anything which is not a column label (defined in the first line of the input file), or an operator, is treated as a number. Each label, operator, and number has to be separated by a space, for example:

`SiO2vTiO2` is incorrect

`SiO2 v TiO2` is correct

or

`6*(Na2O+K2O)v(Al2O3-(P2O5/(5+CaO)))` is incorrect

`6 * ( Na2O + K2O ) v ( Al2O3 - ( P2O5 / ( 5 + CaO ) ) )` is correct

To do a ternary plot, rather than a binary plot, an extra "v" is added.

eg.

A v F v M

Will plot an AFM diagram (using cells labelled A, F, and M from the data file).

H.4 Program Listings

The program source code comprises four files. The main module is *gcplot.c*, and its associated header file, *gcplot.h*. The subroutines for implementing ternary plots are contained in modules *pltri.c*, and *pltri.h*.

```
#include <stdio.h>
#include <math.h>
#include "plplot.h"
#include "gcplot.h"
#include "pltri.h"
#include <ctype.h>
#include <string.h>
#include <stdlib.h>
#ifndef AMIGA
#include <sys/types.h>
#else
#include <exec/types.h>
#endif
#ifdef MSDOS
#include <malloc.h>
#endif
#define VERSION 1.48
#define RewindCell()  while (CurrentCell->prev!=NULL) CurrentCell=CurrentCell->prev

/*                  GCPLOT.C
 *
 *  VERSION: 1.48
 *  CREATED: 4/9/93
 *  UPDATED: 30/09/96
 *  AUTHOR : A. Roach
 *  MACHINE: UNIX
 *  PURPOSE: To plot Harker diagrams and other variation diagrams
 *           This is the next development of the HARKER program
 *  HISTORY:
 *  V1.48 30/09/96- Fixed a bug/feature that prevented negative values
 *                  from being plotted on axes
 *  V1.47 22/08/95- Added ability to print out labelwith plot point in
 *                  ternary diagrams as well as binary
 *  V1.46 22/08/95- Added some new features, namely Label plotting beside point
 *                  I was always going to do this, but after Karen needed it
 *                  I decided to increase its priority. New command is
 *                  "#lp", which means label plot.
 *                  usage is #lp [scale] (set to 0 to stop plotting)
 *  V1.45 22/08/95- MAJOR bug found in the code which was stopping single
 *                  graphs from being printed out. That mistake was fixed
 *                  in version 1.44, but introduced a new problem (recursive
 *                  file loading was no longer supported). Hopefully this will
 *                  fix it
 *  V1.44 21/08/95- replaces "home brewed" stricmp function with a reference
 *                  to a function in plplots library.
 *                  Tried to track down a major bug stopping me plotting half
 *                  the stuff I want to plot.
 *  V1.43 03/06/95- Changed reference to "index" to "gc_index" to overcome
 *                  a problem with a predefined index value under linux.
 *                  Made a makefile for linux, and added a "stricmp"
 *                  function.
 *  V1.42 16/08/94- Found a small bug in the DX and DY(?) functions which
 *                  was causing an extra log cycle to be plotted on the
 *                  MAX end.
 *  V1.41 12/08/94- Fixed up a minor bug with the LOAD function
 *                  which was causing it to plot a blank graph
```

```
*                    after every plot !
*                    Fixed up a small problem with PLTRI whcih was
*                    causing erroneous plots.
*  V1.40 10/08/94- Added code for the generation of a KEY (#k) with
*                    the symbol, and the corresponding sample.
*  V1.39 10/08/94- Added "sequential" mode plotting which automatically
*                    changes the symbols used in a particular pattern
*  V1.38 09/08/94- Tried to add code to ensure the "safety" of the
*                    Log10 code.
*  V1.37 09/08/94- Cleaned code up a bit in general.
*                    Added code to "GetFloat" and "GetString" thus
*                    removing a lot of duplicate stuff
*  V1.36 29/07/94- Added code to support colour changing for the text
*                    Added code to reset the text size between plots
*  V1.35 29/07/94- Added an option to vary the size of the text which
*                    is printed using the scaling functions
*  V1.34 29/07/94- Added a fix for a new bug which was introduced
*                    by the V1.32-V1.33 fixes which was prohibiting the
*                    manual change of scale functions from working
*  V1.32 13/07/94- Another bug which caused a phantom plot
*                    was (inadvertently) introduced to the
*                    program when the V1.31 "fix" was added. Hopefully
*                    this will correct it.
*  V1.31 05/07/94- Attempted to fix a bug in the MS-DOS version which
*                    made it go "weird" when it tried to read a graphics
*                    file prepared on an MS-DOS machine.
*  V1.30 28/04/94- Port the code to MS-DOS
*  V1.29 07/02/94- To "re-port" the code to UNIX I had to make some
*                    changes to ScnCMD() as it did not like return(-1)
*                    for some strange reason.
*  V1.28 24/01/94- Cleaned up the command line option code a little bit,
*                    changed the code in logscale() so that it was simpler,
*                    removed unused symbols, added "progress" to command line
*                    options so that not all of the "verbose" data had to be
*                    printed every time
*  V1.27 23/01/94- Added support for ternary plots by incorporating calls
*                    to the additional library "pltri.c"
*  V1.26 22/12/93- Continuing struggle to make the "general purpose" code
*                    work. At least it now loads it, hopefully by the end of
*                    this version it will also print it !
*  V1.25 21/12/93- Made code "general purpose" so it will load any
*                    format of data.
*  V1.24 21/12/93- Added mode to place text on the graph, changed the
*                    `#t' for `title' to `#c' for `caption'
*  V1.23 21/12/93- Changed the entry point for the default values code.
*  V1.22 18/12/93- Fixed up (hopefully) bug which I think was causing the
*                    vector function to plot beyond the last loaded vector (?),
*                    and added code for loading default values.
*  V1.21 18/12/93- Added code for plotting discriminatory vectors
*  V1.20 18/12/93- Ported code over to the Amiga (hopefully !!!)
*  V1.19 26/11/93- Deleted some redundant code, particularly the "verbose"
*                    code, and added support for nested loads
*  V1.18 25/11/93- Added more of the new interface code
*  V1.17 25/11/93- Added new interface code for command line processing etc
*  V1.16 11/11/93- Optionally added ability to change font to the extended
*                    font, and added additional command line to optionally
*                    scale plot point, added support for HERCHY codes if
*                    code > 127
*  V1.15  3/11/93- Made further changes to try to get the program to
*                    support logramithic axis, in particular added the
*                    void PlotPoint ( void ) function
*  V1.14  1/11/93- Added support for logarithmic axis,
*                    can't work out why it does not work yet
*  V1.13 29/10/93- Fixed tiny bug which caused all data to be included
*                    in the calculations of the axis
*  V1.12 28/10/93- Added ability to selectively filter out certain
*                    samples based on print code
*  V1.11 28/10/93- Fixed up a small problem with the orientation
*  V1.10 27/10/93- Eliminate (hopefully) zeros from the data
*  V1.09 27/10/93- Having a lot of trouble evaluating the two parts
*                    of the equation - can get X values OK, but not Y
*                    so for this version will change the way the string
```

```
 *                    is tokenised
 *  V1.08 26/10/93- Number of problems with 1.07 ie it did not work,
 *                    hopefully fixed some of them with this
 *  V1.07 25/10/93- Never actually got around to compiling V1.06,
 *                    but made enough changes to 1.05 to warrant a new
 *                    version
 *  V1.06 24/10/93- Changed name, increased num of elements etc.
 *  V1.05 4/9/93  - Added option for plotting K2O/Na2O
 *  V1.04 4/9/93  - Made a small changes to init_plot()
 *  V1.03 4/9/93  - Changed PrintData() again, also tweaked with the
 *                    decimals in init_plot()
 *  V1.02 4/9/93  - Program worked in 1.01, but changed PrintData() so
 *                    extraneous 0's were not printed, and adjusted some
 *                    of the decimals places for the step functions
 *  V1.01 4/9/93  - Fixed up minor bugs
 *  V1.00 4/9/93  - Hopefully wrote the first bit of the code !
 *
 */

void PlotIt ( void );
void PlotGraph( void );
void PlotPoint(void);
void PlotLines( void );
void EraseLines( void );
void EraseText( void );
void RewindSample( void );
void nothing (void);
void PrintData( void );
void init_plot(float maxx, float maxy, float minx, float miny);
void PlotKey(int k_cols,int k_rows,float k_scale);
void ReadData( FILE *fr );
void ReadLines( FILE *fr );
void FilterFile (FILE *ft);
void GetSymbolFile (FILE *ft);
void program_end(char *s);
int main (int argc,char *argv[]);
float Evaluate ( void );
int Index( void );
int ReadGraphFile (FILE *fg);
int ScanCmd(char *Me,char *with[],int n);

#define stricmp strcasecmp

struct Sample *CurrentSample;
struct LineSeg *CurrentLine;
struct TextStuff *CurrentText;
struct Cell *CurrentCell;

char *Progress[4]={"|","/","-","\\"};

char *CmdLineOpts[12]={"-d","-np","-nz","-o","-v",
                 "-x","-s","-g","-f","-p","-P","-b"};

char *GraphFileOpts[18]={"#x","#y","#xa","#ya","#t","#","#v","#l","#dx","#dy",
                "#p","#a","#b","#c","#ps","#pc","#k","#lp"};

char *options[7] ={"+","-","*","/","(",")","v"};

char *token[40],XTitle[40],YTitle[40],ZTitle[40],GTitle[40];
char Xaxisopt[10],Yaxisopt[10];
char LabelToPlot[40];
char *strp,strbuf[80];
int total_cells=0;
int Verbose=0;
int Triplot=0;
int SampleCell=-1;
int CodeCell=-1;
int ColourCell=-1;
int ori=0;
int gc_index=0,tokens=0,zeros=1,plotfont=0,plotextended=0,dox=0,doy=0;
float plotscale=1;
float CurrentPrintScale=1;
```

```
float CurrentPrintColour=1;
float LabelPlotScale=0;
float xmaxscale,ymaxscale,xminscale,yminscale;

int main (int argc,char *argv[])

{
int i,display=0,plot=1;
int x=1,y=1,graphinput=0,filterinput=0,result=0,sequentialmode=0;
FILE *fr,*fg,*ft;

/*
 *   Process Command Line
 */

if (argc>1)
   {
    for (i=1;i<argc;++i)
         {
          result=ScanCmd(argv[i],&CmdLineOpts[0],12);
          switch (result) {
               case DISPLAY_ALL:
            display=1;
            break;
               case DONT_PLOT:
            plot=0;
            break;
               case NO_ZEROS:
                 zeros=0;
            break;
               case ROTATE_ORIENTATION:
            ori=1;
            break;
               case VERBOSE_MODE:
            Verbose=2;
            break;
               case PROGRESS_MODE:
            Verbose=1;
            break;
               case ALTERNATE_FONT:
            ++I;
            plotextended=1;
            plotfont=atoi(argv[i]);
            break;
                case SYMBOL_SCALE:
            ++I;
            plotscale=atof(argv[i]);
            break;
                case GRAPH_FILE:
            ++I;
            graphinput=I;
            break;
                case FILTER_FILE:
            ++I;
            filterinput=I;
            break;
                case SEQUENTIAL_MODE:
             ++I;
             sequentialmode=I;
             break;
                case PAGE_LAYOUT:
            ++I;
            x=atoi(argv[i]);
            ++I;
            y=atoi(argv[i]);
            break;
                default:
            fr=fopen(argv[i],"r");
            if (fr==NULL) program_end("Could not open input file !\n");
            break;
                          }
            }
```

```
        }
else
      {
        program_end("\nUSAGE\n\n\tGCPLOT [input file] <[-p x y]|-d|-np|-k>\n"
              "\t\t-p  sets x by y sub-pages\n"
              "\t\t-g  input file for types of graph to plot\n"
              "\t\t-f  input file for sample filter\n"
              "\t\t-s  scale point by a factor of []\n"
              "\t\t-b  use file [] for symBol defination\n"
              "\t\t-x  used extended font [] as default font\n"
              "\t\t-d  prints out all data to STDIO\n"
              "\t\t-v  Verbose\n"
              "\t\t-P  Show progrees\n"
              "\t\t-o orientation Horz < Vert \n"
              "\t\t-nz dont plot zeros\n"
              "\t\t-np dont plot graphs\n\n");
      }
ReadData(fr);
fclose(fr);
if (filterinput!=0)
    {
     ft=fopen(argv[filterinput],"r");
     if (ft==NULL) program_end("Could not open filter file !\n");
     FilterFile (ft);
     fclose(ft);
     }
if (sequentialmode!=0)
    {
     ft=fopen(argv[sequentialmode],"r");
     if (ft==NULL) program_end("Could not open Symbol File !\n");
     GetSymbolFile (ft);
     fclose(ft);
     }

if (display!=0)
   PrintData();

if (graphinput!=0)
     {
       fg=fopen(argv[graphinput],"r");
       if (fg==NULL) program_end("Could not open graph specification file !\n");
     }
else
     {
       program_end("No Plot type specified\n");
      }
if (plot==1)
    {
#ifndef AMIGA
   plfontld(plotextended);
   plsori(ori);
   plstar(x,y);
#else
   plstar(x,y);
   plfontld(plotextended);
#endif

   if (plotextended!=0) plfont(plotfont);
   plssym(0.0,plotscale);
   do {
        Triplot=0;
        CurrentPrintScale=1;
        CurrentPrintColour=1;
        strcpy(Xaxisopt,"bctns");
        strcpy(Yaxisopt,"bctns");
        if (ReadGraphFile(fg)==1) PlotGraph();
      } while (!feof(fg));
   plend();
   fclose (fg);
   }
program_end("Finished\n");
return(1);
```

```
}


void nothing (void)
{
}

void ReadData( FILE *fr )
{

char *linebuf, *b, buf[20], *bb;
int I=0,j=0;

linebuf=(char *)malloc(1024);
if (linebuf==NULL) program_end("\nInsufficent memory in ReadData (1)\n");

CurrentSample=(struct  Sample *)malloc(sizeof(struct Sample));
if (CurrentSample==NULL)
    program_end("Problem Allocating memory in ReadData (2)\n");
CurrentSample->prev=NULL;
CurrentSample->next=NULL;
CurrentCell=(struct Cell *)malloc(sizeof(struct Cell));
if (CurrentCell==NULL)
   program_end("Problem Allocating memory in ReadData (3)\n");
CurrentCell->prev=NULL;
CurrentCell->next=NULL;

  bb=fgets (linebuf,1024,fr);
  b=strtok(bb,"\t,| \n");

/*
 * Try to work out the format of the file by determining what cells
 * make up the file
 */

  do  {
        strcpy(&CurrentCell->label[0],b);
        CurrentCell->num=i;
        ++i;
        b=strtok(NULL,"\t,| \n");
        if (b==NULL) break;
        CurrentCell->next=(struct Cell *)malloc(sizeof(struct Cell));
        if (CurrentCell->next==NULL)
           program_end("Problem Allocating memory in ReadData (4)\n");
        CurrentCell->next->prev=CurrentCell;
        CurrentCell=CurrentCell->next;
        CurrentCell->next=NULL;
      } while (84!=94);

total_cells=CurrentCell->num;

/*
 * Work out which Cell has the Sample number, colour and code
 */

do {
    if (stricmp(&CurrentCell->label[0],"sample") ==0)
       SampleCell=CurrentCell->num;
    if (stricmp(&CurrentCell->label[0],"code")==0)
       CodeCell=CurrentCell->num;
    if (stricmp(&CurrentCell->label[0],"symbol")==0)
       CodeCell=CurrentCell->num;
    if (stricmp(&CurrentCell->label[0],"colour")==0)
       ColourCell=CurrentCell->num;
    if (stricmp(&CurrentCell->label[0],"color")==0)
       ColourCell=CurrentCell->num;
    if (CurrentCell->prev!=NULL)
       CurrentCell=CurrentCell->prev;
    else
       break;
   } while (1!=65);
```

```
 free(linebuf);

if (Verbose>0)
   {
   printf("\nGCPLOT V%3.2f\n",VERSION);
   printf("\nNumber of Cells = %d\n",total_cells+1);
   printf("\nLoading  ");
   }
 CurrentSample->Element=(float *)malloc(sizeof( float ) * (total_cells+1));
 if (CurrentSample->Element==NULL)
    program_end("\nProblem Allocating additional memory in ReadData (5)\n");

 fscanf(fr,"%s",&buf[0]);
 if (strcmp(&buf[0],"ZZ")!=0)
    while (feof(fr)==0) {
          if (Verbose>0)
             {
              printf("\b%s",Progress[j]);
              ++j;
              if (j==4) j=0;
             }
          CurrentSample->code=5;
          CurrentSample->colour=1;
          CurrentSample->plot=1;

          for (i=0;i<=total_cells;++i)
              {
           if (i==SampleCell)
             strcpy(&CurrentSample->SampleNum[0],&buf[0]);
           else if (i==ColourCell)
                CurrentSample->colour=atoi(&buf[0]);
           else if (i==CodeCell)
                CurrentSample->code=atoi(&buf[0]);
           else
                CurrentSample->Element[i]=atof(&buf[0]);
               fscanf(fr,"%s",&buf[0]);
              }

          if (feof(fr)!=0) break;
          if (strcmp(&buf[0],"ZZ")==0) break;

          CurrentSample->next=(struct  Sample *)malloc(sizeof(struct Sample));
          i=0;
          if (CurrentSample->next!=NULL)
             {
              CurrentSample->next->prev=CurrentSample;
              CurrentSample=CurrentSample->next;
              CurrentSample->next=NULL;
              CurrentSample->Element=(float *)malloc(sizeof( float ) * (total_cells+1));
              if (CurrentSample->Element==NULL)
            program_end("\nProblem Allocating additional memory in ReadData (6)\n");
             }
         else
             program_end("Problem Allocating additional memory in ReadData (7)\n");
                }
if (Verbose>0) printf("\n");
}

void program_end(char *s)
{
plend();
if (CurrentText!=NULL)
   EraseText();
if (CurrentLine!=NULL)
   EraseLines();
if (CurrentSample!=NULL)
   {
    while (CurrentSample->next!=NULL) CurrentSample=CurrentSample->next;
    while (CurrentSample->prev!=NULL)
          {
          CurrentSample=CurrentSample->prev;
          free(CurrentSample->Element);
```

```
            free(CurrentSample->next);
            }
        free(CurrentSample->Element);
        free(CurrentSample);
       }
printf("\n***Exited***\n%s",s);
exit(0);
}

void PlotIt ( void )
{

if (Triplot!=1)
   pllab(XTitle,YTitle,GTitle);
else
   pltlab(XTitle,YTitle,ZTitle,GTitle);
RewindSample();
while (6!=4)
      {
       if (zeros==0)
          {
           if (CurrentSample->x!=0)
           if (CurrentSample->y!=0)
          PlotPoint();
          }
      PlotPoint();
      if (CurrentSample->next==NULL)
         break;
      else
         CurrentSample=CurrentSample->next;
      }
    plcol(1);
if (CurrentLine!=NULL)
    {
    PlotLines();
    EraseLines();
    }
if (CurrentText!=NULL)
    {
    while (CurrentText->prev!=NULL)
          CurrentText=CurrentText->prev;
     do {
        plcol(CurrentText->colour);
        plschr(0,CurrentText->scale);
        plptex(CurrentText->x,CurrentText->y,CurrentText->dx,
               CurrentText->dy,CurrentText->just,(char *)CurrentText->text);
        if (CurrentText->next==NULL) break;
        CurrentText=CurrentText->next;
        } while (543!=49839);
     EraseText();
    }
}

void PlotPoint( void )
{
float x=0,y=0,z=0,i=0,total;
char PlotText[43];
if (CurrentSample->plot==1)
  {
   plcol(CurrentSample->colour);
   if (Triplot==1)
      {
       x=CurrentSample->x;
       y=CurrentSample->y;
       z=CurrentSample->z;
       if (CurrentSample->code>127)
          pltsym(1,&x,&y,&z,CurrentSample->code);
       else
          pltpoin(1,&x,&y,&z,CurrentSample->code);
       if (LabelPlotScale>0)
          {
           total=x+y+z;
```

```
            sprintf(PlotText," %s",CurrentSample->SampleNum);
            plschr(0,LabelPlotScale);
            plptex(((x/total)*50)+(100*(((y+z)/total))*(z/(y+z))),
                  (100*x/total*.866025),0,0,0,PlotText);
             plschr(0,1);
            }
       }


   else
       {
        if (strchr(Xaxisopt,'l')!=NULL)
           {
           if (CurrentSample->x<=0)
              x=-99;
           else
           x=log10(CurrentSample->x);
           }
        else
           x=CurrentSample->x;
        if (strchr(Yaxisopt,'l')!=NULL)
           {
           if (CurrentSample->y<=0)
              y=-99;
           else
           y=log10(CurrentSample->y);
           }
        else
           y=CurrentSample->y;
        if (CurrentSample->code>127)
           plsym(1,&x,&y,CurrentSample->code);
        else
           plpoin(1,&x,&y,CurrentSample->code);
        if (LabelPlotScale>0)
           {
            sprintf(PlotText," %s",CurrentSample->SampleNum);
            plschr(0,LabelPlotScale);
            plptex(x,y,0,0,0,PlotText);
             plschr(0,1);
           }
       }
   }
}

void PlotGraph( void )

{
float maxx=-1000000000,maxy=-100000000,minx=10000000,miny=1000000;
int gospot=0;
gc_index=0;
RewindSample();

while (6!=4)
       {
        CurrentSample->x=Evaluate();
        ++gc_index;
        CurrentSample->y=Evaluate();
        if (Triplot==1)
           {
            ++gc_index;
            CurrentSample->z=Evaluate();
            gc_index=0;
            gospot=1;
           }
        else
           {
            gc_index=0;
            if (CurrentSample->plot==1)
              {
           if (dox==0)
              {
                if (maxx<CurrentSample->x)
```

```
                maxx=CurrentSample->x;
                 if (minx>CurrentSample->x)
                {
                 if ((zeros==0)&&(CurrentSample->x==0))
                    nothing();
                 else
                    minx=CurrentSample->x;
                 }
                }
           if (doy==0)
              {
               if (maxy<CurrentSample->y)
                  maxy=CurrentSample->y;
               if (miny>CurrentSample->y)
                  {
                if ((zeros==0)&&(CurrentSample->y==0))
                   nothing();
                else
                   miny=CurrentSample->y;
                  }
               }
              }
          }
       if (CurrentSample->next==NULL)
         break;
       else
         CurrentSample=CurrentSample->next;
       }

    if ((minx!=maxx)&&(miny!=maxy))
    if ((miny!=1000000)&&(maxy!=-1000000000)&&(maxx!=-1000000000))
       gospot=1;
    if ((dox==1)||(doy==1))
       gospot=1;
    if (gospot==1)
      {
   pladv(0);
   pllsty(1);
   if (Triplot==1)
      {
      pltspa();
       if (Verbose>1)
          printf("\nPlotting %s against %s against %s\n",XTitle,YTitle,ZTitle);
      }
   else
      {
       plvpor((PLFLT)0.2,(PLFLT).9,(PLFLT)0.2,(PLFLT)0.9);
       init_plot(maxx,maxy,minx,miny);
      }
   PlotIt();
   }

}

void PrintData( void )

{
int i=0;
RewindSample();
RewindCell();

do {
    printf("%s  ",CurrentCell->label);
    if (CurrentCell->next==NULL) break;
    CurrentCell=CurrentCell->next;
   } while (42!=56);
do {
    for (i=0;i<total_cells;++i)
        {
         if (i==SampleCell)
            printf("%s  ",CurrentSample->SampleNum);
         else if (i==CodeCell)
```

```
            printf("%d  ",CurrentSample->code);
         else if (i==ColourCell)
            printf("%d  ",CurrentSample->colour);
         else
            {
             printf("%5.2f  ",CurrentSample->Element[i]);
            }
         }
   if (CurrentSample->next==NULL) break;
   CurrentSample=CurrentSample->next;
   } while(123!=59843);
}

void RewindSample( void )
{
while (CurrentSample->prev!=NULL) CurrentSample=CurrentSample->prev;
}

void init_plot(float maxx, float maxy, float minx, float miny)
{
float rangey=0,rangex=0;
float logscale (float a);

if (dox==0)
   {
    rangex=abs(maxx-minx);
    xmaxscale=maxx+(rangex/10);
    xminscale=minx-(rangex/10);
   }
if (doy==0)
   {
    rangey=abs(maxy-miny);
    ymaxscale=maxy+(rangey/10);
    yminscale=miny-(rangey/10);
   }

if (strchr(Xaxisopt,'l')!=NULL)
  {
   if (dox==0)
      {
       xmaxscale=logscale(xmaxscale);
       xminscale=log10(xminscale);
      }
  else
      {
      xmaxscale=log10(xmaxscale);
      xminscale=log10(xminscale);
      }
  }

if (strchr(Yaxisopt,'l')!=NULL)
  {
   if (doy==0)
      {
       ymaxscale=logscale(ymaxscale);
       yminscale=log10(yminscale);
      }
  else
      {
      yminscale=log10(yminscale);
      ymaxscale=log10(ymaxscale);
      }
  }

if (dox==0)
   {
     if (strchr(Xaxisopt,'l')==NULL)
        if (xminscale<0)
            xminscale=0;
   }

if (doy==0)
```

```
    {
     if (strchr(Yaxisopt,'l')==NULL)
        if (yminscale<0)
            yminscale=0;
    }

if (Verbose>1)
   {
     printf("\nPlotting %s against %s\nMaximum x = %f Minimum x = %f"
            "\nMaximum y=%f Minimum y=%f\n"
            "X axis scaleing from %f to %f in %f steps\n"
            "Y axis scaleing from %f to %f in %f steps\n",XTitle,YTitle,
            maxx,minx,maxy,miny,xminscale,xmaxscale,rangex/5.0,
            yminscale,ymaxscale,rangey/5.0);
   }
    plschr(0,1);
    plwind((PLFLT)xminscale,(PLFLT)xmaxscale,(PLFLT)yminscale,(PLFLT)ymaxscale);
    plbox(Xaxisopt,(PLFLT)0,0,Yaxisopt,(PLFLT)0,0);
dox=0;
doy=0;
}

float logscale (float a)
{
float b=0;

for (b=0.000001;b<1000000;b=b*10)
     {
     if (b>a) break;
     }
  b=log10(b);
return(b);
}

void GetString (char *Text)
{
char *b;
b=strtok(NULL,"\n");
strcpy(Text,b);
}

float GetFloat ( void )
{
char *b;
b=strtok(NULL," \n");
return (atof(b));
}

int GetInt ( void )
{
char *b;
b=strtok(NULL," \n");
return (atoi(b));
}

int ReadGraphFile (FILE *fg)
{
void GetString (char *Text);
float GetFloat ( void );
int GetInt( void );
char *b;
int i=0,rc=0,outcome=0,k_rows,k_cols;
float k_scale;
FILE *fr;

do {
    strp=NULL;
    strp=fgets (strbuf,sizeof(strbuf),fg);
    if (strp==NULL) break;
    b=strtok(strbuf," \n");
    outcome=ScanCmd(b,&GraphFileOpts[0],18);
    switch (outcome) {
```

```
case LINE_COMMENT:
   break;
case XAXIS_CAPTION:
   GetString(XTitle);
   break;
case YAXIS_CAPTION:
  GetString(YTitle);
  break;
case AAXIS_CAPTION:
  GetString(XTitle);
  Triplot=1;
  break;
case BAXIS_CAPTION:
  GetString(YTitle);
  Triplot=1;
  break;
case CAXIS_CAPTION:
  GetString(ZTitle);
  Triplot=1;
  break;
case YAXIS_OPTIONS:
  GetString(Yaxisopt);
  break;
case XAXIS_OPTIONS:
  GetString(Xaxisopt);
  break;
case TITLE_CAPTION:
  GetString(GTitle);
  break;
case VECTOR_DRAW:
  if (CurrentLine!=NULL) EraseLines();
  ReadLines(fg);
  break;
case KEY:
  k_cols=GetInt();
  k_rows=GetInt();
  k_scale=GetFloat();
  PlotKey(k_cols,k_rows,k_scale);
  rc=0;
  break;
case LOAD_FILE:
  b=strtok(NULL,"\n");
  fr=fopen(b,"r");
  do {
      rc=0;
      CurrentPrintColour=1;
      CurrentPrintScale=1;
      strcpy(Xaxisopt,"bctns");
      strcpy(Yaxisopt,"bctns");
      if (ReadGraphFile(fr)==1) PlotGraph();
     } while (!feof(fr));
  fclose(fr);
  fr=NULL;
  rc=0;
  break;
case X_DEFAULT:
  dox=1;
  xminscale=GetFloat();
  xmaxscale=GetFloat();
  break;
case Y_DEFAULT:
  doy=1;
  yminscale=GetFloat();
  ymaxscale=GetFloat();
  break;
case LABEL_PLOT:
  LabelPlotScale=GetFloat();
  GetString(LabelToPlot);
  break;
case PRINT_COLOUR:
  CurrentPrintColour=GetInt();
break;
```

```
      case PRINT_SCALE:
        CurrentPrintScale=GetFloat();
      break;
      case PRINT_LINE:
        if (CurrentText==NULL)
           {
            CurrentText=(struct TextStuff *)malloc(sizeof(struct TextStuff));
            if (CurrentText==NULL)
               program_end("Error allocating memory to TEXT\n");
            CurrentText->prev=NULL;
            CurrentText->next=NULL;
           }
        else
           {
            CurrentText->next=(struct TextStuff *)malloc(sizeof(struct TextStuff));
            if (CurrentText==NULL)
               program_end("Error allocating memory to TEXT\n");
            CurrentText->next->prev=CurrentText;
            CurrentText=CurrentText->next;
            CurrentText->next=NULL;
           }
        CurrentText->x=GetFloat();
        CurrentText->y=GetFloat();
        CurrentText->dx=GetFloat();
        CurrentText->dy=GetFloat();
        CurrentText->just=GetFloat();
        GetString((char *)CurrentText->text);
        CurrentText->colour=CurrentPrintColour;
        CurrentText->scale=CurrentPrintScale;
        break;
        default:
        rc=1;
        token[i]=b;
        while (token[i]!=NULL)
          {
           ++i;
           b=strtok(NULL," \n");
           token[i]=b;
           if (i==40) program_end("\nToo many parts in the equation\n");
          }
        tokens=i;
        break;
      }
 } while (rc!=1);
 return(rc);
 }

 float Evaluate( void )
 {
 float result=0;
 float tempresult=0;
 int z=0;
 char *b;

 while (gc_index<tokens)
   {
 z=Index();
 if (z==TokenError)
   {
   printf("\nError in evaluating the token %s\n",token[gc_index]);
   program_end("");
   }

 switch (z) {
  case Number:
   b=token[gc_index];
   result=atof(b);
   ++gc_index;
   break;
  case Plus:
   ++gc_index;
   result=result+Evaluate();
```

```
  break;
 case Minus:
  ++gc_index;
  result=result-Evaluate();
  break;
 case Times:
  ++gc_index;
  result=result*Evaluate();
  break;
 case Division:
  ++gc_index;
  tempresult=Evaluate();
  if (tempresult!=0)
  result=result/tempresult;
  else result=0;
  break;
 case LeftBrace:
  ++gc_index;
  result=Evaluate();
  break;
 case RightBrace:
  ++gc_index;
  return(result);
  break;
 case Versus:
  return(result);
  break;
 default:
if (z<=total_cells)
  {
    result=CurrentSample->Element[z];
    ++gc_index;
  }
else
  {
  printf("\nSomething really strange must have happened !\n");
  exit(10);
  }
  break;
             }
}
return(result);
}


int Index( void )
  {
int i=0,operation=-1;

if (gc_index>tokens)
  program_end("Index > Tokens\n");

for (i=0;i<=6;++i) {
  if (strcmp(token[gc_index],options[i])==0)
    {
    operation=i+100;
     }
              }
if (operation==-1)
  {
   RewindCell();
   do {
        if (stricmp((char *)token[gc_index],&CurrentCell->label[0])==0)
           {
            operation=CurrentCell->num;
           }
        if (CurrentCell->next==NULL) break;
        CurrentCell=CurrentCell->next;
      } while (6!=4);
   }
if (operation==-1)
   operation=999;
```

```
return(operation);
}

void FilterFile (FILE *ft)
{
char buf[80];
          RewindSample();
          while (6!=4)
            {
           CurrentSample->plot=0;
              if (CurrentSample->next==NULL)
           break;
              else
           CurrentSample=CurrentSample->next;
            }

      while (!feof(ft))
        {
          fscanf(ft,"%s",&buf[0]);
          RewindSample();
          while (6!=4)
            {
              if (strcmp(CurrentSample->SampleNum,buf)==0)
           CurrentSample->plot=1;
              if (CurrentSample->next==NULL)
           break;
              else
           CurrentSample=CurrentSample->next;
            }
        }

    }

int ScanCmd(char *Me,char *with[],int n)
{
int i=0;
do {
  if (strcmp(Me,with[i])==0) return (i);
++i;
} while (i<n);
return(255);
}

void ReadLines( FILE *fr )
{
int i=0;
char *b;

CurrentLine=(struct  LineSeg *)malloc(sizeof(struct LineSeg));
if (CurrentLine==NULL)
    program_end("Problem Allocating memory in lines\n");
CurrentLine->prev=NULL;
CurrentLine->next=NULL;
  strp=fgets (&strbuf[0],sizeof(strbuf),fr);
  b=strtok(strp,"\n");
CurrentLine->Seg=atoi(b);
while (feof(fr)==0) {
  strp=fgets (&strbuf[0],sizeof(strbuf),fr);
  b=strtok(strp," \n");
      if (strcmp(b,"#z")==0)
        {
         break;
        }

      if (strcmp(b,"#n")==0)
         {
         CurrentLine->num=i;
         CurrentLine->next=(struct  LineSeg *)malloc(sizeof(struct LineSeg));
         i=0;
         if (CurrentLine->next!=NULL)
            {
             CurrentLine->next->prev=CurrentLine;
```

```
            CurrentLine=CurrentLine->next;
            CurrentLine->next=NULL;
            }
        else
            program_end("Problem Allocating memory in lines\n");
        strp=fgets (&strbuf[0],sizeof(strbuf),fr);
        b=strtok(strp," \n");
        CurrentLine->Seg=atoi(b);
         }
      else
         {
         CurrentLine->x[i]=atof(b);
         b=strtok(NULL,"\n");
         CurrentLine->y[i]=atof(b);
         ++i;
         }
         if (i==50)
            {
         CurrentLine->num=i;
         CurrentLine->next=(struct  LineSeg *)malloc(sizeof(struct LineSeg));
         if (CurrentLine->next!=NULL)
            {
            CurrentLine->next->prev=CurrentLine;
            CurrentLine=CurrentLine->next;
            CurrentLine->next=NULL;
            }
         else
            program_end("Problem Allocating memory in lines\n");
         CurrentLine->x[0]=CurrentLine->prev->x[i-1];
         CurrentLine->y[0]=CurrentLine->prev->y[i-1];
         i=1;
         }

                  }
 CurrentLine->num=i;
}

void PlotLines( void )
{
int i=0;
while (CurrentLine->prev!=NULL) CurrentLine=CurrentLine->prev;
do {
    pllsty(CurrentLine->Seg);
    plline (CurrentLine->num,&CurrentLine->x[0],&CurrentLine->y[0]);
    if (CurrentLine->next==NULL)
       break;
    else
       CurrentLine=CurrentLine->next;
    } while(6!=1);
}

void EraseLines( void )
{
if (CurrentLine!=NULL)
   {
    while (CurrentLine->next!=NULL) CurrentLine=CurrentLine->next;
    while (CurrentLine->prev!=NULL)
         {
         CurrentLine=CurrentLine->prev;
         free(CurrentLine->next);
         }
     free(CurrentLine);
     CurrentLine=NULL;
    }
}

void EraseText( void )
{
if (CurrentText!=NULL)
   {
    while (CurrentText->next!=NULL) CurrentText=CurrentText->next;
    while (CurrentText->prev!=NULL)
```

```
          {
          CurrentText=CurrentText->prev;
          free(CurrentText->next);
          }
      free(CurrentText);
      CurrentText=NULL;
     }
}

void GetSymbolFile (FILE *ft)
{
int j=0;
int i=0;
RewindSample();
if (Verbose >0)
   printf("\nLoading Symbol Map  ");

do {
    fscanf(ft,"%d",&CurrentSample->code);
    fscanf(ft,"%d",&CurrentSample->colour);
        if (Verbose>0)
            {
             ++i;
             if (i==10)
                {
            i=0;
            printf("\b%s",Progress[j]);
            ++j;
            if (j==4)
               j=0;
                }
            }
   if (feof(ft)!=0)
      rewind(ft);
   if (CurrentSample->next==NULL)
      break;
   CurrentSample=CurrentSample->next;
   } while (65!=23);
}

void PlotKey(int k_cols,int k_rows,float k_scale)
{
float x=5000000,y=0,xx;

RewindSample();
y=k_rows;

do {
    if (x>(k_cols-1))
       {
       pladv(0);
       plvsta();
       plschr(0.0,k_scale);
       plwind(0,k_cols+(k_cols/10),0,k_rows+(k_rows/10));
       x=0;
       }
    plcol (CurrentSample->colour);
    xx=x+.1;
    if (CurrentSample->code>127)
       plsym(1,&xx,&y,CurrentSample->code);
    else
       plpoin(1,&xx,&y,CurrentSample->code);
   plptex(xx+.1,y,1.0,0.0,0.0,CurrentSample->SampleNum);
   if (CurrentSample->next==NULL)
      break;
   CurrentSample=CurrentSample->next;
   --y;
   if (y<1)
      {
      y=k_rows;
      ++x;
      }
```

```
   } while (891!=203);
}
```

```
/*   PLTRI.C
 *   Suplimentary module for PLPLOT.LIB
 *   to allow plotting on Tertiary diagrams
 *  Second revision for lib V4.99
 *
 *  revised  11/08/94 (Thankx Jim !!)
 *  revised  02/10/96
 */

#include "plplot.h"
#define sin60 0.866025403
#define tan60 1.732050808

void pltlab(char *a,char *b, char *c, char *title);
void pltline(int n,float *a,float *b,float *c);
void pltjoin(float a1,float b1,float c1,float a2,float b2,float c2);
void pltsym(int n,float *a,float *b,float *c,int code);
void pltpoin(int n,float *a,float *b,float *c,int code);
void pltspa ( void );

void pltline(int n,float *a,float *b,float *c)

{
      PLINT i, level;
      PLFLT total,x,y,x1,y1;

       total=a[0]+b[0]+c[0];
       for(i=1; i<n; i++)
        {
        total=a[i]+b[i]+c[i];
        if (total>0)
            {
             y=100*a[i]/total*sin60;
             if (c[i]+b[i]>0)
              {
               x=((a[i]/total)*50)+(100*(((b[i]+c[i])/total)*(c[i]/(b[i]+c[i]))));
              }
              else
                x=50;
           pljoin(x1,y1,x,y);
           x1=x;
           y1=y;
          }
        }
}

void pltjoin(float a1,float b1,float c1,float a2,float b2,float c2)

{
PLFLT x,y,x1,y1,total;
 total=a1+b1+c1;
        if (total>0)
            {
             y1=100*a1/total*sin60;
             if (c1+b1>0)
              {
               x1=((a1/total)*50)+(100*(((b1+c1)/total)*(c1/(b1+c1))));
              }
              else
                x1=50;
            }

   total=a2+b2+c2;
        if (total>0)
            {
             y=100*a2/total*sin60;
             if (c2+b2>0)
              {
```

```
            x=((a2/total)*50)+(100*(((b2+c2)/total)*(c2/(b2+c2))));
            }
           else
             x=50;
          }
   pljoin(x,y,x1,y1);
}

void pltsym(int n,float *a,float *b,float *c,int code)

{
        short int i;
        PLINT level;
        PLFLT total,x,y;
        for (i=0; i<n; i++)
          {
          total=a[i]+b[i]+c[i];
          if (total>0)
              {
              y=100*a[i]/total*sin60;
              if (c[i]+b[i]>0)
                {
                x=((a[i]/total)*50)+(100*(((b[i]+c[i])/total)*(c[i]/(b[i]+c[i]))));
                }
               else
                 x=50;
              plsym(1,&x,&y,code);
             }
          }
}

void pltpoin(int n,float *a,float *b,float *c,int code)

{
        short int i;
        PLINT level;
        PLFLT total,x,y;
        for(i=0; i<n; i++)
          {
          total=a[i]+b[i]+c[i];
          if (total>0)
              {
              y=100*a[i]/total*sin60;
              if (c[i]+b[i]>0)
                {
                x=((a[i]/total)*50)+(100*(((b[i]+c[i])/total)*(c[i]/(b[i]+c[i]))));
                }
               else
                 x=50;
              plpoin(1,&x,&y,code);
             }
          }
}

void pltspa ( void )
{
PLFLT minx,maxx,miny,maxy;
PLFLT xx,yy;
plgspa(&minx,&maxx,&miny,&maxy);
xx=maxx-minx;
yy=maxy-miny;
if (xx>yy) xx=yy;
if (yy>xx) yy=xx;

plsvpa(0.0,xx,0.0,yy);
plwind(-5.0,105.0,-10.0,100.0);
pljoin(0.0,0.0,100.0,0.0);
pljoin(0.0,.0,50.0,(100*sin60));
pljoin(50.0,(100*sin60),100.0,0.0);
}

void pltlab(char *a,char *b, char *c, char *title)
```

```
{
plmtex("t",1.0,0.5,0.5,title);
plptex(-5,-3,1,0,0,b);
plptex(105,-3,1,0,1,c);
plptex(50,90,1,0,0.5,a);
}
```

```
/*
 *      GCPLOT.H
 *
 *  TYPE    : Include file
 *  CREATED: 4/9/93
 *  UPDATED: 1/11/93
 *           25/11/93
 *           18/12/93
 *           23/01/93
 *           29/07/94
 *           10/08/94
 *  HISTORY: Modified from the HARKER.H include file to
 *           accomodate trace elements
 *
 */

/*
 *   Sample Array indicies
 *
 */

#define SiO2   0
#define TiO2   1
#define Al2O3  2
#define Fe2O3  3
#define FeO    4
#define MnO    5
#define MgO    6
#define CaO    7
#define Na2O   8
#define K2O    9
#define P2O5   10
#define H2Op   11
#define H2Om   12
#define CO2    13
#define Total   14
#define Ba      15
#define Cr      16
#define Cu      17
#define Ga      18
#define Nb      19
#define Ni      20
#define Pb      21
#define Rb      22
#define Sr      23
#define Th      24
#define U       25
#define V       26
#define Y       27
#define Zn      28
#define Zr      29
/*
 *      Structure definitions
 *
 */

struct Sample {
       struct Sample *prev;
       struct Sample *next;
       float *Element;
       float x,y;
       float z;
       int code;
```

```
        int colour;
        int plot;
        char SampleNum[20];
};

struct LineSeg {
        struct LineSeg *prev;
        struct LineSeg *next;
        float x[50];
        float y[50];
        int Seg;
        int num;

};

struct TextStuff {
        struct TextStuff *prev;
        struct TextStuff *next;
        float x;
        float y;
        float dx;
        float dy;
        float just;
        float scale;
        int colour;
        char *text[80];

};

struct Cell {
        struct Cell *prev;
        struct Cell *next;
        char label[20];
        int num;
            };

#define TokenError -1
#define Plus 100
#define Minus 101
#define Times 102
#define Division 103
#define LeftBrace 104
#define RightBrace 105
#define Versus 106
#define Log 107


#define Number 999
#define DISPLAY_ALL 0
#define DONT_PLOT 1
#define NO_ZEROS 2
#define ROTATE_ORIENTATION 3
#define VERBOSE_MODE 4
#define ALTERNATE_FONT 5
#define SYMBOL_SCALE 6
#define GRAPH_FILE 7
#define FILTER_FILE 8
#define PAGE_LAYOUT 9
#define PROGRESS_MODE 10
#define SEQUENTIAL_MODE 11

#define XAXIS_CAPTION           0
#define YAXIS_CAPTION           1
#define XAXIS_OPTIONS           2
#define YAXIS_OPTIONS           3
#define TITLE_CAPTION           4
#define LINE_COMMENT    5
#define VECTOR_DRAW     6
#define LOAD_FILE       7
#define X_DEFAULT       8
#define Y_DEFAULT       9
#define PRINT_LINE      10
```

```
#define AAXIS_CAPTION 11
#define BAXIS_CAPTION         12
#define CAXIS_CAPTION         13
#define PRINT_SCALE    14
#define PRINT_COLOUR   15
#define KEY            16
#define LABEL_PLOT     17
```

```
/*   PLTRI.H
 *   Header file for the Tertiary Module
 *
 */
void pltlab(char *a,char *b, char *c, char *title);
void pltline(int n,float *a,float *b,float *c);
void pltjoin(float a1,float b1,float c1,float a2,float b2,float c2);
void pltsym(int n,float *a,float *b,float *c,int code);
void pltpoin(int n,float *a,float *b,float *c,int code);
void pltspa ( void );
```

Appendix I

Sample Numbers and Location

On the following table, the abbreviations in the formation column are as follows: WEIR = Weirs Basalt; SUGAS = Sugars Basalt; HECTO = Hectro Tuff; MTCRO = Mount Crosby Formation; BRISB = Brisbane Tuff; CHILI = Chillingham Volcanics; DAYBRO = Dayboro Tonalite; ENOGGERA = Enoggera Granite; SAMSO = Mount Samson Granodiroite; SAMFORD = Samford Granodiorite; MTBYRON = Mount Byron Volcanics; MORT = Moreton Island rhyolites; STRAD = Stradbroke Island rhyolites.

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0005-01	56748	WEIR	Basaltic andesite	4800.8	69540.5	-27.5371	152.7983		X					X
ARPHD0006-01	56749	WEIR	Basaltic andesite	4801	69542	-27.5357	152.7985		X		X			
ARPHD0009-01	56750	WEIR	Basaltic andesite	4803	69540.5	-27.5371	152.8005		X					X
ARPHD0015-02	56751	WEIR	Basaltic andesite	4789.5	69533.6	-27.5433	152.7868		X					X
ARPHD0015-03	56752	WEIR	Basaltic andesite	4789.5	69533.6	-27.5433	152.7868		X					X
ARPHD0018-01	56753	WEIR	Basaltic andesite	4792	69538	-27.5393	152.7893		X	X				
ARPHD0022-01	56754	SUGAS	Basaltic andesite	4854.5	69528	-27.5484	152.8526		X	X				X
ARPHD0022-05	56755	SUGAS	Basaltic andesite	4855.5	69528	-27.5484	152.8536		X	X				
ARPHD0022-06	56756	SUGAS	Basaltic andesite	4855.5	69528	-27.5484	152.8536		X	X				X
ARPHD0022-07	56757	SUGAS	Basaltic andesite	4855.5	69528	-27.5484	152.8536		X	X				
ARPHD0022-09	56758	SUGAS	Basaltic andesite	4855	69529.5	-27.5471	152.8531		X	X				
ARPHD0022-11	56759	SUGAS	Basaltic andesite	4855	69529.5	-27.5471	152.8531		X	X				
ARPHD0058-01	56760	HECTO	Rhyo-dacite tuff	4764	69512.5	-27.5623	152.7609		X	X				
ARPHD0063-01	56761	BRISB	Rhyolite ignimbrite	4943.5	69898	-27.2145	152.9429		X					X
ARPHD0065-01	56762	BRISB	Rhyolite ignimbrite	4943	69896.5	-27.2158	152.9424		X	X				
ARPHD0071-01	56763	BRISB	Rhyolite ignimbrite	4967.5	69869	-27.2406	152.9672		X					X
ARPHD0071-02	56764	BRISB	Rhyolite ignimbrite	4967.5	69869	-27.2406	152.9672		X					X
ARPHD0072-01	56765	BRISB	Rhyolite ignimbrite	4869	69871.5	-27.2383	152.8677		X					X
ARPHD0072-02	56766	BRISB	Rhyolite ignimbrite	4869	69871.5	-27.2383	152.8677		X					X
ARPHD0207-01	56767	CHILI	Clast of RH IGNB	5181	69139	-27.8996	153.1839				X			X
ARPHD0245-04	56768	CHILI	Rhyolite Tuff	5202	69007	-28.0187	153.2055							X
ARPHD0246-18	56769	CHILI	Dacite Tuff	5205.5	69007.5	-28.0182	153.2090							X
ARPHD0073-01	56770	BRISB	Rhyolite ignimbrite	4969.5	69870	-27.2397	152.9692		X					X
ARPHD0075-01	56771	BRISB	Rhyolite ignimbrite	4971.5	69867.5	-27.2420	152.9712		X	X	X	X		
ARPHD0076-01	56772	BRISB	Rhyolite ignimbrite	4972.5	69867	-27.2425	152.9722		X					
ARPHD0305-01	56773	CHILI	Volcanic Glass	5222.5	68876.5	-28.0421	147.9165							X
ARPHD0077-01	56774	BRISB	Rhyolite ignimbrite	4972	69867	-27.2424	152.9717		X					
ARPHD0246-18	56775	CHILI	Dacite Airfall	5205.5	69007.5	-28.0182	153.2090							
ARPHD0081-03	56776	BRISB	Rhyolite ignimbrite	4970	69822	-27.2831	152.9697		X					

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0286-01	56777	BRISB	Fumeroale Centre	5033	69607	-27.4772	153.0334							X
ARPHD0286-02	56778	BRISB	Fumeroale Outside	5033	69607	-27.4772	153.0334							X
ARPHD0083-01	56779	BRISB	Rhyolite ignimbrite	5006.5	69716.5	-27.3783	153.0066		X					
ARPHD0083-02	56780	BRISB	Rhyolite ignimbrite	5006.5	69716.5	-27.3783	153.0066		X					
ARPHD0084-01	56781	BRISB	Rhyolite ignimbrite	5006.5	69714	-27.3806	153.0066		X					
ARPHD0085-01	56782	BRISB	Rhyolite ignimbrite	5007.3	69713.5	-27.3810	153.0074		X					
ARPHD0086-01	56783	BRISB	Rhyolite ignimbrite	5008	69714	-27.3806	153.0081		X	X	X	X	X	
ARPHD0088-01	56784	BRISB	Rhyolite ignimbrite	5024.5	69714	-27.3806	153.0245		X	X			X	
ARPHD0088-02	56785	BRISB	Rhyolite ignimbrite	5024.2	69714	-27.3806	153.0245		X	X		X	X	
ARPHD0088-05	56786	BRISB	Rhyolite ignimbrite	5024.2	69714	-27.3806	153.0245		X				X	
ARPHD0090-03	56787	BRISB	Rhyolite ignimbrite	5023.5	69681.3	-27.4101	153.0238		X				X	
ARPHD0091-01	56788	BRISB	Rhyolite ignimbrite	5023	68681.3	-28.3128	153.0235		X	X				
ARPHD0092-01	56789	BRISB	Rhyolite ignimbrite	5022.5	69681.5	-27.4099	153.0228		X	X	X	X	X	
ARPHD0092-03	56790	BRISB	Rhyolite ignimbrite	5022.5	69681.5	-27.4099	153.0228		X	X	X	X	X	
ARPHD0092-04	56791	BRISB	Rhyolite ignimbrite	5022.5	69681.5	-27.4099	153.0228		X	X				
ARPHD0093-02	56792	BRISB	Rhyolite ignimbrite	5022.5	69680.2	-27.4111	153.0228		X		X	X		
ARPHD0093-03	56793	BRISB	Rhyolite ignimbrite	5022.5	69680.2	-27.4111	153.0228		X		X	X		
ARPHD0095-01	56794	BRISB	Rhyolite ignimbrite	5019	69693	-27.3995	153.0192		X					
ARPHD0095-02	56795	BRISB	Rhyolite ignimbrite	5018.5	69693	-27.3995	153.0187		X					
ARPHD0095-03	56796	BRISB	Rhyolite ignimbrite	5018.5	69693	-27.3995	153.0187		X					
ARPHD0097-01	56797	BRISB	Rhyolite ignimbrite	5017.5	69699	-27.3941	153.0177		X		X		X	
ARPHD0098-01	56798	BRISB	Rhyolite ignimbrite	5016	69697.5	-27.3955	153.0162		X				X	
ARPHD0098-02	56799	BRISB	Rhyolite ignimbrite	5016	69697.5	-27.3955	153.0162		X		X	X	X	
ARPHD0098-03	56800	BRISB	Rhyolite ignimbrite	5016	69697.5	-27.3955	153.0162		X	X	X	X		
ARPHD0099-01	56801	BRISB	Rhyolite ignimbrite	5016.5	69698	-27.3950	153.0167		X			X	X	
ARPHD0099-02	56802	BRISB	Rhyolite ignimbrite	5016.5	69698	-27.3950	153.0167		X	X			X	
ARPHD0099-04	56803	BRISB	Rhyolite ignimbrite	5016.5	68698	-28.2978	153.0168		X	X	X	X		
ARPHD0099-05	56804	BRISB	Rhyolite ignimbrite	5016.5	69698	-27.3950	153.0167		X					
ARPHD0100-01	56805	BRISB	Rhyolite ignimbrite	5017.5	69698	-27.3950	153.0177		X				X	

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0111-01	56806	BRISB	Rhyolite ignimbrite	5049.5	69655	-27.4338	153.0501		X		X		X	
ARPHD0118-01	56807	BRISB	Rhyolite ignimbrite	5030.5	69659.5	-27.4298	153.0309		X	X	X	X		
ARPHD0118-02	56808	BRISB	Rhyolite ignimbrite	5030.5	69659.5	-27.4298	153.0309		X					
ARPHD0118-03	56809	BRISB	Rhyolite ignimbrite	5030.5	69659.5	-27.4298	153.0309		X					
ARPHD0121-01	56810	BRISB	Rhyolite ignimbrite	5043.5	69622.5	-27.4632	153.0440		X				X	
ARPHD0121-03	56811	BRISB	Rhyolite ignimbrite	5043.5	69622.5	-27.4632	153.0440		X					
ARPHD0124-02	56812	BRISB	Rhyolite ignimbrite	5038.5	69618.5	-27.4668	153.0390		X					
ARPHD0126-01	56813	BRISB	Rhyolite ignimbrite	5036	69621.5	-27.4641	153.0364		X					
ARPHD0127-01	56814	BRISB	Rhyolite ignimbrite	5036.5	69621.3	-27.4643	153.0369		X	X				
ARPHD0128-01	56815	BRISB	Rhyolite ignimbrite	5037	69620.5	-27.4650	153.0374		X					
ARPHD0128-02	56816	BRISB	Rhyolite ignimbrite	5037	69620.5	-27.4650	153.0374		X					
ARPHD0129-03	56817	BRISB	Rhyolite ignimbrite	5037.5	69620.2	-27.4653	153.0380		X	X				
ARPHD0130-01	56818	BRISB	Rhyolite ignimbrite	5041	69630	-27.4564	153.0415		X			X		
ARPHD0130-02	56819	BRISB	Rhyolite ignimbrite	5041	69630	-27.4564	153.0415		X					
ARPHD0132-01	56820	BRISB	Rhyolite ignimbrite	5036	69622	-27.4636	153.0364		X			X		
ARPHD0132-02	56821	BRISB	Rhyolite ignimbrite	5036	69622	-27.4636	153.0364		X					
ARPHD0133-02	56822	BRISB	Rhyolite ignimbrite	5027	69625.5	-27.4605	153.0273		X			X		
ARPHD0133-04	56823	BRISB	Rhyolite ignimbrite	5028.5	69626	-27.4600	153.0288		X					
ARPHD0134-01	56824	BRISB	Rhyolite ignimbrite	5027.5	69628	-27.4582	153.0278		X					
ARPHD0134-02	56825	BRISB	Rhyolite ignimbrite	5027.5	69628	-27.4582	153.0278		X			X		
ARPHD0134-03	56826	BRISB	Rhyolite ignimbrite	5028	69627.5	-27.4587	153.0283		X					
ARPHD0134-05	56827	BRISB	Rhyolite ignimbrite	5028	69627.2	-27.4589	153.0283		X					
ARPHD0135-01	56828	BRISB	Rhyolite ignimbrite	5032	69601	-27.4826	153.0324		X			X		
ARPHD0135-02	56829	BRISB	Rhyolite ignimbrite	5032	69601	-27.4826	153.0324		X					
ARPHD0156-01	56830	BRISB	Rhyolite ignimbrite	5034.5	69606.5	-27.4776	153.0349		X			X	X	
ARPHD0156-02	56831	BRISB	Rhyolite ignimbrite	5034.5	69606.5	-27.4776	153.0349		X	X	X	X		
ARPHD0157-01	56832	BRISB	Rhyolite ignimbrite	5034	69607.5	-27.4767	153.0344		X		X	X		
ARPHD0157-02	56833	BRISB	Rhyolite ignimbrite	5034	69607.5	-27.4767	153.0344		X	X		X		
ARPHD0161-01	56834	BRISB	Rhyolite ignimbrite	5101	69582	-27.5020	153.1033		X			X		

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0162-02	56835	BRISB	Rhyolite ignimbrite	5102	69579.5	-27.5020	153.1033		X			X		X
ARPHD0163-01	56836	BRISB	Rhyolite ignimbrite	5101.5	69579	-27.5024	153.1028		X			X		
ARPHD0166-01	56837	BRISB	Rhyolite ignimbrite	5100	69577	-27.5042	153.1012		X			X	X	
ARPHD0166-02	56838	BRISB	Rhyolite ignimbrite	5100	69577	-27.5042	153.1012		X					
ARPHD0166-03	56839	BRISB	Rhyolite ignimbrite	5100	69577	-27.5042	153.1012		X	X		X		
ARPHD0168-01	56840	BRISB	Rhyolite ignimbrite	5106	69565.5	-27.5146	153.1073		X					
ARPHD0181-01	56841	MT_BYRON	Rhyolitic lava	4685	70022	-27.1022	152.6822		X	X				
ARPHD0186-01	56842	CHILI	Rhyolitic lava	5168.5	69173	-27.8689	153.1712		X		X			
ARPHD0187-01	56843	CHILI	Volcanoclastic sandstone	5166	69186	-27.8571	153.1686		X		X			
ARPHD0191-01	56844	CHILI	Rhyolitic lava	5180.4	69129.5	-27.9081	153.1833		X	X				
ARPHD0192-2	56845	CHILI	Rhyolitic lava	5181.3	69129	-27.9086	153.1842		X	X	X			
ARPHD0204-01	56846	CHILI	Rhyolitic tuff	5184	69134	-27.9041	153.1870				X			
ARPHD0204-03	56847	CHILI	Rhyolitic tuff	5184	69134	-27.9041	153.1870			X	X			
ARPHD0210-03	56848	CHILI	Rhyolitic lava	5181.5	69126	-27.9113	153.1844		X	X				
ARPHD0212-01	56849	CHILI	Rhyolitic lava	5193	69071.5	-27.9605	153.1962		X		X			
ARPHD0213-01	56850	CHILI	Rhyolitic lava	5194.5	69071	-27.9609	153.1977		X		X			
ARPHD0215-01	56851	CHILI	Rhyolitic lava	5194	69082	-27.9510	153.1972		X	X	X			
ARPHD0217-03	56852	CHILI	Rhyolite ignimbrite	5195	69075	-27.9573	153.1982		X	X				
ARPHD0218-01	56853	CHILI	Rhyolite ignimbrite	5176	69075.8	-27.9566	153.1789				X			
ARPHD0221-01	56854	CHILI	Rhyolitic lava	5194	69073	-27.9591	153.1972		X	X				
ARPHD0223-02	56855	CHILI	Rhyolitic lava	5194	69074	-27.9582	153.1972		X		X			
ARPHD0228-01	56856	BRISB	Rhyolite ignimbrite	5025.5	69639.5	-27.4478	153.0258		X					
ARPHD0228-02	56857	BRISB	Rhyolite ignimbrite	5024.5	69639	-27.4483	153.0248		X					
ARPHD0228-03	56858	BRISB	Rhyolite ignimbrite	5024.5	69639	-27.4483	153.0248		X					
ARPHD0235-01	56859	CHILI	Rhyolitic lava	5189?	69004?	-28.0214	153.1923		X		X			
ARPHD0240-14	56860	CHILI	Rhyolitic lava	5195.2	69006	-28.0196	153.1986			X				
ARPHD0240-20	56861	CHILI	Rhyolite ignimbrite	5196	69006	-28.0196	153.1994			X	X			
ARPHD0247-02	56862	CHILI	Rhyolite air-fall tuff	5196	69006	-28.0196	153.1994		X		X			

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0250-01	56863	CHILI	Dacitic air-fall tuff	5191.5	68956.5	-28.0643	153.1949		X	X	X			
ARPHD0260-01	56864	MTCRO NS295	Rhyo-dacite tuff	4788	69534	-27.5429	152.7853	17		X	X			
ARPHD0260-02	56865	MTCRO NS295	Rhyo-dacite tuff	4788	69534	-27.5429	152.7853	90		X	X			
ARPHD0260-03	56866	WEIR NS295	Basaltic andesite	4788	69534	-27.5429	152.7853	135		X	X			
ARPHD0260-04	56867	WEIR NS295	Basaltic andesite	4788	69534	-27.5429	152.7853	196		X	X			
ARPHD0260-05	56868	WEIR NS295	Basaltic andesite	4788	69534	-27.5429	152.7853	210		X	X			
ARPHD0260-06	56869	WEIR NS295	Basaltic andesite	4788	69534	-27.5429	152.7853	275		X	X			X
ARPHD0260-07	56870	WEIR NS295	Basaltic andesite	4788	69534	-27.5429	152.7853	275			X			
ARPHD0261-01	56871	HECTO GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	622		X	X			
ARPHD0261-03	56872	HECTO GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	647			X			
ARPHD0261-04	56873	HECTO GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	658.4		X				
ARPHD0261-05	56874	HECTO GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	662.6		X	X			
ARPHD0261-06	56875	HECTO GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	662.1		X				
ARPHD0261-07	56876	HECTO GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	711.3			X			
ARPHD0261-08	56877	HECT GSQ26	Rhyo-dacite tuff	5849	69359.1	-27.6983	153.8611	742.2			X			
ARPHD0261-09B	56878	MTCRO GSQ26	Rhyo-dacite tuff	4788	69534	-27.5429	152.7853	828						
ARPHD0261-11	56879	GSQ26E	Rhyolitic lava	5849	69359.1	-27.6983	153.8611	1077		X				

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0261-12	56880	GSQ26E	Rhyolitic lava	5849	69359.1	-27.6983	153.8611	1067		X				
ARPHD0261-13	56881	GSQ26E	Rhyolitic lava	5849	69359.1	-27.6983	153.8611	1067			X			
ARPHD0261-15	56882	GSQ26E	Rhyolitic lava	5849	69359.1	-27.6983	153.8611	1042		X	X			
ARPHD0261-16	56883	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1037		X	X			
ARPHD0261-18	56884	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1033		X				
ARPHD0261-19A	56885	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1027		X	X			X
ARPHD0261-19B	56886	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1027		X	X			
ARPHD0261-20	56887	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1022		X				
ARPHD0261-23	56888	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1011		X	X			
ARPHD0261-24	56889	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	1000		X	X			
ARPHD0261-26	56890	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	985		X	X			
ARPHD0261-27	56891	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	983		X	X			
ARPHD0261-29	56892	GSQ26F	Basalt	5849	69359.1	-27.6983	153.8611	980		X				
ARPHD0261-30	56893	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	970		X	X			
ARPHD0261-31	56894	GSQ26F	Dacite tuff	5849	69359.1	-27.6983	153.8611	968		X	X			
ARPHD0261-32	56895	GSQ26F	Dacite tuff	5849	69359.1	-27.6983	153.8611	953		X				
ARPHD0261-33	56896	GSQ26F	Basaltic andesite	5849	69359.1	-27.6983	153.8611	953		X	X			
ARPHD0261-34	56897	GSQ26F	Dacite tuff	5849	69359.1	-27.6983	153.8611	935		X	X			
ARPHD0266-03	56898	SAMSO	Granodiorite	4844	69798	-27.3047	152.8423			X				
ARPHD0267-01	56899	SAMSO	Granodiorite	4843	69794	-27.3083	152.8413			X				
ARPHD0267-02	56900	SAMSO	Granodiorite	4843	69794	-27.3083	152.8413			X				
ARPHD0268-02A	56901	SAMSO	Granodiorite	4842	69791	-27.3110	152.8403			X				
ARPHD0268-02B	56902	SAMSO	Granodiorite	4842	69791	-27.3110	152.8403			X				
ARPHD0268-03	56903	SAMSO	Granodiorite	4842	69791	-27.3110	152.8403			X				
ARPHD0269-01	56904	SAMFORD	Granite	4767.5?	69921?	-27.1935	152.7653			X	X			
ARPHD0270-01	56905	ENOGGERA	Granite	4669	69951	-27.1662	152.6659			X				
ARPHD0270-03	56906	ENOGGERA	Granite	4669	69951	-27.1662	152.6659			X	X			
ARPHD0272-02	56907	DAYBRO	Granodiorite	4840	69918	-27.1963	152.8385			X				
ARPHD0286-04	56908	BRISB	Rhyolite ignimbrite	5033	69607	-27.4772	153.0334		X			X		

Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER
ARPHD0287-01	56909	BRISB	Rhyolite ignimbrite	5033	69606	-27.4781	153.0334		X			X		
ARPHD0369-01	56910	CHILI	Rhyolitic lava	5200	68987.2	-28.0366	153.2035		X	X				
ARPHD0400-01	56911	CHILI	Rhyolitic tuff ?	5300.5	68541.5	-28.4387	153.3069		X	X				
ARPHD0401-04	56912	CHILI?	Comendite	5302	68542	-28.4382	153.3084		X	X				
ARPHD0413-01	56913	CHILI	Rhyolitic lava	5280	68545.5	-28.4351	153.2859		X	X				
ARPHD0415-01	56914	CHILI	Rhyolite air-fall tuff	5273.5	68541	-28.4392	153.2793		X	X				
ARPHD0418-01	56915	CHILI	Rhyolitic lava	5275	68540	-28.4401	153.2808		X	X				
ARPHD0429-01	56916	CHILI	Rhyolitic lava	5361	68515	-28.4625	153.3687		X	X				
ARPHD0435-01	56917	CHILI	Rhyolitic lava	5374	68503	-28.4733	153.3821		X	X				
ARPHD0018-03	56918	WEIR	Basaltic andesite	4792	69538	-27.5393	152.7893		X					X
ARPHD0018-04	56919	WEIR	Basaltic andesite	4792	69538	-27.5393	152.7893		X					X
ARPHD0022-01	56920	SUGAS	Basaltic andesite	4854.5	69528	-27.5484	152.8526		X					X
ARPHD0060-03	56918	HECTO	Rholite Tuff	4781	69509.5	-27.5650	152.7781		X					
ARPHD0256-02	56919	CHILI	Rhyolite Lava	5219.5	68873.5	-28.1392	153.2235		X					
ARPHD0115-01	56920	BRISB	Arenite	5047	69657	-27.4320	153.0476							
ARPHD0237-01	56921	CHILI	Rhyolite Lava	5192.8	69006	-28.0196	153.1961		X					
ARPHD093-04	56922	BRISB	Rhyolite Ignimbrite	5022.5	69680.2	-27.4111	153.0228		X					
ARPHD0450-01	56923	MORT	Rhyolite Lava											
ARPHD0448-03	56924	MORT	Rhyolite Lava	5450	70108	-27.0241	153.4537							
ARPHD0238-01	56925	CHILI	Rhyolite Lava	5193.5	69005.8	-28.0198	153.1968							
ARPHD0197-01	56926	CHILI	Rhyolite lava	5181.5	69132.2	-27.9057	153.1844							
ARPHD0246-02	56927	CHILI	Rhyolite tuff	5205.5	69007.5	-28.0182	153.2090		X					
ARPHD0224-01	56928	CHILI	Rhyolite lava	5194.3	69074.8	-27.9575	153.1975		X					
ARPHD0236-04	56929	CHILI	Rhyolite lava	5195.5	69005.5	-28.0200	153.1989		X					
ARPHD0099-03	56930	BRISB	Rhyolite ignimbrite	5016.5	69698	-27.3950	153.0167		X			X		
ARPHD0129-01	56931	BRISB	Rhyolite ignimbrite	5037.5	69620.2	-27.4653	153.0380		X					
ARPHD0129-05	56932	BRISB	Rhyolite ignimbrite	5037.5	69620.2	-27.4653	153.0380							
ARPHD0039-04	56933	HECTO	Re-worked tuff	4776	69512.5	-27.5623	152.7731		X					
ARPHD0245-02	56934	CHILI	Rhyolite tuff	5202	69007	-28.0187	153.2055		X					
ARPHD0198-01	56935	CHILI	Rhyolite lava	5183	69131	-27.9068	153.1860							
Sample	MU Sample	Formation	Rock Type	Easting	Northing	Latitude	Longitude	Depth	Oriented	Geochem	Thin Section	Flow Direction	AMS	OTHER

ARPHD0450-01	56936	MORT	Rhyolite lava											
ARPHD0248-08	56937	CHILI?		5190.7	68958.2	-28.0628	153.1941							
ARPHD0079-01	56938	BRISB	Rhyolite ignimbrite	4972	69865	-27.2443	152.9717		X					
ARPHD0261-10	56939	HECTO		5849	69359.1	-27.6983	153.8611	896.84						
ARPHD0261-09	56940	GSQ26		5849	69359.1	-27.6983	153.8611	828						
ARPHD0261-22	56941	GSQ26		5849	69359.1	-27.6983	153.8611	1021.1						
ARPHD0261-17	56942	GSQ26		5849	69359.1	-27.6983	153.8611	1039.3						
ARPHD0261-21	56943	GSQ26		5849	69359.1	-27.6983	153.8611	1020.9						
NS93380	56944													
ARPHD0261-14	56945	GSQ26		5849	69359.1	-27.6983	153.8611	1054.5						
ARPHD0261-22	56946	GSQ26		5849	69359.1	-27.6983	153.8611	1021.1						
ARPHD0261-02	56947	GSQ26		5849	69359.1	-27.6983	153.8611	622.24						
ARPHD0090-02	56948	BRISB	Rhyolite ignimbrite	5023.5	69681.3	-27.4101	153.0238		X					
ARPHD0184-02	56949	MT_BYRON		4660.5	70040	-27.0858	152.6576							
ARPHD0200-01	56950	CHILI	Rhyolite lava	5181.5	69133.5	-27.9045	153.1844							
ARPHD0235-13	56951	CHILI												
ARPHD0077-01	56952	BRISB	Rhyolite ignimbrite	4972	69867	-27.2424	152.9717		X					
ARPHD0386-02	56953	STRAD	Rhyolite lava	5534	69662	-27.4265	153.5403							
ARPHD0238-02	56954	CHILI	Rhyolite lava	5193.5	69005.8	-28.0198	153.1968							
ARPHD0222-02	56955	CHILI	Rhyolite lava	5194	69073.5	-27.9587	153.1972							
ARPHD0245-07	56956	CHILI	Rhyolite tuff	5202	69007	-28.0187	153.2055							
ARPHD0240-04	56957	CHILI	Rhyolite lava	5195.2	69006	-28.0196	153.1986		X					
ARPHD0246-24	56958	CHILI	Arenite	5205.5	69007.5	-28.0182	153.2090							
ARPHD0295-09	56959	CHILI	Rhyolite ignimbrite	5224	68888.5	-28.1256	153.2281		X					
ARPHD0245-07	56960	CHILI	Rhyolite lava	5202	69007	-28.0187	153.2055		X					
ARPHD0090-01	56961	BRISB	Rhyolite ignimbrite	5023.5	69681.3	-27.4101	153.0238		X					
ARPHD0257-02	56962	CHILI	Rhyolite lava	5220	68874	-28.1387	153.2240		X					
ARPHD0249-02	56963	CHILI	Rhyolite lava?	5191	68958.5	-28.0625	153.1944							
ARPHD0022-02	56964	SUGAS	Basaltic andesite	4854.5	69528	-27.5484	152.8526							
ARPHD0022-03	56965	SUGAS	Basaltic andesite	4854.5	69528	-27.5484	152.8526							

Appendix J

Notes on Techniques used for Palaeo-topographic Reconstruction

J.1 Topography of the Brisbane Area

The 3D topographic reconstruction of the Brisbane area during the eruption of the Brisbane Tuff was prepared using Digital Elevation Modelling software. Construction of the model utilised different techniques, assumptions, and data sources, not simply the current outcrop pattern of the Brisbane Tuff. Naturally any such model involves extensive interpretation of the available data and will contain intrinsic uncertainties, however, it is confidently believed that sufficient evidence exists to validate the model in a quantative form. The overall shallow dips on the Brisbane Tuff (generally approximately 10°), and its structural simplicity aided in the reinterpretation and reconstruction of the topography. The model was primarily devised using contact relations observed in the field, flow lineation data sympathetic to original topography (Ui *et al.*, 1989; Wilson 1980, 1993; Elston & Smith, 1970; Elwood, 1982), together with the various facies of the unit. These factors combined illustrate the different depositional environments and mechanisms present in different parts of Brisbane at the time of the eruption. The knowledge of these environments, combined with studies of the pre- and post- ignimbrite geology and present topography, were used to help formulate the model.

Abundant evidence exists to indicate that at least the northern exposures of the ignimbrites were deposited in a valley, which extended from the Windsor area through to the New Farm and Kangaroo Point areas. The western contact of the ignimbrite with the basement is well exposed in many localities, and as discussed at length in Chapter 2, these contacts are suggestive of valley-fill deposit. It has been suggested that this provides evidence only the western contact, and no information can be gained indicating the width of the valley into which the formation was erupted. However, there are exposed eastern contacts between Brisbane Tuff with basement rocks in the New Farm, and Kangaroo Point area, whose proximity with established western contacts provides an indicator to the width of the valley, and it is from this that the thinnest portion of the valley has been calculated. The nature of the contacts in these areas, as with those on the western margin of the formation, are also suggestive of a valley-fill deposit. The width of the valley to the north was in part extrapolated from the width of the valley in this region. Although the eastern basement contact is not exposed north of New Farm, the ignimbrite is still believed to be confined to a relatively narrow belt/valley closely parallelling the present outcrop. Several compelling facts support this supposition. Measured sections from basement in the Ascot area, inferred to be east of the confining valley wall, show no ignimbrite in their content. Scout drill holes for petroleum exploration in the 1950's, and water wells prior to this period (Higgenson, 1946), have no recorded occurrences of Brisbane Tuff east of the present outcrop and inferred valley. Simple triple-point problem solving would suggest that if the ignimbrite in this region was anything but a valley fill deposit, or the valley was much wider than has been indicated on the re-construction, then some ignimbrite occurrences would be exposed in sequences and outcrops east of the present occurrences. No such occurrences have been mapped by either the author or the Geological Survey of Queensland (Grimes *et al.*, 1986). Acknowledging these observations, sections accompanying the 1:100,000 sheet map covering this area do not include the Brisbane Tuff west of the inferred valley contact. It should be noted, that despite the interpretation of a different depositional environment by Grimes *et al* (1986), and a different mechanism for the exclusion of the Brisbane Tuff east of the present outcrop, their published surfical and sub-surface geology fully supports the interpretations which were used in this re-construction of the valley location.

The present-day topography of the Brisbane region is dominated by hilly and mountainous regions over areas where the Palaeozoic basement is exposed, and flat and low-lying regions over areas where the Mesozoic basins are presently exposed. Considering that the Palaeozoic rocks in the present landscape occupy areas with significantly higher ground than the Mesozoic basins, it can be reasonably assumed that these areas were similarly forming relative topographic highs during the Triassic. The present-day locations of large mountains and hills therefore serve as an indicator to the dissected remains of large Triassic mountain chains and mountains. The present distribution of isolated hills and mountains of Palaeozoic basement rocks, structural data, and foliations present in these rocks, and triple point calculations from the distribution of the Brisbane Tuff and other Mesozoic units, were used to infer the positions of the hills and mountain chains on the reconstructions. The two main occurrences of these are the North D'Aguilar Block and Beenleigh Block, both of which play fundamental roles in the lateral confinement of the Ipswich Basin, and hence can be assumed to have been major mountain chains in the Late Triassic. Since most of the folding which occurs within the Mesozoic basins is related to basin-subsidence rather than orogenic-scale tectonic events, it could be assumed that the neighbouring Palaeozoic highs, which have been assumed to play a lateral confining role in the distribution of the Mesozoic basins and therefore occur at the margins of the basins, were relatively immune to such movements and deformations. Finally, as no known orogenic scale tectonic deformation has occurred following the inception of the Ipswich Basin, the possibility that the folding exposed these blocks after the formation of the basin can be ruled out.

J.2 Ipswich basin Geometry

The 3D model of the Ipswich Basin was constructed using techniques similar to the Brisbane area topography map. A major assumption in the construction of this map was that during the late Triassic the two major sub-basins constitute the Ipswich Basin were not the one basin dislocated by later strick-slip faulting. Little is known about minor sub-basin offshore from Moreton Island other than a significant thickness of Late Triassic sedimentary rocks occurs in drill core (Crook and Hoyling, 1968), and this thickness of sedimentary rocks is not repeated elsewhere in the basin except in the vicinity of the main basin axis. The rough geometry of the main basin, in addition to being generated to fit the basin model proposed for the Ipswich Basin, was derived from a combination of many different data sets including : magnetic and gravity data from Wellman *et al.* (1994); seismic sections from Korsch *et al.* (1989) and O'Brien *et al.* (1991); published geological sections from Grimes *et al.* (1986) and Cranfield *et al.*(1981); and drill logs from Hawkins (1956), Siller (1963), Houston (1965, 1967a), Crook and Hoyling (1968), Cranfield *et al.*(1976), Cranfield (1980,1981), and Almond (1982).

Due to the tile resolution of the DEM model generated, specific fine details such as the relationship between the West Ipswich Fault and the South Moreton Anticline could not be included on the model. Also, the vertical scale is diagrammatic only, with no scale implied.